

**ASSESSMENT OF THE EFFECTS OF INQUIRY AND DEMONSTRATION
METHODS ON PERFORMANCE OF BIOLOGY STUDENTS' IN SECONDARY
SCHOOLS IN FEDERAL CAPITAL TERRITORY, ABUJA, NIGERIA**

BY

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ZARIA, NIGERIA**

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DECEMBER, 2017

DECLARATION

I hereby declare that the work in the thesis entitled “Assessment of the Effects of Inquiry and Demonstration Methods on Performance of Biology Students’ in Secondary Schools in Federal Capital Territory, Abuja, Nigeria” has been carried out by me in the Department of Educational Foundations and Curriculum, Faculty of Education, Ahmadu Bello University, Zaria. The information derived from the sources of literature has been duly acknowledged in the text and a list of references provided. No part of this thesis was previously presented for another degree or diploma at this or any other Institution.

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Date

CERTIFICATION

This thesis entitled ASSESSMENT OF THE EFFECTS OF INQUIRY AND DEMONSTRATION METHODS ON PERFORMANCE OF BIOLOGY STUDENTS' IN SECONDARY SCHOOLS IN FEDERAL CAPITAL TERRITORY, ABUJA, NIGERIA by SuraiyaTukura SHAIBU meets the regulations governing the award of the degree of Doctor of Philosophy in Education (Curriculum and Instruction) of the Ahmadu Bello University, Zaria and is hereby approved for its contributions to knowledge and literary presentation.

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DEDICATION

This work is dedicated to the blessed memory of Late Father Alhaji J.U Tukura, My Mother HajiaZainabTukura and my lovely family.

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ABSTRACT

This study assessed the effects of Inquiry and Demonstration methods on Performance of Biology Students' in Secondary Schools in Federal Capital Territory, Abuja, Nigeria. The study was anchored on five objectives which include to: determine the performance of students taught Biology using Inquiry and those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja; investigate the performance of students taught Biology using demonstration and those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja; and to compare the performance of students taught Biology using inquiry and demonstration compared to those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja. Also, five research questions and five hypotheses were postulated in line with the stated objectives. Relevant literatures were reviewed on the key variables for this study. The study adopted quasi-experimental research design. The target population of the study comprised 23,422 SSII students consisting of 12,350 males and 11,072 females. A sample of 342 SSII students from six intact classes was purposively sampled from the entire 56 secondary schools in Abuja. The instrument used for data collection was a multiple-choice objective test titled "Biology Inquiry and Demonstration Performance Test (BIDPT)". The instrument was validated by the researcher's supervisors. The reliability of the instrument was pilot tested using a test/retest method. The reliability coefficient of the test/re-test scores was computed by means of Pearson Product Moment Correlation Coefficient (PPMCC) and a reliability value of 0.849 was obtained. The data was collected through the administration of pre-test and post-test. The bio-data of the respondents was analysed using descriptive statistics which involves frequencies and percentages while mean and standard deviation were used to answer the research questions. Independent t-test was used to test all the hypotheses at 0.05% level of significance. Findings of the study showed among others that students taught Biology using Inquiry method performed far better than those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja (.000 <0.005). The performance of students taught Biology using demonstration method was far better than those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja (.000 <0.005). Students taught Digestive System in Biology using inquiry method performed far better than those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja (.001 <0.005). The study concluded that, students tend to learn concepts in Biology as well as skills and how to solve problems using practical method and that Inquiry based learning require the student to do more than just report on a topic. Recommendations were made to include that teachers should use guided inquiry in teaching Biology more than unguided inquiry since the method has proved effective in enhancing students' academic performance in Biology. And that Ministry of Education and relevant academic and professional bodies like Science Teachers Association of Nigeria (STAN) and Teachers Registration Council of Nigeria (TRCN) should enlighten teachers on the use of inquiry and demonstration teaching methods through organized in-service trainings, workshops and seminars.

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LIST OF ABBREVIATIONS AND SYMBOLS

ADPRIMA	Educational Information for New and Future Teachers
ASSSRJ	Advance in Social Science Research Journal
BIDPT	Biology Inquiry and Demonstration Performance Test
BYU	Brigham Young University
CAST	Centrefor Applied Special Technology
CESAC	Comprehensive Education Study and Adaptation Centre
CTM	Conventional Teaching Method
CIRT	Centre for Innovation in Research and Teaching
DM	Demonstration Method
FCDA	Federal Capital Development Authority
FCT	Federal Capital Territory
FME	Federal Ministry of Education
FRN	Federal Republic of Nigeria
GCE	General Certificate in Education
GDSS	Government Day Secondary School
GSS	Government Secondary School
IBL	Inquiry Based Learning
IMM	Interactive Multi Media
ISTE	International Society for Technology in Education
KICD	Kenya Institute of Curriculum Development
MDG	Millennium Development Goals
MKO	More Knowledgeable Other
NCE	Nigerian Certificate in Education
NECO	National Examination Council
NERDC	Nigerian Educational Research and Development Centre
NOUN	National Open University of Nigeria
NPE	National Policy on Education
NRC	National Research Council
NTI	National Teachers Institute

RAAs	Research Assistants
SSAT	Social Studies Achievement Test
SSE	Secondary School Education
SSS	Senior Secondary School
STAN	Science Teachers Association of Nigeria
SUST	Journal of Humanities
TRCN	Teachers Registration Council of Nigeria
UBE	Universal Basic Education
UVU	Utah Valley University
WAEC	West African Examinations Council
WASSCE	West African Senior School Certificate Examination
WEEJS	International Journal of Arts and Combined Sciences
ZPD	Zone of Proximal Development
3D	Three-Dimensional

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OPERATIONAL DEFINITION OF TERMS

Biology is a natural science concerned with the study of life and living organisms, including their structure, function, growth, evolution, distribution, and taxonomy.

Inquiry method is a style or method of teaching where the learner is seeking to discover and create answers to recognized problems through procedure of making a diligent search.

Demonstration method of teaching and learning is a method in which teachers dramatize topics to be taught by either the use of items or recorded materials.

Conventional or Lecture Method refers to an oral presentation of lesson given to a class by the teacher. The teacher usually dispenses facts and opinions about content, while students listen passively and sometimes make contribution when they are familiar with the topic.

Academic Performance is defined as the measure of what a person has accomplished after exposure to an educational programme

Technique refers to the principle and methods used in instruction.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

A decree was signed on February 4, 1976, establishing the Federal Capital Territory, Abuja and setting up the Federal Capital Development Authority (FCDA). The FCT has borders on the north with Kaduna State, on south-east with Nassarawa State, on the south-west with Kogi State and on the west with Niger state. There are six Area Councils in the Federal Capital Territory and fifty six secondary schools in Abuja. The secondary education is divided into junior and senior secondary level. Therefore, this research focused on senior secondary school in which Biology is offered as a subject.

Science subjects constitute a major part of the subjects being offered in most post-primary institutions in Nigeria today. The importance of science subjects has been emphasized by Federal Government in the National Policy on Education, Section 5, Item 22 (c) which states in specific terms that “The Secondary School Education shall provide trained manpower in the applied science and technology (National Policy on Education – FRN, 2013). The National Policy on Education further added that science subjects constitute part of the core subjects at both Junior and Secondary School levels. The importance attached to science by the Federal Government could be due to the general belief that science is capable of improving and changing skills, attitudes and cognition by increasing pupils’ store of knowledge about themselves, their environment and their world.

The importance of Biology in the development of any nation cannot be underrated especially in Nigeria where the national income rests on petroleum and petrochemical industries. Biology is a natural science concerned with the study of life and living organisms, including their structure, function, growth, evolution, distribution, and

taxonomy (Aquarena Wetlands Project, 2004). Biologists study the structure, function, growth, origin, evolution and distribution of living organisms (Bagley, 2014). Modern Biology is a vast and eclectic field that recognizes the cell as the basic unit of life, genes as the basic unit of heredity, and evolution as the engine that propels the synthesis and creation of new species.

It is also understood today that all organisms survive by consuming and transforming energy and by regulating their internal environment to maintain a stable and vital condition. Nwagbo and Chikelu (2011), also agreed that 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. Biology as a branch of science and the prerequisite subject for many fields of learning contributes immensely to the technological growth of the nation.

In spite of the importance of Biology in nation building, students' attitude, interest and performance in Biology in West African Examination Council (WAEC) have not been encouraging (Iliyasu, 2006). A lot of efforts have been made in research work through conferences, workshops and seminars organized to find solutions to students' poor performance and low interest in Biology but still the students' academic performance in the subject is below expectations (Onu, 2004). The poor performance of students in secondary Biology (WAEC Chief Examiners Report, 2014), has made it a matter of necessity to think about what can be done to improve the situation. Most of the misconceptions about biological concepts by the students in secondary schools are carried to tertiary institutions which may lead to their poor performance in Biology (Onu, 2004). Thus, when students misperceive Biology with incorrect scientific understanding then, the teaching/learning process of Biology in secondary school will be crippled.

On the other hand, the quality of Biology education bears a direct relationship with the quality of the Biology teachers and their methods of teaching. Hence, the purpose of teaching science (Biology in particular), according to Nwagbo and Chikelu (2011), which is, “to make the students learn to know what they are taught; that is, teachers teach to impart knowledge and skills to students”, cannot be justified without the use of appropriate or good method of teaching. Maikano (2007) and Dukawa (2007), observed that most teaching methods employed at the secondary school in Biology teaching is conventional method and this lead to the poor academic achievement in the subject. With increasing number of studies on inquiry and demonstration (Maizuwo, 2011; Kikas, 2004), even if the new teaching strategies (Inquiry and Demonstration) are effective in correcting misconception, it is difficult for them to be applied to school education because they require more time to process compared to Conventional teaching-learning methods.

Thus, it is necessary to establish a teaching strategy, which is highly applicable to School education curricula and effective in teaching Biology, and in which most students are interested. Effective teaching of Biology depends on the available suitable methods employed by the teachers at different levels on different concepts. These include, Laboratory, Lecture, Discussion, Guided Discovery, Expository, Concept Mapping, Problem Solving, Field Trip, Project, Demonstration and Inquiry Teaching Methods among others (Maizuwo, 2011). In this study, therefore, Inquiry and demonstration teaching methods was employed in the teaching of Biology and to see its effect on shifting misconception students harboured which has affected their academic performance.

Education Broadcasting Corporation (2004), simply defined inquiry as seeking for truth, information or knowledge by questioning. In another perspective, Onan in Aniaku (2012), defined inquiry as student-learning method that encourages students to create personal knowledge by questioning and use of investigation process. Inquiry teaching

method is also a term used in science teaching that refers to a way of questioning, seeking knowledge or information or finding out about phenomena, it involves investigating data and arriving at a conclusion (Sola and Ojo, 2007).

Inquiry helps students to learn and experience Biology first-hand, by taking on the role of scientist. The student use Inquiry process to develop explanations from their observations (evidence) by integrating what they already know with what they have learned (Opara, 2011). The author added that the students learn discrete Biology concepts and skills and how to solve problem using practical approaches. In Inquiry situation students learn not only concept but also self-direction, responsibility and social communication. It also permits students to assimilate and accommodate information. According to Sola and Ojo (2007), Inquiry is a way people learn when they are left alone. Cheval and Hart (2005), classify Inquiry teaching method into three classes, namely: structured Inquiry, guided Inquiry and open Inquiry.

There is a debate as to which type of Inquiry is best. According to Waddy (2014), the types of Inquiry teaching methods include: confirmation inquiry, structured inquiry, guided inquiry, and open/true inquiry. Any form of Inquiry (structured, guided, or open) can be useful to students when taught appropriately well. Structured Inquiry is the most teacher-centred of the types of Inquiry where you give students an open question and an investigation method. They must use the method to craft an evidence-backed conclusion (Guido, 2017). This type of Inquiry is commonly seen in science classrooms in the form of laboratory exercises. The teacher provides fairly structured procedures for the Inquiry activity, and Students carry out the investigations. Structured Inquiry could be described as the most conventional method to Inquiry (Cheval and Hart, 2005). On the far side of the spectrum is an open Inquiry. This type of Inquiry requires the least amount of teacher intervention and is student-centred. Students often work in groups and plan all phases of

their investigations. This is the purest form of Inquiry conducted in science classrooms (Cheval and Hart, 2005). Guided Inquiry falls in the middle of the Inquiry instructional spectrum. In Nigeria the emphasis for student-centred learning and use of inquiry teaching method was intensified with the introduction of Universal Basic Education (UBE) scheme in 2004 with the aim of eliciting high cognitive process in student (Federal Ministry of Education, 2008).

Demonstration method of teaching and learning is a method in which teachers dramatize topics to be taught by either the use of items or recorded materials, while Students are made to practice the skills demonstrated in readiness for the time they will be asked to display their level of efficiency in the performance of those skills. It is one of the effective methods of learning Biology education subjects or courses as it explains steps/acts of an operation/principles and shows how a process, procedure or an experiment to be carried out, what to do, and why it should be done that way (Ajoma, 2009). Demonstration teaching strategy is of key importance in teaching sciences (Vladimir inMaizuwo, 2011). Demonstrations should be relatively short (as compared with other methods of teaching), performed with the simplest equipment that ensures the same effect and it is vital that the science behind them is well understood at the secondary school (Maizuwo, 2011). Teacher-demonstration method therefore, is a teacher-centred method of teaching whereby the teacher illustrates a procedure to be followed and thereafter students follow those procedures to solve the given problems. For instance, Gracia (2015), illustrated an example using Human Biology System Foldable. The teacher demonstrates how to draw the diagrams on cardboard and how to fix the foldable on the diagrams drawn. The students then learn by imitating the teacher. According to Aliyu (2008), teacher-demonstration is a method of teaching whereby all new subject matter is presented and explained by the teacher before it is imitated by students in the class. This study was

therefore carried out so as to salvage the students' poor performance as a result of the ineffective teaching and learning method used in teaching Biology in secondary schools in Federal Capital Territory, Abuja.

1.2 Statement of the Problem

This study was inspired in response to students' persistent poor performance in Biology. This perhaps can be partly ascribed to inadequate teaching and instructional methods adopted by Biology teachers. This according to Marakinyo (2009), the falling level of academic performance is attributed to teacher's non-usage of verbal reinforcement and inquiry teaching methods. Opara (2011), noted that inquiry teaching when fostered in different ways (guided or unguided) can ultimately and positively affects students understanding, achievement and interest in Biology. Inquiry teaching method was chosen in this study because; even though it is highly scientific in nature it is seldom practiced in our tertiary institutions (Sola and Ojo, 2007). Biology as a science subject is bulky in nature.

As a student and later as a Biology teacher, the researcher observed that the science teachers used lecture/conventional method in teaching to enable them cover the syllabus within the stipulated time; and this did not give room for proper understanding of the subject. The Chief WAEC Examiner Report (WAEC, 2014), noted that the rush over the topics to cover could be responsible for the poor performance in Biology. Identification of this problem is a first step in trying to look for a way to remedy poor performance in Biology. It has been shown that if the right method or methods is used in teaching Biology, then problem of poor performance can be minimized (Heeman, 2005; Bryan, 2007). However, the rate of failure of students in science subjects, particularly Biology in the secondary schools, has assumed a serious dimension. This is evident in the West African Senior School Certificate Examination results from 2011 to 2015 for Federal Capital

Territory public schools Abuja was 9.2%, 21.4%, 32.2%, 17.7% and 30.2% respectively which reveal very poor performances. NECO/SSCE results from 2011 to 2015 for Federal Capital Territory public schools is 5.7%, 23.4%, 39.0%, 36.9% and 58.7% respectively. These also revealed poor performances. According to Ajaja (2011), these poor performances were occasioned by the very poor state of resources for teaching and learning Biology; and the unchallenging environment under which the business of teaching Biology takes place. The state of the Biology laboratories in schools ranged from total absence of laboratories to ill-equipped ones. The researcher added that the situation therefore calls for a search for alternative methods that will shunt the use of laboratories but yet guarantee effective learning by students.

In the light of this, Biology teachers need to seek suitable ways of tackling the current massive failure in Biology if they are to halt the drifts of science students to art and social sciences. Adunola (2011) in Ganyaupfu (2013), had this view, and observed that regular poor academic performance by the majority students is fundamentally linked to application of ineffective teaching methods by teachers to impart knowledge to learners. In order for the method used for teaching to be effective, the author maintains that teachers need to be conversant with numerous teaching strategies that take recognition of the magnitude of complexity of the concepts to be covered.

The researcher's interaction with the Biology teachers in secondary schools in Federal Capital Territory, Abuja showed that many of them do not think of any teaching method apart from the lecture method and reviewing past question papers as means of imparting knowledge in Biology to their students. This, to the researcher, does not provide a good way for students to learn; most especially as was observed by John (2009), who said that Biology is not a subject that can be mastered by mere memorization of the basic rules. It requires total involvement of the learners in the learning process, sound theoretical

knowledge and intensive practice in application of basic principles. It is as a result of these problems that the researcher was prompted to carry out an investigation to assess the effects of Inquiry and Demonstration methods in teaching Biology.

1.3 Objectives of the Study

This study was carried out with the objectives to:

1. determine the performance of students taught Biology using inquiry method and those taught using conventional method in secondary schools in Federal Capital Territory, Abuja;
2. investigate the performance of students taught Biology using demonstration method and those taught using conventional method in secondary schools in Federal Capital Territory, Abuja;
3. compare the performance of students taught Biology using inquiry and demonstration with those taught Biology using conventional method in secondary schools in Federal Capital Territory, Abuja;
4. find out the academic performance of students when taught Digestive System in Biology using inquiry and conventional methods in secondary schools in Federal Capital Territory, Abuja; and
5. ascertain the effect of the use of demonstration and conventional methods on academic performance of students when taught Transport System in Biology in secondary schools in Federal Capital Territory, Abuja.

1.4 Research Questions

The following research questions were raised to guide the study:

1. What is the performance of students taught Biology using Inquiry and conventional methods in Secondary Schools in Federal Capital Territory, Abuja?

- 2 What is the performance of students taught Biology using demonstration and those taught using conventional methods in Secondary Schools in Federal Capital Territory, Abuja?
- 3 What differences exist in the performance of Students' taught Biology using inquiry and demonstration methods compared to those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja?
- 4 What is the performance of students taught Digestive System in Biology using inquiry and conventional methods in secondary schools in Federal Capital Territory, Abuja?
- 5 What effect has demonstration and conventional methods on academic performance of students when taught Transport System in Biology in secondary schools in Federal Capital Territory, Abuja?

1.5 Research Hypotheses

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

- H₀₁: There is no significant difference in the performance of students taught Biology using inquiry and those taught using conventional methods in Secondary Schools in Federal Capital Territory, Abuja.
- H₀₂: There is no significant difference in the performance of students taught Biology using demonstration and those taught conventional methods in Secondary Schools in Federal Capital Territory, Abuja.
- H₀₃: There is no significant difference in the performance of students taught Biology using inquiry and demonstration methods compared to those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja.

H0₄: There is no significant difference in the academic performance of students when taught Digestive System in Biology using inquiry and conventional methods in secondary schools in Federal Capital Territory, Abuja.

H0₅: There is no significant difference on academic performance of students when taught Transport System in Biology using demonstration and conventional methods in secondary schools in Federal Capital Territory, Abuja.

1.6 Basic Assumptions

The study was based on the assumptions that:

1. Inquiry method of teaching has effect on students' performance in Biology in Secondary Schools in Federal Capital Territory, Abuja.
2. Demonstration method of teaching has effect on students' performance in Biology in Secondary Schools in Federal Capital Territory, Abuja.
3. Difference exist in the performance of students' taught Biology using inquiry and demonstration method compared to those taught using conventional methods in Secondary Schools in Federal Capital Territory, Abuja.
4. Difference exists in the academic performance of students when taught Digestive System in Biology using inquiry and conventional methods in secondary schools in Federal Capital Territory, Abuja.
5. Difference exists in the use of demonstration and conventional methods on academic performance of students when taught Transport System in Biology in secondary schools in Federal Capital Territory, Abuja.

