EFFECTS OF BIOLOGY PRACTICAL ACTIVITIES ON STUDENTS' ACADEMIC PERFORMANCE IN SENIOR SECONDARY SCHOOLS IN ADAMAWA STATE, NIGERIA

BY

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AUGUST, 2018

DECLARATION

I hereby declare that the work in this dissertation titled EFFECTS OF BIOLOGY PRACTICAL ACTIVITIES ON STUDENTS' ACADEMIC PERFORMANCE IN SENIOR SECONDARY SCHOOLS IN ADAMAWA STATEhas been carried out by me in the Departmentof Educational Foundations and Curriculum under the supervision of Dr. A. Guga and Dr (Mrs.)Hanna .O. Yusuf. The information derived from the literature has beendulyacknowledged in the text and a list of references provided. No part of this dissertation was previously presented for another degree or diploma at this or any other institution.

_____ _____

Monica GOJI Date

CERTIFICATION

This Dissertation entitle EFFECTS OF BIOLOGY PRACTICAL ACTIVITIES ON STUDENTS' ACADEMIC PERFORMANCE IN SENIOR SECONDARY SCHOOLS IN ADAMAWA STATEby Monica GOJI meets the regulations governing the award of the degree of Master in Curriculum and Instruction of the Ahmadu Bello University, Zaria and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This work is dedicated to my beloved parents Mr. Gregory Goji and Mrs. Paulina Gregory Gojifor being the motivators to the fulfillment of my dream.

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The study could not have been possible without the encouragement, sacrifice, co-operation and support received from many individuals. My boundless gratitude goes to God Almighty that made it possible to realize my dream. Credit is given to those, whose original ideas are used.

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ABSTRACT

Thisstudyexamined the effectsof biology practical activities on the academic performance of students that weretaught biology in Senior Secondary Schools of Adamawa State.The study had four objectives which included to: compare the pre-test and post-test performancesof students taught biology usingpractical activities in Senior Secondary Schools in Adamawa State; determine the level of retention of students taught biology concepts using practical activities and lecture method in senior secondary schools in Adamawa state;compare the mean performance score of rural and urban students taught biology using practical activities and lecture method in senior secondary schools in Adamawa state andcompare the mean performance of students taught biology practical activities using real specimen and those taught using chart among senior secondary school students in Adamawa state.In line with the objective four research questions were raised and four hypotheses postulated.The study used a quasi-experimental research design.The population of the study consisted ofall 89,196 SS2 biology students in Adamawa state spread across 288 public secondary schools. From this, a sample of one hundred and sixty (160)studentsdrawn fromfour different schools with two from urban and two from rural areas. The research instrument used for this study was Biology Practical Test (BPT), which consisted of items grouped into three sections (A, B and C) They were all practical skills test itemsconsisting of Essay practical questions on different topics. Section 'A,' classification of living things, Section 'B,' Classification of fruits and reproduction in flowering plants, Section 'C,' Nutrition in animals and digestion in birds. Mean and standard deviation were used to analyze the data while Independent t-test statistics was used to test the hypotheses at 0.05 level of significance. Findings revealed that: the post-test performance of students taught biology using practical activities was significantly higher than their pre-test performance; students taught biology concepts using practical activities had significantly higher retention level than those taught using lecture method.The used of practical activities significantly enhance academic performance in both rural and urban schools.Students taught biology using real specimen performed significantly better than those taught biology using charts.Hence, the study concluded thatpractical activities produced students with significantly higher academic performance in biology. It was therefore, recommended among others that the use of practical activities in teaching biology should be encouraged in all secondary schools that offer biology in Adamawa state and other states in Nigeria.

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LIST OF ABBREVATIONS

BAT	Biology Achievement Test
BPT	Biology Practical Test
BPA	Biology Practical Activities
CLT	Constructivist Learning Theory
CESAC	Comparative Education Study and Adaptation Centre
FRN	Federal Republic of Nigeria
FME	Federal Ministry of Education
GDSS	Government Day Senior Secondary
NSP	Nigeria Integrated Science Project
NERC	Nigerian Education Research Council
NERDC	Nigerian Education Research and Development Council
NEST	Nigeria Environmental Study/ Action Team, NationWide Education and ScholarshipTest
SADC	South African Development Committee
STAN	Science Teachers Association of Nigeria
STD	Social Development Theory
SCORE	Science Community Representing Education
SPSAT	Science Process Skill Acquisition Test
PSAT	Process Skill Acquisition Test
TL	Traditional Learning
TS	Transverse Section
LS	Longitudinal Section
WAEC	West African Examinations Council

OPERATIONAL DEFINITION OF TERMS

Biology: This isthe naturalscience that involves the study of life and living organismsincluding their structure,function, growth, origin and evolution. The life processes or characteristic phenomena of a group or category of living organismsisdivided into many specialized field that cover their morphology,physiology, anatomy, behavior and distribution.

Effect: As used here, effect means a noticeable impact of methods on the teaching and learning in Senior Secondary Schools or achange, which is a result or consequence of an action outcome of result of using appropriate teaching method on students as measured by performance test.

Performance: This means what you get out of an activity performed by students. It is a measurement in terms of specific and desirable results in examination and the extent to which a students, teacher or institution has achieved their educational goals.

Practical Activities: These constitute student-centered teaching-learning approach, where the student has some control over the process and directs more or less the instructional activities, with the teacher providing adequate guidance.

Lecture Method: This refers to an oral presentation of lesson given to a class by the teacher. The teacher usually dispenses facts and opinions about contents,while studentslisten passively and make their own contributions when they are familiar with the topic.

Retention: In this study, retention is the ability of students to remember what they have learned in the later time or recall Biology concepts they have been taught 2weeks and 8 weeks after the lesson, it take place when learning is coded into memory.

Secondary Schools: This refers to an institution designed to provide spaces and learning environments for the teaching of students under the direction of the teachers or post primary institution in which students take WAEC examination.

CHAPTER ONE
INTRODUCTION

1.1 Background to the Study

Science is a great enterprise, which nations depend on in order to advance technologically. Science therefore is receiving much emphasis in education because of its significance and relevance to life and society. Chinwe and Chukelu (2008) defined science as the study of environment through which people can develop both the mind of inquiry, discipline and logical power of thought. Science includes subjects like biology, chemistry and physics. Justiny (2016) stated that science, as dynamic human activity, is concerned with the understanding of the world. According to him, science is more concerned with various investigative processes and activities with regard to developing, acquiring and controlling knowledge, skills, capabilities and attitudes about the natural factors of the environment.

Biology is an integral part of science that focuses on living things (Plants and Animals). Biology is also a branch of science and prerequisite subject for many fields of learning; it contributes immensely to the technological growth of the nation. This includes medicine, agriculture, forestry, nursing and biotechnology. The study of biology in senior secondary schools can equip students with useful concepts, principles and theories that will enable them face challenges before and after graduation (Nwagbo&Uzomaka, 2011). According to Ogundipe (2013), a place where practical activities takes place is known as the laboratory. Thatbiologist's work in the laboratory does not necessarily mean that practical can only be done in the laboratory. It only points to the fact that, the condition in the laboratory can be organized for effective practical activities. Practical activities in biology provide opportunities for students to learn science by actually participating in the laboratory experiment. Ogundipe (2013) maintained that practical activities should engage students in hand-on, mind-on activities, using varieties of instructional materials

to drive the lesson home. Nwagbo (2008:41) has stated that; "the use of practical activities (approach) to the teaching of biological concepts should therefore be a rule rather than an option to biology teachers, if we hope to produce students that would be able to acquire necessary knowledge, and competence needed to meet the scientific and technological demands of the nation".

Research in biology has shown that students learn more from practical biology lesson when they are given the opportunity to learn through doing than when they are allowed to observe (Ibe 2004; Mandor 2008; Nwosu 2014). They enjoy measuring and classifying data, observing specimens, manipulating apparatus, designing experiments, interpreting data, testing of hypothesis and making inferences. These mental processes can only be developed and acquired if the students are allowed to participate in practical activities. The laboratory activities are usually less formal than conventional classroom teaching. Thus, a biology practical class offers opportunities for productive, co-operative and exchanges among students and with teacher that have the potential to promote learning.

Realizing the importance of science skills as solution to scientific problems, the Federal Government, among other things, stated as one of the national goals of education in Nigeria that; "education should aim at helping the students in the acquisition of appropriate skills and abilities as equipment for students to live in, and contribute to the development of the society". (FederalRepublic of Nigeria (FRN), 2013:29). In order to realize this goal, associations such as Science Teachers' Association of Nigeria (STAN) and Nigeria Integrated Science Project (NSP) were set up by the government to look into the various curricula used at various levels of the Nigerian educational system. These goal and aspiration cannot be realized except through the effective effort of the classroom teacher.

WAEC Chief Examiner's Report (2010, 2013 & 2014), in Sangodoyin (2015:85), attributed the source of students' poor performance in practical biology to the following: "The high conceptual nature of biology practical which make it difficult to understand, lack of interest in the subject on the part of the students and inadequate practical work, shortage of qualified and pedagogically trained biology teachers". The neglect of the practical aspect of biology in schools has been blamed on such factors as the inability of the school authority to provide materials and equipment for practical work and teacher's failure to recognize the importance of practical work in science teaching. Onwu (2017) observed that teachers have an obligation to help students to become critical thinkers and problem solvers. This is only attainable when appropriate teaching and learning strategies are adopted, particularly at the senior secondary school level.

Bichi (2012) reported that various teaching methods were used by teachers in the teaching of biology aimed at bringing about meaningful learning. These include lecture method, demonstration method, discovery method and experimentation method, among many others. However, the most commonly used is the lecture method. This is mostly employed among science teachers because of some ofits advantages, which include the fact that it can be used to cover a large content area at a time and the students are given the same content at the same time. The discovery method brings home to students their notions of the nature of scientific evidence; students come to learn that answers to questions could often be obtained from investigations they can carry outthemselves.A good demonstration method holds the learner's attention, thus facilitating learning by giving students the opportunity to see and hear what is actually happening in the classroom. Thismethod has failed in the recognition of the uniqueness of the inquiry-based nature of science and the learner's individuality(Awotua-Efebo, 2011).Furthermore, it does not facilitate the development of reasoning skills and

processes in the students due to poor retention of students in understanding the biology concepts in practical. These, among other reasons, have not enhanced learning in students and thus have led to poor performance of students in biology practical.Based on the foregoing, the researcher considered it necessary to explore the effects of biology practical activities on students' performance in senior secondary schools in Adamawa State.

1.2 Statement of the Research Problem

The dwindling students' performance in science especially biology has been a source of concern to all stakeholders. Many scholars have tried to find out,various reasons for the poor performancein biology among students in senior secondary schools. Despite the efforts by science educators, the performance of many students in science is still at abysmal level. This situation is easily attributed to factors such as teachers' teaching method, inadequate qualified biology teachers, lack of instructional materials and non-availability of laboratory facilities. Other factors such as wrong spelling of technical terms, wrong representation of view, poor drawing, inability to identify some illustrated organisms, inability to write brief and precise answers and poor grasp of the subject matter lead to failure of students in practical biology (Soyinbo, 2010).

The majority of secondary schools in rural and urban areas do not have laboratories. Where these laboratories exist, they are poorly equipped. The learners, therefore, have to memorise practical work theoretically in order to pass the examination when they are writing practical biology papers. Most of the learners sit for examinations without being exposed to practical work.A sound theoretical and practical knowledge of biology is needed for the management of our natural resources, provision of good health facilities, and favourable life environment. Thus, the teaching and learning of biology has to be encouraged in the schools. Moreover, this neglect, no doubt has relegated these

subjects to the background in our senior secondary certificate examination. A close look at the 2016 – 2017 SSCE result in Adamawa state, confirm that students' performance has been very poor generally and particularly in biology practical. Failure is a great problem, as it will affect the students' performances in science in senior secondary schools.In the light of the above, it should be a general concern of every Nigerian, including the researcher to view this backwardness with some seriousness. There is great need to look into the issue of teaching and learning of the science subjects (biology).Biology is needed in medicine, nursing, pharmacy and food technology. Thus, this study sought to determine the effect of biology practical activities on students' academic performance in senior secondary schools in Adamawa state.

Different studies have been undertaken in different subjects in secondary schools on the effects of different teaching methods such as; Emmanuel (2016) carried out a study on the effect of practical on the achievement of students in chemistry. The objective of the study was to compare the mean achievement score of field dependent (FD) and field independent (FI) students taught chemistry using practical method and those taught using lecture method. The quasi-experimental design was adopted for this study. The population comprised of one hundred students selected from the four co-educational schools in Enugu state. The data were analyzed using mean, standard deviation and analysis of covariance (ANOVA). The results revealed that the field dependent and field independent cognitive styles students taught chemistry using practical achieved better than those taught using lecture method.

Agboola (2017) carried out astudy on "The Effects of Project, Inquiry andLecture-Demonstration Teaching Methods on Senior Secondary Students' Achievement in the Separation of Mixtures Practical Test". The objective of the study was to assess and compare the relative effectiveness of three methods of teaching and conducting

experiments in separation of mixture in chemistry. A quasi-experimental pre-test, post-test control group design was used to conduct the research. The research instruments used for pre-test, post-test was tagged Chemistry Achievement Test (CAT) 1 and 2. A total of two hundred and thirty three senior secondary school one (SSS1) science students constituted the subjects for the study. The data was analyzed using t-test analysis, one-way analysis of variance (ANOVA) and Scheffepost-hoc analysis. The analysis and results of the study showed that the project method brings about a significant difference in the achievement of the experiments of subjects in the experimental group compared with those exposed to inquiry and lecture-demonstration methods of teaching Separation of Mixtures as a Model of Experimental Aspect of Chemistry.

However, the above consulted literatures used the quasi-experimental method to examine the effect between two teaching method (Emmanuel, 2016) and three teaching method (Agboola, 2017). They did not compare the means of students taught biology practical in both urban and rural areas, by extend the difference in means of students taught biology practical using real specimen, and chart which is the gap in knowledge this present study had attempted to fill.

1.3 Objectives of the Study

This study sought to achieve thefollowing objectives:

i. Compare the pre-test and post-test performances of students taught biology using practical activities in senior secondary schools in Adamawa state;
ii. Determine the level of retention of students taught biology concepts using practical activities and those taught using lecture method in senior secondary schools in Adamawa state;

iii. Compare the mean performance score of rural and urban students taught biology using practical activities and lecture method in senior secondary schools in Adamawa state;

iv. Compare the mean performance of students taught biology practical activities using real specimen and those taught using chart among senior secondary school Student's in Adamawa state.

1.4 Research Questions

The following research questions were formulated to guide the study:

1. What is the difference on pre-test and post-test performances of students taught biology using practical activities in senior secondary schools in Adamawa state?
2. What is the level of retention of students taught biology concept using practical activities and those taught using lecture method in senior secondary schools in Adamawa state?
3. What is the difference in the mean score of rural and urban students taught biology using practical activities and lecture method in senior secondary schools in Adamawa state?
4. What is the difference in the mean score of students taught biology practical activities using real specimen and those taught with charts among senior secondary school students in Adamawa state?

1.5 Hypotheses

The following null hypotheses were formulated and tested in the course of the Study:

$H0_1$:There is no significant difference between the pre-test and post-test performances of students taught biology using practical activities in senior secondary schools in Adamawa state.

$H0_2$:There is no significant difference in the level of retention of students taught biology concepts using practical activities and lecture method in senior secondary schools in Adamawa state**.**

$H0_3$:There is no significant difference between the mean score of rural and urban students taught biology using practical activities and lecture method in senior secondary schools in Adamawa state.

$H0_4$: There is no significant difference in the mean score of students taught biology practical activities using real specimen and those taught using chart among seniorsecondary school's students in Adamawa state.

1.6 Basic Assumptions

This study assumed that:

1. Students taught biology performs better in their post-test than in their pre-test using practical activities.
2. The retention level of students is enhanced when taught biology using practical activities than those taught using lecture method.
3. Students taught biology in urban areas perform better than students taught biology in rural areas using practical activities and lecture method.
4. Students taught biology practical activities using real specimen perform better than those taught biology practical activities using chart.

1.7 Significance of the Study

The results obtained from this study will be of great benefit to the following: biology students, teachers, governments, curriculum planners/developers, textbook writers and future researchers.The study will be of relevance to biology students; when they understand more the importance of biology practical skills, they are equipped to secure employment, and this would in no small measure make them contribute

meaningfully to the development of the society. Practical method of teaching can also increase the interest of the student to practical works.

The study will be of benefit to biology teachers, as it will help them in choosing appropriate instructional method and materials capable of releasing students' tension toward the subject. It will also motivate teachers to develop interest in utilizing modern instructional materials like using experiments in teaching topics that are experimental in nature and selecting suitable teaching methods that will be a possible means towards reducing failure in the teaching and learning of biology. The study will also sensitize biology teachers on the benefits of the use of practical techniques for teaching, as it will have a great effect on the academic performance of the students.

The study will serve as a revelation to the government, resulting in the proper equipment of secondary schools with necessary practical materials for the teaching of biology, and posting of qualified biology teachers to secondary schools based on their profession.

This study will also enable the curriculum planners to modify, where necessary, the present system of conducting biology practical activities within the scheme of their evaluation techniques by re-examining the units of the subject matter taught in schools and identifying their corresponding indigenous knowledge and instructional material. This will make the teaching of biology interesting and more meaningful to the students.

This study would furnish authors of secondary school biology textbooks with vital information that would enable the textbooks appeal to the interestexperience and abilities of the students by designing functional books and taking into consideration the type of activities that are learner-centered and of interest to students, which if included in the texts they use will make such texts more beneficial to them and promote the harmonization of biology teaching and learning activities across the country.

This study could also serve as a source of information for further research work on the topic. Additionally, the findings could augment the pool of data required by other educational researchers in their bid to design interventions for solving educational problems in sciences, and biology in particular.Finally, it is hoped that this study will contribute ideas for improving teaching and learning of practical biology in secondary schools, as well as technological policy formulation and development in the country

1.8 Scope of the Study

This studyon the effect of biology practical activities on students' academic performance in biologyisdelimited to Senior Secondary Schools in Yola North EducationalZone of Adamawa State. The study involves Senior Secondary Two (SSII) biology students. The biology content to be covered is delimited to the following topics of practical biology: -Classification of Living Things (Animal Classification), Nutrition in Animals (Food Test), Classification of Fruits, Reproductive System in Plants and Digestive System in Animals (Alimentary Canal in bird).

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

In this chapter, the previous research works and other related literature in relation to the effects of biology practical activities on students' performance in senior secondary schoolswere reviewed.The review explored different researches on the field of study with the hope of determining the gap that this study will fill in terms of its contribution to knowledge.The review wasorganized under the following sub-heading;Theoretical Framework, Conceptual Framework, Concept of Biology, Biology Curriculum in Nigeria, Objectives ofBiology Curriculum,Resources Used for Implementing Biology Curriculum, Problems Facing the Implementation of Biology Curriculum, Concept of Biology Practical Activities, Importance of Biology Practical Activities, The Concept of Academic performance in Biology, Biology Practical Activities, Importance of BiologyPractical Activities, TheNeed for Teaching Biology Practical in Senior Secondary Schools, Availability of Biology Laboratories in Senior Secondary Schools, Equipment and their Use in Teaching Biology Practical, Method of Teaching Biology Practical in Senior Secondary Schools, Effects of Teaching Biology Practical Activities on Students' Performance, Effects of Biology Practical on Students' Retention in Biology, Effects of the Use of Specimens and Chart on Students'Academic Performance in Biology,Effects of School Location on Students'Academic Performance, EmpiricalStudies,Analytical Framework and Summary.

2.2 Theoretical Framework

The Constructivist Learning Theory (CLT) guides this study. The theory was used by Russian psychologist Lev Vygotsky (1896-1934) who also came up with Social Development Theory (SDT), which is applied in education (Bruner, 2015),and was

advanced by Carrel, Scott and James (2010). Constructivism is an active process whereby the teacher collaborates with the learners who create their own new information from prior knowledge during learning. The constructed knowledge in this study is procedure, observation, execution and interpretation skills used in selected tasks that constitute the independent variables while achievement or performance in the skills tested constitutes the dependent variable.

Vygotsky'stheory (2012) proposes learning asa reciprocal experience for the teachers and the students. It emphasizes the affective domain, makes instruction relevant to the learner, helps learners develop attitudes and beliefs that support both present and lifelong learning, and balances teacher-control with personal autonomy in the learning environment. According to this theory, people, (in this context, students), construct their own knowledge from textbooks, personal experiences, the teacher's explanations or any other mode of knowing. In trying to solve novel problems, perceptual or conceptual similarities between existing knowledge or a new problem can remind people of what they already know.Hence, prior knowledge impacts the learning process. Information not connected with a learner's prior experiences impedes quick learning process.Learning science at the school level is not the discovery or construction of ideas that are new and unknown. Rather, it is making what others already know your own.

The difference, from a cognitive perspective, is like that between solving a puzzle and having the solution explained to you by someone who already knows it. The first might involve pursuing several lines of reasoning, and there is no guarantee of eventual success, whereas the second is convergent and with an assured outcome. However, there is still cognitive work to be done to grasp it, to be able to explain it in turn to someone else, or to apply it to new situations (Vygotsky,2012).

An implication of this theory to this present study is that practical tasks to develop students' scientific knowledge should be seen and judged as actsofcommunication and not as opportunities for inquiry. The primary criterion, which a practical task of this sort should satisfy, is that it is an effective means of communicating the idea(s) it is intended to convey. How, we might ask, and how effectively does it augment other forms of communication (verbal, graphical, pictorial, symbolic) that teachers might use. By 'communication' here, it does not simply means act of 'telling', but the whole range of activities that a teacher plans to encourage and support students as they attempt to construct personal meanings that are more closely aligned with the accepted scientific view. To this end, it should be noted that constructivist theory recognizes the essence of acquisition of learning skills through practice and this ultimately will affect performance, which will rationalize the study.

2.3 Conceptual Framework

Miles and Huberman (2014), as a visual or written product that explains graphically, define conceptual framework or in narrative, the main things to be studied key factors, concepts or variables and the presumed relationships. Therefore,the variables/concepts of this study are discussed as follows:

2.3.1 The Concept of Biology

Biology is the study of life. The term 'Biology'is coined from two Greek words: *bios*whichmeans 'life' and *logos* means 'knowledge'. It is a branch of science thathas been structured toequip thestudents with the knowledge of relevant concepts and scientific skillsit is concerned with such topics as the characteristics, classifications and behaviour of organisms and their interactionswiththe natural Environment (Okeny, 2012). Biology compasses a broad spectrum of academic field that are often viewed as independent, relating to living organisms over a wide range of scales, from biophysics to

ecology. However, Biology as a unified science first developed in the nineteenth century, as scientists discovered that all living things shared certain fundamental characteristics and were best studied as a whole. Nlewem (2015) has asserted that today, Biology is one of the most prominent scientific fields; biology is a standard subject of instruction at schools and universities around the world. As a vast field, biology is divided into a number of sub disciplines (Onyegegbu, 2012). The old division by types of organisms remains with subjects such as Botany, encompassing the study of plants; Zoology with the study of animals, and Microbiology as the study of microorganisms. The field may also be divided based on the scale at which it is studied; molecular biology looks at the fundamental chemistry of life; cellular biology considers the basic building block of all life, the cell physiology looks at the internal structure of organisms, and ecology considers how various organisms are interrelated.

Generally, similar plants or animals are arranged in particular groups, some special branches of Biology have been created on the basis of different types of living things under discussion and research. For example,phycology includes only members of algae; fungi are treated in mycology; virology deals with viruses only; bacteria are considered in bacteriology; helminthological is based on study of worms only; insects are discussed in entomology. According to Brook (2013), applied field of Biology such as medicine are more complex and involve many specialised sub disciplines. Biology is the science that explores life forms, and as such, not only extends our knowledge and understanding of the natural world, including ourselves, but can also increase our sensitivity, enjoyment and concern for the natural world. According to Hodson(2012), plant, animals and the human form have inspired all world cultures in many ways, for instance in literature and particularly in art, as well as in science. Thus, Biology should

not be seen as a cold, insensitive activity but one, which must demand a developing empathy with the natural world.

2.3.2 Biology Curriculum in Nigeria

The Senior Secondary School Biology Curriculum was first introduced in 1977. At that time, the duration for secondary school education was five years. The Biology teaching was started in class four, and in class five the students took the West African School Certificate Examination (WASCE). In keeping with the dynamics of social change and demands on education, there was the need to broaden the curriculum. The quest for improving the method of teaching and learning of secondary school Biology began in 1982 by the Nigerian Education Research Council (NERC, 2017).