1.7 Significance of the Study

The study is of great benefit to Biology Teachers, Students, Curriculum Planners, Ministry of Education, Textbooks Publishers, Parents/guardians, Educational Administrators and Future Researchers. Biology teachers benefitted by using the

appropriate teaching methods; Inquiry and Demonstration in inculcating the principles and concepts of Biology to their students which will enhance the Students' academic performance. In addition, it will aid the teachers in preparing students for higher learning of Biology in Universities or Colleges as well as clerical job in public and private sectors of the economy, making this study imperative. The findings from this study would assist the teachers to increase their confidence and to improve their teaching strategies particularly in remedying misconceptions held by students in Biology at the Secondary School level. The findings from this research work provided a teaching/learning strategy that teachers' of Biology could adopt so that students in their classes will benefit maximally, thereby meeting the needs of individual students in the class. This research formed a different dimension of innovations in the teaching and learning of Biology.

Findings from this study could motivate students to achieve excellent grades in Biology which the researcher believed could have a ripple effect in their performance in other subjects as a result of increased confidence. It will improve students' achievement and interest in biology, thereby increasing the number of students who will go into the study of important science courses like Medicine, Pharmacy, Nursing, Biotechnology and Agriculture. Students, who may be potential teachers, may benefit more from the findings of the study; as it will help them improve their understanding of the identified and related concepts of Biology. Hence, improve their academic performance and be able to teach it effectively.

Moreover, it will equally be of great use to the curriculum planners as it assisted them to suggest relevant methods for teaching different topics in the curriculum. Students' academic performance will improve through the use of appropriate teaching methods. The findings will also influence the curriculum innovation programme in Biology. The findings from this study would therefore shed light on the instructional strategy that is suitable for

both sexes. The Federal Government of Nigeria will benefit by using the findings of this study to engage teachers and administrators in training programmes that can model this new educational approach.

The Federal Ministry of Education at both the State and Federal level benefitted from this study by using the findings of this study to engage teachers in various form of workshops, seminars and conferences in training programme that can model and modify this new teaching and learning methods. The findings in this research are useful to Parents/Guardians who are interested in seeing improvement in the performance of their students in the science subjects.

This study would help the educational administrators towards decision making and enforcement of the use of inquiry and demonstration methods by the Biology teachers. Additionally, this study would be relevant to the textbook writers and publishers as it will assist in designing course workbook with effective teaching methods. Meanwhile, it has stirred up further researches as regarding methods of teaching and inculcating Biology at the Secondary School levels.

1.8 Scope of the Study

This study assessed the effect of Inquiry and Demonstration methods on students' performance in Biology in secondary schools in Federal Capital Territory, Abuja. The research is limited to students offering Biology in SS II classes in the six sampled schools in Federal Capital Territory, Abuja. The choice of the class was because at this level, the students are exposed to comprehensive principles, practical and procedures in Biology as a science subject. The study was delimited to two teaching methods (Inquiry and Demonstration) in the teaching of Biology and its effect on academic performance.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter reviewed literature considered relevant to the present study. The idea is to identify, discuss, analyse, critique and integrate literature works of other researchers which were suitable for this work. A review of related literature can be defined as the process of collecting, selecting, reading books, journals, reports, abstracts, and other reference materials (Reosura, 2010). The reviews in this chapter were examined under the following sub-headings for ease of referencing: Introduction, Conceptual framework which is further discussed under Concept of Biology, Concept of Inquiry method, Concept of Demonstration Method and Concept of Students Academic Performance. The Theoretical framework include Jean Piaget's Development Theory, Bruner's Theory of Cognitive learning, John Dewey's theory and Vygotsky's learning theories. Other sub headings include Biology Education Curriculum, Gender and Academic Performance, Instructional Methods in the Teaching of Biology, Empirical Studies and Summary

2.2 Conceptual Framework

In order to properly understand issues surrounding this study, key concepts such as Biology, inquiry methods, demonstration methods and academic performance were explained. A concept is basically an idea or ideas put together to give meaning to a thought or various thoughts which one can observe with our own sense organs. Klausmeir (1972) and Davis (1973) in Maizuwo (2011), stated that concepts can be defined in a number of ways, which are; structurally, systematically, operationally and axiomatically. Structural definitions look at properties or attributes of a concept. Systematic definitions look at the procedure used to distinguish the concept from other concepts. Axiomatic definitions look at numerical and logical relationship among concept. In order to properly understand issues

in this study, key concepts such as concept of Biology, concept of inquiry method, concept of demonstration and concept of students' academic performance were discussed below:

2.2.1 Concept of Biology

Biology is one of the fields in the natural sciences that studies living things. The word 'Biology' is coined from two Greek words; 'bios' meaning life, and 'logos' (logia) which means study, to know (Odaibo, Gbenro, Ala, Olaniran & Chukwuka, 2012). Thus the concept Biology is concerned with the study of life. However, Biology is the branch of science that studies life using inquiry methods and discoveries, hence North Carolina Standard Course of Study (2004) in (Aniaku, 2012), stated that since Biology involves inquiry and discovery that inquiry should be the central theme in Biology teaching and learning for students to experience the world of life around them and to actually do Biology as opposed to learning Biology. Miller and Levine (2002) in Aniaku (2012), states that Biology in addition to studying life, studies also the structures, functions, growth, origin, evolutions, distributions, inter-relationships, problems such as diseases and adaptations of living things and proposes solutions where possible. Sub-disciplines of Biology are defined by the scale at which organisms are studied, the kinds of organisms studied, and the methods used to study them: Biochemistry examines the rudimentary chemistry of life; Molecular Biology studies the complex interactions among biological molecules; Botany studies the Biology of plants; Cellular Biology examines the basic building-block of all life -the cell; Physiology examines the physical and chemical functions of tissues, organs and organ systems of an organism; Evolutionary Biology examines the processes that produced the diversity of life; and Ecology examines how organisms interact in their environment (Science Museum, 2013). Fowler, Roush and Wise (2013), wrote that concepts of Biology includes interesting applications, features a rich art programme and conveys the major themes of Biology.

There has been a nationwide push to develop learning outcomes for all university courses, in order to set a standard for what students should know upon completion of a course. However, as noted in the literature, college students coming out of introductory courses show a surprising lack of understanding (NRC, 1997) in(Howell, McDonald, Esplin, Schaalje & Booth, 2013), about basic Biology concepts and principles such as evolution (Alters & Nelson, 2002) and ecology (Mason, 1992) in(Howell, McDonald, Esplin, Schaalje & Booth, 2013), and even significant chronic misconceptions about key ideas such as the importance of scientific reasoning. In order to combat this rising phenomenon, some investigators (Bransford, Brown & Corking, 1999) in(Howell, McDonald, Esplin, Schaalje & Booth, 2013), have reported that students are more likely to develop usable knowledge if teachers give repeated feedback on student understanding. It is also deemed important for teachers to allow students time, both in laboratory and lecture, for principles to stimulate understanding and creative thinking (Crow, 2004) in(Howell, McDonald, Esplin, Schaalje & Booth, 2013).

However, even when feedback is provided and students are given time to ponder the principles, it has been repeatedly noted that many students still do not understand why certain topics are included in a course. Students often consider them "boring" or unrelated to their career path. Hence, the intent of the present study is to evaluate what themes in Biology are important to learn, from both a student and a teacher point of view, so that desirable course outcomes can be established and student perceptions of these outcomes can be evaluated (Howell, McDonald, Esplin, Schaalje & Booth, 2013).A survey was conducted in which each participant (student and faculty member) was asked to rank seventeen themes in Biology from the most important to the least important. These themes were chosen by the authors of the survey, with input given by other life science professors involved in teaching introductory Biology courses at Brigham Young University (BYU)

and Utah Valley University (UVU). Based on a sampling of introductory Biology textbooks most frequently used at the two institutions (Campbell, 2008; Starr & Taggart, 2008; Raven, 2008) in (Howell, McDonald, Esplin, Schaalje & Booth, 2013), the seventeen topics were key themes covered in all three of the introductory Biology textbooks reviewed. The authors added that this survey revealed surprising discrepancies in the learning outcomes expected by students and by teachers. The current results reflect the outcome for students at only a single university and the life science faculty of two universities, but it would be interesting to learn whether administering the survey at multiple institutions would produce a similar outcome (Howell, McDonald, Esplin, Schaalje & Booth, 2013). The survey contained seventeen concepts to be ranked from one (most important) to seventeen (least important). These concepts were chosen based on topics traditionally included in introductory Biology textbooks (Howell, McDonald, Esplin, Schaalje & Booth, 2013). These themes were: Scientific Reasoning/Method, The Cell, Evolution, and Cell Division Biological Molecules. The Central Dogma, Mendelian Genetics, Ecology, Bioenergetics (cellular respiration), Photosynthesis, Metabolism and Enzymes, History of Science, Fundamentals of Chemistry, Plant Reproduction, Embryonic Development, Immunology and Viruses.

In conclusion, Faculty ranked the importance of eleven of the seventeen Biology concepts in a significantly different order than the students. Evolution was ranked as one of the most important concepts for faculty, whereas students ranked it much lower. Ecology was ranked as least important by major students and third to lowest by non-major students, but was ranked much higher by faculty. Scientific reasoning/method was also ranked by faculty as one of the top three most important concepts to teach, while students ranked it significantly lower in importance. These results indicate that students are not learning or understanding the importance of what faculty view as the key concepts in Biology.

Evolution is the capstone of Biology, and ecology is vital for understanding the "big picture" of Biology.

A clear understanding of these two concepts is a must for our citizen scientist. Scientific reasoning and the scientific method are the driving forces behind all experimental Biology. More time needs to be devoted to the process of science so that an appreciation for scientific reasoning will sink in. The outcomes in this investigation may reflect previous student exposure to or experience with these biological concepts (Howell, McDonald, Esplin, Schaalje & Booth, 2013). The authors opined that this is probably why a large proportion of United States citizens do not accept evolution as a vital capstone of all Biology. The authors believed that this study should be repeated on a larger scale, with faculty and student participants from throughout the nation, in order to evaluate the severity of the discrepancy between faculty and student perspectives of what is truly relevant in Biology. The design of the illustrations in our textbooks clearly needs to be improved so that our students can see the value of scientific reasoning. This will undoubtedly help them see connections from theme to theme. It is hoped that all students leave their Biology courses with the ability to apply biological principles in their lives, to help them recognize the importance of Biology and to allow them the opportunity to solve real-world problems in their community, the nation, and the world.

The concepts in Biology are taught using different teaching methods such as the Inquiry process which involves asking questions that stimulate students to think and to develop scientific knowledge and scientific habit such as curiosity, creativity, objectivity and open mindedness. This is needed for understanding of biological concepts, knowledge construction and knowledge transfer to similar situations. Biology as science of life provides potentials for the use of inquiry and demonstration methods. In view of this, the present study identified that the two types of teaching methods (Inquiry and

demonstration) are more effective than the Conventional teaching method in improving student's performance and interests in Biology.

2.2.2 Concept of Inquiry Method

Inquiry is a process of seeking for truth or query into an idea. Inquiry based curriculum has been shown to develop independent and critical thinking skills, positive attitudes and curiosity toward science and increased achievement in biological content (Hall & McCudy, 1990 in Franklin, 2015). Hughes (2014), also agreed with Franklin (2015) that interest in learner-centred pedagogies, particularly inquiry-based learning (IBL), has increased since the year 2000. This is because constructivist learning theories such as IBL emphasize the development of higher-order cognitive skills that have been identified as critical for the development of scientific thinking (that is, theory explication and experimental protocol construction). Warner and Myers (2014), asserts that teachers play a vital role in adapting the inquiry process to the knowledge and ability level of their students. When using inquiry-based lessons, teachers are responsible for

1. starting the inquiry process;
2. promoting student dialog;
3. transitioning between small groups and classroom discussions;
4. intervening to clear misconceptions or develop students' understanding of content material;
5. modelling scientific procedures and attitudes; and,
6. utilizing student experiences to create new content knowledge.

The authors added that, educators should ensure that each of the six stages of the inquiry cycle, as shown below, is complete.

Six Stages of the Inquiry Cycle

1. Inquisition – stating a "what if" or "I wonder" question to be investigated
2. Acquisition – brainstorming possible procedures
3. Supposition – identifying an "I think" statement to test
4. Implementation – designing and carrying out a plan
5. Summation – collecting evidence and drawing conclusions
6. Exhibition – sharing and communication results (Llewellyn, 2002 in Warner & Myers, 2014).

These six stages are illustrated further in Figure 1:

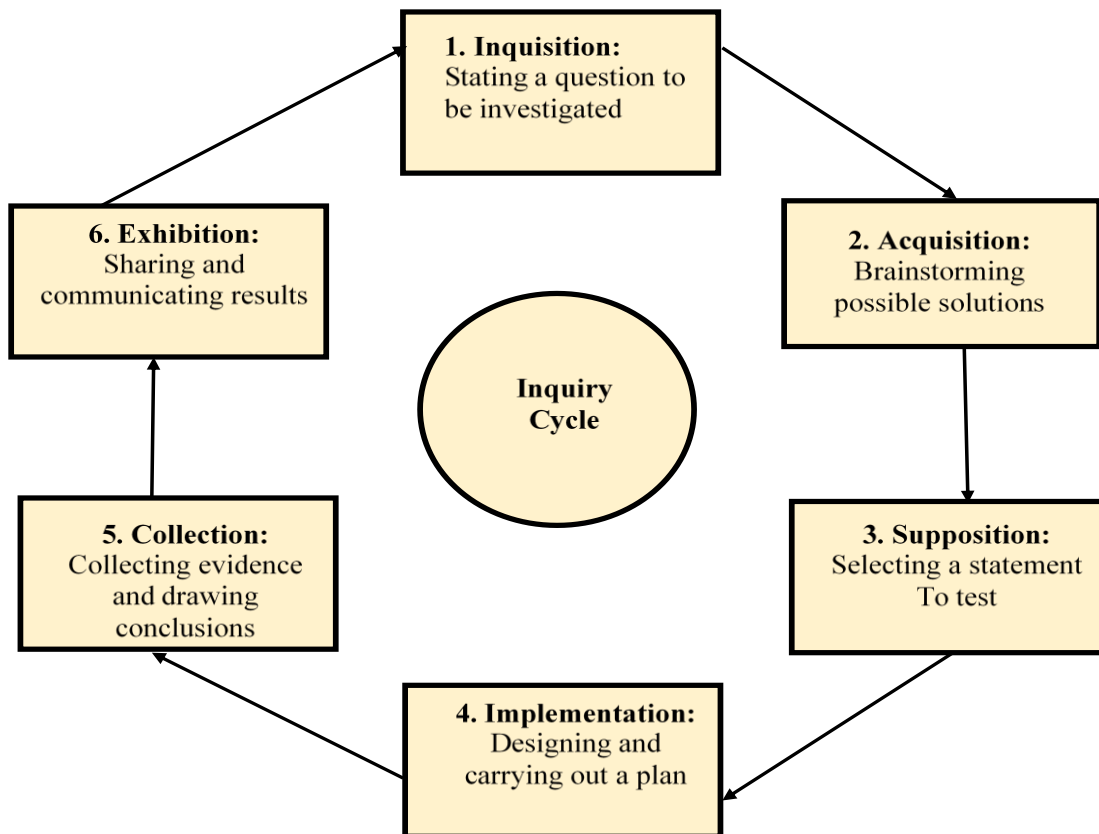


Figure 1: The inquiry cycle

Source: Warner and Myers (2014). Retrieved from <https://edis.ifas.ufl.edu/wc076>

Warner and Myers (2014), wrote that ‘while completing inquiry-based lessons, students develop important skills that will help them become successful, lifelong learners’. This statement is in agreement with the views of Hughes (2014) and Franklin (2015).

There are four essential elements on which inquiry based learning depends, which are, first is that the patterns and meanings should not be deceptive to the beginners, second is that the useful knowledge about a field should be structured, third is that the knowledge which is structured should be applicable, transferable and accessible to a vast range of situations, fourth is that the structured knowledge should be easily retrieved so that new information in that particular field could be gained without much effort (Teach-nology.com, 2017). Inquiry teaching method has been described as problem solving, critical thinking, reflective inquiry and deductive thinking. It is a method of teaching that involves probing, finding out investigating, analysing, synthesizing, discovering, evaluating, questioning and thinking (Muhammad, 2007 cited Muhammad, 2011).

In another development, inquiry method is defined as teaching method which heavily depends upon the learner's involvement with the learning task. The method is based on the assumption that the subject is to learn actively by fully participating in the learning task. It is a method that leads to effective learning outcomes which will be meaningful to the learner (Muhammad (2007) in Muhammad, 2011). The researcher also agrees with Muhammad (2007) cited Muhammad (2011), with where he wrote 'this implies that inquiry method requires putting learners into situation in which they must to be engaged in intellectual operation that constitutes finding out'. Kyle and Gadsden (1996) in Muhammad (2011), viewed inquiry teaching method as a strategy of teaching where students examine ideas, existing issues, probe and question them freely, and practice on their own or with little guidance from the teacher. The author opined that students seek for information to answer or solve their problems. Therefore, inquiry teaching is educative, experimental and produces a lot of fun and joy as students learn by doing activities.

2.2.3 Concept of Demonstration Method

Demonstration method is a teaching method where the teacher visually shows the students what is expected from them in a particular topic/lesson. The students in turn imitate the teacher as an affirmation that learning has taken place. K12academia.com (2016), stated that demonstration involves showing by reason or proof, explaining or making clear by use of examples or experiments. Put more simply, demonstration means to clearly show. In teaching through demonstration, students are set up to potentially conceptualize class material more effectively as shown in a study which specifically focuses on chemistry demonstrations presented by teachers. The author further explained that demonstrations often occur when students have a hard time connecting theories to actual practice or when students are unable to understand application of theories. Farrant in Danjuma (2012), considered this method as effective in teaching and learning process. This must obtain combined verbal explanation and practical illustration or example, the handling or operation of a piece of equipment or materials. It is a means of providing practical learning experience in the classroom which are more realistic for the students.

The demonstration method of teaching shows learners how to do a task using sequential instructions with the end goal of having learners perform the tasks independently (Coffey, 2015), the author further explained that when using the demonstration model in the classroom, the teacher, or some other expert on the topic being taught, performs the tasks step-by-step so that the learner will eventually be able to complete the same task independently (Coffey, 2015).

The demonstration method of teaching shows learners how to do a task using sequential instructions with the end goal of having learners perform the tasks independently. Aliyu in Musa (2015), defined Demonstration as an “illustration of a point in a lecture or lesson by means of something other than conventional visual-aid apparatus”.

Demonstration is about the presentation of a pre-arranged series of events or equipment to a group of students for their observation. Demonstration can be carried out by; the teacher alone, the teacher with a student, the student who is knowledgeable in the activity, or an invited guest (National Teachers Institute NTI, 2006). Demonstration teaching strategy simply means displaying something, for example, when a Science teacher shows the action of carbon dioxide on a blue moist litmus paper, he is presenting a demonstration (Abdullah inMaizuwo, 2011). It has been shown that students particularly like experimental demonstration because they usually have more action(Bunkure, 2007). He added that teachers should however endeavour to remove from demonstration, all elements of magic “show biz” or entertainment.Sola and Ojo (2007), referred to the teacher-demonstration method as lecture-demonstration. They believe that a good demonstration is always accompanied by explanation which is usually a lecture they concluded by defining lecture demonstration methodas a teaching technique that combines oral explanation with “doing” to communicate processes, concepts and facts. It is particularly effective in teaching a skill that can be observed. Some of the important guidance for a successful demonstration is given below (Aliyu inMusa, 2015):

1. Plan all the activities relating to demonstration in great detail.
2. Ensure that all the equipment, illustrations and other relevant materials are procured in time and kept ready before the demonstration begins.
3. Breakdown the demonstration into suitable steps so that it can be easily understood by the students.
4. Proceed with the demonstration slowly so that all the students may grasp the details.
5. Wherever possible, involve students in demonstration.

6. Ascertain after every step whether the students have grasped the meaning, contents and explanation. Repeat if they have not followed it.
7. Give suitable verbal explanations for heightening the interest of the students.
8. Encourage students to analyse record and tabulate the results of their observation.
9. Make an assignment based on the demonstration.

2.2.4 Concept of Students' Academic performance

Academic performance is defined as the measure of what a person has accomplished after exposure to educational programme. In research conducted by Harry and Newcomb (1990) in Muhammad (2011), on the effect of inquiry method and the essential benefits of inquiry method, he shows that students exposed to inquiry instructional method scores higher than those students whom were taught the same concept using subject matter approach. Campbell (2006) in Aniaku (2012), referred to academic achievement as the outcome of a teaching and learning process. The extent to which a student, teacher or institution has achievement their educational goals'. Similarly Adeyemi (2008) in Aniaku (2012), described academic achievement as the scholastic standing of a student at a given moment which states individual's intellectual abilities; which can be measured by grades obtained from examinations or continuous assessments (tests or quiz). Aubrey (1970) in Ibrahim (2015) sees Academic performance as activities that ensure that goals are consistently being met in an effective and efficient manner. The author concluded that, academic performance is the effectiveness and improvement of students towards specific goals set up to be achieved. Ahmad (2007) in Ibrahim (2015) observed that the influence of methods of teaching and effectiveness on the learning outcome of students as measured by students' academic performance on subject of several studies; is a significant predictor of students' academic performance.

In Nigeria, the level of students' academic achievement in the secondary school is determined by grades obtained from external examination that is, Senior School Certificate Examination conducted by external examination bodies WAEC, GCE and NECO respectively. The pattern of grading candidates score in the examination is such that distinction grades were represented by A1-B3, credit grades C4-C6, ordinary Pass D7-D8 and failure grade F9 (Adeyemi, 2008). A sample of students West African School Certificate Examination result in Biology in the study area 2005-2010 indicate that majority of the students obtain grades within the range of D7 – F9. This result indicates poor achievement in Biology since the least requirement for further studies in the tertiary institutions is C6. The poor student achievement in Biology is linked to the use of Conventional lecture/expository method in the teaching and learning of Biology (Nwagbo, 2006; Isiugo-Abanihe, 2010 in Aniaku, 2012).

The researcher believes that the effective uses of inquiry and demonstration teaching methods should produce students with higher performance. Apart from teaching methods, socio-economic background, personality of the students, interest of the student and mastery of subject matter, emotional state of mind and teachers experience greatly influence academic performance.

2.3 Theoretical Framework

The theoretical framework for this study is based on the constructivist learning theories as propounded by Piaget's Development Theory, Bruner's Theory of Cognitive Learning, Dewey's Cognitive Theory and Vygotsky's Learning Theory. Learning theories are theoretical frameworks describing how information is absorbed, processed and retained during learning. Cognitive, emotional, and environmental influences, as well as prior experience, all play a part in how understanding, or a world view, is acquired or changed and knowledge and skills retained (Ormrod, 2012). There are three sets of

learning theory generally used in educational circles, under the headings of: behaviourism, cognitive and social learning theories (Atherton, 2013). He added that Behaviourism is primarily associated with Pavlov (classical conditioning) in Russia and with Thorndike, Watson and particularly Skinner in the United States (operant conditioning), while Humanistic "theories" of learning tend to be highly value-driven and hence more like prescriptions (about what ought to happen) rather than descriptions (of what does happen) and then social learning theories. It is also the basis of the educational approach known as constructivism, which emphasises the role of the learner in constructing his own view or model of the material and what helps with that.

Bello and Abimbola (2012) in Aniaku (2012), stated that the newer idea of the cognitive psychologists about learning is that learning is an active internal process of construction where learners' prior knowledge plays a significant role in further conceptual learning. The authors explained that the newer ideas of the cognitive psychologists and the constructivists' epistemological views formed the cornerstones of inquiry teaching and are linked to the works and philosophies of Dewey, Vygotsky, Bruner and Piaget among others.

Constructivists' Views on Learning

Constructivism is a learning theory found in psychology which explains how people might acquire knowledge and learn. It therefore has direct application to education. The theory suggests that humans construct knowledge and meaning from their experiences and that Constructivism is not a specific pedagogy (The University of Sydney, 2017). The history of constructivism has roots in classical antiquity, going back to Socrates' dialogues with his followers, in which he asked directed questions that led his students to realize for themselves the weaknesses in their thinking. The Socratic dialogue is still an important tool in the way

constructivist educators assess their students' learning and planned learning experiences but it became an emerging philosophy of 21st century. Jean Piaget, is considered as a founder of individual constructivism (Singh and Yaduvanshi, 2015). Constructivism according to Educational Broadcasting Corporation (2004), is not a teaching theory but rather a theory of learning which argued that human beings generate knowledge and meaning from interaction between their experience and ideas'. Thus to the constructivists, learning is simply the experience gained by learner's interaction with the environment. This agrees with (learning-theories.com, 2015) which stated that constructivism assumes that all knowledge is constructed from the learner's previous knowledge, regardless of how one is taught. Thus, even listening to a lecture involves active attempts to construct new knowledge. Hence, the Constructivists like the cognitive theorists see learners as active creator of knowledge. To construct knowledge, Orlich in Aniaku (2012), noted that learners must ask questions, explore and assess what are known, which are the elements of inquiry teaching methods. In view of the application of inquiry process into knowledge construction (constructivism), inquiry and constructivism are interrelated and share some common characteristics which are summarized by Orlich in Aniaku (2012), as follows:

- i. the focus is on the student
- ii. the pace of instruction is flexible not fixed
- iii. Students are encouraged to search for implications
- iv. Students are encouraged to generate multiple conceptions
- v. Students must justify their methods for problem solving
- vi. Neither constructivism nor inquiry sees itself as the sole learning model for content
- vii. Nature provides the object and humans classified them.

Constructivism as a paradigm or worldview posits that learning is an active, constructive process. The learner is an information constructor. People actively construct or create their own subjective representations of objective reality. New information is linked to prior knowledge, thus mental representations are subjective (learning-theories.com, 2015). The constructivism learning theory argues that people produce knowledge and form meaning based upon their experiences (Teachnology.com, 2017), which agrees with the statements of Aniaku (2012), and learning-theories.com (2015). Two of the key concepts within the constructivism learning theory which create the construction of an individual's new knowledge are accommodation and assimilation. Assimilating causes an individual to incorporate new experiences into the old experiences. This causes the individual to develop new outlooks, rethink what were once misunderstandings, and evaluate what is important, ultimately altering their perceptions. Accommodation, on the other hand, is reframing the world and new experiences into the mental capacity already present. Individuals conceive a particular fashion in which the world operates. When things do not operate within that context, they must accommodate and reframing the expectations with the outcomes (Teachnology.com, 2017).

Considering the interrelationship of inquiry and constructivism, this study poses as a question; how constructive can a learner be when using inquiry or demonstration methods of teaching? To provide an answer to the above question, the researcher reviewed the ideas, philosophies and relevance of Piaget, Bruner, Dewey and social constructivist learning theories of Vygotsky to this study.

2.3.1 Piaget's Development Theory

Piaget (1896-1980) was one of the most influential researchers in the area of developmental psychology during the 20th century (Huitt & Hummel, 2003). According to Farrant (2002) in Neboh (2009), the Piaget's theory of intellectual development holds that

cognitive development takes place from active interaction of the child with his environment. This means that the basis of learning is the child's own ability as he interacts with his physical and social environment. The author added that Piaget is of the opinion that a child must act on the objects in his environment for him to learn. This means that he should be actively involved and should not be passive. The active involvement of the child may be in form of direct manipulations, visual observations or through mental or internal transportation or change.

According to Piaget, mental activity of the child is organized into structures. Various mental activities are related to each other and grouped together in clusters, which are known as "schemas" or patterns of behaviour. Martins-Omole (2015), wrote that Piaget theory is based on the idea that the developing child actively and adaptively builds cognitive structures for understanding and responding to physical experience within his or her environment. Piaget considered intellectual activity to be a biological function. Martins-Omole (2015), wrote that Piaget theory of intellectual development involves four stages:

Sensorimotor stage (Infancy). In this period (which has 6 stages), intelligence is demonstrated through motor activity without the use of symbols. Knowledge of the world is limited (but developing) because it's based on physical interactions/experiences. Children acquire object permanence at about 7 months of age (memory). Physical development (mobility) allows the child to begin developing new intellectual abilities. Some symbolic (language) abilities are developed at the end of this stage.

Pre-operational stage (Toddler and Early Childhood). In this period (which has two substages), intelligence is demonstrated through the use of symbols, language use matures, and memory and imagination are developed, but thinking is done in a nonlogical, nonreversible manner. Egocentric thinking predominates.

Concrete operational stage (Elementary and early adolescence). In this stage (characterised by 7 types of conservation: number, length, liquid, mass, weight, area, volume), intelligence is demonstrated through logical and systematic manipulation of symbols related to concrete objects. Operational thinking develops (mental actions that are reversible). Egocentric thought diminishes.

Formal operational stage (Adolescence and adulthood). In this stage, intelligence is demonstrated through the logical use of symbols related to abstract concepts. Early in the period there is a return to egocentric thought. Huitt and Hummel (2003), wrote that only 35% of high school graduates in industrialized countries obtain formal operations; many people do not think formally during adulthood. Piaget used the term assimilation, accommodation and reorganization to explain his views about the learning processes in children. The child assimilates new objects by making accommodation that build new cognitive structures. Nnachi (2007) in Aniaku (2012), observed that although Piaget recognized the importance of environment in child development but he laid much emphasizes on the role of cognitive structure which helps the child to build experience from important event to be superior to the environmental influences. This agrees with the view in (teachnology.com, 2017), which implied that in piaget's theory, no matter how much a young person tried in obtaining new knowledge, this would not be humanely possible in specific circumstances purely due to the fact that their brain wasn't ready to go through the next routine of change.

In the Piagetian system, according to Woolfolk and Nicolich in Neboh (2009), the schema is the primary unit of cognitive organization. This means that it is the basic building block of thinking. Piaget believed that mental activity which is involved in cognitive organisation, is a process of adaptation which is divided into two opposing but inseparable processes of assimilation.

Relevance of Piaget Theory to this study

Piaget development Theory is in favour of inquiry method. Piaget sees the teacher as a facilitator or a guide in the teaching and learning process whose role is to provide a rich environment for students to explore their inquisitiveness. In line with Piagets' view, Okebukola (2002), stated that a science classroom filled with materials to explore encourage students to become active constructor of their own knowledge. Piaget view,likeinquiry and demonstration methods of teaching sees learning as active process in which students should be given freedom to understand and construct meaningful knowledge at their own pace through the school environment orpersonal experience.

The implication of Piaget's theory to this study is that the teacher should desist from answering questions for the students. The teacher acts like a facilitator and encourages the students to answer the question thereby coming up with their conclusions instead of being told. Another relevance of Piaget's theory of constructivism to inquiry and demonstration methods is that it addresses how learning actually occurs, not focusing on what influences learning. The role of teachers is very important, instead of giving a lecture, the teacher function as facilitator whose role is to aid the student when it comes to their own understanding. This takes away focus from the teacher and lecture and puts it upon the student and their learning (Teachnology.com, 2017).This is exactly what inquiry method is about, taking the focus away from the teacher.

2.3.2 Bruner's Cognitive Theory

Bruner was a cognitive theory developmental Psychologist who conducted an in-depth study in such areas likes human perceptions motivation, learning and thinking (Nnachi, 2007 inAniaku, 2012). A major theme in the theoretical framework of Bruner is that learning is an active process in which learners construct new ideas or concepts based

upon their current/past knowledge. The learner selects and transforms information, constructs hypotheses, and makes decisions, relying on a cognitive structure to do so. Cognitive structure (i.e., schema, mental models) provides meaning and organization to experiences and allows the individual to "go beyond the information given" (Culatta, 2015). According to Rhalmi (2011), Bruner's theory is very influential and has direct implications on the teaching practices. He outlined the following as the main ideas of the theory which can be summarized as follows:

1. Learning is an active process. Learners select and transform information.
2. Learners make appropriate decisions and postulate hypotheses and test their effectiveness.
3. Learners use prior experience to fit new information into the pre-existing structures.
4. Scaffolding is the process through which able peers or adults offer supports for learning. This assistance becomes gradually less frequent as it becomes unnecessary.
5. The intellectual development includes three stages. The enactive stage which refers to learning through actions. The iconic stage which refers to the learner's use of pictures or models. The symbolic stage which refers to the development of the ability to think in abstract terms.
6. The notion of spiral curriculum states that a curriculum should revisit basic ideas, building on them until the student grasps the full formal concept.
7. Although extrinsic motivation may work in the short run, intrinsic motivation has more value.

Relevance/Implications of Bruner's theory to this study

Rhalmi (2011), added that Bruner's learning theory has direct implications on the teaching practices. Some of the implications of Bruner's Theory to this study include:

1. Instruction must be appropriate to the level of the learners. For example, being aware of the learners' learning modes (enactive, iconic, symbolic) will help to plan and prepare appropriate materials for instruction according to the difficulty that matches learners' level.
2. The teachers must revisit material to enhance knowledge (demonstration method). Building on pre-taught ideas to grasp the full formal concept is of paramount importance according to Bruner. Feel free to re-introduce vocabulary, grammar points, and other topics now and then in order to push the students to a deeper comprehension and longer retention.
3. Material must be presented in a sequence (inquiry and demonstration method) giving the learners the opportunity to:
 - a. acquire and construct knowledge,
 - b. transform and transfer his learning.
4. Students should be involved in using their prior experiences and structures to learn new knowledge (inquiry method).
5. Help students to categorize new information in order to able to see similarities and differences between items.
6. Teachers should assist learners in building their knowledge. This assistance should fade away as it becomes unnecessary as practiced in Inquiry method of teaching.
7. Teachers should provide feedback that is directed towards intrinsic motivation. Grades and competition are not helpful in the learning process. Bruner states that learners must "experience success and failure not as reward and punishment, but as information" (Bruner, 1961 in Rhalmi, 2011).

Bruner advocated the discovery oriented learning method in schools which he believes helps the students discover relationship between levels or groups. The relevance of

Bruner's theory to inquiry approaches is that teachers should create situations that would help learners to discover facts by themselves. In (learning-theories.com, 2007), discovery learning is an inquiry-based, constructivist learning theory that takes place in problem solving situations where the learner draws on his or her own past experience and existing knowledge to discover facts and relationships and new truths to be learned. Students interact with the world by exploring and manipulating objects, wrestling with questions and controversies, or performing experiments which are basically inquiry method. As a result, students may be more likely to remember concepts and knowledge discovered on their own (learning-theories.com, 2007).

2.3.3 Dewey's Cognitive Theory

Dewey was a philosopher, psychologist and educational reformer who contributed and influenced education and social reforms especially in such topic like inquiry teaching and learning among others. Dewey states that 'knowledge emerges only from situations in which learners have to draw them out of meaningful experience (Aniaku, 2012). The author added that, Dewey argued that education and learning are social and interactive processes; and that the school as a social institution provides an environment in which social reforms can and should take place. He sees the classroom as a social context where students can take part in manipulating materials and thus form a community of learners who construct their knowledge together. Dewey believed in one permanent frame of references; namely the organic connection between education and personal experience. He maintained that every experience enacted modifies further experience and results in positive attitude and growth of understanding. Aniaku (2012), added that another vital issue raised by Dewey, he believed that students thrive in an environment where they are allowed to experience and interact with the curriculum, as such Dewey emphasized that all students should have the opportunity to take part in their own learning. This agreed with the

view of Wheeler (2017), which states ‘that for education to be at its most effective, children should be given learning opportunities that enabled them to link present content to previous experiences and knowledge’.

Dewey was of the view that the primary responsibility of educators is to assist shaping the experience by providing enviroing condition that will help students to utilize their surroundings to build up experiences that interact with personal desires of the students to make learning take place (Educational Broadcasting Corporation, 2004). The author added that, Dewey encouraged hands-on learning and states that it is impossible to procure knowledge without the use of objects which impress the mind. Notwithstanding, Dewey was wary of placing too much emphasis on the child’s abilities, but preferred to place his trust in a more balanced approach to education where teacher, students and content were given equal importance in the learning equation (Wheeler, 2017).In conclusion, Dewey inBhuiyan (2015), stated that Education is not preparation for life. Education is life itself. Education, therefore, is a process of living and not a preparation for future living.

The relevance of Dewey’s Theory

The implication of Dewey’s theory in this study is that in the learning process, students must be engaged in meaningful activities that arouse their interest. The teacher’s role should be to provide enabling environment for active learning of Biology through inquiry and demonstration methods. Rhalmi (2011), stated that Dewey’s theory is learner-centred (just like in inquiry and demonstration methods). He argues that in order for education to be most effective, content must be presented in a way that allows the student to relate the information to prior experiences, thus deepening the connection with this new knowledge. Just like in Piaget’s theory, the teacher’s role should be that of a facilitator and a guide. The teacher is seen as a partner in the teaching-learning process. Another

implication of Dewey's view to this study; the teacher should observe the interest of the students, observe the directions they naturally take, and then serve as someone who helps develop problem-solving skills (Jordan, 2017).

2.3.4 Vygotsky's learning theory

The major theme of Vygotsky's theoretical framework is that social interaction plays a fundamental role in the development of cognition. Vygotsky's learning theories seem to be paramount to the existing models of learning and development due to its pursued multidimensional approach which pays special heed to the cognitive, affective, social, and contextual aspects of change (Shabani, 2016). Galloway (2015), wrote that in order to gain an understanding of Vygotsky's theories on cognitive development, one must understand two of the main principles of Vygotsky's work: the More Knowledgeable Other (MKO) and the Zone of Proximal Development (ZPD). The author added that the MKO is somewhat self-explanatory; it refers to someone who has a better understanding or a higher ability level than the learner, with respect to a particular task, process, or concept.

Vygotsky (1978) in Galloway (2015), defines the ZPD as the distance between the "actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers". Vygotsky in Galloway (2015), believed that when a student is at the ZPD for a particular task, providing the appropriate assistance (scaffolding) will give the student enough of a "boost" to achieve the task. Once the student, with the benefit of scaffolding, masters the task, the scaffolding can then be removed and the student will then be able to complete the task again on his own. Vygotsky (1978) in Culatta (2015), states: Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (interpsychological) and then inside the child (intrapsychological). This applies equally to

voluntary attention, to logical memory, and to the formation of concepts. All the higher functions originate as actual relationships between individuals (Culatta, 2015).

Vygotsky (1982) in Shabani, Khatib and Ebadi (2010), reiterates the fact that social interaction with cultural artifacts forms the most important part of learner's psychological development. Cultural tools or artifacts include all the things we use, from simple things such as a pen, spoon, or table, to the more complex things such as language, traditions, beliefs, arts, or science. The authors added that Vygotsky states in his genetic law of development that any higher mental function necessarily goes through an external social stage in its development before becoming an internal, truly mental function. Thus, the function is initially social and the process through which it becomes an internal function is known as internalization. This also agrees with (McLeod, 2014), who opined that Individual development cannot be understood without reference to the social and cultural context within which it is embedded. Higher mental processes in the individual have their origin in social processes. As in Galloway (2015), Vygotsky argued that, "learning is a necessary and universal aspect of the process of developing culturally organized, specifically human psychological function". In other words, social learning tends to precede development. Vygotsky holds that a learner is not able to imitate anything; imitation is possible only to the extent and in those forms in which it is accompanied by understanding.