The new Biology curriculum was adapted and revised from 1985 edition by Comparative Education Study and Adaptation Centre (CESAC). In most secondary schools,biology is compulsory for all science and optional for Art and Humanity programmes'. The topics offered in the course of 3 years prepare the students for higher education in any of the Biology related programmes. According to the National Policy on Education (2009), the Senior Secondary School shall be comprehensive with a core-curriculum, designated to broaden student's knowledge in Science. The Biology curriculum at the directives of the Federal Government is for societal and individual development, and has its cardinal objectives. These objectives include the preparation of students to acquire:

1) adequate laboratory and field skills in biology;
2) meaningful and relevant knowledge in biology;
3) ability to apply scientific knowledge to everyday life in matter of personal and community health and agriculture;
4) reasonable and functional scientific altitude(FRN, 2009).

In pursuance of the stated objectives, the contents and context of the curriculum place emphasizes on field studies, guided discovery, laboratory techniques and skills along with conceptual thinking (Adomi, 2015).The curriculum is intended to provide a modern biology course as well as meet the need of the learner and the society through relevant and functional contents, methods, processes and applications. It covers the major themes of: organization of life, the organism and its environment and continuity of life.

The themes are of direct relevance to the society and the learner. In planning the new biology curriculum, the spiral approach to sequencing a science course was adapted. In the approach, the concepts to be taught are arranged in such a way that they run throughout the three-year post basic course, with the concepts being discussed in greater depth as the course progresses. The curriculum is organized into six sections: Topic, Performance Objective, Content, Activities (teacher and students), Teaching and Learning Materials and Evaluation Guide (NERDC,2009). Such organization provides maximum guide to the teacher in secondary schools. Aladejan (2008) opined that modern biology thrives on casual chains that permit the understanding of physiological evolutionary process in terms of physical activities entities such as molecules, cells and organisms.

2.4. Objectives of Biology Curriculum

Biology is one of the core science subjects offered in Nigeria senior secondary schools. The aim and objective of biology curriculum was categorized intoconcept domain, process approach, creativity domain, attitudinal, application and connection domains.Theconcept of domain aims at grouping the observable universeinto manageable unit for study and todescribe any physical and biological relationship existing in the units (Yarger,2013). The current senior secondary school biology syllabus made in 2008, advocates this and comprises facts, concept, laws and existing hypothesis and theories being used by biologist. Numerous information is classified usually into manageable

topics such as cell diversity of living things, life process, genetic and evolution and so forth. All these processes can be achieved through group work during practical activities. The biology syllabus seeks to make students more creative and cause them to use their own initiative to solve problems of life.

Attitudinal domain such as value, human feeling and decision-making skills are also important to be addressed at the senior secondary school level. Practical work done in group, enable students to develop positive attitude toward themselves and toward biology and science in general and science teachers. The students also develop sensitivity and respect for others, while expressing personal feelings, values as well as social and environmental issues in the application and connection domain. The biology curriculum also recommends the use of demonstration, individual practical, group discussion, field work, project work and building models in secondary schools(Odunsi,2015). Therefore, the importance of new skills, new attitudes and new values for effective teaching of practical biology in our secondary schools cannot be overemphasized. Skillsshould be developed in order to improve the society and the world.

2.4.1 The Resources Used for Implementing Biology Curriculum

In Nigeria, secondary school curriculum is designed to encourage all students to achieve their spiritual, intellectual and social potentials as well as to understand the relevance of learning in their daily lives.Onyeachu (2008) stated that the nation expends vast amounts of time and resources on designing what ought to be learned in schools in order to elevate social consciousness and improve economic viability in Nigeria. This section discusses the resources used for effective implementation of biology curriculum.

1. Textbooks

Textbooks in the context of school are materials used by teachers and students as standard work on particular subject or skill. They are designed for classroom use with

appropriate vocabulary, illustrations, student exercises and teacher guides/aids (Ariyo, 2014).Textbooks offerfacts, ideas, experiments, diagrams that have been properly collected, arranged and discussed. They increaseknowledge and induce further reading. Biology textbooks with activity exerciseshelp students to be actively involved in the teaching/learning process. Thomas (2017) stated that this goes a long way to improve curriculum implementation in schools since it makes it possible for the learners to think for themselves, ask questions in class and to complete assignments in biology, thereby increasing objective and reflective thinking in science.

2. Laboratory

Biology laboratory is a place where researchers, teachers and students carry out biological activities. Johnson(2017) asserts that biology laboratory should be designed to have a large space for free signs and labels, clearly visible and posted; a storeroom where chemicals, specimens and other materials for biology activities are placed or stored. The governmentprovides adequate finances for school to build more laboratories and other social amenities to ease congestion in the existing facilities in schools and to improved curriculum implementation in biology (Ali, 2011).

3. Specimens

These are collection of real objects or things asteaching materials. In biology, specimens of plants and animals are collected and usedfor instructional purposes.Kphigst (2016) has stated that a biology specimen can be a whole organism or its part. They can be life (fresh) or preserved specimens.Specimen arouse the interest of the students, by creating variety, which helps to sustaintheir attention, for instance, using dissected rat or bird to explain the alimentary tract/canal of animals.Examples of specimeninclude cockroach, lizard, bird, bones of the skeleton, a whole plant or its part (leaf, root, and stem) and so forth (Gabanja, 2010

4. Chalkboard

Black/white and green board: This is one of the most useful visual aids for effective teaching of biology. The teacher uses it to illustrate verbal presentations in a sequential and orderly manner. It also allows for point-to-point explanation, building from simple to complex. It allows the teacher to integrate other teaching materials (such as, charts, maps, diagrams) into his/her lesson at the right time, to emphasize the contents involved (Uche, 2015). The chalkboard can be used to illustrate diagrams, test questions, assignments or any other information that will facilitate curriculum implementation in schools.

2.4.2 Problems Facing the Implementation of Biology Curriculum

Curriculum implementation in biology is defined by Guga and Bawa (2012) as actualization, concretization and making real the planned curriculum. According to Okello (2016), the implementation is a network of varying activities involved in translating curriculum designs into classroom activities and changingstudents' attitude towards accepting and participating in these activities. However, the curriculum implementers (teacher, head teachers, standard officers and others)are faced with barriers, which hinder the successful implementation of biology curriculum in Nigeria.The third is the challenge of inadequate funding. Most often curriculum innovation faces a lot

i. **The Teacher**

The major setback in effective curriculum implementation in Biology is the problem of unqualified teachers especially specialist teacher in their areas and technical subjects Cronin-Jone (2014) based on his study of challenges and prospects of science teaching affirmed that there are unqualified science teachers in the state. These teachers for many years have not upgraded their certificates by going for in-service training, this

affects their output and it is the major reason of failure in many curriculum projects in the 1960's educational system in secondary schools.

ii. Culture and Ideology

Ideology or culture is that system of beliefs which gives general direction to the educational policies of those who hold those beliefs. Educational ideologies include; values, beliefs and assumptions about children Learning, Teaching, knowledge and curriculum. The society suppose to be changed after acquiring biology knowledgesome communities may resist a domineering culture or government ideology and hence affect the implementation of the centrally planned curriculum in biology (Adomi, 2015).

iii.Assessment

Assessments in the form of examinations influence curriculum implementation tremendously. Due to the great value given to public examination certificates by communities and schools, teachers tend to concentrate on subjects that promote academic excellence. This action by the teacher obviously can affect the achievement of the broad goals and objectives of the curriculum in biology subjects (Andre, 2012).

iv.Resource Materials and Facilities

According to Tichafa (2017), for the officially designed biology curriculum to be fully implemented as per plan, the Government or Ministry of Education should supply schools with adequate resource materials such as textbooks, teaching aids and stationery in order to enable teachers and learners to play their role satisfactorily in the curriculum implementation process. The quality of resource materials and the availability of appropriate facilities have a great effect on biology curriculum implementation.

v.Poor Funding

Fund refers to money every project requires for its effective implementation. In support of this,Gwany (2015) argued that the education industry is usually the first and

easiest victim of budget cut during austerity and low profile, structural adjustment and other economic reform strategies. He lamented that the present level of underfunding by the state, the public sector, of education has resulted in stagnation and decay. This affects implementation of a well-designed biology curriculum in secondary schools.

2.5 The Concept of Biology Practical Activities

Biology practical activities are defined as the learning experiences in which students interact with materials or with secondary source of data to observe and understand the natural world (Lunetta, 2017). Practical biology is viewed as any science teaching and learning activity which involves students, working individually or in small groups, manipulating and observing real objects and materials, as opposed to the virtual world (Science Community Representing Education [SCORE], 2010).

Biology practical activities are the scientific instruction, which brings about learning activities in science. There are student-centred methods of doing schoolwork, but laboratory work is the flagship for learning in science and extension of biology (Singer, 2005;Lowman&Harderoad, 2008;Gidding, 2016;Woolnough, 2013). According to The Macmillan Dictionary (2008),Biology practical activities are defined as an examination or lesson in which a student makes things or does experiments. The term refers to what appertains to practice or action “doing”. The “doing” depends on acquisition of the required skills. The terms practical and skills go hand in hand for effective learning of biology, as spelt out in the biology syllabus. Practical skills are tested exclusively in the practical paper. However, findings of practical may be tested in a theory paper. The level of competence in practical skills may determine performances in a class and ultimately at the national level.

Hodson (2012) observed that going through the materials needed for a practical, for example, thoserequired for testing for types of food and doing the stipulated practical

using the provided materials,is expected of a student. Roberts(2010) reported from research findings that, “doing” has been found to be the easiest skill attainable by student respondents; many professed to like the “doing” aspect of science practical learning skills but the liking may not translate into performance in schools. Roberts (2010) also conducted a study and noted that practical nature of science results in solving problems scientifically.

2.5.1 Biology Practical Activities

Biology practical activities is an inquiry and hands on activity which makes it possible to transfer knowledge on higher order cognitive levels and create curiosity in students. Shoemaker (2009) reported that practical activity develops problem solving skills and a deeper understanding of the concepts and principles in biology for students. When students do biology, hands on, they will understand it and will enjoy the learning process since it will be relating what they have learnt to real life situationsBigala, (2016:74) stated that the challenges of the modern world require individuals who can apply their theoretical knowledge to solve practical real life problems such as environmental and economic challenges. Hence, practical work prepares students for adult life since it fosters the theory they would have learned. Students, through doing practical work, would be doing what real scientists do and they would appreciate that theories are generated from research. Benson (2014) observed that doing practical work forms the basis for good research skills in students. The project approach, therefore, enhances the development of many practical work skills. Shoemaker (2009) explained how science is best taught in a holistic way, which reflects the instructiveness of the real world.

Another factor as highlighted by Michael (2008),is the role of practical activities as perceived by the teacher in developing countries. In many cases, these activities are

seen as having the role of confirming scientific knowledge as opposed to be exploratory in nature.He further stated that this role may in part be due to the difficulties in accessing information in developing countries. Access to libraries, computer information network, journal and textbook are limited,therefore making exploratory type activities particularly difficult. Apart from not being a component on the implementation of practical activities, poor maintenance of laboratory facilities and lack of laboratory assistants requiring teachers to spend lengthy periods preparing experiments. Indeed, many teachers are found to lack the knowledge, skill and confidence necessary to perform routine maintenance tasks, and this restricts the amount of practical work that could be perform (Cook &Taylor, 2016).

The new trend toward social, ethical and humanistic value of biology demands that the government should equip laboratories for practical purpose and create the right attitude of teaching the subject so that students can inject their experience into the science practice. Ileje (2012),in his reports for success in practical work in biology, stated that students must be given opportunities to participate in the laboratory. He added that teachers should expose the students to the rudiments of practical activities in biology. They should encourage the need to equip the laboratory for practical purpose; this will help students to understand and assimilate some of the biology terms, and theories will be made easy to them, so that they will wish to continue with it in future study.

2.5.2 Importance of Biology Practical Activities

Biological science should be taught primarily as a practical subject. Shulman and Tamir's (2013) review of research on science teaching identify three rationales generally advanced by those that support the use of the scientific knowledge as follows:

(1) The subject matter of science is highly complex and abstract

(2) Students need to participate in enquiry to appreciate the spirit and methods of science.
(3) Biology practical work is intrinsically interesting to students.

They also compiled a list of objectives of using laboratory work in teaching biology practical. The list included the teaching and learning of skills, concepts, attitudes, cognitive abilities, and understanding the nature of science. Also, there is hardly any practical method's book that does not usually list the objectives of science laboratory work (Abdullahi, 2001; Collette &Chiappetta, 2012). All science curricula in Nigeria list practical activities that should go with each curriculum item listed.

The current West African Examination Council (WAEC) syllabus and the National Education Research Council (2009), Federal Ministry of Education for Senior Schools, have recommended that the teaching of all science subjects listed in the syllabus should be practical based; perhaps, to demonstrate the importance attached to practical work in science. Thus, several decades of emphasizing the level of laboratory work in science teaching have elevated the importance to the level of a dogma. Yarger (2013) note that science education should treat practical work as the main course(p.g. 201) rather than an extra or "the desert after a meal''. This dogma about the importance of laboratory work originated from the view of a few American educationists in the early sixties that extolled the importance of biology practical work in science teaching. Notable among these personalities are the [Phelps Strokes Commission of 1920, the Ashby Commission of 1950, the AlvanIkoku Conference on science] All these conferences, committees and commissions were geared towards providing a functional science education programme in Nigeria. According to Abimola (2016), they all extolled the virtues of teaching science as a process of inquiry or discovery.

Charles (2012), who advocated the use of the method of science as a mode of inquiry to satisfy our doubts, upheld that the ultimate goal of these advocates of practical

work is to train students in the ways of practicing scientists, so that students can become good scientists in the future. The surprise, by which the former Soviet Union took America and perhaps the world in launching the Sputnik into space in 1957, motivated their positions. Emphasis in science teaching at this time shifted from the products of science, that is, what science teaches and what is learnt, to the processes of science, that is, how we teach and learn science (Bates, 2015). According to Shulman and Tamir (2013), this shift in emphasis lacked empirical evidence because the influence of the educationists mentioned above formed the basis of the shift. As a result of this influence, and the need to match the Soviet feat, America commissioned and executed several curriculum development projects. Such curriculum development project included the Biological Science Curriculum Study, which started in 1959; Chemical Bond Approach began in 1958; Physical Sciences Study Committee was initiated in 1956, and Science- a process approach which started in 1967 and so forth. They were all practical based. These curriculum development activities, with emphasis on practical work, spread to Nigeria and elsewhere in the world.

In the view of Ughamadu (2011),the large-scale destruction of natural flora and fauna upset the natural interdependence among living organisms. These facts also are evident in practical biological studies. Some of these interference which also have serious effects on man, can be better understood when the studies involve practical work. It is therefore important that practical, as part of the study of biology, should go hand in hand with theory. Nwoke (2009) posited thatbiology practical work stimulates learner interest in the science subject they are studying, when they are made to personally engage in useful activities; knowledge obtained through practical work and experience promote long term memory that theory alone cannot do. From these reasons, it becomes obvious that a learner acquires more in any science lesson, if giving the opportunity to do

activities ranging from manipulating apparatus classification and verifying results (Okonampa,2017).Appropriate practical work enhances students'experience, understanding, skills and enjoyment of science. Practical work enables the students to think and act in a scientific manner. Millar (2014) had suggested that practical work should be viewed as the mechanism by which materials and equipment are carefully and critically brought together to persuade the physical learner about the veracity and validity of the scientific world. The teacher must make sure that practical work is a problem-solving task, put forward in terms of a problem. Unless students are faced with a problem to solve, as well as dissection to make or specimen to draw, they are working solely at the physical level of science in secondary schools.

2.5.3The Concept of Academic Performance in Biology

Academic performance refers to a successful accomplishment or performance in particular subject area (Biology)It is indicated by grades, marks and scores of descriptive commentaries. It also refers to how Students deal with their studies and how they cope with or accomplish different tasks given to them by their teachers in a fixed time or academic year. Fajola (2017), used the notion of academic self-concept in referring to Individuals' knowledge and perceptions about themselves in academic performance, and convictions that they can successfully perform a given tasks in Biology practical at a designated levels. Rothstein (2014) argues that; academic performances refer to an activity that ensures that goals are consistently being met in an effective manner. He concludes that academic performance is the effectiveness and improvement of students towards specific goals set up to be achieved in the school system. Musek in Johnstone (2014:89) stated that there are two broad groups of definitions of academic performance. The first one could be considered more objective, because it refers to numerical scores of a student's knowledge, which measure the degree of student's adaptation to schoolwork

and to the educational system. The second group is a more subjective one, as its determination ofacademic success in reliant upon the student's attitudes towards his academic performance and himself, as well as by the attitudes of significant others towards his/her success in the schools system.

2.5.4 The Need for Teaching Biology Practical in Senior Secondary Schools

Biology practical activities are important in order to understand biology concepts. If biology education aims to enhance the understanding of the natural world by students and how it functionsthen the students have to experience and observe the relevant biology phenomena. Recent studies advocate for a change in teaching methods so that students participate fully and understand difficult Biology concepts (Millar, 2018). Students should understand processes and structures; develop skills in manipulation, processing information in Biology and conducting scientific investigations. Hence, the teaching methods such as learner design, reciprocal, inclusion, divergent and self-check could enhance the teaching of Biology practical activities (Capel, Leask& Turner, 2017). Ormrod (2015) insists that in Biology practical, students are exposed to first-hand experience of the scientific inquiry process as well as constructing conceptual knowledge through a designed student-centred investigative method. Hence, the learning process is usually considered more important than the acquisition of factual knowledge in student-centred methods. Discovery learning as an inquiry-based learning method enables students to be actively involved in investigating a topic or problem, obtaining appropriate information, interpreting causes and effects where necessary, and reaching the conclusions or solutions. However, it has been observed that inquiry-based instruction requires the most expert teachers and there is need to prepare novice teachers in several domains of teaching, including pedagogic content knowledge, students' knowledge, and classroom management knowledge. In senior secondary schools, the majority of Biology

teachers are not experts, they are degree holders who have deep knowledge in content but lack teaching methodology (Mulkeen, 2017).

The general goal of biology teaching is to equip the learner with the basic knowledge, skills and attitude that will enable him or her to lead an independent and useful life, both to himself/herself and the larger community in which she/he lives(Okenyi, 2012). Educating people in science especially biology has been widely acknowledged as a way of promoting economic development, eliminating poverty and introducing social welfare.Any Biology curriculum activity intended for senior secondary school must make room for individual differences and students' full participation in its execution. Also the students learn to work and think in a scientific manner as the first and most important consequence of their studies.Okenyi(2012) By implication, it means that as far as possible the teaching and learning in biology classes should be child-centered, so that the activities of the child would have the most important educative influence on the child, This helps the child to develop High Order Thinking Skills that is, HOTS in Biology. TheNational Policy on Education (2009) shows that there is a need to look into the process of teaching and learning that is going on in our schools in relation to methods and strategies that are used in the delivery of the content. This calls for a teaching technique that will help the learner to maximize self development; to develop the habit of self learning; and create in the learner ability to think for himself. Hence, the researcher feels it is necessary to investigate the use of practical in the teaching of biology in senior secondary schools(Ezeh,2014).

2.5.5 Availability of Biology Laboratories in Senior Secondary Schools

Laboratory has been conceptualized as a room or building specially built for teaching and demonstration of theoretical phenomenon into practical terms. Faronmi (2008) argued that 'seeing is believing' is the effect of using laboratories in the teaching of biology subjects as students tend to understand and recall what they hear or are told. Laboratory is essential to the teaching of biology,and the success of any science course is much dependent on laboratory practical provision made for it.

The inadequacy of science laboratory and equipment, in some cases, their complete absence in Nigerian schools has negatively affected the teaching and learning of biology.Igbojinwaekwu (2011) andOriaifo (2010) noted that many schools in Nigeria lack laboratories; those that have lack the required facilities or apparatus. This lacks, of well-equipped biology laboratories tend to deny students the chances/opportunities of offering biology in the Senior School Certificate Examination. In the same vein,Aghenta (2017) agreed that materials needed for quality learning in Nigerian schools are acutely in short supply at all levels; school buildings are inadequate, old and dilapidating; classrooms and laboratories are inadequate and ill equipped; chemicals, tools, books, teaching aids, and so forth, are terribly inadequate. Aghenta (2017) added that, these materials are the ingredients for promoting quality education, but unfortunately, they are hardly available to the teachers. This is a serious disadvantage to the science students. Urevbu (2010) insisted that laboratory/practice work consists of a range of activities, from true experimental investigation to confirmatory exercises and skill learning. He concluded that laboratory/practical work is indispensible because:

i. science is experimental,
ii. laboratory is a place where one learns most readily what questions can be asked fruitfully and how they must be put,

iii. it is where one learns why science insists on precise measurement, accurate observations, conciseness and clarity in communication.

iv. it is helpful in bridging the gap between abstract ideas and realities (Ahlgren,2013).

According to Mackay (2013), interest lost in practical biology lesson by students could be easily regained by the presentation of materials that would catch their interest through experimentation in the laboratory.Feyerabend (2010) reported that science students are thrown into confusion when biology is taught as an abstract subject. Supporting this, Okebukola (2016) stated that the drift of students from sciences to social sciences or arts is due to the dull and complete theoretical nature of science lessons in Nigerian schools as a result of lack of facilities in the laboratory. He further asserted that the present situation had deprived the intending biology students the opportunity of having a first-hand experience of what and how science looks like.In addition, when physical and material resources are provided to meet the needs of a school system, students will not only have access to reference materials maintained by the teacher but individual students will also learn at their own pace. The net effect is that it increases the overall academic performance of the students(Ogunyemi2014). In his own contribution, Gamoran (2011) asserted that school resources and books in the library alone has little impact on students' achievement once students' background variables are taken into account. This means that before such students could perform well, educational materials at the secondary level must be providedto propel them to higher achievement. At the higher educational level, they must also be supplied with the requisite material.

Evidence aboundsto support the claim that physical structure is significantly related to school academic performance. Effort must therefore be made to renovate the dilapidated science laboratories and schools offering science without separate laboratories

for the science must be assisted to construct more laboratories. In this study, careful note will be made of the available biology teaching and learning materials. Special attention will be paid to these materials used during lessons to maximize the students' learning in schools(Obemeata2016).

2.5.6 Equipment and theirUses in Teaching Biology Practical

There are many apparatuses that a biology teacher can use frequently while working in the laboratory. They promote student- centered activities in a classroom (Babu,2015). Such equipment includes the following;

i. **Microscope**: Microscope is a device used to view very small objects by magnifying the image. The viewingcan be done through optical and non-optical means. The optical group is the largest, which uses lenses and ambient light to view objects. It varies in configuration and range of magnification.

ii. **A simple hand lens**: A magnifying glass (called a hand lens in laboratory contexts) is a convex lens that is used to produce a magnified image of objects. The lens is usually mounted in a frame with a handle. Scientists use hand lens to view little things such as specimen, bugs or small particles that do not need to be put under the microscope in conducting experiments in science laboratory work.

iii. **Petri dish**: Petri dish is a shallow cylindrical glass or plastic lidded dish that biologists use to culture cells such as bacteria, small mosses and eukaryotic cell in a medium or on solid agar.

iv. **Dissection pin**: Plated steel with T head that are easy to place and remove, ideal for dissection work.

v. **Test tube rack**: Test tube rack is a wooden or plastic holder of test tube in the laboratory. It has small holes, each of which holds one test tube in an upright

position.Test tube rack is used to hold and transport test tube during experiment or while examining culture in the lab.

vi. **Beaker**: Beaker is a type of cylindrical container used to mix chemicals, liquids and other substances together for scientific testing. They are also used routing in laboratory experiments to calculate the volumes of various liquids in the laboratory.

vii. **Wash bottle**: Wash bottles is used for dispensing small quantities of distilled water.

viii. **Scalpel**: Scalpel works like a knife and is used in dissection for small incisions, starting holes for scissors to cut out thin slice and peel part of a specimen during experiment.

ix. **Cover slips (very thin glass cover):** Used for covering the material placed on glass slide to be observed under the microscope. This protects the objective lens.

x. **Flask**: A bottle with a narrow neck used in the laboratory for performing experiments keeping solution, for heating solution.

xi. **Pipette**: A slender graduated glass tube for measuring and transferring known volume of liquid.

xii. **Florence Flask:**glass; common size are 125ml, 250ml, 50ml may be heated; used in making and for storing solution.

xiii. **Dissecting pan:** Metal pan filled with tar or paraffin used to hold down specimens with pins.