Vygotsky's Social Development Theory, according to (Anastasia, 2016), has four (4) key concepts; Social interaction plays a central role in cognitive development, Social learning precedes development, Language accelerates cognitive development and lastly, Self-initiated discovery and collaborative dialogue aid in a child's cognitive development. The author added that (this also agrees with the view of Galloway, 2015), More

Knowledgeable Other (MKO), refers to a person with a better understanding and considerably higher or superior level of ability, skill or knowledge about a particular subject, task or process, than the person who is attempting to learn (also called the learner).

Relevance of Vygotsky's theory to this study

The most important application of Vygotsky's theory to this study is in his concept of a Zone of Proximal Development (ZPD). This concept is important as the teacher should take cognisance of the child's development when teaching Biology. It allows a teacher to know what a student is able to achieve and then helps the child attain that level by themselves. Vygotsky claims, in Turuk (2008), this is what also happens in schools. Students do not merely copy teachers' capabilities; rather they transform what teachers offer them during the processes of appropriation.

Another implication of Vygotsky's theory to this study is that it's the teacher's job is to make sure that students are active in constructing their own knowledge through social interactions. Emphasis is laid on the social interactions in the knowledge construction process. Also, the active role of the student is stressed in building understanding, asking questions and appropriate use of information with the use of inquiry and demonstration methods. Another relevance of this theory to this study, teachers should understand that cooperative learning occurs when children at different levels help each other in or outside the classroom.

2.4 Biology Education Curriculum in Secondary Schools in Nigeria

Science is defined as a systematic process of making enquiry about living and non-living things in their environment while the term Biology is coined from two Greek words 'bios' meaning 'life' and 'logos' meaning 'to study'. Hence Biology can simply be defined as the study of life. In other words, it is defined as the study of plants and animals

(Michael, 2012). Biology according to Nwagbo and Chukelu in Martins-Omole (2015), is a branch of science and the prerequisite subjects for many fields of learning that contributes immensely to the technological growth of nature. These include Medicine Pharmacy, Forestry, Agriculture, Biotechnology and Nursing. The authors further stated that the study of Biology in secondary schools can equip students with useful concepts, principles and theories that will enable them face challenges before and after graduation. Biology is one of the compulsory science subjects for all students. The subject is taken for 3 years in senior secondary schools in Nigeria from SS1 to SS3.

Curriculum is defined in different ways by different authors although with some similarities. Glenn (2004) in Yusuf (2012), defines curriculum as the sum total of a learners' experience. According to Yusuf (2012), curriculum can be defined as totality of planned and unplanned, guide and unguided learning experiences learners are exposed to in a school setting for the purpose of attaining its educational goals. The author added that Curriculum is viewed as a composite whole including the learner, the teacher, teaching and learning methodologies, anticipated and unanticipated experiences, output and outcomes possible within a learning institution. Offorma (2004) in Ifeobu (2014), defined curriculum as a deliberately and systematically planned attempt to change the behaviour of the young and inexperienced and also to enable them to gain the insight that will enable them to build a better society. Thus curriculum is a continuous process of a series of activities undertaken by the school to improve upon the life of the individual and society. The author listed the major elements that influence type of curriculum offered by schools and the extent of its implementation to include: The nature of the society, Philosophy of education, Psychology of learning, Subject specialists, the learners, the teachers, Examinations bodies, Economy of the society, Resources and Values. Ogunsanju (2006) in Okojie, Akinrinade & Saliu (2014), on the other hand, views curriculum as a written document indicating the subject

matter taught at any specified level within an established school system. The author further explained that curriculum refer to a plan which guides and governs the environment and activities of live classroom situations. Decades ago, people view curriculum as strictly the laid out topics to be taught in a particular subject. Now, curriculum has evolved and it's seen as a totality of experience of a student to achieve educational goals.

The history of science curriculum in Nigeria indicated that before and shortly after independence in 1960, the curriculum was characterised by so much defects which called for a strong need for improvement. Among the defects is the fact that the curriculum was incapable of producing for the nation, individuals with the right orientations capable of salvaging the nation. The content aspects of the curriculum were a combination of disjointed topics in each of the science subjects with no unifying concepts to make both teaching and learning easily attainable (Neboh, 2009). The author explained that in the junior classes, it was General Science with the topics merely selected from the sciences. In the upper classes, the topics taught were geared towards passing of external examinations and so did not appear to meet the needs of the society. The teaching of science courses was by recitation, which violates sound learning (Bajah, 1983 & Eze, 2001 inNeboh, 2009).Akujieze (2007)inIfeobu (2014)noted that the attempt to base the education of Nigeria, especially science education on the needs and demands of Nigerian people has culminated series of commissions, committees and conferences. Notable among these are the Phelps Stokes Commission of 1920, the Ashby commission of 1950, the Alvan Ikoku conference on curriculum. The author added that all these conferences, committees and commissions were geared towards providing a functional science education programme inNigeria. According to Idika (2008)inIfeobu (2014), the different commissions, conferences and committees were set up at different stages of development of science education in Nigeria.

The trend in science teaching and learning changed by 1967, when the Ford Foundations, through the Federal Ministry of Education, helped to establish the Comprehensive Education Study and Adaptation Centre (CESAC) at the University of Lagos. The aim was to study the nation's system of education, identify its defects and devise original solutions. Science teaching and learning in schools from then focused more on the needs of the learners and the society at large (Okeke, 1985; Okoye, 2002; Onyeokoro, 2009). Infeibu (2014), opined that the effect to the Ashby report as seen among others in diversification of secondary science curriculum. The 1969 National Curriculum Conference marked the beginning of a significant change in the teaching of science in the country. The National Policy on Education, which is the outcome of the conference, declared the general aim of primary, secondary and tertiary education levels as to pursue effective science and technology programs which would enable the citizenry adapt to the rapid techno-scientific development of the nation (FME, 2004). The Federal Government stated some objectives in the core curriculum for the Secondary Biology (FME, 2004). They include the preparation of pupil to acquire;

- a. adequate laboratory and field skills in Biology;
- b. meaningful and relevant knowledge in Biology;
- c. the ability to apply scientific knowledge to everyday life in matter of personal and community health and Agriculture; and
- d. reasonable and functional scientific attitude.

A critical look at the Biology objectives as stated, the researcher believes that Biology curriculum activity intended for secondary school must make room for individual differences and students' full participation. This means that any curriculum outlined for Biology classes should be child-centred, as they learn best by doing and getting actively involved in the learning processes.

The Biology 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. According to NERDC (2014), the Biology curriculum covers four major themes namely: 1) organization of life (2) organisms at work (3) the organisms and its environment and (4) continuity of life

These themes are of direct relevance to the society and the learner. NERDC (2009), stated that in the planning of the new curriculum, the spiral approach to sequencing a science course was adopted. 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 a greater depth as the course progresses.

2.5 Instructional Methods in the Teaching of Biology

Instructional methods and teaching methods are usually used interchangeably by different authors and researchers. Instructional methods and teaching methods mean the same thing. Regardless of what we call such processes, they are primarily descriptions of the learning objective-oriented activities and flow of information between teachers and students(Kizlik, 2015). The author further explained that Direct and Indirect instruction are two main categories that many educators find useful for classifying teaching methods, but it is, as you will see, a bit more complicated than placing all instruction into two categories. Any instructional method a teacher uses has advantages, disadvantages and requires some preliminary preparation. Often times, a particular teaching method will naturally flow into another, all within the same lesson, and excellent teachers have developed the skills to make the process seamless to the students(Kizlik, 2015).The author explained that Instructional methods involve different activities of the teacher and the learner such as questioning, explanations, demonstration or directions. The activities can

be referred to as skills or techniques. Thus Instructional methods involve different techniques.

Instructional methods, according to (The University of Tennessee, 2012), are ways that information is presented to students. Such methods fall into two categories: teacher-centred approaches and student-centred approaches. There is not one "best" approach to instruction. Some goals are better suited to teacher-centred approaches while others clearly need student-centred approaches (Shuell, 1996 in The University of Tennessee, 2012). According to Farooq (2013), there are different types of teaching strategies used by the subject teacher. He manipulates them according to the need of the students, subject matter and of course, the instructional objectives and then implements them in classroom teaching. Selection and manipulation of teaching strategies is done at pre-active phase of teaching while implementation is done at interactive phase of teaching.

Teacher-centred instruction has been criticized as ineffective and grounded in behaviourism; (Marshall 1992, Stoddard, Connell, Stgofflett & Peck, 1993) in (The University of Tennessee, 2012). However, this is not the case if delivered effectively (Eggen & Kauchak, 2001 in The University of Tennessee, 2012)). According to UNCC (2016), there are over 150 instructional methods. Among which are: lecture by teacher, class discussion, discussion groups, presentations, gaming and simulation, use of dramatization, use of technology and instructional resources.

However, for this research work, (O'Bannon, 2002 & Campbell, 2006 in Aniaku, 2012), divided teaching methods into two approaches: teacher-centred and student-centred. In the teacher-centred approach, the teacher dictates or takes over lesson procedure and organises class activities. O'Bannon (2002) in Aniaku (2012), stated that teacher-centred approach includes all the teaching methods grounded in behaviourism such

as Lecture, discussion and recitation. Teacher-centred classroom is thus rigidly structured and only factual information is conveyed to learners.

2.5.1 Teacher-Centred Method

The teacher-centred method is also referred to as the conventional method which includes the following:

a. Lecture method

It is the most common teacher-centred method to teaching and learning which includes all the teaching methods that the teacher dominates in the lesson procedure and takes the lead in coordinating the classroom activities as regards to what to be done. O'Bannon (2002) in Aniaku (2012), stated that teacher-centred method includes all the teaching methods grounded in behaviourism such as Lecture, demonstration, discussion recitation and so forth. Teacher-centred classroom is thus rigidly structured and only factual information is conveyed to learners. For instance in the lecture method, the instructor presents fact and principles orally. In view of this, the lecture method has been criticized to be a poor method of teaching hand-on skills in sciences including Biology although it provides for the effective use of time and manpower especially in presenting ideas to a large group of people (Aniaku, 2012). The term teacher-centred method therefore comes from the roles of the teacher in the Conventional classroom as possessor of knowledge and decision maker and decides how knowledge should be transferred to learners in the teaching and learning process (Aniaku, 2012).

Lecture method is a method of teaching in which the teacher delivers preplanned lesson to the students with little or no instructional aids. In using this method the teacher talks about science while the student read about science (Maikano, 2007 in Maizuwo, 2011). Modern lecture method however allows some interactions between the teacher and the learner (Maikano, 2006 in Maizuwo, 2011). Lyop and Mangut (2001) in Martins-Omole

(2015), wrote that lecture method is characterised by a steady flow of information from teacher to student, the teacher dispenses facts and opinions about procedures or contents, expressing his own ideas or citing an authority. Lecture method was used in this research as a medium of instruction to the control group. In this, the control group was introduced to the various topics in Biology through the normal classroom interaction. In this method of teaching, the teacher delivers the lesson to the students with little or no instructional aides using the Blackboard and chalk. According to (Awotua-Efobo, 2001; Nwagbo, 1999; Gbamanja, 1991 inNeboh, 2009), all agree that in the lecture method, the teacher comes to the class fully armed with a mass of facts, probably gathered from books and would start to pour out the facts. The teacher presents ideas or concepts, develops and evaluates them and summarizes the main points at the end, while the students listen and take down notes. Usually during the course of lecturing, students' questions are not normally encouraged and in cases where questions arise, they are usually for clarification of important facts.

Advantages of Lecture method

The lecture or Conventional teaching method listed by Ajaja (2013), has the following advantages: (i) it is easy to create interest in a topic or subject by the teacher. (ii) Students easily acquire knowledge, new information, and explanation of events or things. (iii) It helps students to clarify and gain better understanding of a subject, topic, matter or event. (iv) Students and teachers cover more content materials within a short period of time.

Disadvantages of Lecture method of Teaching

Lecture methods are usually preplanned and have steady flow of information, however there are some disadvantages listed by Eya and Igbokwe (2000) inNeboh, (2009) as follows: (i) It does not develop student's manipulative skills in science, as they are passive listeners. (ii) It does not cater for individual differences among the students, with

the result that the slow learners and the academically weak students are dragged at the pace they cannot cope with. This may lead to low achievement and loss of interest. (iii) The method appeals only to the sense of hearing. This makes the method not suitable for teaching science in the secondary schools. Alio (2002) in Neboh (2009), stated that a complete learning takes place when the child uses all his senses in the learning process. (iv) another major drawback of lecture method is that it is essentially a unidirectional mode of communication. The listening student in most cases has little or no information to influence the nature and rate of flow of information. One way communication offers little in the way of interaction and feedback, which is very essential for learning to occur. When used excessively, the lecture method encourages intellectual passivity, which is the opposite of learning and may not develop in the students the processes of inquiry and problem solving.

b. Discussion Method

When we talk about discussion, we're typically considering the social activity of engaging in conversation around a particular topic, or set of topics. In the educational context this is obviously a powerful tool with which to engage pupils in using subject-based language, in engaging ways (University of Cambridge, 2012). Discussion method, also called the Socratic Method after the Ancient Greek philosopher Socrates, who would engage his students with questions and dialogue. Because the class is small, the tutor is able to determine each student's progress, and students have ample occasion to make their difficulties known (Thomas Aquinas College, 2017).

Some merits of discussion method include: the students are permitted equal opportunity to get involved in the learning process, the students try to give more practical and logical reasons for their beliefs and dis-beliefs as a result of which, feeling of healthy competition gets developed in them. And when the students have to express their views

and opinions in front of large number of students, they achieve new levels of self-confidence, which help them in getting success in the future life (Mallick, 2012). Some disadvantages of discussion method include student's reticence, anxiety on loss of control, uncertainty about the place of discussion in the curriculum (Gall & Gillett, 2010). Some other disadvantages of discussion method include small size of student is required, time consuming, only few students dominate the class and the probability of going off track from the topic is very high (Hammond, 2017).

c. Recitation Method

This instruction involved little more than the teacher lecturing and students reciting memorized passages or orally answering a series of questions as directed by the teacher's textbook guide. Sheryl (2011), stated that student learning was determined through the accuracy of the recitation and appropriateness of responses to teacher questions. Students were then introduced to the next topic and their assignment in the textbook. They were expected to work quietly and individually on their preparations for recitations (Sheryl, 2011).

In view of these shortcomings, Isiugo – Abanihe (2010) in Aniaku (2012), characterised the conventional or teacher-centred methods as poor methods of teaching sciences because it limits science skill acquisition and hands-on activities that characterize science teaching and learning especially in Biology. The persistent use of conventional teaching methods has been reported to account for poor students' performance in Biology.

2.5.2 Student-Centred Method

Student-centred method includes all teaching methods that involves planning, teaching and assessment centres around the needs and abilities of students (ISTE, 2017). This also agrees with (Aniaku, 2012), which stated that this method underscore the teacher

as a decision maker and problem solver in the classroom but rather see teachers as guides, facilitators, mentors, coach or consultants in the teaching and learning process. According to O'Bannon (2002) in Aniaku (2012), student-centred method is grounded in constructivism, with the epistemological view that learners are the architects of their own idiosyncratic meanings of concepts and natural phenomena. The author added that in view of this, student-centred method is based on constructivists' principles and ideas.

However, Campbell (2006) in Aniaku (2012) inferred that the cognitive learning theory also advocates for student-centred idea. Thus student-centred method is based on the constructivists as well as cognitive theories with the educational applications linked to the works of Dewey and Piaget among others. The author added that the student-centred method is relevant to Biology teaching because in Biology teaching, creating an environment that will encourage students to interact with materials and specimens enables students to construct meaningful knowledge and learn Biology first hand. Some of the student-centred methods include inquiry method, demonstration method, discovery method, Field trip method, project method, concept mapping method amongst others.

a. Discovery Method

Discovery method is a way of learning new things on your own. Borich (2004) in Ajaja (2013), wrote that discovery learning involves presenting pupils with information in a form which requires them to discern relationships within the information and to structure and make sense of the information and relationship. This form of self-directed learning could promote higher forms of thinking with the aid of meta-cognitive strategies. Discovery Learning is a method of inquiry-based instruction; discovery learning believes that it is best for learners to discover facts and relationships for themselves (learning-theories.com, 2016). Discovery learning in science places a strong emphasis on practical work

organized in such a way that pupils make observations, look for patterns, and come up with possible explanation for those patterns (Ajaja, 2013).

Discovery method has the following advantages: It helps the pupil understand the material better by showing him that the concepts involved are so reasonable that he can discover them himself or herself; It helps a learner to remember concepts, principles and laws better since what is discovered is by far less likely to be forgotten; It helps the individual to learn on his own so that he or she may become increasingly independent of the teacher; and it keeps the teacher in touch with his or her class (Ajaja, 2013). Despite these advantages, the method has the following disadvantages: educators fear that discovery learning will not cover the course content; requires too much time for preparation and learning; and class sizes are too large especially in Nigeria Public Schools.

b. Project method

This instructional method according to Lyop and Mangut (2001) in Martins-Omole (2015), is employed by teachers for individual instruction. This method provide for the needs of individual students or small groups so that those with special abilities have opportunities to fulfil themselves. Ikoha and Eneogwe in Martins-Omole (2015), explained that project method of teaching originated in the early twentieth century. It was greatly influenced by Dewey's problem method of teaching and it is an original work of Kilpatrick who advocated purposeful activity, problem solving, the need and interest of the individual child in action, learning and conduct. Some merits of Project Method of Teaching Biology by Mallick (2017), are as follows: (i) students get proper freedom to execute the project in accordance with their interest and abilities, because of which they get their psychological needs, interests and desires satisfied to a considerable extent. (ii) Habit of critical thinking gets developed among the students through this method. (iii) Students get the ample chances in which they can develop coordination among their body and mind (iv)

the selected project correlates with the real problems of life which students confront in their everyday life. Thus, they find it quite interesting to sort out such problems. Not only this, through the information gained, they become able to solve out their own life problems independently and effectively. The author stated some demerits of Project Method to include: (i) this method takes a lot of time to plan and execute a single project. As the time available with the teacher is limited in the schools, thus they find it difficult to make use of this method in their class. (ii) It is not possible to design different projects for different topics and it is also not possible to cover all the topics or content in a single project. Thus, this method becomes impractical in nature, while large amount of financial resources are required, which seems difficult to arrange in our nation as we have to face shortage of resources in every sphere of life.

c. Concept Mapping Instructional Method

Concept Maps are graphical tools for organizing and representing knowledge. They include concepts usually enclosed in circles or boxes of some types, and relationship between concepts indicated by a connecting line linking two concepts. They were developed in 1972 in the course of Novak's research programme at Cornell where he sought to follow and understand changes in children's knowledge of science (Martins-Omole, 2015). Concept maps, according to the Centre for Applied Special Technology (CAST) in Ehlen (2017), visually illustrate relationships among words, concepts and facts. The term "concept map" may assume other names, such as graphic organizer, knowledge map and advance organizer. Some advantages of concept mapping according to Qarareh (2010) in Martins-Omole (2015, include:

- Provide teachers with meaningful structured method
- Development of deep meaningful teaching, moving towards critical thinking rather than surface method

- It allows students to reflect on their own misunderstanding and take ownership of their learning.

Although instructors often use concept maps to promote learning, these visuals have potential disadvantages; they muddle relationships and discourage critical thinking. In addition, they may be ineffective at certain learning stages and for some learning styles (Ehlen, 2017).

d. Experimentation Instructional method

Experimentation is a method of teaching Biology where most of the activities take place in the Laboratory. According to NOUN (2007) in Martins-Omole (2015), experimentation is a means by which students acquire meaningful learning of science concepts to the point of achieving transfer and application of knowledge. Hence, it exposes them to acquire attitudes and skills of a scientist. The author added that this method of teaching science is one of the effective ways of learning. Advantages of experimental teaching methods as listed in NOUN (2007) in Martins-Omole (2015), include:

- a. It fosters opportunity for the acquisition of science processes like manipulation, measuring and classifying.
- b. It enables students to have direct sensory experience of scientific knowledge example working with living organism; it enables the learner not only to acquire knowledge but also to appreciate life.
- c. It helps in retention of information as the students interact with the scientific process.
- d. It aids student in problem solving and arriving at conclusions.

One of the disadvantages of experimental instructional method is the lack of ecological validity due to the artificial nature of the study (setting) making it difficult to generalise results from the experimental situation to real life (Goddard, 2015).

2.6 Inquiry Method

The Historical development of inquiry method started with the inclusion of inquiry into K–12 science curriculum which was recommended by Dewey (1910), a former science teacher. Dewey considered that there was too much emphasis on facts without enough emphasis on science for thinking and an attitude of the mind (Chayya, 2013). The author added that, Dewey encouraged K–12 teachers of science to use inquiry as a teaching strategy where the scientific method was rigid and consisted of the six steps: sensing perplexing situations, clarifying the problem, formulating a tentative hypothesis, testing the hypothesis, revising with rigorous tests, and acting on the solution. According to Pappas (2014), Joseph Schwab was one of the key founders of the Inquiry-based Learning Model relies upon the idea that individuals are able to learn by investigating scenarios and problems, and through social experiences. This agrees with Dewey's model where the students are actively involved, and the teacher has a role as facilitator and guide (Barrow, 2006). Schwab 1960 in (Chayya, 2013), describes two types of inquiry: 1. Stable (growing body of knowledge) 2. Fluid (invention of new conceptual structures that revolutionise Science). Dewey in Witt and Ulmer (2010), discusses his ideas of new education, which are parallel constructivism and inquiry-based learning. Dewey suggests that the constructivist method is more learner-centred and more meaningful to the child because the child is the starting-point, the centre, and the end. He continues to further characterize the need for constructivism by stating, subject-matter never can be got into the child from without. Learning is active. It involves reaching out of the mind. It is the child and not the subject matter which determines both quality and quantity of learning.

Problems to be studied according to Dewey in Barrow (2006), must be related to students' experiences and within their intellectual capability; therefore, the students are to be active learners in their searching for answers. The launching of Sputnik on October 4, 1957, caused the nation to question the quality of the science teachers and the science curriculum used in schools. Joseph and Schwab (1966) in Barrow (2006) believed that students should view science as a series of conceptual structures that should be continually revised when new information or evidence is discovered. He recommended that science be taught in an inquiry format. Besides using laboratory investigation to study science concepts, students could use and read reports or books about research and have discussions about problems, data, the role of technology, the interpretation of data, and any conclusions reached by scientists (Barrow, 2006). To provide clarification, the National Research Council-NRC (2000) in Barrow (2006), published *Inquiry and the National Science Education Standards* and identified five essential features of inquiry, regardless of grade level:

1. Scientifically oriented questions that will engage the students;
2. Evidence collected by students that allows them to develop and evaluate their explanations to the scientifically oriented questions;
3. Explanations developed by students from their evidence to address the scientifically oriented questions;
4. Evaluation of their explanations, which can include alternative explanations that reflect scientific understanding; and
5. Communication and justification of their proposed explanations.

According to the NRC (1996, 2000) in Barrow (2006), K–12 teachers of science must know that inquiry involves three main domains, which are:

- (a) The cognitive abilities that their students must develop;

(b) An understanding of methods used by scientists to search for answers for their research questions; and

(c) A variety of teaching strategies that help students to learn about scientific inquiry, develop their abilities of inquiry, and understand science concepts.

When students practice inquiry, it helps them develop their critical thinking abilities and scientific reasoning, while developing a deeper understanding of science (NRC, 2000 inBarrow, 2006). According to Anderson (2002) inBarrow (2006), the last half of the 20th Century associated inquiry with “good science teaching and learning.” His synthesis of the research about inquiry identified that both teachers and students must be considered. Anderson considered that science teacher’s beliefs and values about students, teaching, and the purpose of education influence their adoption and implementing of inquiry. Specifically, he described three barriers or dilemmas that influence the implementation of inquiry as envisioned by the NSES (NRC, 1996):

1. Technical dilemmas include the ability to teach constructively; the degree of commitment to the textbook; the challenges presented by state assessments; the difficulties of implementing group work; the challenge of the new teacher role as a facilitator; the challenge of the new student role as an active, rather than a passive, learner; and inadequate professional development.
2. Political must be addressed at local and state levels because of funding ramifications.
3. Cultural dilemmas include quality of textbooks and support materials, views about purposes of assessment, and view of preparation for the next science class.

According to Anderson inBarrow (2006), these dimensions must be addressed systematically. Science teachers who implement inquiry as described in this paper must be aware that students will require a longer learning time because students bring to each

investigation their current explanations and abilities (prior knowledge). However, research studies (Bransford, Brown & Cocking, 1999 in Barrow, 2006) have shown that students will develop a deeper understanding of the science concepts when their prior knowledge is considered as they integrate new knowledge. Over the past century, inquiry had multiple meanings; Barrow (2006) hopes that, in the first decade of the 21st Century, we can reach consensus about what is inquiry by using the three domains of inquiry (abilities, understandings and teaching strategies) as described by the NRC in 1996.

According to Franklin (2015), who opined that inquiry based curriculum and teaching techniques have emerged as a combination of several theories such as ‘constructivism’, ‘Blooms taxonomy of learning’, ‘multiple intelligences’, ‘whole language’ and ‘accelerated learning’. The author compared characteristics of inquiry method to more traditional approaches in a tabular form as seen below. In inquiry method, the student role is that of a problem solver and the curriculum goals are process oriented while in the Conventional method, the students are meant to follow the direction of the teacher and its curriculum goals are product oriented. The table below highlights the differences between the traditional/conventional method to Inquiry method.

Table 1: Inquiry Vs Traditional Method

	Inquiry Based	Traditional
Principle Learning Theory	Constructivism	Behaviourism
Student Participation	Active	Passive
Student Involvement in Outcomes	Increased Responsibility	Decreased Responsibility
Student Role	Problem solver	Direction follower
Curriculum Goals	Process oriented	Product oriented
Teachers Role	Guide/facilitator	Director/ transmitter

Source: Franklin (2015). Inquiry based approaches to science education: Theory and practice. Retrieved on 23/4/2016 from <http://www.brynmawr.edu/Biology/franklin/franklin.html>.

2.6.1 Features of Inquiry Method

There is a debate as to which type of Inquiry is best. According to Waddy (2014), there are four types or level of Inquiry teaching methods as listed in figure 2:

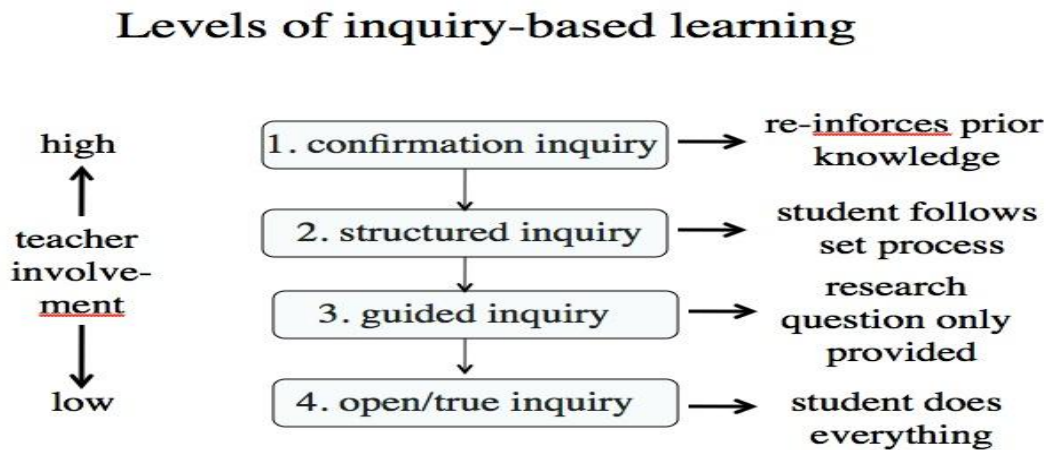


Figure 2: Types of Inquiry Based Learning

Waddy (2014). The Inquiry Method.<http://cognitiverigor.blogspot.com.ng/2014/08/using-guided-inquiry-in-science.html>.

The general consensus is that, any form of Inquiry (structured, guided, or open) can be useful to Students when taught appropriately. Structured Inquiry is the most teacher-centred of the three types of Inquiry. This type of Inquiry is commonly seen in science classrooms in the form of laboratory exercises. The teacher provides fairly structured procedures for the Inquiry activity, and Students carry out the investigations. Structured Inquiry could be described as the most traditional method to inquiry (Cheval and Hart, 2005),and it is a great way to introduce inquiry-based methods to students. It allows them to exercise their question-asking abilities, in order to get ready for deeper and more autonomous inquiry (Merritt, 2017). The author added thataiding students through a structured inquiry unit often requires personalized coaching to help students formulate and approach questions, to ensure that everyone can keep up with the process.On the far side of the spectrum is an open Inquiry. This type of Inquiry requires the least amount of teacher

intervention and is student-centred. Students often work in groups and plan all phases of their investigations. This is the purest form of Inquiry conducted in science classrooms (Cheval and Hart, 2005). This was also agreed by Zion & Mendelovici (2012), who wrote that open inquiry is the most complex level of inquiry-based learning, teachers define the knowledge framework in which the inquiry will be conducted, but allows the students to select a wide variety of inquiry questions and approaches (student-designed or selected). The authors further stressed that the students are engaged in continuous decision-making throughout each stage of the open inquiry process, starting from the stage of finding the interesting phenomenon to be inquired. Open inquiry simulates and reflects the type of research and experimental work that is performed by scientists and demands high-order thinking capabilities.

Guided Inquiry falls in the middle of the Inquiry instructional spectrum. This method is commonly used when Students are asked to make tools or develop a process that results in a desired outcome. The Guided inquiry teaching method according to Massialas (1991) as in Bakke and Igharo (2013), is a teaching method that enables students to move step by step from the identification of a problem, defining the problem, formulation hypothesis, collection of data, verification of results, and generalization to the drawing of conclusion. This view also agrees with that of Walkup (2014), who opined that guided inquiry focuses on processes, not outcomes. We want to avoid assessing student proficiency simply on the quality of their finished products, such as the PowerPoint they create to broadcast their results to the class. Therefore, evidence of instruction plays a critical role in inquiry learning. According to Pappas (2014), who also agreed with Waddy (2014), on the four levels or forms of inquiry commonly used in inquiry-based instruction. He wrote that:

- a. In Confirmation inquiry, learners are given a question, as well as a method, to which the end result is already known. The goal is to confirm the results. This

enables learners to reinforce already established ideas, and to practice their investigative skills;

- b. In Structured inquiry, learners are given the question and the method of achieving the result, but the goal is to provide an explanation that is already supported by the evidence gathered during and through the investigative process;
- c. In Guided inquiry, learners are only given a question. The main goal is to design the method of investigation and then test the question itself. This type of inquiry is not typically as structured as the previously mentioned forms and
- d. In Open inquiry, learners must form their own questions, design investigative methods, and then carry out the inquiry itself. They must present their results at the end of the process.

In addition to the four main types of inquiry known, VCAA (2017), wrote on a fifth inquiry method called Coupled inquiry which combines a guided-inquiry investigation with an open-inquiry investigation: the teacher chooses an initial question to investigate as a guided inquiry and students then build on the guided inquiry to develop an extension or linked investigation in a more student-centred open inquiry approach.

In an instructional setting, inquiry-based learning can give instructors the opportunity to allow students to fully explore problems and scenarios, so that they can learn from not only the results, but also the process itself. They are encouraged to ask questions, explore their environments, and obtain evidence that support claims and results, and design a convincing argument regarding the way they reached to the end result (Pappas, 2014). Another researcher (MacKenzie, 2016), wrote that adopting an inquiry-based learning (IBL) method in a classroom has been the most meaningful change made in teaching. The benefit of increased student agency in learning, the authentic connections we

make to the world around us, and the 21st-century skills inquiry-based learning (IBL) nurtures are great reasons to explore how inquiry can enhance what is done in the classroom. He opined that there are four types of student inquiry methods (Structured, Controlled, Guided and free Inquiry). In Structured Inquiry, it gives the teacher control of the essential question, the starting point -for example, “What is the importance of the scientific method?” These questions are not answered in a single lesson and do not have a single answer, and, in fact, our understanding of an essential question may change over time as we research it.

In Structured Inquiry, the teacher also controls specific learning activities, the resources students will use to create understanding, and the summative assessment learners will complete to demonstrate their understanding. Secondly, in Controlled Inquiry, the teacher provides several essential questions. Learners unpack several resources predetermined by the teacher to provide valuable context and rich meaning relative to the essential questions. All learners typically demonstrate their understanding using the same summative assessment. Thirdly, in Guided Inquiry, the teacher further empowers student agency by providing several essential questions, having the students select the resources they will use to research their answers, and allowing them to choose how they will demonstrate understanding. Finally, MacKenzie (2016), added that free Inquiry allows learners, with the support of the teacher, to construct their own essential question, research a wide array of resources, customize their learning activities, and design their own summative assessment to demonstrate their learning. This type of inquiry is similar to open inquiry as explained earlier by Pappas (2014) and Waddy (2014). The four types are represented in figure 3:

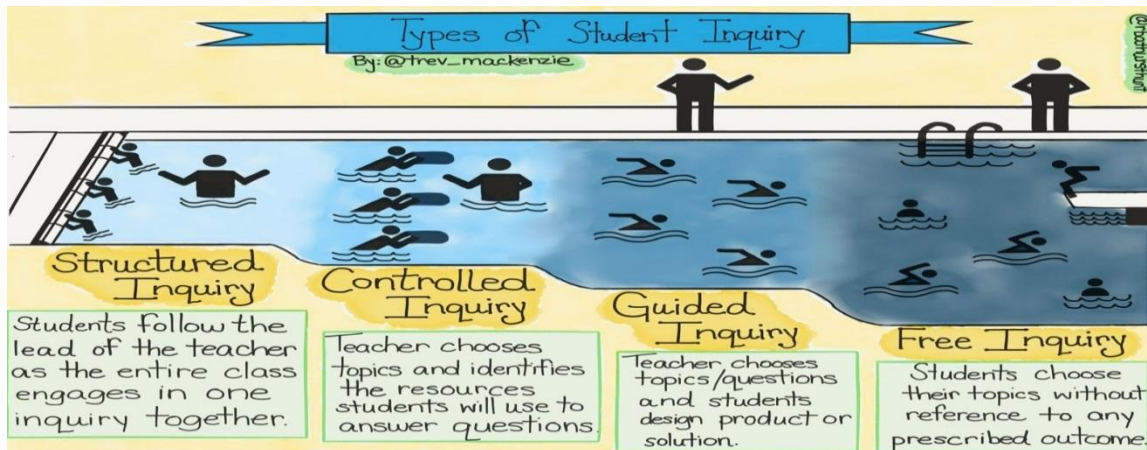


Figure 3: Types of Student Inquiry

MacKenzie (2016). <https://www.edutopia.org/article/bringing-inquiry-based-learning-into-your-class-trevor-mackenzie>.

2.6.2 The Inquiry Process

The inquiry process puts the emphasis on student as a scientist. The five basic inquiry process as listed by Inquiry page (2010), is presented in figure 4:

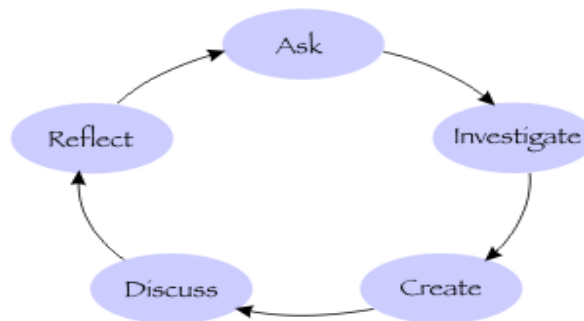


Figure 4: The Inquiry Cycle

Inquirypage (2010). http://www.cii.illinois.edu/InquiryPage/inquiry_process.html.

Ask It begins with the desire to discover. Meaningful questions are inspired by genuine curiosity about real-world experiences. A

question or a problem comes into focus at this stage, and the learner begins to define or describe what it is.

Investigate Taking the curious impulse and putting it into action is what we call the investigation process. At this stage the learner begins to gather information: researching resources, studying, crafting an experiment, observing, or interviewing, to name a few. The learner may recast the question, refine a line of query, or plunge down a new path that the original question did not-or could not-anticipate. The information-gathering stage becomes a self-motivated process that is wholly owned by the engaged learner.

Create As the information gathered in the investigation stage begins to coalesce, the learner begins to make connections. The ability at this stage to synthesize meaning is the creative spark that forms all new knowledge. The learner now undertakes the creative task of shaping significant new thoughts, ideas, and theories outside of his/her prior experience.

Discuss At this point in the circle of inquiry, learners share their new ideas with others. The learner begins to ask others about their own experiences and investigations. Shared knowledge is a community-building process, and the meaning of their investigation begins to take on greater relevance in the context of the learner's society. Comparing notes, discussing conclusions,

and sharing experiences are all examples of this process in action.

Reflect Reflection is just that: taking the time to look back at the question, the research path, and the conclusions made. The learner steps back, takes inventory, makes observations, and possibly makes new decisions. Has a solution been found? Do new questions come into light? What might those questions be? And so it begins again; thus the circle of inquiry (Inquiry page, 2010).

Another author, Walkup (2014) modified a chart developed by Cornelia Brunner (2012), to explain the Inquiry process in a tabular form as explained in figure 5.

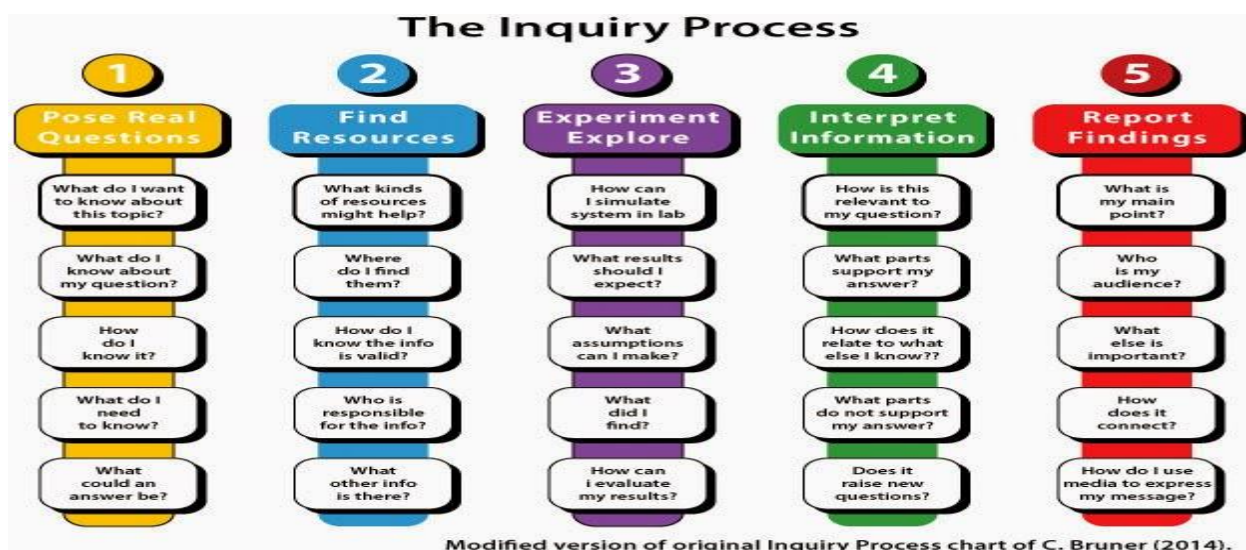


Figure 5: Bruner Inquiry Process Chart

Walkup, (2014). Using Guided Inquiry in Science. <http://cognitiverigor.blogspot.com.ng/2014/08/using-guided-inquiry-in-science.html>.