2.5.7 Methods of Teaching Biology Practical

One important aspect in the study of the sciences and biology is the method used during impartation of knowledge to the students (Okebukola, 2011). Teaching biology through investigation, research activities and problem solving and by linking these with a focus on local environment achieves better understanding of biology as opposed to rote learning of scientific facts and theories for examinations after which learning

ends.Iroegbu (2016) claimed that teaching biology in Nigeria schools has become more of theoretical rather practical work. There is the need to search for more effective strategies that are likely to improve achievement among senior secondary school students. Such strategies perhaps, include co-operative based learning instructional strategies (activity-based), which have been found to improve biology learning outcomes (Slavin, 2010).

Edward (2013)explained that group work during practical is a pervasive and influential method. Peer tutoring is a personalized system of instruction which is learner rather than teacher feature of the classroom ecosystem, which must be encouraged in the teaching and learning of biology in the senior secondary schools.

The methods used in teaching practical biology can be categorized into four main groups (Ariyo 2014).

a. The activity – based method
b. Discovering method
c. Demonstration method
d. Experimentation

a. **Activity-Based Method of Teaching**

The activity- based method of teaching consider students as very important in the instructional process, where teachers build on the students' experiences. Also, the procedure used for the activity – based method of teaching is based on current information and research in developmental psychology involving cognitive, affective, experimental and maturational issues.

According to Lazarowitz-Heads and Bird (2012), learning methods generally involve heterogeneous groups working together on tasks that are deliberately structured to provide specific assignments and individual contributions for each group members. Practical work is found to enhance the teaching and learning of science and for that

matter biology at all levels. Co –operative learning within groups will enable students to have cognitive as well as social benefits as they clarify their own understanding and share their insights and ideas with each other, as they interact within the group during biology practical activities.

The activity – based methods of teachings have the following advantages:

i. Students are trained to easily identify problems with local interest and impact.
ii. Students are also encouraged to use local resources in locating information that can be used in problem resolution (Ariyo 2014).

Though this method is perceived to be one which helps students to explore, there are some disadvantages. They include the following:

i. Lesson may take a very long time for students to go through the activity successfully.
ii. Students normally become frustrated, especially when they fail to discover or find the solution to a problem.
iii. Managing, organizing and controlling of students towards effective achievements of results can be difficult.
iv. It can be an expensive method of teaching considering resources, materials and funds to be provided for the learning process (Ariyo 2014).
v. In spite of the disadvantages of the activity-based method of teaching, it enables students to have more hands on than minds-on experiences in the teaching and learning of science.

According to Kember (2008), the activity or experience in curriculum requires teachers with wide range of experience, broad education with training in educational psychology, coupled with the provision of physical facilities such as large classroom,

ready and flexible building to allow for many activities and free practice. With process skills developed, students will be able to utilize them to solve other problems.

b.Discovery Method

The teaching method prescribed by the Nigerian Biology Curriculum is discovery/laboratory and experimental method of teaching. The discovery method of teaching, according to Yusuf (2012), is the method of teaching where the classroom teacher provides the learner necessary opportunities to discover new fact, new rules, methods or techniques of solving problems as well as, new values for themselves. Mccarthy (2015) said that modern science curricular emphasizes learner's involvement in science activities through discovery method.The label of discovery learning can cover a variety of instructional techniques.

Craufurd (2014) stated that discovery learning can occur whenever the students are not provided with an exact answer but the materials in order to find the answer themselves. In addition, Abdullahi (2010) opined that discovery method involves an unstructured exploration in the laboratory in which the student, through his mental processes such as deserving, measuring, classifying, can draw general conclusions from data that he has generated. From the instructional point of view, two discovery methods are recognized, which are: guided inquiry and unguided inquiry. The guided inquiry involves instructional modes, which can be either deductive or inductive in nature. The inquiry is employed when a learner is expected to use principle in order to discover solution to a particular problem.Unguided inquiry is also called ‘’pure discovery ‘’ Mayer (2009),asserts that a discovery method equips the learner with the vital means of acquiring knowledge through active participation and he develops his own mind by using it to solve problems in sciences.

c.Demonstration method

Demonstration is a skill that is been learnt and taught.It involves showing by offering example of how something works or steps involved in a process (Yusuf, 2012). Demonstration is seen as the process of teaching through example or experiment. Beydogan(2016) observed thata science teacher might teach an idea by performing an experiment for students. Demonstration may be used to prove a fact through a combination of visual evidence and associated reasoning.Lyop and Mangut (2015) defined demonstration as the act of showing or displaying something. According to them, it involves showing something for the students to see. They state that teachers normally do demonstration method but students can perform sometimes demonstration individually or in small groups. According to Alfred (2016) in Lyop and Mangut (2015), the demonstration method serves various purposes in teaching. These purposes include setting a problem, illustrating a point that is the most popular use of demonstration or it can serve as a climax performance on exciting students, which is an excellent way to end lesson.

Kim (2014) lists the following reasons as justification for the use of demonstration method:

i. It is effective for teaching manipulative and applied practical skill.
ii. It gives opportunity for the use of sophisticated apparatus and difficult experiments.
iii. It guides students' thinking along the same channel.
iv. Hazardous and dangerous experiments can be carried out.

In using demonstration method for instruction, Okoro (2011) pointed out that for demonstration to be effective, the teacher should: plan the demonstration, prepare students for demonstration, Carry out the demonstration process and re-state the

important point connected with it. Tutor vista (2017) state that teacherscannot only demonstrate specific learning concept within the classroom, they can also participate in demonstration classrooms to help improve their own teaching strategies, which may or may not be demonstrative in nature. It is possible for students to learn how to perform manipulative operation by reading or being told how to do them. However, they can learn faster and more effectively.When they are shown how the work is done, it enhances students' rate of comprehension of specific objectives. Howard (2012) was of the opinion that, in teaching through demonstration, students are set up to potentially conceptualize class materials more effectively as shown in a study which specifically focused on biology demonstrations presented by teachers. Erick (2015) said that memorization of a list of facts is a detached and impersonal experience, whereas the same information conveyed through demonstration become personally relatable. This is because demonstration involves showing by reason or proof, explaining or making clear by the use of examples or experiments. Put more simply, demonstration means tobe clearly showed.

Demonstrations help to raise students' interest and reinforce memory retention because they provide connections between facts and real world application of those facts. The demonstration method provides things close to real life event; results are seen and answers are given immediately with the demonstration method. According to Erick (2015) , demonstration often occurs when students have a hard time connecting theories to actual practical or when students are unable to understand application of theories. It is usually used in the laboratory for experiments in schools.

e. Experimentation in Biology Teaching

Experimentation is a method of learning science concepts, not through what the teacher tells the students, but through what is involved in the process of investigation,

carrying out experiments as well as other practical activities (Yusuf, 2012). Experimentation involves activity-oriented learning. In this case, the emphasis is on doing. Most times, the activities are carried out in the biology laboratory. (Ranis, 2017) stated that experiments in biology can be carried out by individual students or group of students working together. The latter is used when the equipment and materials needed for the experimentation cannot ground to individual students. The laboratory work involved in the process of experimentation can be broken down into different phases since it involves whole class activity.

Phase One: Pre-Laboratory Session

Phase Two: Laboratory Session

Phase Three: Post-Laboratory Session (Ranis, 2017).

Phase One: Pre–Laboratory Session

For a biology teacher to carry out effective experimentation in biology laboratory, careful planning and proper organization are necessary. The Teacher has to ensure that all equipment are in good working condition. Subsequently, the experiment is trial tested by carrying it out first to ensure that the chemicals and tools to be used are still very active and the procedure carefully followed by the teacher (Ranis,2017). This pre-laboratory session is very important because it reduces errors which the teacher may have committed in the actual laboratory session. Also, the sitting arrangements of students are put into consideration as well as the time to spend in carrying out the investigation.

Phase Two–Laboratory Session

During the laboratory session, the teacher will first of all interact with the students by telling them what to do, the purpose of the experiment, the procedure to be followed in carrying out the investigation as well as safety measures to be taken to avoid incidence of accident. The teacher clarifies any doubt or problem arising from the students and by so

doing gives them adequate encouragement and support in the learning process (Kim, 2014)

Phase Three–Post Laboratory Session

In this session, the teacher discusses the result of the investigation in order to clarify students who may be in doubt. The teacher can also summarize the process as well as the result of the investigation in the form of backboard summary. Finally, students are allowed to clean up their tables and wash off equipment before leaving the laboratory.

Advantages of Experimentation

i. Experimentation enables students to have direct sensory experience of scientific knowledge such as working with living organisms; it enables the learner not only to acquire knowledge but also to appreciate life.
ii. Experimentation fosters opportunities for the acquisition of science process skills such as manipulation, measurement, classification and so forth.
iii. It helps in the retention of information as the students interact with the scientific process.
iv. The uses of experiments help students to develop scientific attitude such as enquiry, curiosity, carefulness, objectivity, honesty and so forth.

Disadvantages of Experimentation

i. Experimentation in biology teaching is wasteful in terms of resources to be used in carrying out the investigation unlike demonstration.
ii. It is also time consuming in carrying out a single experiment. What the teacher can say in five minutes may take one hour to investigate.
iii. It also exposes the teacher's ignorance on those areas he is not competent enough to handle.

iv. In experimentation, lack of background knowledge about the activities may make students to dislike the subject.

The experimentation methodwas adopted for this study as it enables students to have direct sensory experience of scientific knowledge such as working with living organisms; it enables the learner not only to acquire knowledge but also to appreciate life.

The uses of experiments will help the students to develop scientific attitude such as enquiry, curiosity, carefulness, objectivity, honesty and so forth. It will also help the researcher tohave a firsthand contact with the students during the practical activities for a careful observation and interception where necessary.

2.6 Effects of Teaching Biology Practical on Students' performance

Teaching involves sharing experiences between the teacher and the learner. It helps the teacher to identify what to learn through the use of syllabus and the scheme of work drawn.Onah(2015)observe thatbiology being one of the science subjects cannot be taught or learnt effectively in the absence of practical. Iloeje (2008), in his lesson for effective biology practical activities,statethat of all the five sense organs used, the sense of sight is the highest of them. Kildare and Okoro (2012) established that students understand better when they involve themselves in experiment during practical and obtain their result. They went on to state that such students cannot only remember the procedure involved but also feel proud of themselves of obtaining the correct results, thus stressing the need to match theory with practical. Unfortunately, Chukwu (2009) observe that practical periods, which are very necessary for successful study of biology, are not enough. He highlights the need for the students to be exposed to series of practical activities; the theory and practical aspect of biology need not to be separated but should be taught as component parts of a subject, and not as separate entities.

According to Collins (2011), practical work puts the students at the centre of learning where they can participate in, rather be told about biology. In this way, the desire and eagerness to know more about what the subject can offer is developed. However, the reality on ground is that most experiments are sterile, un-illuminating exercises whose purpose is often lost on the learners. In many countries, biology practical work is ill conceived, confused and unproductive (Hodson, 2012). Whatever goes on in the laboratory has little to do with actual students learning science. Demonstrations are usually done by the teachers who also often miss the point of the demonstration. Small group work is done, but the follow- up discussions on the purpose of the exercise is usually counterproductive.Collins (2011) noted that there is usually limited planning and formulation of hypotheses, mostly done by the teachers. In many cases, the experiments are derived from mostly irrelevant cultural settings with the attendant equipment disasters. The students follow a fixed programmer of experimental manipulations and observations set by the teacher's cookbook style. This research acknowledges a great role that is well planned and delivered; practical work in biology can influence students' learning in secondary schools.

2.6.1 Effects of Biology Practical Activities on Students' Retention in Biology

Retention isdefined as the ability of one to remember what he has learned in the later time. It takes place when learning is coded into memory. Thus, appropriate coding of incoming learning or incoming information provides the index that may be consulted; so that retention takes place without elaborate search (Oyedokun, 2017).According to Paul (2017), retention is a base model for which the meaningful stimuli are processed by the brain at a deep level. This model is attributed to the long-time memory (retention) which is based on our ability to process semantic knowledge deeply by associating recall items. Retention according to Chauhan (2016), is a direct correlate of positive transfer of

learning; This means that high retention may lead to high performance which is a factor of many variables such as interval between learning and retrieval, intervening experiences, specific subject involved, teaching strategies/methods used in biology practical, among others. Evidence from researches showthat there is no consistency on the variables that may lead to the students retaining more of what they have learnt. Separate studies carried out by Ndukwe (2010),Nnadi (2013) and Eze (2017) showed that there is no significant difference between the students' retention ability in biology practical activity.

Theincrease in knowledge lies solely on the ability to remember. Farrant (2012) explained that if an individual cannot grasp and keep hold of what is taught and learnt, it will seem like trying to fill a bucket without bottom with water. This means that if students cannot retain what they learn, then there is no need expecting them to perform well in classroom activities. That is in line with what Bruner (2015) said, that students participation in a lesson is a basis for understanding, achievement and retention. For instance, if a student memorizes some principles, concepts or processes in the class and quotes them when the teacher asks, and forgets them immediately, the student cannot be expected to remember it in future.

However, Eriba and Sesugh (2008);Onekutu (2013) in their studies found out that students' retention can be variously affected by practical activities, in various types of methods used and other variables like motivation and interest of the students toward biology practical in secondary schools.

2.6.2 Effects of the Use of Specimen and Charts on Students' Academic Performance

The materials used by teachers to teach and drive home their subject point at the primary and secondary level of our educational system is incontrovertibly a paramount

importance issue in practical classroom interaction and successful transfer of knowledge from the teacher to the learner (Prased, 2015). Instructional material is a material which assists teachers to make their lessons explicit to learners. They are also used to transmit information, ideas and note to learners. Specimens and charts are those materials that serve as supplement to the normal process of instruction. Specimen is a sample or small piece of the real object. Even a tiny piece of real object stimulates interest in students to learn more and more, that is, specimen of a leaf, cockroach, bird, feather, frog, grasshopper and flower can be very eye catching and stimulating, depending on how it is used in science classroom and laboratory for teaching (Wittich&Schuller, 2012).

They are limited by their collection, energy and time consumption. Classroom dissection desensitizes students to the sanctity of life. Research has shown that a significant number of students at every education level are uncomfortable with the use of animals in dissection. Again, experimentation studies suggest that exposing young students to animals dissection as science can foster callousness toward animals and even dissuade some from pursuing career in science. According to Ogunleye (2017),the preservation and discarding of dead animal specimen in classroom leads to additional risk toxic chemicals such as formaldehyde or formalin. Formalinhas been identified as a carcinogen in humans and the departments of health has designated it as a hazardous air pollutant and waste constituent. The scope of the toxic chemical waste generated by the disposal of dissected specimen makes the practice a problem on the student's health.

Charts are widely used visual/graphical aids, which present concepts and ideas that are complicated and that cannot be comprehended easily by just mere words, matter written or oral. Charts are mixture of different types of graphics, that is, pictures, diagrams, cartoons, graphs and written text or drawings. Teacher usually restricts one idea per chart and thus making concept clear without ambiguity.Brown, Lewis

andHarcleroad, (2015) define charts asystematic arrangement, events, factors or ideas in a graphic or pectoral formthat can be arranged in a way visible to the entire class, such as charts of different cells (plant and animals), organs (heart, kidney, liver), systems (digestive, respiratory, excretory). Thesecan be displayed to serve as an additional visual aid. Chart presents facts and information in few wards, thus helping the learner to grasp the key points of the concept. Chart has a dual purpose of allowing easy view of what is presented as well as sustaining student's attention. However, chart has the disadvantage of being expensive if prepared for commercial use. It also lacks motion and depth and may not represent the actual size of the object being portrayed in the classroom.

According to Mari (2010), it is likely that if students see the organism they are studying physically and even in its natural location, they will remember and understand better than when they are taught only theoretically. Many facts about living things are continuously discovered in the laboratories and practical studies; most of these facts are been discovered as biologists physically study the organisms in their natural environments.

2.6.3 Effects of School Location on Students' Academic Performance

The environment in which learning takes place has been identified as one of the factors that determine effectiveness of learning, especially among secondary school students (Muluku, 2012). According to Agboghoroma (2009), school setting (whether urban or rural)playsan important role in students' performance. The location of a school can affect student's knowledge of the sciences including biology, physics and chemistry as well as general knowledge and attitude.

There is a general believe that rural environment is less stimulating to the rural students than the urban environment to the urban students. It therefore appears that students in urban environment enjoy more academic opportunities than their counterparts

in the rural environment and consequently perform comparatively better than them.(Akpochafo, 2010). Rural environment is a setting that poses enormous challenges to schools and learners towards effective study. Rural schools face significant barriers when it comes to education. There are many aspects about rural schools that make them less fortunate than other types of schools. The actual environment of rural schools sometimes makes it hard for students to succeed because these schools are geographically and culturally isolated due to their locations, and they usually lack the conditions that urban schools have. In addition, the location of these rural schools forces them to put in more efforts in order to network with people and to get the materials needed for teachers and students (Berliner, 2014).

Rural education makes the students academically weak and exhibit negative attitude to learning, especially Biology that require absolute concentration(Onah, 2011;Owoeye, 2009). In Nigeria, rural education is associated with disadvantage in the public discourse. While research on this matter has not yielded consistent results, Fan and Chen (2009) said that rural schools are disproportionately likely to have an inadequate pool of teachers qualified in these subjects and insufficient funds to maintain up-to-date laboratory facilities. However, students in the urban schools may appear likely in a separate conceptual location with their counterpart in the rural schools. This is partly because they enjoy township amenities unlike their counterpart in the rural schools. Miriogu (2012) expressed that these days' students in the urban schools have access towell qualified teachers that are practically oriented and well equipped laboratories. Nevertheless, given the nature of Biology, however, students in the rural schools may likely not enjoy all these, but they are closer to nature than their counterpart in the urbanarea. In the villages, trees, forest lives, and aquatic lives are common site when compared to cities.So, this rare opportunity may place them in another conceptual

location when compared to their counterpart in the cities. Onwuegburu(2015); Olagunju and Abiona(2009);Taiwo(2009) pointed to the fact that essential material resources are inadequately provided in rural secondary schools in Nigeria. The state of affairs may be responsible for students non-impressive performance in public examinations such as West African Secondary School Certificate Examinations (WASSCE) in the subject in Adamawa state.

In their submission, however, Adejoh and Ityokyaa (2014) found no significant difference in the provision of laboratory and workshop material resources between rural and urban senior secondary schools.

2.7Analytical Framework

Biology Education is an application of principles of education in teaching and training in order to transfer the knowledge of biology on students for effective teaching of the subject.Biology practical activities has a great role to play, these can make teaching and learning more effective. The study is guided with a theorise which is relevant to the present study on the effect of Biology practical activities on students academic performance in senior secondary school in Adamawa state.

There are different models and theories that have been adopted by researchers to explain the different teaching method. However, this study adopts the 5E model.The 5E Instructional Model was developed by Bybee(1997) inLandes(2010) which can be used to design a science lesson, and is based upon cognitive psychology, constructivist-learning theory, and best practicesin science teaching. Bybee declares that using this approach, students redefine, reorganize, elaborate, and change their initial concepts through self-reflection and interaction with their peers and their environment. Learners interpret objects and phenomena, and internalize those interpretations in terms of their current conceptual understanding. Science teachers and curriculum developers may integrate or

apply the model at several levels. The model can be the organizing pattern of a sequence of daily lessons, individual units, or yearly plans (Bybee, 1997). Each phase of the 5E Instructional Learning Cycle, as it has been modified from Bybee are:

Engagement: In this first phase of the cycle, the teacher aims to assess student prior knowledge and/or identify possible misconceptions. This student-centred phase should be a motivational period that can create a desire to learn more about the upcoming topic. However, this phase does not serve as a time to lecture, define terms, provide explanations, or record definitions.

Exploration*:* This phase is also student-centred and incorporates active exploration. Students are encouraged to apply process skills, such as observing, questioning, investigating, testing predictions, hypothesizing, and communicating, with other peers. The teacher's role is one of facilitator or consultant. This phase is also unique because the students are given a "hands-on" experience before any formal explanation of terms, definitions, or concepts are discussed or explained by the teacher.

Explanation*:*A "minds-on" phase follows the exploration phase, and this is more teacher-directed and guided by the students' prior experience during the exploration phase. The explanation phase enables students to describe their understanding and pose questions about the concepts they have been exploring. It is likely that new questions will be generated. The explanation phase is an essential, minds-on part of the 5E lesson.

Elaboration: The activities in this phase of the learning cycle should encourage students to apply their new understanding of concepts, while reinforcing new skills. Students are encouraged to check for understanding with their peers, or to design new experiments or models based on the new skills or concepts they have acquired.The goal of this phase is to help develop deeper and broader understandings of theconcepts.

Evaluation: Assessment in an inquiry-based setting is very different to that in traditional science lessons. Both formal and informal assessment approaches are appropriate, and should be included. Students may also have the opportunity to conduct self assessment or peer-assessment. However, the evaluation may also include a summative experience such as a quiz, exam, or writing assignment.

Obiekwe and Chinwe (2012) used the 5E (Engagement, Exploration, Explanation, Elaboration and Evaluation) modelin Nigeria on the teaching of biology concepts , the model revealed that students who were exposed to the 5E method achieved better results than those whose teachers used the lecture method. Some teachers laid too much emphasis on content and the use of 'chalk and talk' approach which does not enhance the teaching and learning of Biology. This slackness and 'shy- away' attitude from activity based-approach of instructional delivery has led to abstraction, which makes the students passive and more inclined to rote memorisation (Obiekwe&Chinwe, 2012). Such teacher-centred method that puts the students as passive recipients of knowledge and the teacher as the only source of knowledge might not improve achievement or stimulate positive attitude towards Biology practical lessons (Nwagbo, 2008).

The academic performance of biology students in senior secondary schools in Adamawa state is been drawback as a result of inadequate qualified biology teachers, lack of instructional materials and non-availability of laboratory facilities wrong spelling of technical terms, inability to write brief and precise answers and the choice of appropriate teaching technique. Therefore, to adopt interactive principles of learning and the 5E model will improve the performance of the student. This model was adopted in full fletch in administering the pre-test, treatment and post-test to the study population.

2.8 Empirical Studies

The following related literatures were reviewed; to determine what gap this present study would fill and its contribution to knowledge.

Chinwe (2011) investigated the effects of biology practical activities on secondary school students' process skill acquisition in Abuja Municipal Area Council. The study was intended to ascertain the differential effects of biology practical activities and lecture method on the acquisition of science process skills, the effect of practical activities on science process skills of male and female students. The research adopted the quasi-experimental method, specifically the Pre-test, Post-test, Non Equivalent Control Group Design. The populations comprised one hundred and eleven senior secondary one (SS1) biology students randomly drawn from two co- educational schools. Two research questions and two null hypotheses guided the study. An instrument known as Science Process Skill Acquisition Test (SPSAT) was used for data collection. The data collected were analyzed using mean, standard deviation and Analysis of Covariance ANCOVA) at0.05level of significance. The results revealed that practical activities method was more effective in fostering students' acquisition of science process skills than the lecture method. There was no interaction between method and gender on students' process skill acquisition.

The study is related to the present study as both studies are interested on the effect of biology practical activities' on senior secondary school students,although Chinwe's study was more focus on science process skill in teaching. The present study is investigating the effect of biology practical in the teaching of biology. The study is similar to the present study as both used quasi-experimental research design, mean standard deviation for data collection in the research.

Olufemi (2013) carried out another study on the effect of practical assisted instructional strategy on students 'achievement in biology. The objective of the study

sought to determine the effect of instructional strategy on better performance in biology, interaction effect of gender and instructional strategy on students' achievement in biology. The population of 150 students was used for the study in Ado-Odo Ota local Government Area of Ogun State. The study adopted a randomized pre-test, post-test control group quasi-experimental design; the instrument used for data collection was biology achievement test (BAT) with a reliability coefficient of 94. Two research hypotheses were tested at .05 level of significance, using Analysis of Covariance (ANCOVA), and t-test. The results indicated that practical assisted instruction was more effective in fostering learning than the traditional lecture method. The result also showed that instructional strategy helped the students to learn the biology topics better. The findings also revealed that there was no significant interaction between instructional strategy and gender in respect to achievement in Biology.The present study indicated that the students in the experimental group, taught with practical activities, showed greater performance in the lesson than students in the control group taught with lecture method.

The study by Olufemi is similar to that of the researcher because intact classes of SS II students were used in the schools. However, the population of the researcher was larger than that of the study under consideration and the research design was a quasi experimental research which also investigated the effect of practical assisted instruction performance of students in biology.