In the first column (Walkup, 2014), explained that the students examine their current knowledge about a topic and their confidence in what they know. In the second column, students are to brainstorm where they might be able to hunt down information. In

the third column compels the student to evaluate the source of his or her knowledge as worthy or credible. In the fourth column, students analyse what they found, then generate new questions for further inquiry. And lastly, in the fifth column, with the defined target population in mind, the student selects an appropriate medium for delivering the results.

Another inquiry process by Franklin (2015,) stated that the inquiry process aims to enhance learning based on (1) increased student involvement, (2) multiple ways of knowing and (3) sequential phases of cognition. By using student derived investigations, knowledge is more relevant and meaningful. This investment in the curriculum and learning process leads to active construction of meaningful knowledge, rather than passive acquisition of facts transmitted from a lecturer. The author developed a cyclical process of inquiry in which the interpretation is similar to Walkup (2014). The diagrammatic representation of Franklin (2015), inquiry process is shown in figure 6.

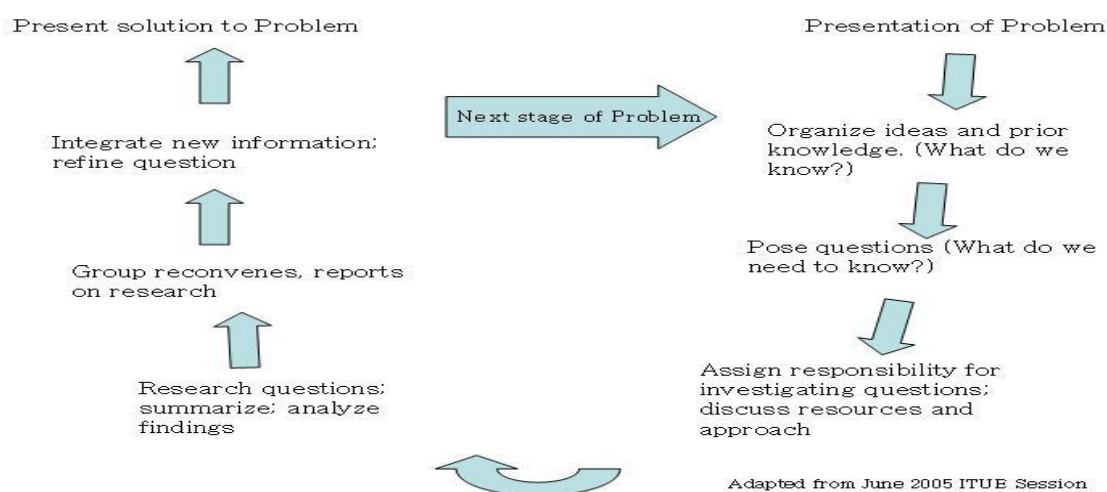


Figure 6: Process of Inquiry Based Curriculum

Source: Franklin (2015). <http://www.brynmawr.edu/Biology/franklin/franklin.html>

Inquiry teaching method was chosen in this study due to its scientific nature, it is student-centred and it involved all scientific process (Sola and Ojo, 2007). In Nigeria, the emphasis for student-centred learning and use of inquiry teaching method was intensified

with the introduction of Universal Basic Education (UBE) scheme in 2004 with the aim of eliciting high cognitive process in student (Federal Ministry of Education, 2008). An example of inquiry based teaching by Garcia (2014), is illustrated on figure 7. Students will create their own cell membrane. They will colour the characters that make up the cell membrane, cut them out, and then glue them around the animal cell.

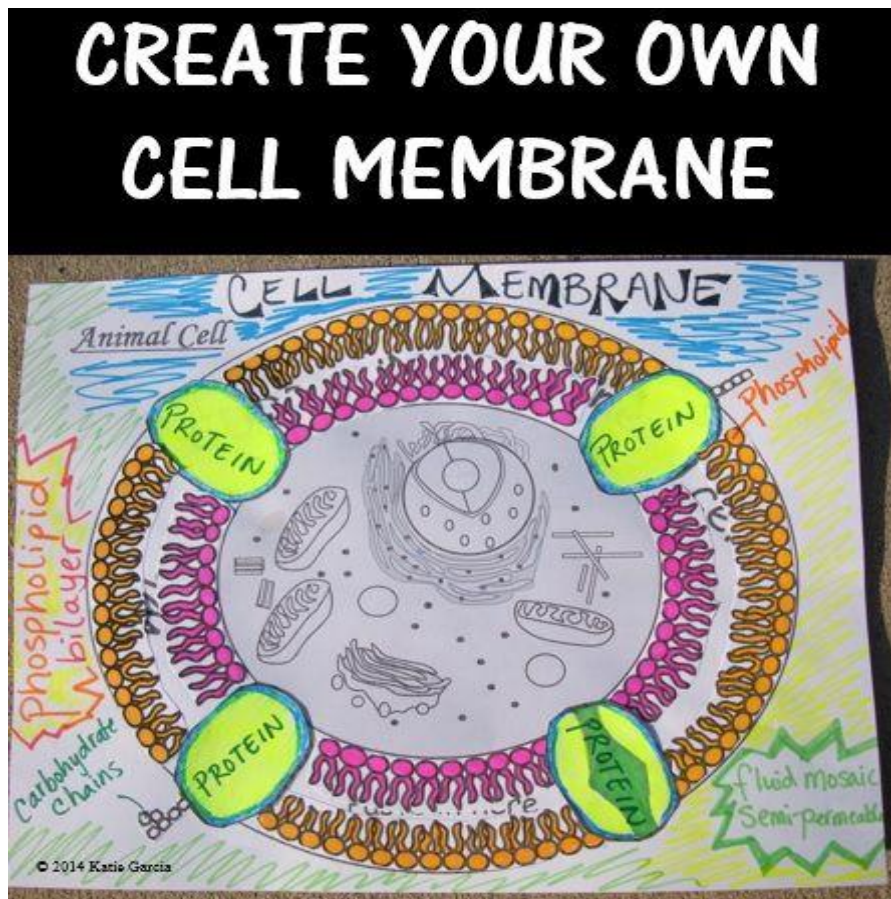


Figure 7: Cell Membrane

Garcia (2014). Cell membrane. <https://www.pinterest.com/pin/212724782376486617/>

2.6.3 Advantages and Disadvantages of Inquiry Method

A good number of researchers (Timothy & Awodi, 1997; Ibe & Nwosu, 2003; Jensen, 2008; Opara, 2011; & Bybee, 2011 in Aniaku, 2012), indicated that inquiry method is an effective method for teaching Biology because it has much academic gains; it increases students' understanding of science concepts, principles and facts, enhances students achievement and interest, encourages active participation of students in the teaching and learning process and enables students to construct meaningful biological knowledge. Inquiry is therefore deemed necessary for teaching and learning Biology because when students understand concepts and principles of a subject, knowledge of such subject can be constructed, sustained and transferred to a similar situation. Inquiry teaching method is one way of making sense out of what we experience and therefore requires thinking (Blair & Simon, 1998 in Muhammad, 2011).

Students learn best when they take an active role and practice what they have learned (Smart & Csapo, 2007 in Naureen and Jeffery, 2010). It's very important that in order to facilitate inquiry-based learning, the teacher make simple changes and organize the classroom in a way so she could manage transition and gain attention as the children use hands-on investigative activities, use of science journals, use of group-based activities, and guided students to reflect on their learning process. Theorists such as John Dewey believed that inquiry-based scientific method could improve education. Children can also use their natural activity and curiosity when learning about a new concept (Vandervoort, 1983; Dewey, 2008; in Naureen & Jeffery, 2010).

Inquiry method of teaching requires taking into consideration the psychological needs of the child rather than introducing science as a logical coherent subject (Eshach, 1997; Henderson & David, 2007 in Naureen and Jeffery, 2010). Piaget, another theorist believes that as the child grows and his brain experiences intellectual development, he/she

starts to construct mental structures through his interaction with the environment (Lawson & Renner, 1975 in Naureen and Jeffery, 2010).

Some disadvantages of inquiry method as stated by Waters (2012), include: Difficult to manage in courses with large student enrolment, requires significant amount of time that students must be in the laboratory and thirdly, Students can become easily frustrated.

2.6.4 Influence of Inquiry method on Students' performance in Biology

Inquiry-based instruction is a student-centred and teacher guided instructional method that engages students in investigating real world questions that they choose within a broad thematic framework. Inquiry based instruction complements traditional instruction by providing a vehicle extending and applying the learning of students in a way that connects with their interests within a broad thematic framework. Njoku (2004) in Martins-Omole (2015), stated that inquiry based learning is primarily a pedagogical method developed during the discovery learning movement of the 1960s as response to traditional forms of instruction. The students use the inquiring process to develop expiations from their observations by integrating what they already know with what they have learned. They learn concepts in Biology and skills and how to solve problems using practical method. Inquiry based learning require the student to do more than just report on a topic. The student must go beyond the simple memorization of facts and regurgitation of information and into the realm of creating new and deeper understanding through identification and subsequent application of solutions to a specific topic. Its efficacy in enhancing students' achievement in Biology in comparison with that of the conventional lecture method is the focus of the study.

Inquiry is a method of teaching in which students are guided by the teacher to find facts for themselves. It is student-centred and activity oriented (Akuma, 2007). The method

helps to increase the degree of students' interest, confidence, innovativeness, problem-solving ability and consequently improve their performance in both theory and practice (Fatokun & Yalams, 2007 in Umunadi, 2009). The method also influences students to engage in relatively sophisticated mental processes like hypothesising, raising questions, observing (comparing, classifying), measuring and calculating, manipulating materials and equipment effectively, devising and planning investigations, designing and making, communicating effectively, finding patterns, relationships (inferring) and predicting (CommonResources, 2013). Students' academic achievement refers to students' performance or attainment in a subject. According to Nwagbo (2001) in Aniaku (2012), achievement in teaching/learning process has to do with attainment of a set of objectives of instruction. If a learner accomplishes a task (for example, a Biology problem) successfully and attains the specified goal for a particular learning experience, he is said to have achieved. Adesina (2005) in Ibrahim (2015), opines that every device available to the teacher should be used to capture the interest of the child to fire his/her imagination.

In order to influence or improve student's achievement and arouse their interest, students have to be taught Biology with hands-on teaching method (inquiry) with different learning materials so as to enable them acquire the cognitive competence they need to pass Biology (Ali, Toriman & Gasim, 2014). The present study accessed the effect of inquiry method on students' performance in Biology.

2.7 Demonstration Method

Demonstration method came about as a result of complexity of learning where the students found it difficult to reconcile the theory and the practical aspect of learning. Basic concepts centred on time, space and mathematics are first required to demonstrate and teach probable theories that accurately describe universal phenomenon such as nature, planets, species, and the world around us (K12academia.com). The history of demonstrating

concepts which lead to specific definitions goes back to the careful observations of ancient Greek philosophers and natural philosophy. Socrates, Plato, and Aristotle attempted to carefully define words that included natural phenomena and objects. The modern scientific method often uses demonstrations that carefully describe certain processes and parts of nature in great detail. In science, often one demonstrates how an experiment is done and shows this to others (K12academia.com). In demonstration method, the teaching strategy is the careful plan of actions to achieve a goal, or the art of developing, or carryout such a scheme. This is an elaborate and systematic plan of Action. These are all plan made to help learners to access the information (Mgina, 2017). Farooq (2013), explained that Demonstration method focuses to achieve psychomotor and cognitive objectives. The structure is given in three successive steps: (i) Introduction- in this step, objectives of the lesson are stated. The teacher may be called demonstrator. He demonstrates the activity before the student that is to be developed. (ii) Development- Students try to imitate the demonstrated activity. If there is any query the teacher tries to satisfy them by further demonstration and illustrations. (iii) Integration -at this step, the teacher integrates all the activities and then these activities are rehearsed, revised and evaluated. The author added that Demonstration teaching strategy is based on the following principles (a) Learning by doing maxim is followed (b) Skills can be developed by imitation (c) The perception helps in imitation.

People can also communicate values and ideas through demonstrations. This is often done in plays, movies, and film. Pictures without words can show or demonstrate various types of actions and consequences. An example of demonstration method by Garcia (2015), is illustrated in figure 8. Students will create their own human Biology foldables using cardboard papers to illustrate various topics taught in the Biology

class by imitating the teacher. An example of a human Biology foldable diagram in figure 8:

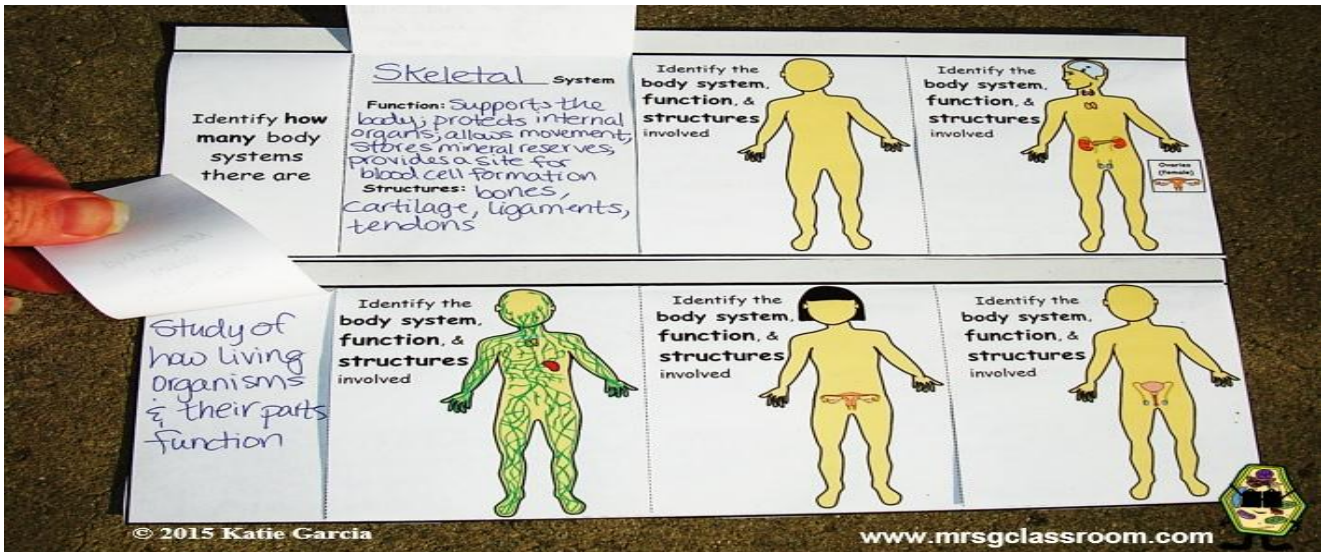


Figure 8: Human Biology System Foldables

Garcia (2015). Human Biology System Foldables. <https://www.mrsgclassroom.com>

2.7.1 Types of Demonstration Method

There are three types of demonstration method namely; step by step, the whole process and spot demonstration (Chikuni, 2003 in Iline, 2013). In the whole process of demonstration, the teacher demonstrates the full process from the beginning to the end without interruption by learners' participation (Chikuni, 2003 in Iline, 2013). For Gwarinda (1993) in Iline (2013), the step by step demonstration is done stage by stage with teacher explaining each action as the operation proceeds. Chikuni (2003) in Iline (2013), also note that the step by step demonstration takes place when the process is presented in stages. The stages are inter-spaced by learner' participation. In addition the two types of demonstrations, McKeachie (1986) in Iline (2013) suggested a third type called the spot demonstration. Spot demonstration is usually done after the teacher identifies a problem or a mistake being made by the pupils. This is done after the procedure has been shown

before. For Petty (2000) in Iline (2013), if the teacher spots a problem, pupils will then be stopped from proceeding with the task. The teacher will re-demonstrate the skill. This strategy helps to prevent worsening of the problem.

2.7.2 Advantages and Disadvantages of Demonstration Method

Teacher-demonstration methods have several benefits as stated by (Aliyu in Musa, 2015); the following are benefits of teacher-demonstration method:

- a) It gives students confidence. They turn to their textbook reducing the problem work with a feeling of assurance.
- b) It uses the textbook as a teaching aid, not as the major instructional medium. The textbook becomes a reference source and supplements the class presentation.
- c) It permits the use of sound teaching principles.
- d) It places a premium understanding as opposed to memorization, copying is discouraged because students have confidence in the ability to do the work on their own.

Other instructional advantages of demonstration teaching strategy (Aliyu; McDermott in Maizuwo, 2011), were highlighted as follows:

- i) It can be used to introduce a lesson, and to climax a lesson, it is an attention inducer and a powerful motivator when it is employed to start a lesson. This statement is agreed by (Augustine, 2004 in Ibrahim, 2015), which states demonstration can also be used to introduce a certain topic for study by presenting some vivid illustration.
- ii) It saves time, where materials and time are very important.
- iii) The teacher shows how to avoid breakages through demonstrations. The teacher also shows the correct use of equipment and apparatus through demonstration.

- iv) It allows the teacher to use activities that ordinarily would be too dangerous for students to carry out themselves example an activity involving dangerous chemicals.

Demonstration method has some demerits; Mallick (2012), listed four demerits which are as follows:

- a. It is not possible to impart information of all the topics included in the syllabus through this method.
- b. Generally numbers of students in the classroom are found to be large as a result of which majority of them fail to get advantages from experiments conducted under this method.
- c. The numbers of students are generally found to be very large in the classrooms, thus, all the students do not get opportunity to play an active role in the learning process and a large number of them cannot even touch the apparatus, which was used by the teacher.
- d. Generally it is found that pace at which experiments are conducted by the teachers in the classrooms are very high as a result of which large number of students fail to understand the information provided by them. It will be unjustly to blame the teacher for conducting experiments on such a fast pace, as they also have limited period of time for this purpose. This is in agreement with Murshed (2012), where he stated 'This method is suitable to intelligent students and not to average students'.

Demonstrations can be used to provide examples that enhance lectures and to offer effective hands-on, inquiry-based learning opportunities in classes or laboratories. Used in classes of all sizes in multiple grades and subject areas, demonstrations are most commonly found in science and technology courses (Eley and Norton, 2004).

Demonstration as one of the teaching methods in this research was used as a medium of instruction to the experimental group to see its efficacy on students' performance in Biology as well as their performance when compared with the inquiry method of teaching which has also been used in the experimental group in secondary schools at the Federal Capital Territory, Abuja. Due to the importance of science process skills as a solution to scientific problems, the Federal Government of Nigeria stated as one of its national goals of education in Nigeria that 'Education should aim at helping the child in acquisition of appropriate skills, abilities and competencies, both mentally and physically, for the individual to live in and contribute to the development of the society' (FRN, 2004).

2.7.3 Influence of Demonstration Method on Students' Performance in Biology

A shift from the traditional to a progressive mode of education had led to an increased interest in learners' individual differences. The new paradigm is student-centred (demonstration method) on inclusiveness, cooperative learning and encouraged diversity (Zywnoand Waalen, 2002). An increasing amount of research in the past years points out that the interactive process between individual student and the teacher is very important in determining the nature and quality of learning and development that result from instruction (Nwagbo, 2001 inAniaku, 2012). Some researchers have taken the position that it is the teaching method and not the teacher that is the key to the learning of science. It is believed that most effective learning takes place when the interactive process is one that is best suited to the individual students in terms of learning styles (Zywno and Waalen, 2002).