Akusoba, (2014) carried out a study on the effect of practical work on knowledge retention among ordinary level chemistry students. The objectives of the study included to: determine the effect of practical on students' achievement and retention in chemistry when taught the characteristics of atom;determine the effect of interaction between the teaching strategy and students' gender on achievement and retention in chemistry when taught characteristic of atom. The populations of 160 students were used for the

investigation. To guide the study, five research questions were raised and three hypotheses stated and tested at 0.05 level of significance. A quasi-experimental design was used. Data was collected using 50 item objective test which was administered to the students as pre-test post- test. A reliability coefficient of 0.92 using K-R formula 21 was reported for the test. Result of the study, among others, indicated that teaching qualitative Analysis through practical work makes for better knowledge retention than teaching the content theoretically; the population used for the present study is similar to that of this study under consideration. The instrument used in this study was the per-test and post-test biology achievement test. However, this study did not consider if practical help in retention of biology concepts. The present study was also limited in scope to biology as a subject in senior secondary schools.

The study is related to that of the current research because intact classes of SS2 students were used in schools. In contrast, the population of the researcher was larger than that of the study under consideration and the research design was a quasi-experimentalresearch that carried out a study on the effect of practical work on knowledge, retention, among ordinary level chemistry students.

Amadalo(2012) conducted a study on the effects of practical work in physics on Girls' performance, attitude change and skills acquisition in secondary schools'. The objectives of the study were to determine whether there is an attitude change towards physics for girls because of participating in practical work;to investigate whether practical work enables the girls to acquire science process and practical skills, and to determine the effect of practical work on girls' enrolment in physics class in form three.Quasi-experimental pre-test and post- treatment design were used. The study involved two groups of girls from three sampled medium performing schools in Western Kenya. The Students' Achievement Test(SAT) was administered to the respondents in a staggered

manner throughout the year. A performance test of reliability index, rxy = 0.879 was administered to both groups at the end of form two .The major finding revealed that there is a significant change in the attitude toward physic in the experimental group compared to the control group.

The study is in concert with the present one as both studies are interested on the effect of biology practical activities' on senior secondary school students though the above study was more focused on effect of practical work on Girls' performance, attitude change and skills acquisition. The present study used biology practical test whileAmadalo'sstudy used students' achievement test.

Ahmad (2011) investigated the attitude toward practical biology and its effects on student's achievement. The objective of the study was to examine the relationship between attitude toward science in biology course and student's achievements; quasi-experimental pre-test and post- treatment design was used. The total populations of 185 grade 12 students in Isfahan were used. The research questions among others included: Is there any relationship between attitude toward practical biology and students' achievement in biology courses at the following dimensions motivating biology class,self directed efforts, and family models? The data was analyzed using t-test in the statistical software SPSS version 16.0. The result showed that among attitude toward science dimensions, only ''biology is fun for me'' had meaningful and positive relation with student's achievement in biology. The finding reveals that there was no significant difference between girls and boysattitude toward biology. The research is similar to this study as the both adapted quasi experimental method; the researcher used six topics and also had a higher population. However, the geographical scope of the study is different from this present study.

Macmillan (2014) conducted a similar research which investigated the effect of practical physics knowledge on academic achievementin physics as a school subject.Theresearch was carried out at Pankshin local government Area of Plateau state, Nigeria and the research design employed was a pure experimental design; two research questions were asked which are: What effect does exposure to practical knowledge have on achievement in physics as a subject?To what extend does the exposure to practical physics knowledge in female students differ form that in their male counterparts? The populations of sixty (60) senior secondary school students in Pankshin were tested using 20 item physics Achievement Test (PhyAT) whose reliability was 0.7. The t-test statistic was used to test the hypothesis formulated for the study. The analyses revealed that students exposed to practical physics knowledge achieved higher in physic than students who were not expose to practical physic. Many researches support the fact that practical activities play an important role in Biology teaching, as well as in the acquisition of scientific process skill. The review explored different work on the field of study with a view to determining the gap which this study will fill in terms of contribution to constructive theory.

The finding of the study indicated that practical in physics facilitates students' understanding of physic concept; this implies that high achievement in physics depend largely upon the student participation in practical physics irrespective of gender relating to this study.The reviewed research is related to the present study in that the study was on the effect of practical physics knowledge on academic achievement in physics and the study made use of a quasi-experimental design. The study also covered more than one topic hence is similar to the present study. The study also differs from this study in item educational level and subject.

Emmanuel (2016) carried out a study on the effect of practical on the achievement of students in chemistry. The objective of the study was to compare the mean achievement score of field dependent (FD) and field independent (FI) students taught chemistry using practical method and those taught using lecture method. The quasi-experimental design was used. The population comprised of one hundred students selected from the four co-educational schools in Enugu state. Two research questions and two hypotheses were used. Two instruments group embedded figure test and chemistry achievement test were used. The data were analyzed using mean, standard deviation and analysis of covariance (ANOVA). The results revealed that the field dependent and field independent cognitive styles students taught chemistry using practical achieved better than those taught using lecture method. The population of this study is similar to that of Emmanuel.The research is also similar to this study because the researcher used the lecture method for its control group. This present study sought to find out the effect of biology practical activities on students' performance. The study also covers more than one topic.

The research is related to the present study in that the study sought to find out the effect of biology practical activities on students' performance and the study made use of quasi-experimental design.

Herbert (2010) examined the effect of practical on students' achievement and attitude toward physics lesson. The design for the study was comparative research that employed an experimental group and a second group that was taught in a more traditional teacher-centered manner called the control group. The objective of the study was to examine the effect of practical method on students' physics achievement score and the effect of practical method on students' attitudes toward physics. The population of the study comprisedsixty (60)students from the two classes enrolled into general physics in a

secondary school in Kenya. The data were collected via a pre and post administration of the physics achievement electricity test and practical attitude scale towards physics. The data was analyzed using mean, standard deviation, independent sample t-test and a two way ANOVA. Findings showed that drawing practical instruction was more effective than traditional instruction in improving physics achievement of the participating students. This study under consideration was not on the effects of practical on students' retention which the reviewed study considered. The research was conducted for five weeks unlike this present study considered for eight weeks.

Herbert's study is related to the present study as both studies are interested on the effect of biology practical activities' on senior secondary school students though the above study was more focused on the effect of practical on the achievement and attitude of students toward physics lesson. The study is also different from this study in population and the instrumentused.

Agboola (2017) carried out astudy on "The Effects of Project, Inquiry andLecture-Demonstration Teaching Methods on Senior Secondary Students' Achievement in the Separation of Mixtures Practical Test". The objective of the study was to assess and compare the relative effectiveness of three methods of teaching and conducting experiments in separation of mixture in chemistry. A quasi-experimental pre-test, post-test control group design was used to conduct the research. The research instruments used for pre-test, post-test was tagged Chemistry Achievement Test (CAT) 1 and 2. A total of two hundred and thirty three senior secondary school one (SSS1) science students constituted the subjects for the study. The data was analyzed using t-test analysis, one way analysis of variance (ANOVA) and Scheffepost-hoc analysis. The analysis and results of the study showed that the project method brings about a significant difference in the achievement of the experiments of subjects in the experimental group compared with

those exposed to inquiry and lecture-demonstration methods of teaching Separation of Mixtures as a Model of Experimental Aspect of Chemistry. The research work is related to the present study in terms of methodology and research instrument used but differ in terms of geographical scope and objectives

Hussaini (2011) carried out a study on "Physics Teaching Methods:Practical Vs. Traditional Lecture". The major objective of the study was "to study the effect of three levels of practical method and traditional method of teaching physics on students' performance and their proficiency to apply the physics knowledge in real life situations.Thepre test, posttest control group experimental design was used in the research study. Three instruments were used in the study, which are: physics proficiency test, students' intelligence test and socio-economic status performance. 175 male physics students of 10^{th}grade were selected and used as the sample for the research study. Data were analyzed by using content alignment analysis. The research work explored that there is significant effect of guided, unguided and combination practical on students' achievement than traditional physics teaching method and their proficiency to apply the concepts of physics in real situations. The reviewed work is similar to the present study in that both examined two teaching methods (practicalVstraditional method) on students' achievement but the difference is that the former was performance in physics while the latter is performance in biology.

2.9 Summary

Most of the studies reviewed in this chapter are in agreement with the importance attached to biology practical activities. Many of the researchers support the fact that practical activities play an important role in biology teaching, as well as in the acquisition of scientific process skills. The review presented a moderate analysis of studies that form a framework or some basic concepts, fundamental to this study. Moreover, the review explored different related works from journals articles, textbooks and internet sources on

the field of study with a view to determine the gap which this study will fill in terms of contribution to constructive theory. Theoretical framework was identified where theory related to the topic of study was discussed. In line with the reviewed work, empirical studies were formulated in such a way that other authors' workswere studied; their objectives, research questions, hypotheses, population, locations and even findings were reviewed and compared with the current topic of discussion. These fore researchers revealed that students performed better when exposed to biology practicalactivities as an instructional strategy than when they were taught with conventional method alone.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter explains the research methodology used for this study under the following sub-headings: research design, population of the study, sample and sampling techniques, research instrument, validity of the instrument, pilot study, and reliability of the instrument, procedure for data collection, treatment procedure and procedure for data analysis.

3.2 Research Design

The design for this study was quasi-experimental pre-test, treatment, post-test experimental and control group. The purpose of using this design agrees with the view of Campbell and Stanley(2009) who said: "Experimental is to investigate possible cause and effect as well as the relationship between two or more variables by the application of treatment which cannot be resolved by observation or description". Theexperimental and

control groups were pre-tested to determine the group equivalence at the start of the experimental.The illustration of the design can be seen below.

Experimental Group $O_1 \longrightarrow X \longrightarrow O_2$

Control Group $O_1 \longrightarrow Y \longrightarrow O_2$

Key: O_1: Pretest X: Treatment O_2: Post Test

Y Conventional Approach

Figure 1: Research Design Illustration.

3.3 Population of the Study

The population of this study consisted of all public co-educational senior secondaryschools, class two (SSII)studentswho were offering biology in the five education zones of Adamawa State. The total population composed of eighty nine thousand, one hundred and ninety six (89,196) senior secondary school students spread across two hundred and eighty-eight (288) schools. Table 1 shows the summary of the total population of the SS II students in all the public senior secondary schools in Adamawa State educational zones..

Table 1: Population of the Study

S/N	Educational Zones	Number of Public Schools	No. of Males	No. of Females	Total No. of Students
1.	Yola Zone	41	10,196	5,015	15,211
2.	Gombi Zone	75	15,372	11,849	27,221
3.	Mubi Zone	60	7,068	7,068	11,889
4.	Numan Zone	44	8,561	6,745	15,306
5	Ganye Zone	68	11,300	8,269	19,569
Total		**288**	**36,699**	**52,497**	**89,196**

Source:Adamawa State Educational Resource Centre (2017)

3.4 Sample and Sampling Techniques

The study wasconducted in Yola North Educational Zone out of the five educational zones in Adamawa State. Four (4) co-educational secondary schools were used out of the two hundred and eighty-eight (288) schools, two schools from rural areas and two schools from urban areas. The schools were purposively selected in view of the peculiarities of the study. These include nature and status of the subjects offered by the schools, and the nature of the study. For this study, four intact classes in which the number of students met in each of the classes served as the sample size. Meanwhile, the schools:Government Day Secondary School (G.D.S. S.), Army Barracks and G.D.S.S.,Bajaburewere sampled for the experimental group. Hence G.D.S. S.,Wuro-Jabbe and G.D.S.S., Capitalwere sampled as the control group. Feasibility of the study showed that the sampled schools had student size of one hundred and sixty (160). The classification of the population into control and experimental group is presented in Table 2 below.

Table 2: Sample Size Distribution of Schools Used for the Study.

	Sample Schools		Gender		Total Numberof SSS II Students
			M	**F**	
A	G.D.S.S	Army Barrack	31	17	48
B	G.D.S.S	Bajabure	21	14	35
A	G.D.S.S	Wuro-Jabbe	10	30	40
B	G.D.S.S	Capital	22	15	37
	TOTAL		**84**	**76**	**160**

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3.4.1 Determination of Homogeneity of Sample

There are about 288 public co-educational senior secondary schools within the region under study, out of which four (4) schools were purposefully sampled, based on their homogeneity, that is, the use of the same curriculum. Availability of facilities and

quality of teacherswere considered before selecting the experimental schools.In determining the homogeneity of sample for the study, the researcher picked the schools for the research from the same educational zone. The selected schools in the zone were using the same curriculum. Also, the infrastructure available for students to learn were at equal supply. Both schools must have had a well-equipped biology laboratory. The quality of the teachers that taught in the schools were similar. Biology teachers of the schools used hadthe same qualification, as this made the research unbiased.

3.5 Instrumentation

Biology Practical Test (BPT) was usedin this study. Two tests were used to measure performance; a pre-test was used to test students' pre-requisite knowledge in topics related to the one covered during the study. Appendix B presents sample of the questions used in the pre-test. The post-test measured students' performance at the conclusion of the study. Appendix C shows sample of the questions that wereused for the post-test. The topic was drawn from SSI and SSII syllabus; the items for the BPT were adopted from the past West African Examination Council (WAEC) questions for promotion examination from 2014, 2015, 2016 and 2017. The instrument,BPT, consists of items designed, made up of three sections (A, B and C). They were all practical skill test consisting of essay practical questions. Section 'A' constitutes the classification of living things;Section 'B', classification of fruits and reproduction in flowering plants,and Section 'C'- nutrition in animal and digestion in bird. The students were required to demonstrate behaviours such asmaking careful and accuratemeasurements, observations, experiments, classifications and communication.

The content of the instrument covered all the levels of cognitive and psychomotor domain of learning. The researcher utilized Bloom's Taxonomy of learning, which provides an important framework for teachers to use on higher order thinking, by

providing hierarchy levels. (See Appendix F, G, and H for the list of specimens and marking scheme respectively).

3.5.1 Lesson Plan

The researcher developed sequential lesson plans.Each of the objectives was prepared and matched to their respective instructional guide. The topics werebroken down into achievable behavioral objectives. The lesson plans were given to two experienced biology teachers and experts in Science Education Department, in the Faculty of Education, Ahmadu Bello University- Zaria,for validation. They were requestedto examine the following aspects:

1) clarity and appropriateness of the lesson objectives for the students
2) conformity of the instructional methods and appropriateness of the instructional materials
3) relevance of student activities and evaluation questions for the lessons

3.5.2 Validity of the Instrument

The instrument used in this study was self-developed by the researcher. After drafting the essay practical skill questions for the achievement test, they were given to supervisors who made some adjustments to determine the face and content validity of the instrument. Necessary corrections and modifications were made which led to the final copy. Alasoluyi (2015), who stated that to ascertain the validity of any instrument, supported this technique, it should be given to a panel of experts to determine ifitsitems (contents)can elicit the desired data they are intended to elicit.

3.5.3 Pilot Study

Pilot study was carried out, to determine the reliability and suitability of Biology practical Test (BPT) as study instrument. The instrument was administered twice within an interval of two weeks to 40 Senior Secondary School (SSII) Students in G.G.S.S Yola in Adamawa state. However, this school is part of the population of this study and not

part of the sample to be used for the research but was chosen to ascertain any difficulty that the researcher may encounter when carrying out the main study.

3.5.4 Reliability of the Instrument

The reliability of the instrument was established through trial testing of the instrument of a group of 40 SSII students from G.G.S.S Yola. The data collected from the pilot study was computed using Pearson Product Moment Correlation Coefficient (PPMCC); the reliabilityindex of 0.79 was obtained. Brown (2010) had indicated that reliability co-efficient of 0.5 or more can be considered reliable .This means that the instruments are reliable in conducting the main study.

3.6 Procedure for Data Collection

An introductory letter was presented for permission to be obtained from the authorities of the schools that were involved, for the use of their students and their lesson period twice a week for eight (8) weeks. The letter was presented to both experimental and control schools**.**The students (experimental and control groups) of the study were subjected to pre-test under the same condition to determine the level of their performances for the purpose of comparison. The researcher collected the results. Sixteen (16) weeks lesson plan for experimental group and control group was prepared. The two groups were then exposed to biology practical test. Experimental group was taught for a period of eight (8) weeks using practical format with toad, lizard and flowers while control group was taught using conventional teachingmethod with diagram,photographs and charts for a period of eight (8) weeks as well. A post-test was administered to both experimental and control groups in all the sampled schools at the end of their eight weeks, each with the same items as in the pre-test. This was to determine the mean scores of the two groups. After the test, results were collected for analysis. See Appendices J and K for the list of specimens and marking schemes**.**

3.6.1 Treatment Procedure (Experimental Group)

The experimental group was treated for eight weeks. The double period of the timetable was used for the lesson each to ensure that the lesson and experiments had ample time.

First Week: Lessons One and Two

Unit:Classification of Animals

Content: Kingdom Animalia (fish, toad, lizard); structure of the animal, characteristics and adaptation feature of animals to their environments

Procedure:Students in this group were taught how to carry out the experiments by observing and classifying the animal based on their external features, structures and adaptation features.

Second Week: Lessons Three and Four

Unit:Nutrition in Animal

Content: Food test (test for starch, test for reducing sugar, test for protein, fat & oil test)

Procedure:Students in this group weretaught how to conduct food test on starch, sugar protein and fat& oil using experiments**.**

Third Week: Lessons Five and Six

Unit: Classification of Fruits

Content:Definition of fruit, Types of fruits, classification of fruits

Procedure:Students in this group were taught the definition of fruit, classification of fruits by examining the different types of fruits, example: orange, mango, pawpaw, guava, etc.

Third Week: Lessons Seven and Eight

Unit: Classification of Fruits

Content:Structure of fruitsand dispersal of fruits

Procedure:Students in this group were taught the structure of fruits by examining the transverse sections of the orange and tomato, how to classify the fruits according to their mode of dispersal.

Fourth Week: Lesson Nine

Unit:Reproductive System in Plants (Flower)

Content: Definition of a flower, identification of the structure of a flowering plant, the different types of ovary found in a flower

Procedure: Students in this group were taught how to define flower, examine the structure of flowering plant, identify the various types of ovary using the cut T.S. and L.S. of ovaries of flamboyant flower.

Fourth Week: Lessons Ten and Eleven

Unit: Reproductive System in Plants (Flower)

Content: Identify the various kinds of placentation found in a flower

Procedure: Students in this group were taught how to examine the variousplacentations in a flower, by cutting the flower in T.S section for the student to observe, draw and label them in their practical note book.

Fifth Week: Lessons Twelve and Thirteen

Unit: Reproduction in Plants

Content:Define reproduction and state the types of reproduction in plants

Procedure:Students in this group were taught the definitions and types of reproduction such as sexually and asexual reproduction, as they conducted experiment on grafting and layering, using plants parts.

Sixth Week: Lesson Fourteen

Unit: Reproduction in Plants

Content:Identify the adaptive feature of corn ginger and onion, state the similarities and differences between the specimens.

Procedure:Students in this group were given ginger, onion and corn to observe; examine and classify them based on their features during experiments.

Seventh Week: Lesson Fifteen

Unit: Digestive System

Content: Identify the parts of alimentary canal of a bird and their functions

Procedure: Students in this group were taught digestive system in bird using a dissected chicken in the experimental class, pointing out their function and features of each part.

Eight Week: Lesson Sixteen

Procedure:The teacher made revision of the entire topics taught and examination was administered to the students**.**

Treatment Procedure (Controlled Group)

The regular biology class teachers were used for the study. The control groupwas treated for eight weeks and double period of the timetable was use for the lesson each to ensure that the lesson had ample time based on the application of the instructionalguide, using conventional method.

First Week: Lessons One and Two

Unit: Classification of Animals

Content:Kingdom Animalia (fish, toad and lizard); structure of animals; characteristics and adaptation feature of animals to their environments

Procedure:Students in this group were taught, using charts, the external features, structure and adaptation features of the following specimens: fish, toad and lizard and the teacherdisplayed the subject matter visually at the pacesuitable for students' learning.

Second Week: Lessons Three and Four

Unit:Nutrition in Animals

Content: Food test (test for starch, test for reducing sugar, test for protein, fat & oil test)

Procedure:Students in this groupwere taught, using diagram, how to conduct food test on starch, sugar, protein and fat& oil.

Third Week: Lessons Five and Six

Unit: Classification of Fruits

Content:definition of fruits, types of fruits, classification of fruits

Procedure:Students in this group are taught the definition of fruit, classification of fruits using picture and explanatory drawing showing inter-relation and explaining the external features of the specimens. Example:orange, mango, pawpaw, guava and other.

Third Week: Lessons Seven and Eight

Unit: Classification of Fruits

Content: Structure of fruitsand dispersal of fruits

Procedure:Students in this group were taughtthe structure of fruits; the teacher led adiscussion on the transverse sections of orange and tomato on the blackboard, and classified the fruits according to their mode of dispersal, using a chart.

Fourth Week: Lesson Nine

Unit: Reproductive System in Plants (Flower)

Content: Definition of a flower, identification of the structure of a flowering plant, the different types of ovaries found in a flower

Procedure: Students in this group were taughtthe definition of a flower; the teacher explained the structure of flowering plants, and identified the various types of ovaries, the cut T.S and L.S of ovaries of flamboyant flower on a chart.

Fourth Week: Lessons Ten and Eleven

Unit:Reproductive System in Plants (Flower)

Content: Identify the various kinds of placentation found in a flower

Procedure: Students in this group were taught the various types of placentation in flower,using diagramby the teacher, showing the T.S section of a cut flower. The studentswere asked to list, draw and label them in their practical notebook.

Fifth Week: Lessons Twelve and Thirteen

Unit: Reproduction in Plants

Content:Define reproduction and state the two types of reproduction

Procedure:Students in this group were taught the definition and types of reproduction such as sexually and asexual reproduction, as the teacher demonstrated on grafting andlayering,using a diagram drawn on the black board in the classroom.

Sixth Week: Lesson Fourteen

Unit**:** Reproduction in Plants

Content:Identify the adaptive feature of corn ginger and onion, state the similarities and differences between the specimens

Procedure:Students in this group were given the model of ginger, onion and corn to observe, examine and classify them based on their features during the lesson.

Seventh Week:Lesson Fifteen

Unit: Digestive System

Content: Types of alimentary canal in bird, parts of the alimentary canal description and functions of each part

Procedure: Students in this group were taught digestive system in bird using the charts of a dissected chicken in the classroom, the teacher pointing out the important features and functions of each parts.

Eight Week: Lesson Sixteen

Procedure:The teacher made revision of the entire topics taught, and examination wasadministered to the students.

3.7 Procedure for Data Analysis

The demographic information of the students was interpreted using sample percentages.Mean and standard deviations were used to answer the research questions this is because mean is the most reliable measure to central tendency also the standard deviation is the most reliable estimate of variability. All the four hypotheses were tested usingindependent sample t-test at alpha of 0.05 level of significance.

CHAPTER FOUR
DATA PRESENTATION, RESULTS AND DISCUSSION

4.1 Introduction

This study was carried out with the aim to assess the effects of biology practical activities on students' academic performance in senior secondary schools in Adamawa State.This was achieved by examining 160 students,splitinto treatment group (83) and control group (77). The students were givenpre-test and post-test which were subjected to statistical analysis using appropriate tools and procedure in Microsoft Excel. The results are presented as follows:

Table 3: Students Performance in Biology Test by Method of Teaching in selected Schools of Adamawa State.

GRAD	**PRACTICA**				**LECTURE**			
	Army Barrack		Bajabure		Wuro-jabbe		GDSS Capital	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Failure	2	4.2	1	2.9	15	36.6	23	62.2
Credit	43	89.5	32	91.4	26	63.4	14	37.8
Excellent	3	6.3	2	5.7	0	0	0	0
Total	**48**	**100**	**35**	**100**	**40**	**100**	**37**	**100**

Source: Goji's Field Study, 2017

Results from table 3 shows the students' performance in selected schools of Adamawa State, by method of teaching. Students in schools that were taught biology using practical activities have higher performance at credit level of 89.5% (GDSS Army barracks) and 91.4% (GDSSBajabure) than students who were taught using the Lecture Method, 63.4% (GDSS Wuro-Jabbe) and 37.8% (GDSS Capital). It is also important to note that those taught using lecture method displayed high number of those that performed very low compared to those taught using practical method, as GDSS Capital had a higher percentage of about 62.2%. This is against expectation as the school is located in an urban area.

Table 4:Demographic Information of the Participants

Gender	Frequency	Percentage
Male	84	52.5
Female	76	47.50
Total	**160**	**100**

Table 4 shows the distribution of students by gender. The sampled schools have 52.5% males and 47.5% females. This depicts that there was fair representation of participants by gender, to avoid any form of bias.

Table 5: Distribution of Participants in Groups

Groups	Frequency	Percentage
Experimental	83	51.9
Control	77	48.1
Total	**160**	**100**

Table 5 indicated that 83 participants (51.9%) belonged to the experimental group and 77 representing (48.1%) of the 160 respondents were in the control group. They may not have had equal representation, but the distribution for both control and experimental groups was fairly done in the study, and any form of subjectivity that could have been attributed to group sentiments was eliminated.