Learning styles research has been applied at an ever-increasing rate to the problems of education (Doebler & Eke, 1979 inIkitde & Edet, 2013). Murel (1987) inIkitde and Edet (2013), suggest that learning styles could be an extremely important element in the move to improve curricula and teaching process in school. Anderson and Adams (1992) inIkitde

and Edet (2013), indicated that more attention than ever was being focused on how to meet the challenges of increased diversity in the classroom. They argued that one of the most significant challenges instructors face is to be tolerant and perceptive enough to recognize learning differences among their students.

The interest which students show according to Archibong (1999) in Ikitde and Edet (2013), in science subjects (Biology) and the mastery they demonstrate on completion of a course of study depend on the teaching methods. Inyang (1993) in Ikitde and Edet, (2013), wrote that unfortunately, in spite of the much focus on teaching strategies in science, students' performance in science subjects (Biology) have continued to record a persistent and depressing downward trend. Several factors have been advanced as affecting students' performance, these include the students factors, teachers factors, societal factors, governmental infrastructural problem, language problem and instructional strategies employed by the teacher (Ali, 1984; Chacko, 1987 in Ikitde & Edet, 2013),; and recently students learning styles (Felder, 2002). The author added that to overcome these problems, there is need to strive for a balance of effective teaching strategies such as demonstration to students' individual learning styles (Active/Reflective, Sensing/Intuitive, Visual/Verbal and Sequential/Global). If the balancing is achieved, it is hoped that all students taught in a manner they prefer will lead to an increased comfort level to learn and high achievement. It is against this background that the researcher investigated the effect of demonstration teaching method on students' performance in Biology in secondary schools in FCT, Abuja.

2.8 Student's attitudes towards Biology and Instructional Methods

Attitude is a way of thinking that affects a person's behaviour. Owino; Yungungu; Ahmed & Ogolla (2015), explained that attitude is a very complex and unique concept, it is defined as the tendency to think, feelings or preferences that a person has about an object, based on their belief about the object, which can be positive or negative. The authors

viewed attitude as having different components which include cognitive (knowledge, beliefs and ideas), affective (feeling, like and dislike) and behavioural (tendency towards an action). The authors added that Attitude consists of three basic components, namely thinking, feeling and reacting. The thinking component involves self-belief; the feeling component involves issues relating to value and the reacting component involves the tendency to behave in a certain way. According to Nasr and Asghar (2011), with global scientific and technological growth occurring rapidly, declining student interest in science courses and careers is a worldwide concern that has prompted science education reform efforts on an international scale. The authors added, attitude towards science affects course and career choices of students and it is important to examine its different aspects and reinforce weak aspects through designing different educational programmes.

Biology as an important branch of science plays a substantial role in attitude towards science. George (2006) in Nasr and Asghar (2011), observed that a significant amount of research in science education is devoted to understanding ways we can improve the quality of science education and increase enrolment in science courses and degrees. Nasr and Asghar (2011), added that one of the key factors in learning science is students' attitudes and the development of positive attitudes toward science can motivate student interest in science education and science-related careers. Nasr and Asghar (2011), identified many factors that influence attitudes and achievement among students, some of the factors are associated with parental background and family environment. Other factors relate to individual characteristics such as self-concept, locus of control, and achievement motivation. Still other variables are associated with schools influences such as class climate, teachers, and administrative styles.

Studies have incorporated a range of components in their measure of attitude to sciences including; the perception of teachers; anxiety towards science; the value of

science; self-esteem at science; motivation towards science, enjoyment of science; attitude of peers and friends towards science; attitude of parents towards science; the nature of the classroom environment, achievement in sciences and fear of failure on the course (Osborne, Simon and Collins in Martins-Omole 2015). It is said that a positive attitude is the key to success as opined by Owino; Yungungu; Ahmed & Ogolla (2015). The authors recommended in their research work that Biology teachers should use teaching methodologies that will promote positive attitude towards Biology by encouraging discussion groups, excursions and hands on activities, and making the subject interesting. This is why the researcher used inquiry and demonstration methods to teach Biology which had a positive impact in their attitude as the students performed better than when taught using the conventional method.

2.9 Empirical Studies

The following research works were reviewed for the study: Ugwuadu (2010), conducted a study on the effect of guided inquiry and lecture methods on students' academic achievement in Biology: A case study of Yola North Local Government Area of Adamawa State. The specific objective to determine the effect of guided inquiry and lecture methods on students' academic achievement in Biology. The study used quasi experimental design. The sample of the study was 407 SSII Biology students drawn by purposive sampling technique in which four schools were selected from eight secondary schools in the area of study. The sample consisted of 223 boys and 184 girls. The classes used for the study were selected by simple random sampling using the ballot system. Mean, grand mean, standard deviation and t-test statistic were used to analyse data from the result of Biology Achievement Test used for data collection. The result shows that mean pre-test scores of the experimental and control groups used for the study are insignificant. The mean post-test scores show a wide difference. There was a significant difference between the

achievements of students taught with guided inquiry and those taught with lecture method in favour of guided inquiry. Guided inquiry proved more effective than lecture method in enhancing students' academic achievement in Biology. Recommendations were made among others that: Guided inquiry method should be practised seriously by Biology teachers since the method has proved effective in enhancing students' academic achievement in Biology; and Biology teachers should reduce if not eliminate the use of Lecture method in Biology teaching as it is defective. The method does not enhance students' academic achievement in Biology as revealed by the result of this study.

This study is similar to the present work in the sense that the study is an experimental study which is similar to the present study. The previous study also used a test instrument for data collection and the data collected were analysed using independent sample t-test which was also used in the present study. The dissimilarities that existed between the previous study and the present research is that, the previous study was carried out to determine the effect of guided inquiry and lecture methods on students' academic achievement in Biology in Yola North Local Government Area of Adamawa State, while the present study was carried out to determine the effect of Inquiry and demonstration teaching methods on students' performance in Biology in Secondary Schools in FCT, Abuja

Nnorom (2017), carried out a study designed to investigate the effect of guided-inquiry and demonstration methods of teaching on science process skills acquisition among secondary school Biology students. The design of the study was quasi-experimental, specifically, the non-equivalent, pretest-posttest was used. One hundred and fifty (150) SS1 Biology students in co-educational Government owned schools formed the sample of the study. Three (3) groups' co-educational schools were randomly drawn from the fifty (50) co-educational secondary schools in Ogidi education zone in Anambra state. Intact

classes were randomly assigned to two experimental groups and a control group. The experimental groups' one and two were taught using guided-inquiry and demonstration methods respectively. The control group students were taught using the conventional method. Two research questions and two null hypotheses were formulated to guide the study. A Test of Science Process Skills Acquisition (TOSPSA) of twenty (20) items was developed and used in obtaining data on students' acquisition of the process skills of science. The data were analysed using mean and standard deviation to answer the research questions, while Analysis of Covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. The result revealed that students taught using the guided-inquiry method performed significantly better than those taught using demonstration and conventional methods. It was recommended that teachers should use guided-inquiry method of teaching that challenges students to be involved in the classroom; this will spur their interest to learn. In-service training and workshop should be organized by the Ministry of Education to train teachers in the use of importance of activity method.

The similarity of this study with the present work is that, the study is an experimental study which is similar to the present study. The previous study investigated the effect of guided-inquiry and demonstration methods in teaching Biology which is similar to the present study. The previous study also used a test instrument for data collection and the data collected were analysed using mean and standard deviation which was used in the present study. The dissimilarities that exist between the previous study and the present research is that, the previous study analysed its data with the use of Analysis of Covariance (ANCOVA) at hypotheses of 0.05 level of significance while the present study used independent t-test. The previous study was carried out in Anambra State SS1 students while the present work was carried out in Federal Capital territory, Abuja using SS2 Students.

Maizuwo (2011), conducted a research on the effects of demonstration teaching strategy in remedying misconceptions in organic chemistry among students of colleges of education in Kano State. The objectives of the study were to identify the types of misconceptions among NCE students in organic chemistry; investigate the effect of demonstration teaching strategy in remedying the identified misconceptions in organic chemistry at NCE level; and investigate the gender differences on misconception in organic chemistry at NCE level. The study is of a pre-test post-test quasi-experimental control design. One hundred and twenty six NCE II chemistry students from two colleges of education in Kano state were used as the sample of the study. The instruments used for data collection were; Organic Chemistry Achievement Test (OCAT) and Organic Chemistry Misconception Test (OCMT). The two tests were used to determine group equivalence and level of misconception of the students (pre-tests) and also to determine the effectiveness of demonstration method on the misconception of concepts (post-tests). The data analysis was carried out using statistical package for social sciences (SPSS) version 16 in which the t-test analysis revealed that students taught organic chemistry concepts through demonstration teaching method (experimental group) performed significantly higher than those taught same using lecture method (control group). Thus, demonstration teaching method enhances academic achievement, in addition to remedying students' misconception in organic chemistry. Among other things, the finding of the study was that demonstration teaching method was gender friendly. The study recommends, among other things that: i) chemistry teachers should be encouraged, motivated and assisted to use demonstration teaching method and efforts should be geared towards the use of demonstration teaching method in tertiary institutions (NCE level) by the authorities concerned.

The link of this study with the present work is that, the study was an experimental study which is similar to the present study. The previous study also used a test instrument for data collection and the data collected were analysed using t-test which was used in the present study. The dissimilarities that exist between the previous study and the present research is that, the previous study was carried out to determine the effect of demonstration teaching strategy in remedying misconceptions in organic chemistry among students of colleges of education in Kano State while the present study was carried out to determine the effect of Inquiry and demonstration teaching methods on Students' performance in Biology in Secondary Schools in FCT, Abuja.

Another research was carried out by Muhammad (2011), on the effects of inquiry teaching method on academic achievement, retention and attitudes towards chemistry among diplomastudents of Kano State polytechnic. Specifically, the study has the following objectives to determine the effects of inquiry teaching method in the teaching of chemistry among diploma students of Kano State Polytechnic; investigate the retention ability of students taught chemistry with inquiry teaching method; investigate the effectiveness of inquiry method on academic performance of male and female students in the learning of chemistry; and determine the effect of inquiry teaching method on the attitudes of the students towards chemistry. The study was a pre-test, post-test quasi experimental control group design. A total of seventy (70) students form the sample of the study. Two instruments, namely Chemistry Achievement Test (CAT) and Chemistry Attitude Questionnaire (CAQ) were used for data collection. The CAT was developed by the researcher and validated by experts in chemistry education and psychology. The reliability coefficient of CAT and CAQ were found to be $r=0.785$ and $r=0.82$ respectively. Analysis of data using t-test statistic and weight average revealed that the experimental group which was taught chemistry using inquiry teaching methods performed significantly

better than the control group which was taught using the traditional lecture method and that the experimental group developed positive attitudes toward chemistry after exposure to the inquiry teaching method. Other finding of research was that inquiry method of instruction was gender-friendly and that it enhances retention. The study recommended among others, that chemistry teachers should be encouraged to use inquiry method in the teaching of chemistry.

This study has similarities with the present work. The study was an experimental study and was carried out to assess the effects of inquiry teaching method on performance of students which is similar to the present study. The previous study also used a test instrument for data collection and the data collected were analysed using t-test which was used in the present study. The dissimilarities that exist between the previous study and the present research is that, the previous study was carried out to determine diploma students' performance in chemistry in Kano State Polytechnic while the present study was conducted to determine the performance of students in Biology in secondary schools in FCT, Abuja.

Opara (2011), conducted a research titled: Inquiry Method and Student Academic Achievement in Biology: Lessons and Policy Implications in Ogba/Egbema/Ndoni Local Government Area of River State. The research was carried out with the objectives to: compare the mean achievement scores of schools drawn from the fifteen secondary schools taught through inquiry teaching method in Ogba/Egbema/Ndoni Local Government Area and those taught using the conventional method; compare the mean achievement scores of male fifteen (15) SS1 Biology students taught using inquiry teaching into two classes; and compare the mean achievement scores of to a total of one hundred and twenty (120) students taught using inquiry teaching method in four schools representing the sample of the urban and those in the rural schools. Three research questions with null hypotheses guided the study with the aid of a quasi-experimental research design. These

students were randomly assigned to two groups (treatment and control group). Treatment group were those taught Biology using the sensitized inquiry teaching method while conventional method (lecture) was used for the control group. Biology Achievement Test (BAT) was developed on the following units in Biology, flower pollination, muscle structure and function and seed germination. All these were drawn from anatomy and physiology of flowering plants; and animal physiology in the Biology textbook of SS1, to measure the initial and terminal academic achievement of the students. Data collected from the study was analysed using t-test. Finding shows among others that the inquiry teaching method favours the urban students more than those in the rural schools in Biology achievement.

The similarity of this study with the present research is that, the study was an experimental study and conducted on the Inquiry Method and Student Academic Achievement in Biology, which is similar to the present study. The previous study also used a test instrument for data collection and the data collected were analysed using t-test which was also used in the present study. The dissimilarities that exist between the previous study and the present research is that, the previous study was carried out in Rivers State, while the present study was carried out to determine the effect of Inquiry and demonstration teaching methods on Students' performance in Biology in Secondary Schools in FCT, Abuja.

Ameh and Dantani (2012), explored the effects of lecture and demonstration methods on the academic achievement of students in Chemistry in Nassarawa local government area of Kano State. The study was carried out with the objectives to: find out the difference in the academic achievement of students exposed to lecture method and those exposed to demonstration method; determine if there is any difference in the academic achievement of male students taught using lecture method and those taught using

demonstration method; investigate if there is any difference in the academic achievement of female students taught by demonstration method and those taught by lecture method; and determine the difference in the academic achievement between male and female students taught using demonstration method. Fifty eight (58) Chemistry students (boys and girls) in the Secondary School One (SS1) from two randomly selected schools were involved in the study. Necessary data were collected and the validated reliable data were analysed using t-test at a significant level of 0.05. Results obtained revealed that students performed better in Chemistry when taught using the demonstration method as compared to the lecture method. The boys and girls are better in academic achievement when taught using demonstration method than when lecture method was used. The demonstration method shows equality in the performance of boys and girls. Hence the adoption of demonstration methods in the teaching and learning of Chemistry and science in general is hereby recommended.

This study is similar to the present research because the previous study was carried out to assess the effects of lecture and demonstration methods on the academic achievement of students which is one of the variables of the present research. It is also related to the present study as it was conducted in the secondary schools and the use of t-test for data analysis was also used in the present study. Despite the similarities, the previous study was different to the present research as it determines students' performance in chemistry while the present study determined students' performance in Biology. Also, the previous study was carried out in Kano State while the present study was conducted in FCT, Abuja.

A study was carried out by Ogunbiyi (2012), on Inquiry Method, Teacher Guided Discussion Method and Student's Attitude and Performance in Social Studies in Ifo Local Government areas of Ogun State. The study was carried out with the aim to examine the

relativeness of Inquiry Method and Teacher Guided Discussion method as against the conventional and traditional methods in teaching and learning outcome of some aspects of social studies in secondary schools. A pre-test, post-test, control group experimental design involving two experimental groups and one control group was used in the research work. The subjects of the study consist of one hundred and twenty (120) junior secondary schools two (JSS 2) social studies students in Ifo Local Government areas of Ogun State. A twenty (20) item objectives questions consisting of filling the gap and multiple choice objective test was used for relevant data collection. The results of the pre-test and post-test scores in SSAT (Social Studies Achievement Test) were analysed, using both the descriptive and inferential statistics. The findings showed that there were significant differences among the treatment situations. The Inquiry Method (IM) was found to have been most effective in enhancing learning outcome of the subjects. It was also discovered that a significant statistical interaction existed between the methods of instruction and academic ability were however found to have performed better in SSAT than those on low academic ability in the treatment conditions.

The previous study shared some characteristics with the present research because the previous study was carried on an aspect of the present study that is, inquiry method. It is also related to the present study as t-test was used for data analysis which was also used in the present study. Despite the similarities, the previous study was different to the present research as it investigated Inquiry Method, Teacher Guided Discussion Method and Student's Attitude and Performance in Social Studies in Ifo Local Government areas of Ogun State, while the present study was carried out to determine the effect of Inquiry and demonstration teaching methods on Students' performance in Biology in Secondary Schools in FCT, Abuja.

Ifeanyi-Uche and Ejabukwa (2013), carried out a study on Inquiry Based Method and Student Academic Achievement in Secondary School Home Economics in Orumba South Local Government Area of Anambra State. The objectives of the study were to: compare the mean percentage score of students taught Home economics using inquirybased teaching method and those taught using lecture method; and compare the mean achievement scores of students taught through inquiry basedmethod and those taught using lecture method. The study covered the secondary schools inOrumba South Local Government Area of Anambra State. Quasi-experiment design was used. Two study groups were randomly sampled from the 15 schools in the LocalGovernment Area and assigned to experimental and control groups respectively. Theexperimental groups were taught with inquiry based method while the control group were taughtusing lecture method. A thirty five items Home Economics Achievement test developed by theresearcher and validated by researchers' colleagues was used to assess the subject achievement. Data collected were analysed using percentage, mean and t-test statistics. The findings revealedthat the experimental group (inquiry based method) achieved significantly higher than the controlgroup (lecture method). Based on the findings, it was recommended that inquiry based methodshould be employed in teaching Home Economics.

Hence, the similarities of this study with the present work were that, the study was an experimental study and was carried out on Inquiry Based Method and Student Academic Achievement in Secondary School which is similar to the present study. The previous study also used a test instrument for data collection and the data collected were analysed using t-test which was used in the present study. The differences that exist between the previous study and the present research was that, the previous study was carried out to determine diplomastudents' performance in Home Economics in Orumba South Local Government Area of Anambra State while the present study was conducted to

determine the performance of SS 2 students in Biology in secondary schools in FCT, Abuja.

Musa (2015), conducted a study on the effect of demonstration and assignment methods on students' performance in financial accounting in federal government colleges in Kaduna State, Nigeria. The study was conducted with the aim to: determine the effect of demonstration method on student's performance in financial accounting; find out the effect of assignment method on students' performance in financial accounting; determine whether any difference exists between the performance of students taught financial accounting using demonstration method and those taught using assignment method; find out the extent of influence of demonstration, assignment and lecture methods on performance of students in financial accounting; compare the mean performance of boys and girls in demonstration teaching method; and assess the mean performance of boys and girls in the assignment teaching method. Quasi experimental research design was used for the study. The population of 248 students out of which 90 Financial Accounting students from Federal Government College, Kaduna and Federal Government Girls College, Zaria formed the sample for the study. The mean and standard deviation were used to analyse the data collected, while student t-test was used to test the four null hypotheses at 0.05 level of significance.

The results of the analysis revealed that (a) the mean performance of students taught using Demonstration and Assignment Methods were not significantly different. (b) there was a significant difference in using Demonstration and Assignment Teaching Methods when compared with Lecture Teaching Method. It was concluded, based on the findings, that demonstration Method is significant, but when Assignment Teaching Method is used concurrently the performance was more significant. It was based on the conclusion that these recommendations were given among which was that Financial Accounting

teachers should use Demonstration method in teaching financial accounting in the secondary school. It was further recommended that research should be carried out on Demonstration and Assignment methods in another location in order to confirm its effectiveness on students' performance in financial accounting. This study has similarities with the present study as it was conducted using Quasi-experimental research design while t-test was used for data analysis. The difference that existed between the two studies was that, the previous study was carried out in Kaduna State, while the present research was conducted in FCT, Abuja.