4.2 Response to Research Questions

This section reports the results of the analysis of students' results from both pre-test and post-test, analyzed using descriptive statistics, which includes mean and standard deviation.

4. 2.1 Research Question One: What is the difference on pre-test and post-test performances of students taught biology using practical activities in senior secondary

schools in Adamawa state?Table 6 presents a summary of the analysis carried out in respect to the method of teaching biology in senior secondary schools in Adamawa state.

Table 6: Mean score of students taught biology using practicalactivities

Method	N	Mean	SD
	160		
Pre-test		42.087	9.21
Post-test		55.58	9.45

Source: Goji's Field Study, 2017

Table 6 reveals that the performance of students taught practical activities in their pre-test score have a mean value of 42.087 and standard deviation of 9.21, while the post-test score have a mean value of 55.58 and standard deviation of 9.45. This depicts that students taught biology using practical activities in their post-test had higher mean score compared to their pre-test score in senior secondary schools of Adamawa State, Nigeria.

4.2.2 Research Question Two: What is the level of retention of students taught biology concepts using practical activities and those taught using lecture method in senior secondary schools in Adamawa state?

Table 7: Results of students'retention level in Adamawa State by method of teaching

Method	Pre-test		Post test	
	Mean	SD	Mean	SD
Practical	54	11.46	80.4	12.34
Lecture	42.78	11.97	61.81	10.54

Source: Goji's Field Study, 2017

Table 7 showed that the mean scores for student taught biology using practical activities was 80.40 while that of the students taught using lecture method was 61.81. Thestudents taught using practical or experimental method therefore, have higher retention level than students taught using lecture method in biology among secondary schools located in Adamawa State.

4.2.3 **Research Question Three**: What is the difference in the mean score of rural and urban students taught biology using practical activities and lecture methods in senior secondary schools in Adamawa State?

Table 8: Results for the mean score of students in urban and rural areas

Location	N	Mean	SD
Rural	75	52.55	10.795
Urban	85	53.03	11.88

Source: Goji's Field Study, 2017

Table 8 presents the results for students' performance in urban and rural areas; the result revealed that students in urban areas have a mean score of 53.03 and standard deviation of 11.88 while students in rural areas have a mean value of 52.55 and a standard deviation 10.795.There is little or no difference in the performance of students taught biology based on their locations. This implies that the treatment is good for both urban and rural students.

4.2.4 **Research Question Four:** What is the difference in the mean score of students taught biology practical activities using real specimen and those taught using chart among senior secondary school students in Adamawa State?

Table 9: Mean performance of students taught biology using real specimen and charts.

Variable	N	Mean	SD
Real Specimen	48	51	10.96
Charts	35	30.63	9.24

Source: Goji's Field Study, 2017

Table 9 shows the results of students taught biology practical activities using real specimen and charts. It was observed that students taught biology practical using real specimen had a mean score of 51 and standard deviation of 10.96 while those taught using charts had a mean value of 30.63 and a standard deviation of 9.24. This implies that

those taught biology practical activities using real specimen performed better than those taught using charts.

4.3 Hypotheses Testing

4.3.1 HypothesisOne($H0_1$): There is no significant difference between the pre-test and post-test scores on student performances in biology using practical activities in senior secondary schools in Adamawa state.

Table 10:Paired sample t-test results of students taught biology using practical activities

Method	N	Mean	SD	Df	α	t-cal	t-crit	sig	Decision
Pre-test	160	42.087	9.21	158	0.05	7.78	1.65	.000	Rejected
Post-test		55.58	9.45						

Source: Goji's Field Study, 2017

The Paired sample t-test was used to test the hypothesis as shown in table 4.8 and results revealed that there is a significant difference in the pre-test and post-test score of students who were taught biology using practical activities. This is evident as the calculated or t-statistics value (7.7785) is greater than the critical value (1.65468), and as such, the null hypothesis ($H0_1$) is rejected.

4.3.2Hypothesis Two ($H0_2$): There is no significant difference of student's retention level between students taught biology concepts using practical activities and those taught using lecture method.

Table 10: Independent sample t-test results for retention level of students by method of teaching

Method	N	Mean	SD	Df	α	t-cal	t-crit	sig	Decision
Lecture	77	80.645	11.69	158	0.05	28.25	6.31	.000	Rejected
Practical	83	61.715	10.26						

Source: Goji's Field Study, 2017

From table 10, it is clearly seen that there is a significant difference in the retention level of students taught biology concepts using practical activities and those taught by lecture method, as the calculated t-value (28.25) is greater than the critical value (6.31), which leads to the rejection of the null hypothesis.

4.3.3 Hypothesis Three ($H0_3$): There is no significant difference between the mean score of students' performance in rural and urban areas of Adamawa State.

Table 11:Independent sample t- test results of students in urban and rural areas

Location	N	Mean	SD	Df	α	t-cal	t-crit	sig	Decision
Rural	75	52.55	10.795						
				158	0.05	-1.798	1.65	.074	Retained
Urban	85	53.03	11.94						

Source: Goji's Field Study, 2017

In testing hypothesis 3, the mean score of 52.55 and standard deviation of 10.8 were realizedfor students in rural schools while students in urban schools scored the mean of 53.02 with standard deviation of 11.94. The result in table 4.10 indicates that there is no significant difference between the performance of students in rural and urban zareas using both methods of teaching since the calculated t- value (-1.798) is less than the critical t-value (1.65). The null hypothesis is therefore retained.

4.3.4 Hypothesis Four ($H0_4$): There is no significant difference between students who are taught biology practical activities using real specimen and those taught using charts. The result was summarized in table 12 below.

Table 12: Independent sample t-test result of students taught biology practical activities using real specimen and charts

Variable	N	Mean	SD	Df	A	t-cal	t-crit	sig	Decision
Specimen	48	54	11.46						
				81	0.05	9.89	1.65	.000	Rejected
Charts	35	32.02	11.68						

Source: Goji's Field Study, 2017

Results in the t-test for samples of unequal variance reveal that there is a significant difference in the mean score of students who were taught biology practical activities using real specimen and those taught using charts, as the calculated t-value (9.89) is greater than the critical t-value (1.65). As such, the null hypothesis is rejected and the alternate hypothesis is accepted.

4.4 Summary of Findings

This study was able to make the following findings:

1. Students taught biology using practical activities in their post-testperformed significantly bettercompared to their pre-test scores. P= 000<0.05 alpha level.
2. Students taught biology concepts using practical activities had higher significant retention level than those taught using lecture method with p= 000< 0.05 alpha level
3. The performance of students in urban areas was not significantly better than those students inthe rural areas considering their meanscore with p= 074>0.05 alpha level of significant.
4. Students taught biology practical activities using real specimen performed significantlybetter than thosetaught biology practical activities using charts withp= 000<0.05 alpha level of significant.

4.5Discussion of findings

From the results presented above, senior secondary students taught biology using practical activities performed better in their post-test compared to their pre-test, as there is a great difference in their mean scores.This simply translates that practical activities is best at enhancing students' performances. It is therefore not contestable that the practical method of teaching is more ideal for student's performance as agreed by Collins (2011),

who asserted that practical work puts the students at the centre of learning where they can participate in class activities. In this way, the desire and eagerness to know more about what the subject can offer isdeveloped which consequently improves students' performance, as it is retentive.The results revealed that there is a significant difference in the pre-test and post-test score of students who were taught using practical activities,the null hypothesis was rejected. To buttress this, Roberts (2010) reported that, "doing" has been found to be the easiest skill attainable by student respondents, as many professed to like the "doing" aspect of science practical learning skills, even though the 'liking' may not translate into performance in schools.This finding is consistent with the report ofShoemaker (2009) who observed that practical activities develop problem solving skills and a deeper understanding of the concepts and principles in biology for students. When students do biology, hands on they will understand it and will enjoy the learning process since it will be relating what they have learnt to real life situations.

Students taught biology concepts using practical activities or experimental method therefore, performed better than students taught using lecture method in biology among secondary schools located in Adamawa State, The result revealed significant difference in the performance of the two groups. From the mean score, it was observed that students who wereexposed to practical activities had a significantly higher retention levelcompared with their counterparts who were taught with lecture method.The null hypothesis was therefore rejected. It is important to state that a student's retention level can also be based on the student's skills as confirmed by Eze (2012), whose study on the influence of students' ability levels on their retention using advance organizer, indicated a non-significant influence of students' ability level on their retention. The academic ability is related to intelligence.This finding agreeswith Paul (2017), who reported that retention is a base model for which the meaningful stimuli are processed by the brain at a deep

level. This model is attributed to the long time memory (retention) which is based on our ability to process semantic knowledge deeply by associating recall items.Eriba and Sesugh (2008) and Onekutu (2013) stressed that students' performance and retention can be affected by practical activities, various types of methods used and other variables like motivation and the interest of the students toward biology practical. The finding here clearly showed that the students in the experimental group, taught with practical activities, showed greater performance in the lesson than students in the control group taught with lecture method. The finding is consistent with the study ofIyop and Mangut (2015) who point out that there are inherent setbacks of lecture method. They affirm that it does not promote meaningful learning as it appeals only to the sense of hearing. According tothem, learning that is more effective goes on only when many senses are involved. It also agree with the finding of Ranis (2017) who observed that practical activities is a means by which students acquire meaningful learning of biology concepts to the point of achieving transfer and application of knowledge According to him ,it has proved to be one of the most effective ways of teaching biology.

There is no significant difference in the performance of students in rural areas and students in urban areas; the null hypothesis was therefore retained. This is because the schoolswere properly served with good biology learning materials in Adamawa State, ranging from textbooks and chemicals to enhance practical and lecture method of teaching. It, therefore, appears that students in urban and rural environment enjoy opportunities that are academically convenient, and consequently perform comparatively better than those who lack such opportunities,as confirmed byAkpochafo (2010). The location of these rural schools forces them to use more effort in order to network with people and to get the materials needed for teaching and learning (Berliner, 2014). This finding reflects the finding of Adejo (2015) who stated that as long as both rural and

urban school students are exposed to the same inquiry teaching method, their academic performance would almost be the same.Finding was supported by Adejoh and Ityokyaa (2014),who confirmed that there is no significant difference in the provision of laboratory and workshop material resources between rural and urban senior secondary schools.

The use of real specimen in biology practical have proven to be more effective in students performance than the use of charts as the mean scores of students in senior secondary schools in Adamawa depict so. This finding is supported by Mari (2010), who stated that students who see the organism they are studying physically and even in its natural location remember and understand better than when they are taught only theoretically. The null hypothesis was therefore rejected.

CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The study of biology in senior secondary schools can equip students with useful concepts, principles and theories that will enable them face challenges before and after graduation. This can only be attainable when proper methods of teachings are applied. Therefore, this study is concerned with the effect of biology practical on the academic performance of students in Adamawa State Nigeria. To achieve this, a comparisonwas made between the per-test and post-test performance of students taught using practical activities, their retention level and the performance of students by their location, either urban or rural area. In addition, the performance mean score of students taught biology practical activities using real specimen and those taught using chart was compared.

Related literatures on the concept of biology practical activities, biology curriculum and its implementation and challenges were reviewed in which it was discovered that poor quality and inadequate number of teachers, poor funding, culture and ideology militate against the implementation of biology curriculum. Other literatures such as the need and importance of biology practical activities, the availability of biology laboratories in senior secondary schools and the methods of teaching biology practical were perused. Other works on the effects of location on the performance of students, the retention level of students based on teaching methods and the effects of the use of real specimen and charts on the performance of students were also useful.

The study employed the quasi-experimental design; specifically, the pre-test, post-test non-equivalent group design in which Senior Secondary II (SS2) students were selected from four different schools, from both urban and rural areas. The schools were divided into controlled and experimental groups with a total of 160 students and the

Biology Test Practical was used to examine thestudents. Data for analysis were obtained using the pre-test and post-test treatment for eight weeks. The data wereanalyzed using mean and standard deviation, and hypotheses were tested using the paired t-test for unequal variance.

Findings from this study showed that students taught biology using practical activitiesperformed better than in their post-test compared to their pre-test score as there is a significant difference in their mean score. The retention level of the students taught biology concept using practical activitieswas highercompared to those taught using lecture method.The performance of students in urban areas wasnotbetter than that of the students in the rural areas, considering their mean score. It is noteworthy that settlement plays a significant role in the performances of students as this finding indicate that using both method of teaching, students' performance in either rural or urban areas have no significant difference. Again, students taught biology practical activities using real specimen performed better than those taught biology practical activities using charts.

5.2 Conclusion

Considering the findings of this study, the academic performance of students taught biology in senior secondary schools in Adamawa state using practical activities is very effective giving credence to their pre-test and post-test performances. The students taught using lecture method of teaching scored below credit level, which is a low performance. The study also concludes that student's retention level are influenced when they are practically involved in the learning process than when they just sit and are being lectured.Location does not play a significant role in the performances of studentsas students in urban areas who were taught using both practical activities and lecture method performed equally with those located in the rural areas. This is true as other factors

contribute to the learning and performance of students such social factors.A tiny piece of real object stimulates interest in students to learn more in which it can be statedcategorically that, the use of real specimen in teaching biology practical improves students' performance better than the use of charts. Students hardly forget what they see, feel and touch compared to illustrations that may not be real to them.

5.3 Recommendations

1. The use of practical activities in teaching biology should be encouraged itenhance students' performance in senior secondary schools.
2. Practical activities should be adopted by biology teachers when teaching students the basic concepts in biology this enhances retention level.
3. Schoolsin urban and rural areasshould be exposed to more practical activitiesin Adamawa and other states in Nigeria.
4. The use of real specimens among biology teachers should be encouraged than the use of charts in teaching.

5.4 Contribution to Knowledge

The study contributes to knowledge in the following areas:

1. Practical activities can solve many learning difficulties, especially in biology education in Adamawa state.
2. Practical activities motivation students to learn and improve on their academic performancewith regards to biology.
3. The use of real specimen alongside charts provides a conducive practical teaching for high retention level of senior secondary schoolstudents in biology.

5.5 Suggestion for Further Research

1. Effects of environmental and social factors on the academic performance in biology of senior secondary students in Adamawa state
2. Effectsof study ability in biologyonthe academic performance of students in senior secondary school in Adamawa state

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APPENDIX A

REQUEST TO ANSWER RESEARCH QUESTIONS

I am a postgraduate student of theDepartment of Educational Foundations and Curriculum, Faculty of EducationAhmadu Bello University, Zaria. I am carrying out a research titled: "Effects of biology practical activities on students' performance in senior secondary schools in Adamawa State, Nigeria".

I solicit for your support in answering the research questions appropriately. The answers collected with this research instrument shall be treated confidentially and shall be applied only for the purpose of this research work.

Thank you for your anticipated cooperation.

Yours sincerely,

Goji Monica
P14EDFC8060
07038510637.

APPENDIX B

Biology practical test (BPT) pre-test for experimental and control groups

Instruction

*Answer **all** questions in this section.*

1. *Observe specimens***A, B, C***and***D***closely and use them to answer questions***1**(a) **1**(c).

(a) (i) Classify specimen **A,B** and **C**into their class without reason. [3marks]

(ii)State **two** observable feature of specimen **C**. [2marks]

(iii)Make a drawing 8cm-10cm long of the lateral view of specimen **A**. [8marks]

(b) (i)Name the fruit types of specimen **D** and **E**. [2marks]

(ii)State the type of placentation found in specimen **D**with reason. [1marks]

(iii) Identify specimen **F** and statetwoobservable features. [3marks]

(c) (i)Identify specimen **G** without reason. [1marks]

(ii) State **two**observable feature of specimen**G.** [2marks]

2. *Study carefully specimens***H,I***and***J***and use them to answer question***2**(a) *to***2**(c)

(a) (i)State two observable feature each in specimen **H, J** and **I**.[6marks]

(ii) Name **one** type of food stored in each of Specimen **H, J and I**. [3marks]

(iii)Make a drawing 8cm-10cm long of specimen **H** and label fully. [9marks]

(b) State:

(i)**two** similarities between specimen **H** and **I**. [2marks]

(ii)**two**differences between specimens**I** and **J**. [2marks]

(c) Cut a piece of specimen **L** add two drop of iodine solution.Record your observation and inference. [2marks]

(ii) Place a small quantity of specimen **K** solution in a test tube; add one (1) ml of distilled water and shake. Add few drop of Benedict or Fehling solution. Boil the mixture for few minutes. Record your observation. [2marks]

(iii) Smear a piece of specimen **N** on a filter paper and observe the spot against a source of light. Record your observation. [2marks]

Total 50 marks

APPENDIX C

Biology performance test (BPT) post-test for experimental and control groups

Instruction

*Answer **all** questions in this section*

SECTION A

1.*Study carefully specimens***A, B** and **C***and use them toanswer questions***1**(a) to**1**(c)

(a) (i)Statethe class to which each of specimens**A, B** and **C** belong. [3marks]

(ii) State **three** reasons each for placing each of specimens **A, B**and **C**in their class. [6marks]

(iii)State **two** observable feature that adapt specimens **B** and **C** to their environments. [4marks]

(b) Make a drawing, 8cm-10cm long of the lateral view of Specimen **A**[9marks]

(c) State;

(i)**two** similarities; [4marks]

(ii)**two** observable differences between Specimen **A** and **B** [4marks]

SECTION B

2. *Study specimens***H, J and I***carefully and used them to answer questions***2**(a) to **2**(c).

(a) State ;

(i)**three** observable similarities between specimen **H** and **I** [3marks]

(ii)**three**observable difference between specimen **I** and **J** [3marks]

(iii)Make a drawing 8cm-10cm long of specimen**H** and label fully. [9marks]

(b)(i) Name **one** types of food stored in each of Specimen **H,I** and **J** [3marks]

(ii)State **two** observable Feature each in Specimen **H**, **J** and **I** [6marks]

(c) (i) Identify specimen **G** without reason [1marks]

(ii)State **three** functions of each parts found in specimen **G**. [3marks]

(iii)List **two** ways in which specimen **G** is of economic Importance. [2marks]

SECTION C

3.*Study specimens***D***and***E***carefully and use them to answer questions***3**(a) *to***3** (d)

(a) (i) Name the types of fruits in Specimen **D** and **E** without reason [4marks]

(ii)Make a drawing 8-10cm long of the transverse section of specimen **D** and label fully [9marks]

(iii)Describe the modes of dispersal of specimen **D** and **E** [2marks]

(b) (i)State**three** similarities and difference between specimen **D**and **E.**[6marks]

(ii)Identify the type of placentation found in specimen **D** [2marks]

(iii)Copy the table below into your answer book. Complete the table using your observations on specimen **F**

Number of flora	**Number of floral**	**Colour ofparts**
Sepal		
Petal		
filament		
stigma		

[5marks]

(c) (i) Carefully detach the other petals except the special petal. Make a large labelled drawing (10-12 cm long) of the remaining floral parts. [7marks]

(ii)What types of ovary does specimen **F** has? [1marks]

(d)(i) Cut a piece of specimen **L.**Place a portion on a white tile and add two drop of iodine solution.Record your observation. [1marks]

(ii)Place a small quantity of specimen **K** solution in a test tube; add one (1) ml of distilled water and shake. Add few drop of Benedict or Fehling solution. Boil the mixture for few minutes. Record your observation. [1marks]

(iii) Place a small quantity of specimen **M** in a test tube. Add few drop of sodium hydroxide solution and shake against slowly. Add a few drop of 1% Copper (II) Sulphate solution. Record your observation. [1marks]

(vi)Smear a piece of specimen **N** on a filter paper and observe the spot against a source of light. Record your observation [1marks]

Total 100 marks

APPENDIX D

LESSON PLAN FOR EXPERIMENTAL GROUP

LESSON ONEFOR EXPERIMENTAL GROUP

School: Government Day Secondary School, Army Barrack Yola
Subjec: Biology Practical
Topic: Classification of Living Things
Sub-topic: Animal Classification
Gender: Mixed
Class: SS2A
Duration: 80 minutes

Behavioral objectives: At the end of the lesson, the students should be able to:

i) identify the external features of fish, lizard and toad

ii) identify the characteristics of fish ,lizard and toad

iii) identify adaptation features of the above specimens, to their environment.

Instructional Strategies: Expository,questioning, activity, guided inquiry and demonstration

Instructional Materials: Microscope,fresh killed or preserved specimens of fish, lizard, toad, Petri dish, hand lens and forceps

Reference: Understanding Biology Practical by J.A.Adewuyi (2013) pp 70-81

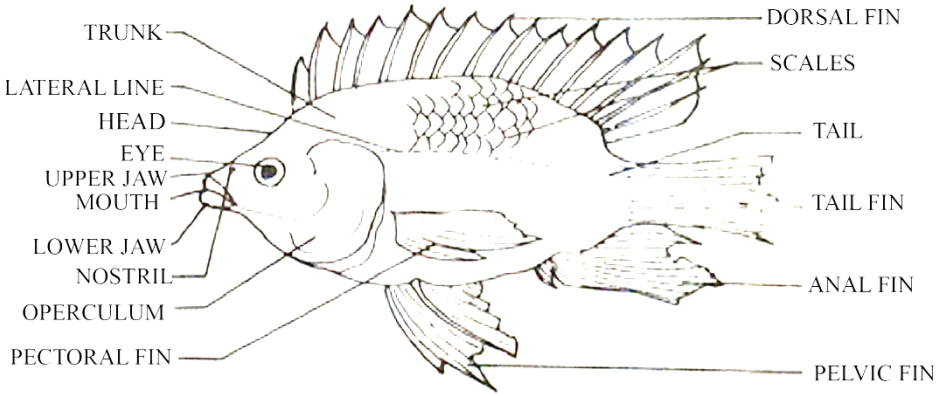
Previous Knowledge: Students are aware of the classification of plant kingdom and their characteristics.

Instructional Procedures:

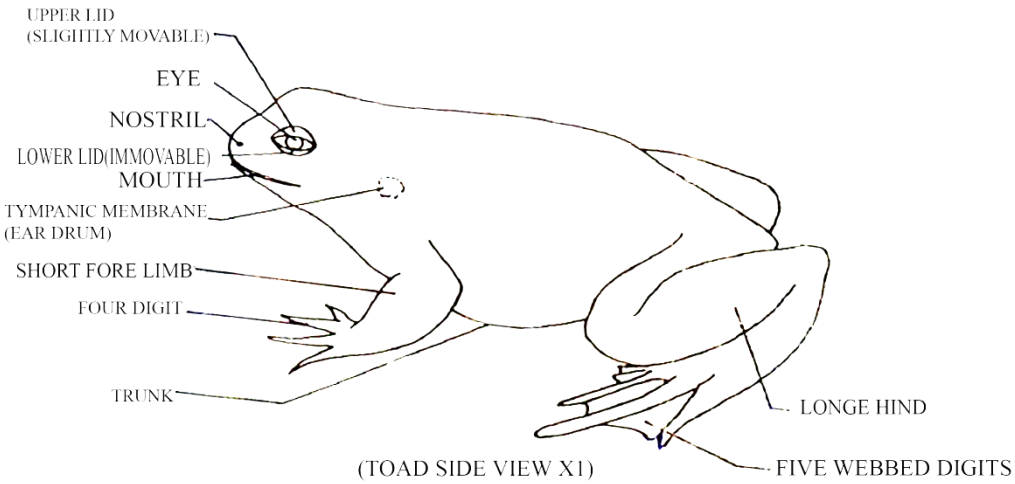
Skill I:

The concept of vertebrate was introduced to the students. They are animals withbackbones or vertebrae column called phylum Chordata.

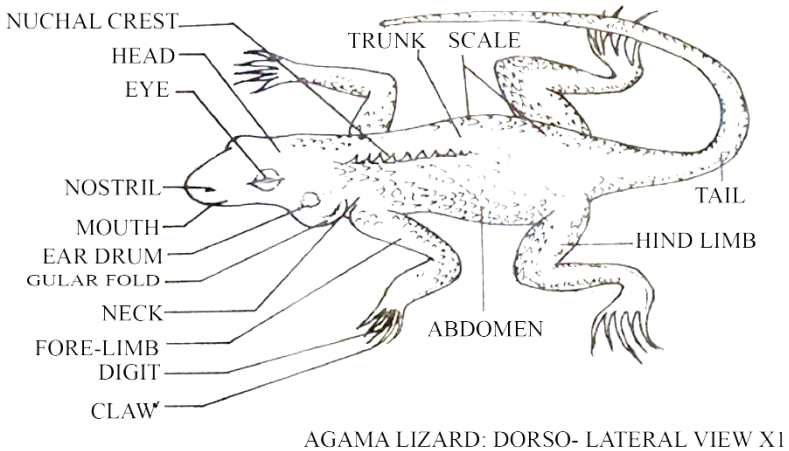
Activity I: Studentscollect and examine the followingspecimens: fish, toad and lizard in a Petri dish on the table. What special feature of these animals enable them to adapt to their environment?



BONY FISH (TILAPIA SIDE VIEW X1)



(TOAD SIDE VIEW X1)



AGAMA LIZARD: DORSO- LATERAL VIEW X1

Skill II:

The students discovered how to identify the characteristics of fish, lizard and toad.

Using a fish specimen, studentsexaming the following characteristics

i. They are aquatic animals, i.e., they can be found in marine or fresh water, ponds, lakes and rivers.

iii. They have fins, whichare used for movement in water.

iv. The skin is covered by scales but few are without scale.

v. They have swim bladder, which enables them to maintain buoyancy in water.

vi. They have gills thatare used for gaseous exchange.

vii. Reproduction is sexual and they have external types of fertilization.

Using a life specimen of toad, students are asked to identify the following characteristics

i. They are cold-blooded animals.

ii. The integument is rough and the integumentary glands keep the integument moist.

iii. They have two pairs of appendages and a three-chambered heart.

iv. Females lay eggs and the fertilization takes place outside the body.

v. At the primary stage of life cycle generally, tadpole larva is seen.

vi. At the tadpole stage, they respire with gills and when mature with lungs.

With a Specimen,(Lizard) the teacher explains the following characteristics:

i. Reptiles have dry, scaly and water proof skin that reduces water loss.

ii. Reptiles have homodont dentition (the same types of teeth).

iii. They have two pairs of limbs, located at the sides of their bodies.

iv. They carry out internal fertilization.

v. They have lungs for respiration.

vi. They are poikilothermic (cold-blooded) animals.

Activity II: Students identify the characteristic of fish, lizard and toad.

Skill III:

The variousadaptation features of fish, lizard and toad to their environment are identified, in the form of demonstration by the students with the guide of the teacher.

Adaptation of the Fish to its Environment

Fishes are successfully adapted for a life in water. Their aquatic adaptations are as follows:-

i. The streamlined shape allows the fish to move easily through water.
ii. The tail fin is a powerful propeller. The paired fins are used for steering and balancing.
iii. Fish use gills as special respiratory organs in water.
iv. Lateral line is sense organs used for detecting pressure changes and movements in the surrounding water.
v. The eye of fishes has a wider range of vision.
vi. The absence of neck avoids friction resistance in water while moving.

Adaptation of the Toad for a Life on Land and Water

i. The toad has longer, stouter and stronger hind limbs for hopping on land.
ii. It has a streamline body for swimming in water without resistance.
iii. It has webbed digits of the hind feet for swimming.
iv. The dry, warty skin protects the body and prevents the loss of water by evaporation.
v. The well developed, bulging eyes give the animal a wider field of vision.

Adaptation of Agama Lizard to its Environment

i. It's body is covered with dry, scaly skin, which protects it from drying up.
ii. The limbs are well suited for its movement. They are long. The hind limbs are longer than the fore limbs.

iii. Each limb has five digits, which end in strong, curved claws.

iv. The neck helps the lizard to move its head freely as to watch its prey without moving about.

v. In order to escape from its enemies, the lizard can change the colour of it skin to blend with the environment, in this way; it can escape detection by its enemies.

vi. Lizard has well developed sense organs.

vii. It completes its life cycle on land.

Activity III: Students observe the specimens using microscope or hand lens individually.

Evaluation: The teacher asks students the following questions to evaluate the lesson.

1. List three (3) external features of the following specimen: fish, lizard and toad.
2. List four (4) characteristic of each specimen fish, lizard and toad.
3. State five (5)-adaptation feature of the above specimen to their environment.

Summary: The teacher summarizes the key point of the lesson. She illustrates with demonstration the external features of the specimens- fish, toad and lizard, their characteristics and adaptation of each of the specimens to their environment.

Assignment: An assignment is given to the students to draw the structure of each specimen(8-10cm) in their practical notebook.

LESSON TWO FOR EXPERIMENTAL GROUP

School: Government Day Secondary School, Army BarrackYola
Subject: Biology Practical
Topic Nutrition in Animals
Sub-topic: Food Test
Gender: Mixed
Class: SS2A
Duration: 80 minutes

Behavioural Objective: By the end of the lesson, the students should be able to:

(i) perform food test experiment on carbohydrate (test for starch)

(ii) perform food test experiment on glucose

(iii) perform food test experiment on protein (Biuret's test)

(v) perform food test experiment on fat and oil (translucent paper test)

Instructional Strategies: Expository, questioning, activity, guided inquiry, demonstration and discussion.

Instructional Material: yam, groundnut, glucose, egg, test tube holder, beaker, bunsen burner, dropper, test tube, hot plates, wash bottle and erlenmeyer flasks.

Previous Knowledge: Students are taught lesson on the classification of food, source and importance of food substance.

Reference:*Comprehensive Biology for Senior SecondarySchool* by ChristNwezer,(2004).

Introduction: The teacher introducesher lesson by asking the students questions on their previous lesson.

1).List seven food substance?

2). What are the sources of protein?

Instructional Procedures:

Skill I:

Places a piece of yam on a tile and adds a drop of iodine. What colour do you notice?

Students' response:'blue-black.' They discover that the colour indicates the presence of starch.

Skill II:

To a little solution of glucose, the students add small quantities of Fehling's solution and heat gently.A brick-red precipitation shows that glucose is present. To another quantity of a little solution of glucose in a test-tube, the students to add Benedict's solution, boil and allow it to cool. A red or orange precipitate is formed. The students discover, that it indicates the presence of glucose.

Activity II: Students are allowed to conduct their own experiment individually**.**

Skill III:

To a protein solution in a test- tube, the students adds equal amount of million's reagent and boils for a few minutes. A brick-red precipitate is formed.The students identified, that it indicates the presence of protein.To $1cm^3$ of protein solution, the students adds 1cm3 of 20% sodium hydroxide and a drop of 1% copper (II) sulphate solution. A violet or purple colour emerges. The teacher informs them that it indicates Biuret's test showing the presence of protein.

Activity III: Students conduct their own experiment individually and make observations based on their finding.

Skill IV:

The students drop the oil provided on piece of paper given to them, and hold it against the sun ray of light entering the laboratory.

The teacher informs them, that translucent spot indicates the presence of fats & oil.

To a small quantity of oil, the teacher instructs the students to add a few drop of Sudan III solution. A red colour appears before boiling; a black precipitate is formed on boiling. The teacher informs them that the red colour shows the presence of fat and oil.

Activity IV: Students carry out the experiment and write down their observation.

Evaluation

The teacher evaluates the lesson by asking students the following questions:

i. In the test for starch, what colour indicates that starch is present in the food beingtested?

ii. In the test for glucose, name the two types of test that can be used and the colourwhich shows that glucose is present.

iii. In the test for protein, what colours help to show that protein is present?

iv. In the test for oil, the effect is called what_____?

Summary: The teacher summarizes the key points of the lesson, by discussing the practical conducted in this lesson, how to test for starch, protein and glucose.

LESSON THREE FOR EXPERIMENTAL GROUP

School: Government Day Secondary School, Army BarrackYola

Subject: Biology Practical

Topic: Fruits

Gender: Mixed

Class: SS2A

Duration: 80 minutes

Behavioural Objective: By the end of the lesson, the students should be able to perform the following:

1. Define a fruit
2. Compare, draw and label the different structure of mango and tomato fruits.
3. list the classification of each fruits
4. differentiate the similarities' and difference of mango and tomatoes fruits
5. Identifythe agents of fruits dispersal.

Instructional Strategies: Expository, questioning, activity,guided inquiry and discussion.

Instructional Materials: Freshorange, tomato, coconut, mango, maize, pepper, guava, pawpaw, okra, cowpea, sharp knives/razor blade, cutting board and hand lens.

Reference: Comprehensive practical biology byObidiwe J.O.C(2010).

Previous Knowledge: It was assumed that students know the process of food test.

Introduction: The teacher introduced the lesson by asking the studentsquestions based on their previous lesson, for instance, how to test for carbohydrate (test for starch).

Instructional Procedures

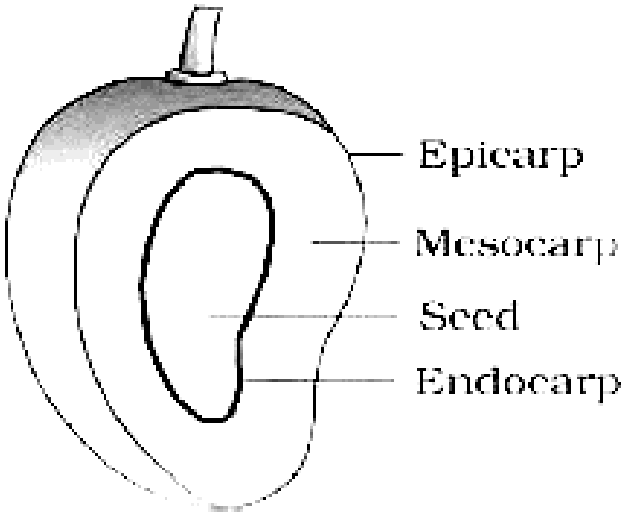
Skill 1:

A brief introduction of the concept of a fruit. The definitionis givenas a mature fertilised ovary of a flower containing one or more seeds or ripened ovary of the flower enclosing a seed.

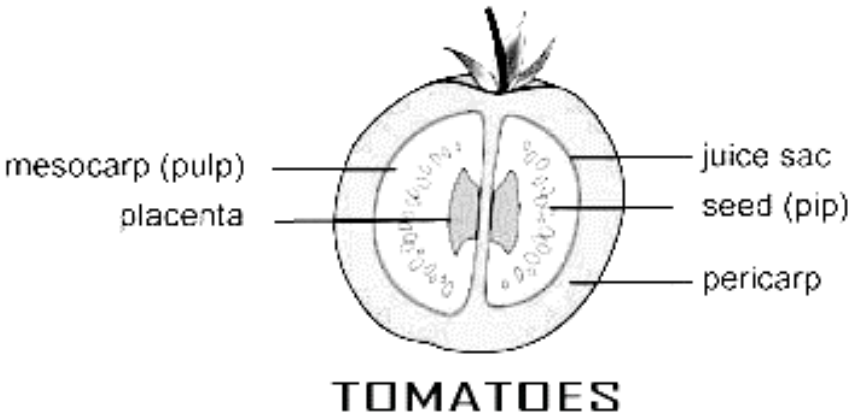
Skill II:

Placing the fruit on the table in a petri dish, use a knife to cut across the fruit in transverse section (T.S) and observe the structure each part of the mango and tomato fruits.

Structure of fruit: Using the specimen, the students identified thatfruit is made up of an outer covering called the epicarp, middle layer called the mesocarp and an inner layer called the endocarp. Within the endocarp is the seed.



X1 MANGO



TOMATOES

X1

Activity II: Students observe and draw the structure of each part of the fruits in their practical workbooks.

Skill IV:

The students discover the various classifications of the fruit by arranging them on the table to see and observe according to their origin and structure.

1. True and false fruit (mango, orange and Cowpea)

2. Simple, aggregate and composite fruit (okro, maze, and pawpaw)

3. Fleshy and dry fruits (Tomatoe, guava, pepper, mongo)

Activity III: Students observe each of thefruits and classify them.

Skill V:

The students identified the similarities and differences between a berry and drupe and they further, displays some agents of dispersal, which are bird, water, insect andman.

BERRY TOMATO	**DRUPE MANGO**
Berry has many seeds	Drupe has only one seed
Mesocarp and endcarp are fused	Mesocarp and endocarp are not fused
Mesocarp and endocarp fuse to form soft pulp	Drupe has hard endocarp
Endocarp is edible	Endocarp is not edible

Similarities between a drupe and a berry

(i) Both have fleshy or succulent mesocarp.

(ii) Both have thin epicarp.

(iii)Both have seed.

Activity IV: Students are allowed to carry out their own observation on the specimen.

Evaluation:

The teacher evaluates the lesson by asking the following questions:

1) List three structures of a fruits.
2) State two agents of dispersal

Summary: The teacher summarizes the key points of the lesson, using demonstration. She defines fruit, describes the different structures of mango and tomatoes; states the classification of each fruit, identifies the similarities and differences between mango and tomatoes, and lists the agents of fruit dispersal.

Assignment: An assignment is given to the students to draw ten different types of fruits (8-10cm) in their practical notebook.

LESSON FOUR FOR EXPERIMENTAL GROUP

School Government Day Secondary School, Army BarrackYola
Subject: Biology Practical
Topic: Reproductive System in Plants (Flower)
Gender: Mixed
Class: SS2A
Duration:80 minutes

Behavioural Objective: By the end of the lesson, the students should be able to.

i). define a flower

ii). identify the structure of a flower

iii). identify the different types of ovary

iv).identify the various kinds of placentation found in a flower

Instructional Strategies: Expository, questioning, activity, guided inquiry and discussion

Instructional Material: Hibiscus or flamboyant flowers, razor blade, hand lens or magnifying lens, cutting board.

Reference:*Comprehensive Practical Biology* by Obidiwe J.O.C. (2010).

Previous Knowledge: Students were taught lesson on the classification of fruits.

Introduction: The teacher introducesher lesson by asking the students questions on their previous lesson.

i) What is a fruit?

ii) List two classifications of fruits?

iii) State three similarities and difference of mango and tomatoes.

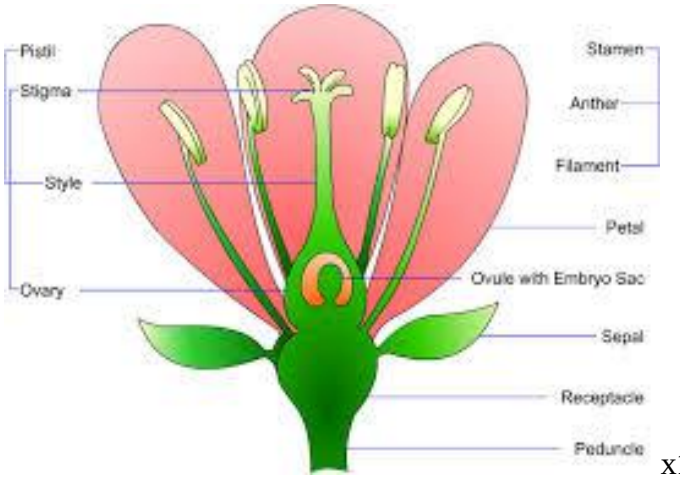
iv) List two agents of fruits dispersal.

Instructional Procedures:

Skill I:

The concept,'flower' was introduced to the students as an organ of sexual reproduction in a flowering plant. The students, using a knife, cuts a flower and divides longitudinally, explaining each structure of the flowering plant to obsevred.

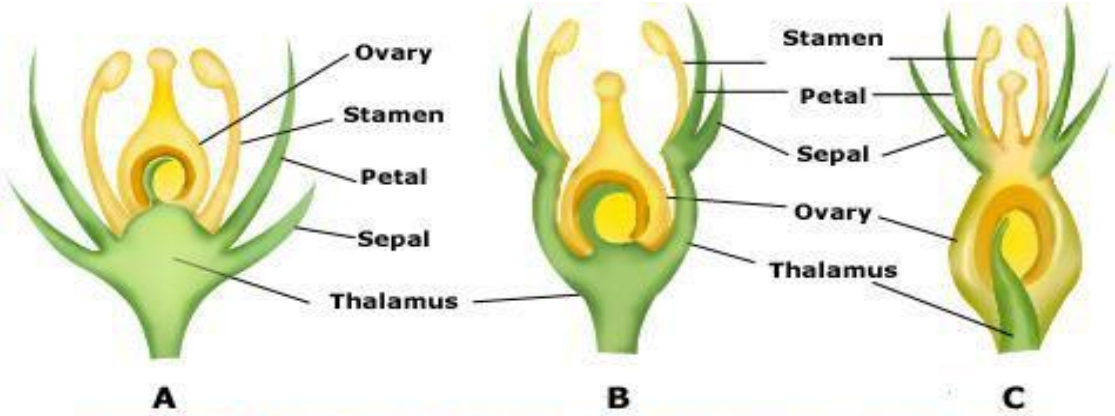
Activity I:Holding a knife in a slanting position, they cut the flower into two half's and each student observes the structure**.**



x1

Skill II:

Using demonstration, the students identifies different types of ovary by placing the flower on the table to observe.



Insertion of floral parts on thalamus, A. Hypogynous (China rose) B. Perigynous (Rose), C. Epigynous

Superior Ovary: This is a flower with a conical receptacle; the ovary is located on the top of the cone. Other floral parts were arranged below the position of the ovary. The ovary of a hypogynous flower is described as superior e.g. the Hibiscus flower.

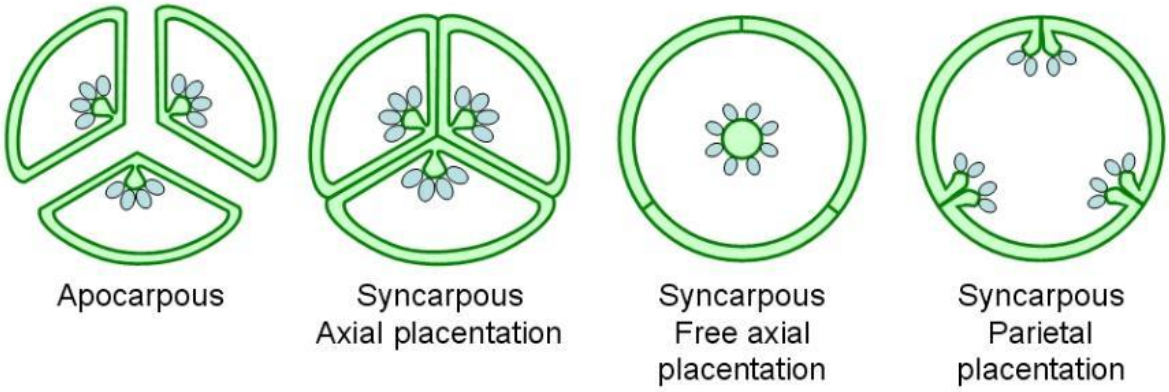
HaIf Inferior Ovary: This is a flower with a cup-shaped receptacle with the ovary located at the centre of the cup. The other flora is arranged at the edge of the cup. The ovary of a perigynous flower is described as half inferior e.g. Rose flower**.**

Inferior Ovary: The ovary is sunk into and fused with the receptacle in this flower. The position of the ovary is below those of the floral parts. The ovary of an epigynous flower is said to be inferior e.g. the flower of Guava.

Activity II: The students observe and practice individually.

Skill III:

Using demonstration, studentsidentifies the various kinds of placentation found in a flower by displaying beans, pride of barbados, pawpaw and tomato on the table for proper observe.



Marginal Placentation: The ovaries are attached to the placenta along one margin of theovary.

Parietal Placentation: In this arrangement, the ovules are attached to the sides of a syncarpous ovary having a single chamber.

Axile Placentation: In an axile placentation, the carpels of a syncarpous ovary meet in the centre to form the placenta to which the ovules are attached.

Basal Placentation: In basal placentation, the ovules was attached to the base of a syncarpous ovary.

Activity III: Studentstake the plant in their hand and observe it minutely.

Evaluation:

The teacher evaluates the lesson by asking students the following questions.

i) What is a flower?

ii) List three structures found in flowering plant.

iii) List two types of ovary in flower.

iv) State the various kinds of placentation found in a flower.

Summary: The teacher summarizes the main point of the lesson. Shedefines a flower; describes the structure of a flower, types of ovary and the different kinds of placentation in flowers.

Assignment: An assignment was given to the students to draw the structure of a flower (8-10cm) in their practical notebook.

LESSON FIVE FOR EXPERIMENTAL GROUP

School: Government Day Secondary School, Army BarrackYola
Subject: Biology Practical
Topic: Reproduction in Plants
Gender: Mixed
Class: SS2A
Duration:80 minutes
Behavioural Objective: By the end of the lesson, the students should be able to perform the following activities,to:

i) define reproduction

ii) list the types of reproduction found in a plants

iii) identify the adaptive feature of corn, ginger and Onion

iv) Identify the similarities and differences between the specimens.

Instructional Strategies: Expository, questioning, activity, guided inquiry and discussion

Instructional Material:corn, ginger, onion, razor blade, hand lens or magnifying lens.

Reference: *Comprehensive Practical Biology* byObidiwe J.O.C (2010).

Previous knowledge: Students are familiar with various types of flower.

Introduction: The teacher introduces the lesson by asking the students questions on theirprevious lesson

1. Define flower.
2. State three types of flower you know.

Instructional Procedures:

Skill I:

The concept of reproductionwas introduced to the students as the production of new individual plants from the previous ones of the same species.

Skill II:

The students explain the two types of reproduction using fresh plants.

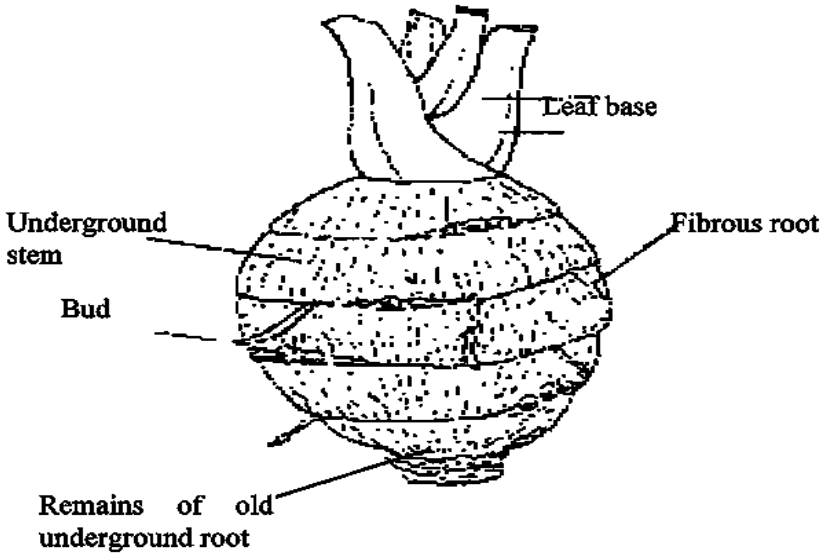
Sexual Reproduction: Sexual reproduction is the production of new individuals by the union of the sex cells or gametes from different parents. The fusion of the male gamete with the female gamete results in fertilization, and a zygote is formed. Sexual reproduction is found in multicellular organisms, flowering plants and higher animals.

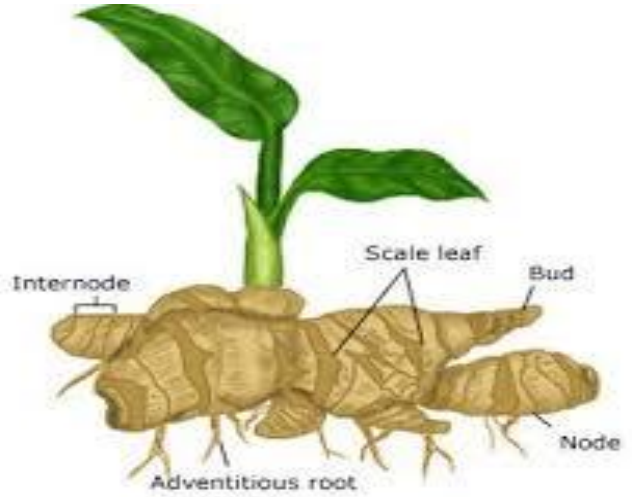
Asexual Reproduction: This is the production of new individuals from one parent; of the same species. Asexual reproduction does not require the union of gametes. Example: binary fission, budding, fragmentation and spore formation.

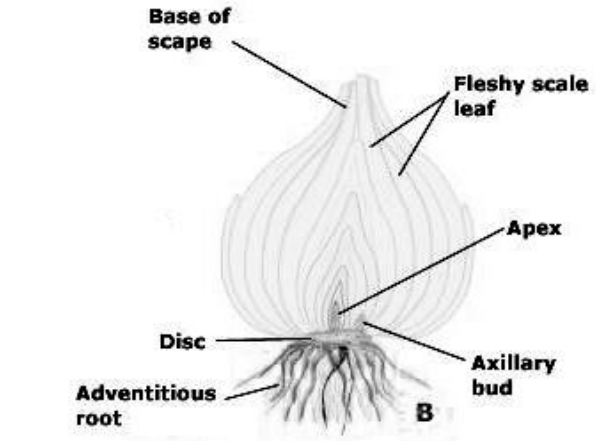
Activity II: Students observe and list the two types of reproduction found in a plant.

Skill III:

The students listed the various features of corn, ginger and onion using the specimens provided.







A. Tunicated bulb of onion B. L.S. of bulb

Activity III: Studentstake the specimens in their hand and observe them minutely**.**

Skill IV:

The students identified the similarities and differences between corn, ginger and onion. They furtherdisplay them on the table for observation.

The Similarities:

i) Presence of nodes/internodes

ii) Presence of aerials shoots

iii) Presence of scale leaves

iv) Presence of adventitious roots

The Differences:

Ginger	Onion
Stem is modifird for storage	leaf modified for storage
stem elongated	stem is reduce/conical shape
buds are covered with scale leaves	buds are covered with fleshy leaves
leaves are not arranged in concentric circles around the stem	leaves are arranged in concentric circles around the stem
axillary bud visible	axillary bud not visible (cover by leaves)

Activity IV: Students observe and conduct the experiment individually.

Evaluation:

The teacher evaluates the lesson by asking the following questions.

i) What is reproduction?

ii) List the types of reproduction in plants.

iii) List three adaptive features of the following: corn, ginger and onion.

iv) State two similarities and differences between the specimens.

Summary: The teacher summarizes the main points of the lesson, using demonstration. She describes the adaptive features of corn, ginger and onion; their similarities and differences.

LESSON SIX FOR EXPERIMENTAL GROUP

School: Government Day Secondary School, Army BarrackYola
Subject: Biology Practical
Topic: Digestive System
Unit Topic: Alimentary Canal of Bird and their Functions
Class: SS2A
Duration: 80 minutes
Behavioural Objective: By the end of the lesson, the students should be able to

1. identify the parts of the alimentary canal of bird;
2. List the function of each of these parts.

Instructional Strategies: Expository, questioning, activity, guided inquiry and discussion

Instructional Material: fresh chicken, dissection trays, dissection kit, chloroform, ethane, formalin, table lamp, Petri dishes , scissors, scalpel (sharp small knife), brush, watch glass , blow pipe , magnifying glass , blade, few pins, dropper.

Reference: *Comprehensive Practical Biology* byObidiweJ.O.C.(2010).

Instructional Procedures:

Skill I:

Usingthe dissected chicken, the students' lists outthe differentparts of alimentary canal found in the chicken.

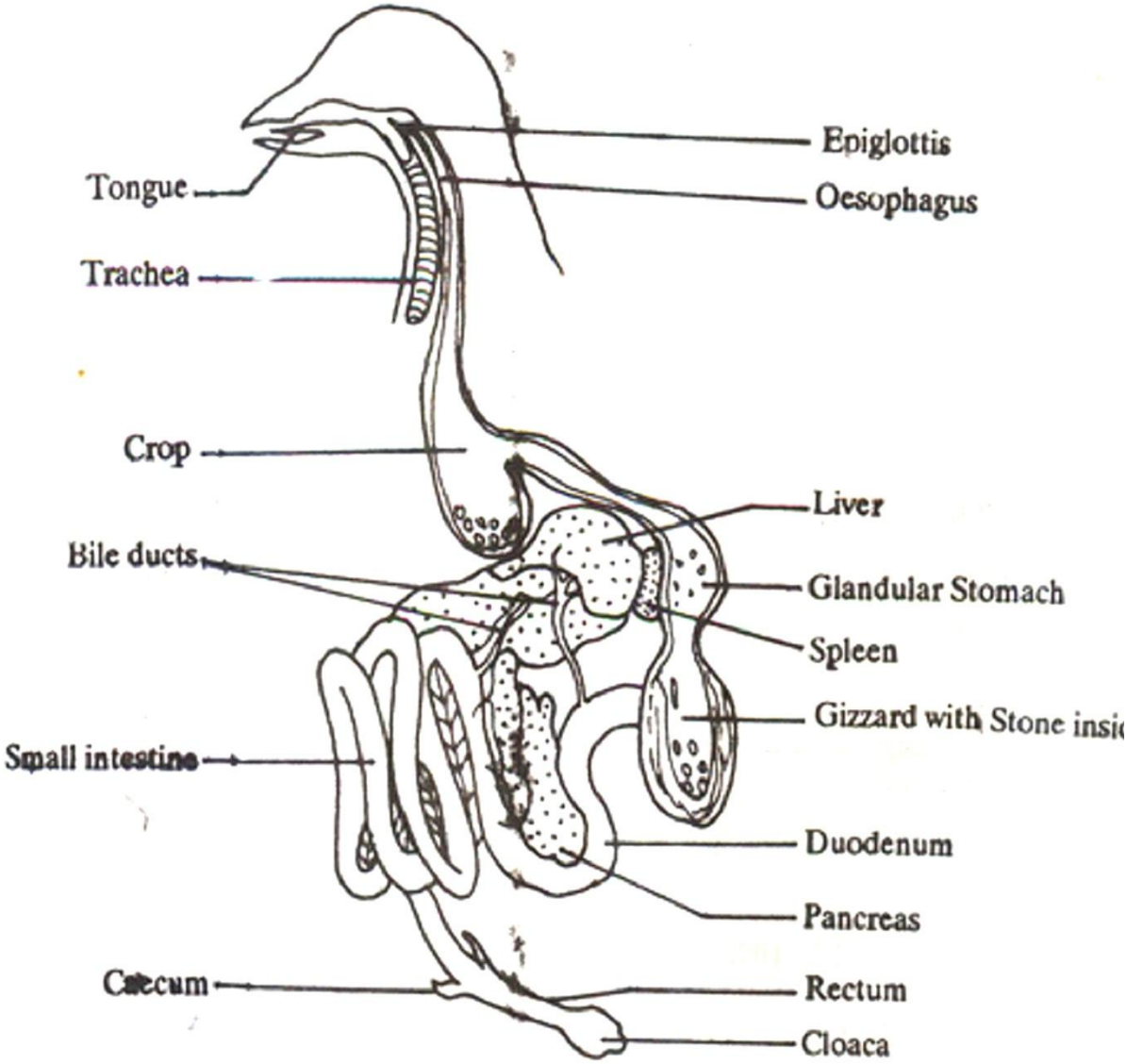


Fig. 108: Alimentary canal of bird

Activity I: Students carry out these activities; theyobserve and note down each of the parts of the alimentary canal of birds, drawing the attention of the teacher when necessary by

Skill II:

The teacher lists out the function of each of these parts.

Activity II: Students note the function of each of those parts.

Evaluation:

The teacher evaluates the lesson by asking the following questions:

1) List seven parts of the alimentary carnal of birds.
2) State the function of each parts you have mentioned.

Summary: The teacher summarizes the main point of the lesson. She describes the alimentary canal of the bird and lists the function of various parts found in the dissected bird.

Assignment: An assignment is given to the students to draw the structure of the dissected bird (8-10cm) in their practical notebook.

APPENDIX E

LESSON PLAN FOR CONVENTIONAL (LECTURE) METHOD

LESSON ONEFOR CONVENTIONAL (LECTURE METHOD)

School: Government Day Secondary School, WuroJabbeYola North
Subject: Biology Practical
Topic: Classification of Living Things
Sub topic: Animals Classification
Gender: Mixed
Class: SS2A
Duration: 80 minutes

Behavioural Objectives: By the end of the lesson, the students should be able to:

i) identify the external features of fish, lizard and toad
ii) identify the characteristics of fish ,lizard and toad
iii) Identify adaptation feature of the above specimen to their environment.

Instructional Strategies: Explanation, questioning and discussion

Instructional Material: The SSCE biology textbooks, chart showing the diagrams of fish, toad, lizard and a sketchbook or practical note book.

Reference: Understanding Biology practical byJ.A.Adewuyi (2013) pp 70-81

Previous Knowledge: Students are aware of the classification of plant kingdom and their Characteristics.

Introduction: The teacher asks the students some questions based on their previous knowledge.

1. What are the five major divisions of plant kingdom?
2. State three similarities and differences between monocotyledonous and dicotyledonous plants?

Students Activities: The students answer the questions.

Presentation:

Step I:

Teacher Activities: The teacher defines vertebrates as an animal with backbones or vertebrae column;vertebrates belong to the phylum Chordata.

Step II:

Teacher's Activities: Using a chart, the teacher illustrates the external features of fish, toad and lizard:

External Features of Fish

Shapes: A fish has a streamline shape; this shape allows the fish to move easily through the water without much resistance.

Scale: The body is covered with over-lapping scales. Scales protect the animal against infection and reduce friction.

Body Parts: The body of the fish is divided into three regions. They are the head, the trunk and the tail. The head merges with the trunk directly.

Fins: These are organs for locomotion and balancing. Fins are outgrowths of the skin. They are of two types. They are (a) paired fins; pectoral fins and the pelvic fins (b) unpaired fin; caudal fins or tail fins, dorsal fin and ventral fin or anal fin.

Gill: The respiratory organs of fishes are the gills. Tilapia has four pairs of gills. They are protected by gill cover or opercula. Each gill is like a comb. The gill has a bony structure, called the gill arch. Gill filaments and gill rockers are also found on the gills.

External Feature of Toad

The body of a toad has two parts. They are (i) The Head (ii) The Trunk

The Head: The head bears the following structure:

i) **Mouth:** The mouth is wide open into the mouth cavity; the upper jaw, tongueattached to the front of the floor of the buccal cavity. It bears a raw of homodont teeth.

ii) **Nostrils:** Toad has a pair of nostrils, which leads into the nasal passage.

iii) **Eye:** There are two large, bulging eyes on the head. It also has a third transparent membrane, called the Nictitating membrane.

iv) **Tympanum:** The tympanum or the eardrum represents the external visible part of the ear.

v) **The Poison Gland:** This is found behind the eardrum. It is a bulged gland, which

Secretes a foul- tasting substance.

The Trunk:

i).**The Forelimbs:** The forelimbs are short. It consists of the upper arm, the forearm, and the hand with four digits.

ii).**Long Webbed Hind Limbs:** The hind limbs are much longer and more stoutly built. They act as paddies and help the frog to swim and spring forward**.**

iii).**Cloaca:** At the posterior end of the trunk is the cloaca. It serves as an anal, urinary and reproductive opening.

The Skin of toad: It is dry and warty. It is also loose and greyish brown in colour. The skin prevents the evaporation of water from the body.

External Feature of Agama Lizard

The body of agama lizard is divided into four parts: head, neck, trunk and tail.

The Head: The head contains the following structures:

i**). Mouth:** This is at the terminal end of the head.

ii).**Nostrils:** A pair of nostril is found on the head.

iii).**Ear drums**: These are shallow depression found behind the eyes.

v).**Gular fold:** This is a fold of skin below the chin.

The Neck: Unlike the fishes and toad, which do not have a neck, Agama lizard has definite neck. Above the neck, there is a median crest of skin, called the nuchal crest.

The Trunk:

(i)Forelimbs: There is a pair of short forelimbs. Each forelimb ends in five digits, which have claws at the tips.

(ii) **Hind limbs:** This second pair of limbs is bigger than the forelimbs. They also end in five, clawed digits

Cloaca: On the underside, just behind the limbs is an opening called cloaca.

Tail: The tail is long and tapering. The body of the lizard is covered by dry, overlapping scales.

Students' Activities: Students observe and listen to the teacher's explanations.

Step II:

Teacher Activities: The teacheridentifies the characteristics of fish, lizard and toad

The following are characteristics of fish:-

i. They are aquatic animals, i.e., they can be found in marine or fresh water, ponds, lakes and rivers.
ii. They have fins, which are used for movement in water.
iii. The skin is covered with scales but few are without scale.
iv. They have swim bladder, which enables them to maintain buoyancy in water.
v. They have gills, whichare used for gaseous exchange.
vi. Reproduction is sexual and they have external types of fertilization.

The Characteristics of Amphibian Animals:

i.The integument is rough and the integumentary glands keep the integument moist.

ii. They have two pairs of appendages and a three-chambered heart.

iii. Females lay eggs and the fertilization takes place outside the body.

iv. At the primary stage of life cycle generally, tadpole larva is seen.

v.At the tadpole stage, they respire with gills and when mature with lungs.

The Characteristics of Reptile Animals:

i. Reptiles have dry, scaly and water proof skin, which reduces water loss.

ii. Reptiles have homodont dentition (the same types of teeth).

iii. They have two pairs of limbs, located at the sides of their bodies.

iv.They carry out internal fertilization.

v. They have lungs for respiration.

Step III:

Teacher's activities: The teacheridentifies each adaptation feature of fish, lizard and toad to their environment.

Adaptation of the Fish to its Environment

Fishes are successfully adapted for a life in water. Their aquatic adaptations are as follows:-

i. The streamlined shape allows the fish to move easily through water.

ii. The tail fin is a powerful propeller. The paired fins are used for steering and balancing.

iii. Fish use gills as special respiratory organs in water.

iv. Lateral line is a sense organ used for detecting pressure changes and movements in the surrounding water

v. The eye of fishes has a wider range of vision.

vi. The absence of neck avoids friction resistance in water while moving.

Adaptation of the Toad for a Life on Land and Water

i. The toad has longer, stouter and stronger hind limbs for hopping on land.

ii. It has a streamline body for swimming in water without resistance.

iii. It has webbed digits of the hind feet for swimming.

iv. The dry, warty skin protects the body and prevents the loss of water by evaporation.

v. The well developed, bulging eyes give the animal a wider field of vision.

Adaptation of Agama Lizard to its Environment

i. It's body is covered with dry, scaly skin, which protects it from drying up.

ii. The limbs are well suited for its movement. They are long. The hind limbs are longer than the forelimbs.

iii. Each limb has five digits, which end in strong, curved claws.

iv. The neck helps the lizard to move its head freely as to watch its prey without moving about.

v. In order to escape from its enemies, the lizard can change the colour of it skin to blend with the environment. In this way, it can escapedetection from its enemies.

vi. Lizard has well developed sense organs.

Students' Activities: The Students listen very actively.

Evaluation: The teacher asks the students the following questions to evaluate the lesson.

4. List three (3) external features of the following specimen: fish, lizard and toad.
5. List four (4) characteristics of each specimen fish,lizard and toad.
6. List four (4) characteristics of each specimen fish,lizard and toad.
7. State fiveadaptation features of the above specimen to their environment.

Summary: The teacher summarizes the main keypoints of the lesson. She describes the externalfeatures of the specimens- fish, toad and lizard, their characteristic and adaptation of the specimens to their environment.

Assignment: An assignment is given to the students to draw the structure of the specimen (10cm) in their practical notebook.

LESSON TWO FOR CONVENTIONAL (LECTURE) METHOD

School: Government Day Secondary School, WuroJabbeYola
Subject: Biology Practical
Topic: Nutrition in Animals
Sub-topic: Food Test
Gender: Mixed
Class: SS2A
Duration:80 minutes
Behavioural Objective: By the end of the lesson, the students should be able to:

1. identify chemicals used for the test of carbohydrate (test for starch) and the result it gives
2. identify chemical used for the test of sugar (glucose) and the result it shows
3. identify chemical used for the test of protein (Biuret's test) and the result it shows
4. identify chemical used for the test of fat and oil (translucent paper test) and the result it shows.

Instructional Strategies: Explanation, questioning, observation and discussion

Instructional Material: The SSCE biology textbooks, chalkboard, a chart showing test for food, chemical, observation and results

Reference: *Comprehensive Practical Biology* by Obidiwe J.O.C (2010).

Previous Knowledge: Students are familiar with these classes of food from the knowledge of Basic Science.

Introduction: The teacher introducesthe lesson by asking the students to list the classes of food.

Student's response: they list the classes of food.

Presentation:

Step I:

Teacher's Activities: Using a chart, the teacher illustrates to the students that on a piece of yam, when iodine is added, turns blue- black indicating the presenceof starch.

Students' Activities: Students listen, jot down notes and ask questions.

Step II:

Teacher‘s Activities: Using the chart, the teacher explains to the students the process of testing for reducing sugar using Fehling’s or Benedict solution and heating the solution. It gives a yellow precipitate for sucrose and black red for simple sugar**.**

Students’ Activities: Students listen, jot down notes and ask questions.

Step III:

Teacher’s Activities: The teacher asks the students to mention examples of protein. Using a chart, the teacher identifies the chemical used for the test of protein, sodium hydroxide and copper (II) solution. It gives a purple or violet colour to fresh milk or egg white solution.

Students’ Activities: Students list examples of protein, listen to the teacher’s explanation and askquestions.

Step IV:

Teacher‘s Activities: The teacher asks the students to list examples of fat& oil using a chart. The teacher explains that it is when groundnut is smeared on a filter paper and observed the spot against a source of light the teacher also explains that the process is called translucent .

Students’ Activities: Students list examples of fats and oil.

Evaluation:

The Teacher evaluates the lesson by asking students the following questions.

1. What is used to test for starch and what colour does it give to show that starch is present?

2. List the chemical used to test for simple and reducing sugars. What colour do they show?

3. List the chemicals used to test for proteins and the colour they show.

4. What is the name of the chemical used to test for fat and oil? What colour does it show?

Summary: The teacher summarizes the lesson, stressing the salient points.

LESSON THREE FOR CONVENTIONAL (LECTURE) METHOD

School: Government Day Secondary School, WuroJabbeYolaNorth
Subject: Biology Practical
Topic: Fruits
Gender: Mixed
Class) SS2A
Duration: 80 minutes

Behavioural Objective: By the end of the lesson, the students should be able to:

1. define a fruit
2. identify , draw and label the different structure of mango and tomatoes
3. list the classification of each fruits
4. identify the similarities and differences of mongo and tomatoes

Instructional Strategies: Explanation, questioning, observation and discussion

Instructional Materials: charts oforange, tomato, coconut, mango, guava, pawpaw, and okra.

Reference: *Comprehensive Practical Biology* byObidiwe J.O.C (2010)

Previous Knowledge: It is assumed that students know the process of food test.

Introduction: The teacher introduced the lesson by asking the students questions based on their previous lesson. 'Describe how to test for carbohydrate, protein, fat & oil.'

Presentation:

Step I:

Teacher's Activities: Teachers define a fruit asa mature fertilised ovary of a flower containing one or more seeds or ripened ovary of the flower enclosing seed. Using a chart, the teacher describes the T.S section of a mango and tomato fruits.

Students' Activities: Students watch and listen to the teacher's explanation.

Step II:

Teacher's Activities: The teacher explains the various classifications of fruits which are:-

1. True and false fruit (mango, orange and cowpea)

2. Simple, aggregate and composite fruit (okra, maize and pawpaw)

3. Fleshy and dry fruits (tomatoes, guava, pepper, mango)

Students' Activities: Students note each of the classifications of fruits and ask questions for clarity, where they are not cleared.

Step III:

Teacher Activities: The teacher explains the similarities' and differences between a berry and drupe, and further displays the diagram of some agents of dispersal which are bird, water, insect and man for the students to see.

Berry tomato	**Drupe mango**
Berry has many seeds	Drupe has only one seed
Mesocarp and endocarp are fused	Mesocarp and endocarp are not fused
Mesocarp and endocarp fused to form soft pulp	Drupe has hard endocarp
Endocarp is edible	Endocarp is not edible

Similarities between a Drupe and Berry

(i) Both have fleshy or succulent mesocarp

(ii) Both have thin epicarp

(iii) Both have seed

Students' Activities: Students observe and listen to the teacher explanation.

Evaluation:

The teacher evaluates the lesson by asking the following questions.

1) List three structures of fruits.
2) State two agents of fruit dispersal.

Summary: The teacher summarizes the key points of the lesson. She defines fruit, describes the different structures of mango and tomatoes; states the classifications of each fruit; identifies the similarities and differences of mango and tomatoes; lists the agents of fruits dispersal.

Assignment: An assignment is given to the students to draw the structure of a tomato (10-12 cm) in their practical notebook

LESSON FOUR FOR CONVENTIONAL (LECTURE) METHOD

School: Government Day Secondary School, WuroJabbeYola North
Subject: Biology Practical
Topic: Reproductive System in Plants (Flower)
Gender: Mixed
Class: SS2A
Duration 80 minutes

Behavioural Objective: By the end of the lesson, the students should be able to:

i) define a flower

ii) identify the structure of a flowering plants

iii) identify the different types of ovary

iv) identify the various kinds of placentation found in a flower.

Instructional Strategies: Explanation, questioning, observation and discussion

Instructional Material: chart ofhibiscus or flamboyant flowers, biology textbook and chalk board

Reference*:* *Comprehensive Practical Biology* byObidiwe J.O.C (2010).

Previous Knowledge: Students are taught the classifications of fruits.

Introduction: The teacher introduces her lesson by asking students questions on their previous lesson.

i) What is a fruit?

ii) List two classifications of fruits.

iii) State three similarities and differences of mango and tomatoes.

iv) List two agents of fruit dispersa

Presentation:

Step I:

Teacher's Activities: The Teacher defines a flower as an organ of sexual reproduction in a flowering plant. The teacher, using the chart, describes each structure of the flowering plant to students.

Structure of flowering plants

The typical flower consist of four sets of floral parts, or whorls: calyx (sepals), corolla (petal), androecium (stamen) and gynoecium (carpels), calyx and corolla are not directly involved in reproduction.

Students' Activities: The Students observe and listen to the teacher's explanation.

Step II.

Teacher's Activity: The teacher identifies the different types of ovary using the chart.

Superior Ovary: This is a flower with a conical receptacle. The ovary is located on the top of the cone. Other floral parts are arranged below the position of the ovary. The ovary of a hypogynous flower is described as superior e.g. hibiscus flower.

HaIf Inferior Ovary: This is a flower with a cup-shaped receptacle with the ovary located at the centre of the cup. The other flora is arranged at the edge of the cup. The ovary of a perigynous flower is described as half inferior e.g. rose flower**.**

Inferior Ovary: The ovary is sunk into and fused with the receptacle in this flower. The position of the ovary is below those of the floral parts. The ovary of an epigynous flower is said to be inferior e.g. the flower of guava.

Students' Activities: Students observe and listen to the teacher's explanation.

Step III:

Teacher's Activities: Using a chart, the teacherexplains the various kinds of placentation found in a flower e.g. beans, pride of barbados, pawpaw and tomato.

Marginal Placentation: The ovaries are attached to the placenta along one margin of theovary.

Axile Placentation: In an axile placentation, the carpels of a syncarpous ovary meet in the centre to form the placenta to which the ovules are attached.

Basal Placentation: In basal placentation, the ovules are attached to the base of a syncarpous ovary.

Students' Activities: The students listen very carefully, put down points.

Evaluation:

The teacher evaluates the lesson by asking students the following questions.

i) What is a flower?

ii) List three structures found in flowering plant?

iii) List two types of ovary in flower?

iv) State the various kinds of placentation found in a flower?

Summary: The teacher summarizes the main point of the lesson. She defines flower, describesthe structure of a flower, types of ovary and the different kinds of placentation in flowers.

Assignment: An assignment is given to the students to draw the structure of a flower (10-12 cm) in their practical notebook.

LESSON FIVE FOR CONVENTIONAL (LECTURE METHOD)

School Government Day Secondary School, WuroJabbeYola North
Subject: Biology Practical
Topic: Reproduction in Plants
Gender: Mixed
Class: SS2A
Duration: 80 minutes

Behavioural Objective: By the end of the lesson, the students should be able to:

i) define reproduction
ii) mentioned types of reproduction
iii) identify the adaptive feature of corn ,ginger and onion
iv) identify the similarities and differences between the specimens.

Instructional Strategies: Explanation, questioning, observation and discussion
Instructional Material: A chart showing the diagram of onion, ginger and corn, lesson notebook.
Reference:*Comprehensive Practical Biology* byObidiwe J.O.C (2010)
Previous knowledge: Students are familiar with various types of flower.
Introduction: The teacher introduces the lesson by asking the students questions on theirprevious lesson.

1. Define flower.
2. List three types of flower you know.

Presentation:
Step I:

Teacher's Activities: The teacher defines reproduction as the production of new individuals from the previous ones, of the same species.
Step II:
Teacher's Activities: The teacher lists and describes the two types of reproduction found in plants.
Sexual Reproduction: Sexual reproduction is the production of new individuals by the union of the sex cells or gametes from different parents. The fusion of the male gamete with the female gamete results in fertilization, and a zygote is formed. Sexual reproduction is found in multicellular organisms, flowering plants and higher animals.
Asexual Reproduction: This is the production of new individuals from one parent, of the same species. Asexual reproduction does not require the union of gametes. Examples: binary fission, budding, fragmentation and spore formation
Step III:
Teacher's Activities: The Teacher identifies the features of corn, ginger and onion.
She explains the similarities and differences between corn, ginger and onion using a chart.

The differences:

Ginger	Onion
Stem is modified for storage	Leaf is not modified for storage
Stem elongated	Stem is reduced/conical shape
Buds are covered with scale leaves	Buds are covered with fleshy leaves
Leaves are not arranged in concentric circles around the stem	Leaves are arranged in concentric circles around the stem
Axillary bud is visible	Axillary bud not visible(cover by leaves)

The similarities:

i) Presence of nodes/internodes
ii) Presence of aerials shoots
iii) Presence of scale leaves
iv) Presence of adventitious roots

Students' Activities: Students listen and jot down points.

Evaluation:

The teacher evaluates the lesson by asking the following question:

i) What is reproduction?
ii) List the types of reproduction found in a plants.
iii) List three adaptive features of the following: corn ,ginger and onion.
iv) State two similarities and differences between the specimens.

Summary: The teacher summarizes the key points of the lesson. She describes the adaptive feature of corn, ginger and onion, their similarities and differences.

Assignment: An assignment is given to the students to draw the structure of onion, ginger and corn (10-12 cm) in their practical notebook.

LESSON SIX FOR CONVENTIONAL (LECTURE) METHOD

School: Government Day Secondary School, WuroJabbeYola North.
Subject: Biology Practical
Topic: Digestive System
Sub topic: Alimentary Canal of Bird
Gender: Mixed
Class: SS2A
Duration: 80 minutes
Behavioural Objectives: By the end of the lesson, the students should be able to:

1. identify the various parts of the alimentary carnal of a bird
2. list the function(s) of each of these parts.

Instructional Strategies: Explanation, questioning, observation and discussion

Instructional Materials: A chart showing the alimentary canal of a bird.

Reference:*Understanding Biology Practical* by J.A Adewuyi (2013) pp 70-81

Previous Knowledge: Students are familiar with some of these parts from eating chicken at home.

Introduction: The teacher introduces the lesson by asking the students to list some parts they know from the alimentary canal of a bird.

Student's response: Students list the parts they know.

Presentation:

Step I:

Teacher's Activities:

Using a diagram on a chart, the teacher points out the various parts ofalimentary canal found in a bird to the student.

Students' Response: Students listen very actively.

Step II:

Teacher's Activities:

Using the diagram on a chard, the teacher lists out the functions of some parts and asks the students to list the functions of some parts**.**

Students' Activities: The Students pay attention and put down point.

Evaluation:

The teacher asks the students the following questions to evaluate the lesson.

1. List five parts of the alimentary canal of bird.
2. List the function of the parts listed above.

Summary: The teacher summarizes the whole lesson by repeating the whole process again in the presence of the students, briefly emphasizingon salient points.

A**ssignment:** The teacher dishes out notes to the students.

APPENDIX F

LIST OF SPECIMENS USED IN PRACTICAL

Specimen A- Tilapia Fish

Specimen B- Lizard

Specimen C- Toad

Specimen D- Tomato

Specimen E- Mango

Specimen F- Pride of Barbados

Specimen G- Alimentary canal of a bird

Specimen H- corn

Specimen I- Ginger

Specimen J- Onion

Specimen K- Glucose

Specimen L- Yam

Specimen M- milk/egg

Specimen N- groundnut

APPENDIX G

MARKING SCHEME FOR THE PRE-TEST (BPT)

1.(a)(i)**The Class of Specimen A,B and C**

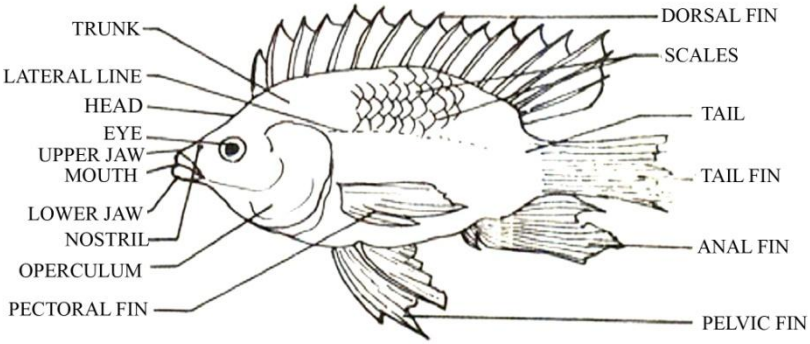
- Specimen **A** (Tilapia) is Pisces
-Specimen **B**(Lizard) is Reptilia
-Specimen **C**(Toad) is Amphibia3x1 (3marks)

(ii)**Observable Features of Specimen C**

The forelimb is short and stout,-It has webbed digits.

2×1 (2marks)

(iii)Drawing of Specimen A



BONY FISH (TILAPIA SIDE VIEW X1)

Title (TL) –Drawing of Specimen **A**/tilapia fish -1mark

Quality

Clarity of lines	(CL)	-1mark
Neatness of labels	(NL)	-1mark
Size	(Sz)	-1mark
Magnification	(Mg) x 0.50 x 1/2 –x.50 x1½	-1mark

Details

Dorsal fin	(DF)
Lateral line	(Ll)
Pectoral fin	(PF)

1×1 (1mark)

Label: Head, Eye, Nostril, Scale, Operculum, Pelvic fin

1× 1 (1mark)

(b)(i)**Name the fruit types of Specimen D and E**

Specimen **D**(Tomato) is a berry

Specimen **E** (Mango) is a drupe

2×1 (2marks)

(ii)**The Types of Placentation Found in Specimen D**

- Axile: This is because the ovules (seeds) are attached to central placenta

1×1 (1mark)

(iii) Specimen **F** is a flower of Pride of Barbados or flamboyant

1×1 (1mark)

The Two Observable Features

-It has brightly coloured sepals, -The filament is long and brightly coloured

2×1 (2marks)

(c) (i)Specimen **G** is alimentary canal of a bird

1×1 (1mark)

(ii) **Observable Features of Specimen G**

Crop,Gizzard,small intestine,liver,duodenum, rectum and cloaca

2×1 (2marks)

Total 20marks

2. (a) (i)**Observable Feature of Specimen H,I and J**

Specimen H/Corn–buds, for propagation/growth;scale leaves, for protection

Specimen I/Ginger-adventitious roots,for anchorage/absorption of nutrient; modified stem, for storage of food

Specimen J/Onion-fleshy leave, for anchorage/absorption of nutrients;-terminal/auxiliary buds, for growth/propagation

2×3 (6marks)

(ii)**Types of Food Stored in Specimen H, I, and J**

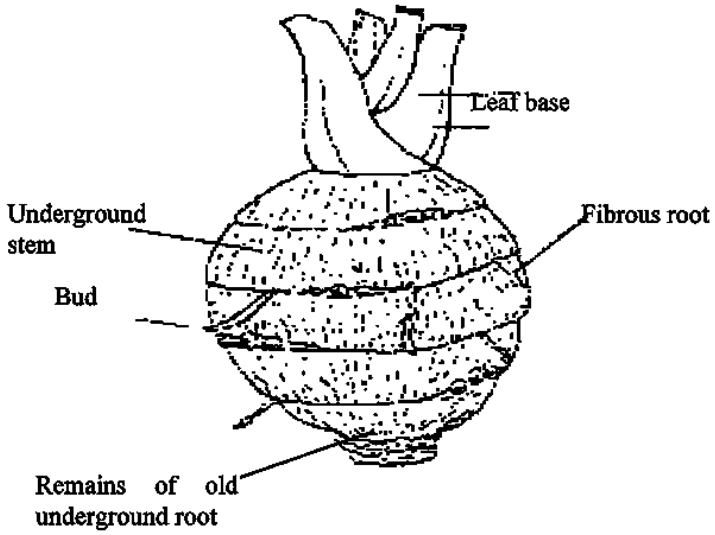
Specimen **H** - Starch

Specimen **J** -Starch/minerals/vitamins

Specimen **I** -Glucose/vitamin

3×1 (3marks)

(iii) **Drawing of Specimen H**



Title (TL) –Drawing of Specimen H/cocoyam corn-1mark

Quality

Clarity of lines	(CL)	-1mark
Neatness of labels	(NL)	-1mark
Size	(Sz)	-1mark
Magnification	(Mg) x 0.5/x1/2-x1.5/x11/2	-1mark

Details

Scale leaves	(SL)
Internodes shown	(IN)
Adventitious roots	(AD)

2×1 (2marks)

Labels:node, internode, bud, scale leaf, aerial shoot, adventitiuous roots

2×1 (2marks)

(b)(i)**Similarities between SpecimensI and J**

Presence of nodes/internodes; presence of aerial shoot; presence of scale leaves

2×1 (2marks)

(ii)**Observable Differences between Specimen I and J**

Specimen I/Ginger	**Specimen J/Onion**
Stem elongated	Stem is reduced/conical shape
Leaves are not arranged in concentric circles around the stem	Leaves are arranged in concentric circles around the stem
Axillary bud visible	Axillary bud not visible (covered by leaves)

2×1 (2marks**)**

(c)(i)**Test-**Cut a pieceof specimen **L.** Add two drops of iodine solution. Record your observation.
Observation-Blue-black colouris formed

Inference-Presence of Starch 2×1 (2marks)

(ii)**Test-**A portion of Specimen **K** solution in a test tube, add one ml of distilled water and shake. Add small quantity of Benedict or fehling solution and boil the mixture for few minute

Observation-A yellow precipitate is observed.

Inference-Presence of sucrose or non-reducing sugar is present.

2×1 (2marks)

(iii)**Test-**To a small portion of Specimen **M,** add small quantity of sodium hydroxide solution and also add a few drops of 1% Copper (II) Sulphate solution.

Observation- Mixture will turn to purple or violet colour.

Inference-Protein is present 2×1 (2marks)

(vi)**Test -**Crush a piece of Specimen **N** on a filter paper and observe the spot against a source of light.

Observation-The drop of oil become more translucent, i.e. it allows more light to pass through when held in front of it.

Inference- The translucency shows the presence of fat and oils

2×1 (2marks)

Total 30 marks

APPENDIX H

MARKING SCHEME FOR THE POST-TEST (BPT)

SECTION A

1.(a)(i)**The Class of Specimen A,B and C**

- The class of specimen A (Tilapia) is Pisces

- The class of specimen B (lizard) is Reptilia

-The class of specimen C (toad) is Amphibia

3×1 (3marks)

(ii)**The Reasons of Specimen A**

It has scales in its body - It has paired fins.

It has lateral lines - It has operculum or gill cover.

The Reason of Specimen B

-It has dry harney scales on the skin -It has fore and hind limbs with clawed digits.

-It has heterodont dentition - It has well developed retractable tongue.

The Reason of Specimen C

-The skin is warty- It has webbed digits.

- It has moist skin-It has bulging eyes and it has eardrum.

3×2 (6marks)

(iii)**Observable Features that Adapt Specimens B to its Environments' B(Lizard)**

-Its body is covered with dry, scaly skin, which protects it from drying up.

-The limbs are well suited for its movement.

- The hind limbs are longer than the fore limbs.

Observable Features that Adapt Specimen C to its Environments' C (Toad)

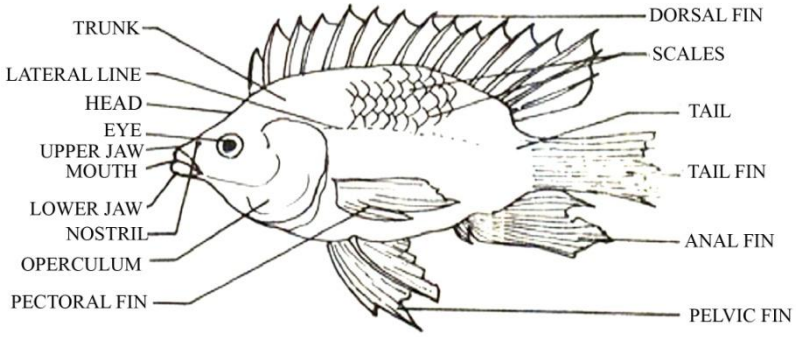
-The toad has longer, stouter and stronger hind limbs for hopping on land.

-It has a streamline body for swimming in water without resistance.

-It has webbed digits of the hind feet for swimming.

2×2 (4marks)s

(b)**The Drawing of Specimen A (Tilapia)**



BONY FISH (TILAPIA SIDE VIEW X1)

Title (TL) –Drawing of Specimen **A**/tilapia fish -1mark

Quality

Clarity of lines	(CL)	-1mark
Neatness of labels	(NL)	-1mark
Size	(Sz)	-1mark
Magnification	(Mg) x 0.50 x 1/2 –x.50 x1½	-1mark

Details

Dorsal fin	(DF)
Lateral lin	(Ll)
Pectoral fin	(PF)

2×1 (2marks)

Label: Head, Eye, Nostril, Scale, Operculum, Pelvic fin

4× ½ (2marks)

(c)(i)**The Similarities between Specimen A (Tilapia) and B (lizard)**

-They both have nostrils.

- Both have scales.

2×2 (4marks)

(ii)**The Differences between Specimens A and B**

Specimen **A** (Tilapia)	Specimen **B** (Lizard)
Lateral lines present	Lateral lines absent
The tail is short	The tail is long

2x2 (4marks)**Total 30marks**

SECTION B

2.(a)(i)**Similarities between Specimens I and J**

-Presence of adventitious root and buds

-Presence of nodes/internodes

-Presence of scale leaves

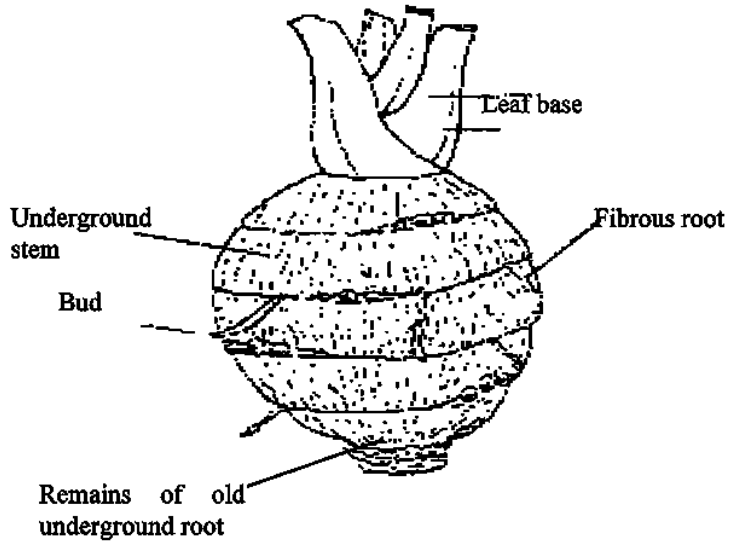
3×1 (3marks)

(ii)**Observable Differences between Specimen I and J**

Specimen **I/Ginger**	Specimen **J/ Onion**
Buds are covered with scale leaves	Buds are covered with fleshy leaves
Leaves are not arranged in concentric circles around the stem	Leaves are arranged in concentric circles around the stem
Axillary bud visible	Axillary bud not visible (covered by leaves)

3×1 (3marks)

(iii) **Drawing of Specimen H**



Title (TL) –Drawing of Specimen H/Cocoyam Corn -1marks

Quality

Clarity of lines	(CL)	-1mark
Neatness of labels	(NL)	-1mark
Size	(Sz)	-1mark
Magnification	(Mg) x 0.5/x ½ -x1.5/1 $^{1/2}$	-1mark

Details

Scale leav (SL)

Internodes shown (IN)

Adventitious roots (AD)

2×1 (2marks)

Lables:node, internode, bud, scale leaf, aerial shoot, adventitiuous roots

2× (2marks)

(b)(i)**Types of Food Stored in Specimen H, I, and J**

Specimen H - Starch

Specimen I -Minerals/Vitamins

Specimen J -Glucose/Vitamin

3×1 (3marks)

(ii)**Observable Feature of specimens H,I and J**

Specimen**H/**Corn

-buds,forpropagation/growth**;** adventitious roots, for anchorage/absorption of nutrient,

Specimen **I**/Ginger

-scale leaves for protection; buds, for propagation.

Specimen**J**/Onion

-scaleleaves,forprotection;terminal/auxiliarbuds, for growth/propagation.

2×3 (6marks)

(c)(i)Specimen **G**is alimentary canal of a bird

1×1 (1mark)

(ii)**Functions of the Parts Found in SpecimenG**.

- Crop secretes enzymes for digestion,
- Gizzard crushes the birds' food.
-Liver and the pancreas discharge their secretions into the duodenum for digestion.
-The cloaca helps in the discharge of urine and faeces.

3×1 (3marks)

(iii) **Economic Importance of SpecimenG**

-It serves as a source of protein.

-It serves as food. 2×1 (2marks)

Total 30marks

SECTION C

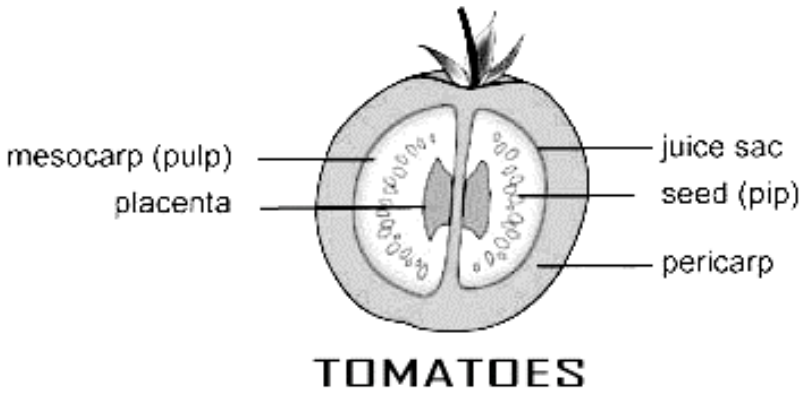
3.(a)(i)**The Types of Fruits in Specimen D and E without Reasons**

-The Specimen **D** is a tomato (derry)

-The Specimen **E** is a mango (Drupe)

4×1 (4marks)

(ii) **Drawing of Specimen D**



TOMATOES

x1

Title (TL) –Drawing of Specimen **D**/Tomatoes		-1mark
Quality		
Clarity of lines	(CL)	-1mark
Neatness of labels	(NL)	-1mark
Size	(Sz)	-1mark
Magnification	(Mg) x 0.5/x ½ -x1.5/1 $^{1/2}$	-1mark
Details		
Pericarp	(P)	
Seed	(S)	
Mesocarp	(M)	

2×1 (2marks)

Lables:Placenta, juice Sac, mesocarp, seed

2×1 (2marks)

(iii) **Modes of Dispersal of Specimen D and E**

man, wind, bird and water

2×1 (2marks)

(b)(i)**Similarities between Specimen D and E**

-Both have fleshy or succulent mesocarp.

-Both have thin epicarp.-Both have seed.

3×1 (3marks)

Differences between a Drupe and Berry

Berry tomato	**Drupe mango**
Berry has many seeds	Drupe hasonly one seed
Mesocarp and endocarp are fused	Mesocarp and endocarp are not fused

3×1 (3marks)

(ii) The type of placentation observed in specimen **D** (Tomato) is Axile placenta.

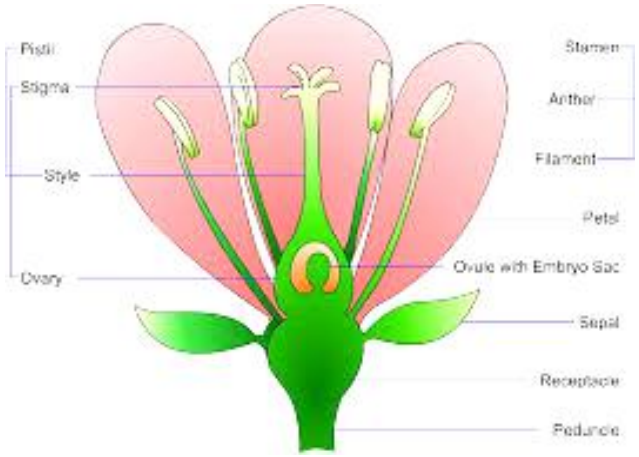
2×1 (2marks)

(iii)**The Observation of Specimen F**

Number of flora	Number of floral	Colour of parts
Sepal	5	Green/red
Petal	5	Yellow
filament	10	Red/pink
stigma	1	Yellow/pink

5×1(5marks)

(c)(i)**Drawing of Specimen F**



Title (TL) –Drawing of Specimen F/Flower -1mark

Quality

Clarity of lines	(CL)	-1mark
Neatness of labels	(NL)	-1mark
Size	(Sz)	-1mark
Magnification	(Mg) x 0.5/x ½ -x1.5/1 ½	-1mark

Details

Ovary	(O)
Filament	(F)
Style	(S)

1×1 (1mark)

Lables:sepal, receptacle, pedicel, petal, stigma

1×1 (1mark)

(ii) The types of ovary in Specimen **F**is superior ovary.

1×1 (1mark)

Test	Observation	Inference
Cut a piece of specimen **L** add two drop of iodine solution.	Blue-black colours is formed	Presence of Starch
A portion of Specimen **K** Solution in a test tube, add one ml of distilled water and shake. Added small quantity of Benedict or fehling solution and boil the mixture for few minute	A yellow precipitate is observed	Presence of sucrose or non-reducing sugar is present
To a small portion of Specimen **M** add Small quantity of sodium hydroxide solution and also add a few drops of 1% Copper (II) Sulphate solution.	Mixture will turn to purple or violet Colour	Protein is present.
Crush a piece of Specimen **N** on a filter paper and observe the spot against a source of light.	The drop of oil become more translucent, i.e. it allows more light to pass through when held in front of it.	The translucency shows the presence of fat and oils.

4×1 (4marks)

Total 40marks

APPENDIX I

THE PILOT STUDY REPORT

Row score of the two sets of tests for determining the coefficient of reliability of the test instruments

S/N	*X*	*Y*	*X-Y*	*Y-Y*	*X-X*	*Y-Y*	*X-X/Y-Y*
1	78	81	+26.1	+23.1	681.21	533.61	602.91
2	78	71	+26.1	+13.1	681.21	171.11	341.91
3	76	60	+24.1	+2.1	580.81	4.41	50.61
4	76	70	+24.1	+12.1	580.81	146.41	291.61
5	75	68	+23.1	+10.1	533.61	102.01	233.31
6	73	70	+21.1	+12.1	445.21	146.41	255.31
7	72	65	+20.1	+7.1	404.01	50.41	142.71
8	69	60	+17.1	+2.1	292.41	4.41	35.91
9	68	62	+16.1	+4.1	259.21	16.81	66.01
10	68	62	+16.1	+4.1	259.21	16.81	66.01
11	68	61	+16.1	+3.1	259.21	9.16	210.91
12	67	60	+15.1	+2.1	228.01	4.41	31.71
13	67	50	+15.1	-7.9	228.01	4.41	31.71
14	66	64	+14.1	+6.1	198.81	37.21	86.01
15	66	60	+14.1	+2.1	198.81	4.41	29.61
16	65	60	+13.1	+2.1	171.61	4.41	27.51
17	65	58	+13.1	+0.1	171.61	0.01	1.31
18	58	56	+6.1	-1.9	37.21	3.61	11.59
19	58	48	+6.1	-9.9	37.21	98.01	60.39
20	57	50	+5.1	-7.9	26.01	62.41	40.29
21	57	60	+5.1	+2.1	26.01	4.41	10.71
22	57	62	+5.1	+4.1	26.01	16.81	20.91
23	56	61	+4.1	+3.1	16.81	9.61	12.72
24	56	42	+4.1	-5.9	16.81	24.81	24.19
25	56	54	+4.1	-3.9	16.81	15.21	15.99
26	55	56	+3.1	-1.9	9.61	3.61	5.89
27	54	50	+2.1	-7.9	4.41	61.41	16.59
28	54	38	+2.1	-9.9	4.41	98.01	20.79
29	54	60	+2.1	+2.1	4.41	4.41	4.41
30	53	65	+1.1	+7.1	1.21	50.41	7.81
31	52	64	+0.1	+6.1	0.01	37.21	0.61
32	52	62	+0.1	+4.1	0.01	16.81	0.41
33	50	54	-1.9	-3.9	3.61	15.21	7.41
34	50	57	-1.9	0.9	3.61	0.81	1.71
35	48	50	-3.9	-7.9	15.21	62.41	30.81
36	48	52	-3.9	-4.9	15.21	34.81	23.01
37	47	45	-4.9	-12.9	24.01	166.41	63.21
38	46	40	-5.9	-17.9	34.81	320.41	105.41
39	45	43	-6.9	-14.9	47.61	220.01	102.81
40	40	44	-11.9	-13.9	141.61	193.21	165.41
	X=51.9	Y=57.9			6282	2846	3356

$$R = \frac{\sum XY}{\sqrt{(\sum X2)\ (\sum Y)2}}$$

$$= \frac{3346}{\sqrt{6282 \times 2846}}$$

$$= \frac{3346}{\sqrt{17878572}}$$

$$= \frac{3346}{4228.3}$$

R= 0-79

APPENDIX J

EXPERIMENTAL GROUP CONDUCTING PRACTICAL









CONVENTIONAL GROUP (LECTURE METHOD)