Unogu (2015), investigated the effects of guided-discovery and demonstration teaching methods on academic performance of financial accounting students' in federal government colleges, Kaduna State. The study was carried out with the objectives to: determine the effects of guided-discovery teaching method on students' academic performance in financial accounting in Federal Government Colleges, Kaduna State; identify the effects of demonstration teaching method on students' academic performance in financial accounting in Federal Government Colleges, Kaduna State; determine the difference between the academic performance of students taught financial accounting using guided-discovery teaching method, and those taught using demonstration teaching method in Federal Government Colleges, Kaduna State; identify the difference between the academic performance of male students taught financial accounting using guided-discovery teaching method and those taught using demonstration teaching method in Federal Government Colleges, Kaduna state; and find out the difference between the academic performance of female student taught financial accounting using guided-discovery teaching method and those taught using demonstration teaching method in Federal Government colleges, Kaduna state. The study utilized the quasi-experimental research design. The population of the study was two hundred and forty eight (248)

students in secondary classes offering financial accounting in Federal Government Colleges, in Kaduna State. A total of forty eight (48) students served as the sample. The instrument used in collecting data for the study was financial accounting achievement test one and financial accounting evaluation test two. Data collected from the study was statistically analysed using mean, standard deviation and standard error for the research questions. The null hypotheses were tested using independent t-test at 0.05 level of significance. Based on the findings and conclusion, one of the recommendations made was that teachers should be encouraged to use guided-discovery teaching method in teaching financial accounting. To achieve this, they should be enlightened on the use of guided-discovery teaching method through organized in-service trainings, workshops and seminars.

This study is similar to the present work. The study is an experimental study which was similar to the present study. The previous study also used a test instrument for data collection and the data collected were analysed using independent sample t-test which was also used in the present study. The dissimilarities that exist between the previous study and the present research is that, the previous study was carried out to determine effects of guided-discovery and demonstration teaching methods on academic performance of financial accounting students' in Federal Government Colleges, Kaduna State, while the present study was carried out to assess the effect of Inquiry and demonstration teaching methods on Students' performance in Biology in Secondary Schools in FCT, Abuja.

Aniaku (2012), investigated the effects of guided and unguided inquiry teaching methods on secondary school students' achievement and interest in Biology in Enugu state. The study was carried out with the objectives to: determine the relative effects of the guided and unguided inquiry method of teaching on students' interest in Biology in secondary schools in Enugu State; find out the influence of gender on the achievements of

students taught Biology using guided and unguided inquiry method of teaching in secondary schools in Enugu State; find out the influence of gender on the interests of students taught Biology using guided and unguided inquiry method of teaching in secondary schools in Enugu State and to find out the interactive effects of guided and unguided teaching methods and gender on students' achievement and interest in Biology in secondary schools in Enugu State. To carry out the study, four research questions and five null hypotheses were formulated. The research design for the study was a quasi-experimental non-equivalent control group pre-test and post-test design. The study was carried out in two purposely selected co-education secondary schools in Nsukka Education zone of Enugu state. Sample for the study consisted of 80 (SSI) students from two randomly selected intact classes in the sampled schools. Data for the study were collected through two researcher developed instruments: Biology Achievement Test (BAT) and Biology Interest Inventory Scale (BIIS). The two intact classes of 40 students each were assigned to experimental group I and II respectively.

The experimental groups I and II were exposed to guided and unguided inquiry methods of teaching respectively. Data for the study were analysed using mean, standard deviation and ANCOVA statistics. The null hypotheses were tested at 0.05 level of probability. Based on the findings of the study and conclusion, one of the recommendations made was that teachers should use guided inquiry in teaching Biology more than unguided inquiry. To achieve this, Biology teachers should be trained and retrained on the job to adopt the use of inquiry teaching methods in the teaching and learning of Biology in the classroom. Training of these teachers could be done by the Government or relevant professional bodies like Science Teachers Association of Nigeria (STAN) through seminars, workshops and conferences.

This study is an experimental study which is similar to the present study. The data collected in the previous study used the researcher's developed instrument which was similar to this study. The previous and present study used mean and standard deviation for their data analysis. A dissimilarity observed between the previous study and present study is that the previous study used ANCOVA for its data analysis while in the present study; independent sample t-test was used. Another difference between the two studies was that while the previous study investigated the effects of guided and unguided inquiry teaching methods in secondary school students' achievement and interest in Biology in Enugu State, the present study assessed the effects of inquiry and demonstration methods on students' performance in Biology in secondary schools in Federal Capital Territory, Abuja.

Aliyu, Guga and Yusuf (2015), conducted a research on the effects of inquiry and lecture methods on social studies students' performance in colleges of education, North West Geo-political zones. The objectives were to determine the effects on performance of students taught using inquiry and lecture methods. The research design adopted for the study was quasi-experimental design. The population of the study was 300 social studies students selected in the Six Federal and State Colleges of Education in the North West region of Nigeria. The research instrument was a forty multiple choice Social studies Performance Test (SPT) used for pre-test and post-test in order to measure the effect of the intervention.

The data obtained were analysed using frequencies means and standard error. The research hypotheses were tested using Independent t-test. The result of the analysis showed that students taught using guided inquiry method performed better than those taught using guided lecture method. Based on the findings of the study and conclusion, one of the recommendations made among others was that the heads of Social Studies department in

various colleges of education should further emphasise the use of inquiry related teaching strategies in the implementation of social studies curriculum.

This study was an experimental study which was similar to the present study. The previous study also used a test instrument for data collection and the data collected were analysed using independent sample t-test which was used in the present study. Some dissimilarity were, while the previous study investigated the effect of inquiry and lecture methods on social studies students' performance in college of education, North West Geopolitical zone Nigeria, the present study assessed the effects of inquiry and demonstration methods on students' performance in Biology in secondary schools in Federal Capital Territory, Abuja.

Another research by Nwagbo and Chukelu (2011), investigated the effects of Biology practical activities on secondary school students' process skill acquisition in Abuja Municipal Area Council. The objective of the study was to determine the effects of Biology practical activities on process skill acquisition among secondary school students. The design of the study was quasi-experimental; specifically the Pre-test, Post-test, Non Equivalent Control Group Design. A sample of one hundred and eleven secondary one (SS1) Biology students randomly drawn from two coeducational schools was used for the study. 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 reliability index fell between 0.05 to positive one (+1). The data collected were analysed using mean, standard deviation and Analysis of Covariance (ANCOVA) at 0.05 level of significance. The results revealed that practical activity 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.

This study was similar to the present work. The previous study is an experimental study which is similar to the present study. The previous study used a test instrument for data collection in Secondary Schools in FCT, Abuja which was also used in the present study. The dissimilarities that exist between the previous study and the present research was that, the previous study was carried out to determine the effect of Biology practical activities on secondary school students' process skill acquisition while the present study carried out a research which assessed the effects of Inquiry and demonstration methods on Students' performance in Biology. Another dissimilarity was that while the previous study used Analysis of Covariance (ANCOVA) at 0.05 level of significance, the present study used independent t-test for its data analysis.

Hashim, Ababkr and Eljack (2015), carried out a research on the Effects of Inquiry Based Science Teaching on Junior Secondary School Students' Academic Achievements: A Case Study in Hadejia Zonal Education Area of Jigawa state, Nigeria. This study was to ascertain the extent to which Inquiry Based Science Teaching could be effective on the Junior Secondary School students' achievement in science. Randomised experimental and control group method was employed with a view to enabling the researcher pin down the efficacy of the Inquiry Based Science Teaching. Inquiry-Based Science Teaching Achievement Test (ISTAT) and the Students' Attitude Questionnaire on Inquiry Based Science Teaching were used as research tools.

The study sample consists of 200 males and 100 females (totalling 300 subjects) junior secondary school third year students out of population of 2,873 in Hadejia zone. T-test for independent samples and Pearson Product-Moment Correlation Coefficient(r) using Statistical Package for Social Science (SPSS) were used for data analysis. The major findings include: Firstly, there is a significant difference in the achievement of experimental and the control groups in favour of experimental group showing that Inquiry

- Based Science Teaching Method is a more suitable method than the Lecture Method of teaching. Secondly, there was a significant difference in the achievement of males and females students exposed to Inquiry - Based Science Teaching Method in favour of male students. Thirdly, there was no significant difference in relationship between academic achievement in science and attitudes towards science after exposure to Inquiry-Based Science Teaching. Descriptive and inferential statistics were used for the data analysis. The data collected were analysed and discussed in relation to the null and alternate hypotheses.

The previous study was similar to the present study in the use of experimental and control groups to find out the effectiveness of Inquiry teaching method in the performance of students as well as the how the data was analysed using descriptive and inferential techniques. One dissimilarity was, while the previous study investigated only the effect of inquiry method in Science in Junior Secondary School Students in Hadejia Zonal Education Area of Jigawa State, Nigeria, the present study however, assessed the effects of two teaching methods (Inquiry and Demonstration) on students' performance in Biology in secondary schools in Federal Capital Territory, Abuja. Nigeria.

Njoroge, Changeiywo & Ndirangu (2014), conducted a research on the effects of inquiry-based teaching (IBT) method on Secondary School students' achievement and motivation in Physics in Nyeri County, Kenya. This study aimed at finding out the effects of IBT method on students' achievement in physics in Nyeri, County. The study adopted a Quasi-Experimental Research Design. Solomon-Four Non-equivalent Groups Design was involved. Stratified random sampling technique was used to select four boys' and four girls' county secondary schools in Nyeri, County. The four schools in each category were assigned to treatment and control groups by simple random sampling technique. Each group had one boys' and one girls' county secondary school. Each school provided one form two class for the study and a total of 370 students were involved. Students in all the

groups were taught the same physics content but the experimental groups were taught using IBT method while the control groups were taught through Regular Teaching Methods (RTM) such as lecture method and teacher demonstrations. The experimental group I and the control group II were pre-tested prior to the implementation of the IBT treatment. After four weeks, all the four groups were post-tested using the Students' Physics Achievement Test (SPAT). The instrument had been validated by five experts in education and pilot tested before use to estimate its reliability. The reliability coefficient using K-R21 was 0.87. The acceptable threshold for reliability coefficient is 0.7 and above. The instruments were scored and data was analysed using t-test, one way ANOVA and ANCOVA at a significance level of coefficient alpha (α) equal to 0.05. The findings of the study showed that Inquiry-Based Teaching (IBT) method resulted into higher students' scores in achievement in physics. The study recommends that Teacher training institutions, Kenya Institute of Curriculum Development (KICD) and physics teachers should use IBT method as the preferred physics teaching method in Kenyan secondary schools.

This previous study was similar to the present study with the use of inquiry method of teaching, adopted a Quasi-Experimental Research Design as well as the use of independent t-test for the data analysis. Some dissimilarity between the previous research and the present research work was that the previous study used both ANOVA and ANCOVA in the data analysis. Also, the previous study was carried out in Kenya in East Africa while the present study was conducted in Abuja, Nigeria, West Africa.

Daluba (2015), conducted a research on the effect of Demonstration Method of Teaching on Students' Achievement in Agricultural Science in secondary school in Kogi East Education Zone of Kogi State. Two research questions and one hypothesis guided the study. The study employed a quasi-experimental research design. The population for the study were 18,225 secondary two (SSII) students in 195 secondary schools. Six (6)

secondary schools were used for the study using purposive random sampling technique. In each of the school selected, two intact classes of the SSII were used. Four hundred and eighty (480) students in the twelve intact classes constituted the sample for the study. The instrument for data collection was a 30-item 'Agricultural Science Achievement Test' (ASAT) using Kuder Richardson 20 (K-R20) formulas, a reliability index of 0.78 was obtained. Research questions 1 and 2 and the only hypothesis were answered using mean, standard deviation and analysis of covariance (ANCOVA) at 0.05 level of significance. The result of study revealed that demonstration method had significant effect on students' achievement than those taught with the conventional lecture method. Useful recommendations such as: efforts should be made by teachers to thoroughly integrate demonstration method in the teaching of agricultural science in secondary schools; efforts should be intensified by teachers to aggressively adopt demonstration method in teaching agricultural science in all classes at the secondary school level were proffered.

This previous study was similar to the present study in the following ways (i) the use of demonstration method of teaching. (ii) The use of Quasi-Experimental Research Design. (iii) The use of purposive random sampling technique. (iv) The use of SSII students in six selected schools and lastly, (v) the use of mean and standard deviation for data analysis. A major dissimilarity between the previous study and present study; while the previous study used analysis of covariance (ANCOVA) at 0.05 level of significance in the data analysis, the present study used independent t-test for its data analysis. Secondly, the previous study was carried out in Kogi State in Nigeria but the present study was carried out in FCT, Abuja, Nigeria.

Another research work was carried out by Muhammad, Bala & Ladu (2016), on the effectiveness of Demonstration and Lecture Methods in Learning Concept in Economics among Secondary School Students in Borno State, Nigeria. Five objectives and three

hypotheses were formulated, and Quasi-experimental Design was used. It was carried out in a classroom setting where classes were intact. The sample population used were SS1 students who were selected for the two groups in two schools, fifty-two students for each school; twenty-six students for each group that was thirteen males and thirteen females. Topics were selected from SS1 secondary school syllabus prepared by West African Examination Council (WAEC) which was considered as a standardized test and was used for the treatment. Twenty-five achievement test objective was conducted, pre-test, post-test were collected and test were given for the groups, before and after treatments. After treatment results were collected and analysed by descriptive statistics of mean, standard deviation and inferential statistics of t-test.

The results of the study revealed that demonstration and lecture methods in learning concepts in economics among secondary school students in Borno state were effective. When the two methods were compared, demonstration method was more effective than lecture method in learning concepts in economics among secondary school students in Borno state. Demonstration groups' results were significantly higher than lecture group's method. It was recommended that economics teachers should maximize the use of demonstration method while teaching and learning certain economics concepts. Moreover, economic teachers should be given the opportunity for in-service training, workshops, seminars and conferences to update their knowledge in methods of teaching and learning economics.

This previous study was similar to the present study in the use of demonstration method of teaching to evaluate the performance of students and the use of quasi experimental design as the research design. In the previous research work, results were collected and analysed by descriptive statistics of mean, standard deviation and inferential statistics of t-test just as in the present study. The dissimilarities include the use of SSI

Economics students in selected schools at Borno State, Nigeria while the present study was conducted at FCT, Abuja SS II Biology students.

Sever and Güven (2014), carried out a research on Effect of Inquiry-based Learning Method on Student Resistance in a Science and Technology course in Turkey. The aim of this study was to identify the resistance behaviours of 7th grade students exhibited during their Science and Technology course teaching–learning processes, and to remove the identified resistance behaviours through teaching–learning processes that were constructed based on the inquiry-based learning method. In the quasi-experimentally designed study, data were collected from 95 students and 14 teachers using both qualitative (students’ follow-up forms, observation, and interview forms) and quantitative (achievement test and personal information survey) methods. In the experimental process, courses given to the control group were taught using the traditional method, whereas those given to the experimental groups used an inquiry-based learning method. The data collected in the spring term of the 2010–2011 academic year were analysed, 25 students were identified as having resistant behaviours such as not participating in the course, not being interested in the course, not taking care of their friends, seeking attention, not respecting the teacher, and providing suggestions to the teacher.

The statistical data analysis showed that there was a significant difference between the pre-test and post-test mean scores of both the control and experiment groups; however, the mean scores of the experimental groups showed a greater increase than those of the control group. While the findings derived from the follow-up forms and the analysis of teacher interviews showed that the experimental process changed the resistance behaviours of students in a positive way, this change was not permanent at the end of the experimental process. As a result, it was found that students can have a variety of resistant behaviours

and these behaviours can be affected positively by different teaching methods that are accepted as effective in that discipline.

The previous study was similar to the present study because inquiry method was used to assess performance of students as well as the use of Quasi-experimental research as its research design. They differ in the sense that the previous study was conducted on resistant behaviour in a primary school in Turkey to science students while the present study was conducted in a secondary school in Abuja, Nigeria to SS2 Biology students.

Bamidele (2015), conducted a research work that investigated the relative effectiveness of Guided Inquiry Strategy and Demonstration Method on the performance of students in practical Chemistry in the secondary schools in Osun State, Nigeria. The study also examined the effects of these methods on the retention ability of the students. The study adopted the non-equivalent pre-test, post-test, control group experimental design. There were two groups; the Guided Inquiry Strategy (GIS) group and the Demonstration Teaching Method (DTM) group. The population for the study consists of all Chemistry students in Secondary School two (SSII) in Ifelodun Local Government Area, of the state. The study sample was made up of seventy eight Chemistry students in Secondary School two (SSII) in their intact classes in two public co-educational Secondary Schools randomly selected in Ifelodun Local Government Area.

The instrument used for the study was Achievement Test in Qualitative Analysis (ATQA). This was used for the pre-test, post-test and retention ability test of the students in qualitative analysis. Results showed that there was a significant difference in the students' performance after exposure to the treatment ($t = 62.712$; $p = 0.000$). Also, students taught with the GIS performed significantly better than those that were taught with the DTM ($t = 27.46$; $p = 0.000$). The mean scores 23.52 and 11.00 for the GIS and DTM respectively). There was also a significant difference in the retention ability of the

two groups ($t = 13.047$; $p = 0.000$), with the GIS group having better retention ability of the concept taught. It was thus concluded that Guided Inquiry Strategy is a very good teaching strategy for practical chemistry because it enhanced the performance and retention of learning.

The previous study was quite similar to the present study because inquiry and demonstration methods were used to assess performance of students. Another similarity is the use of pre-test, post-test, control group experimental design in SSII students. The dissimilarities are in the instrumentation used, the subject that was taught to the students as well as the location of the research work. In the previous study, the instrumentation used was Achievement Test in Qualitative Analysis (ATQA) while in the present study Biology Inquiry and Demonstration Performance Test (BIDPT) was used. In the previous study, the research was carried out in secondary schools students taught Chemistry in Osun State, Nigeria while in the present study, it was carried out in Federal Capital Territory, Abuja, Nigeria Biology students.

Ghumdia (2016), investigated the effect of inquiry strategy on secondary school Biology students' achievements in science process skill acquisition in Biu Educational Zone, Borno State. The design of the study was quasi-experimental of Pre-test, Post-test, Non Equivalent Control Group Design. Samples of one hundred and sixty secondary two (SS II) Biology students randomly drawn from four coeducational schools were used for the study. Three research questions and three null hypotheses guided the study. An instrument known as Biology Students' Process Skill Acquisition Test (BSPSAT) was used for data collection. The data collected were analysed using mean, standard deviation and Analysis of covariance (ANCOVA) at 0.05 level of significance. The results revealed that inquiry-based method was more effective in fostering students' acquisition of science process skills than the lecture method. There was significant effect of treatment on

students' acquisition of science process skills while no interaction between method and gender on students' process skill acquisition. The study recommends amongst other that inquiry strategy should be adapted as viable strategy for studying abstract concepts in Biology. This will enable students to be problem solvers, there by leading to improvement in the performance of students in Biology.

The previous study was similar to the present study because of the use of quasi-experimental of Pre-test, Post-test and Control Group Design in secondary two (SS II) Biology students. The data collected in both studies were analysed using mean, standard deviation. However in the previous study, they further analysed the data using ANCOVA while the present study used Independent t-test. The previous study used Biology Students' Process Skill Acquisition Test (BSPSAT) as the instrument for data collection while the present study used Biology Inquiry and Demonstration Performance Test (BIDPT). The previous study was carried out in Biu, Borno State, Nigeria while the present study was carried out in Federal Capital Territory, Abuja, Nigeria.

Another research work by Bakke and Igharo (2013), sought to find the achievement levels of two groups of secondary schools students who were taught a difficult concept in Further Mathematics using two different methods; the Guided inquiry teaching method and the Conventional teaching method. A 25-items (20 objectives and 5 essay)-type in mathematics test covering the algebra of logic in the four types of logic statements was administered on a sample of 197 students before and after the teaching. These students were randomly drawn from secondary schools in Jalingo Education Zone of Taraba state, Nigeria. The study which lasted for two months generated data that was analysed using mean, standard deviation and analysis of covariance (ANCOVA) with the pre-test scores as covariates at ($P \leq 0.05$) probability level. The results showed that the students who were

taught logic using the Guided inquiry teaching method had better achievement scores than students who were taught using the conventional teaching method.

This previous study has similarities with the present work. The study was an experimental study and was carried out to assess the effects of inquiry teaching method on academic performance of students which was similar to the present study. The previous study used a test instrument for data collection and the data collected were analysed using mean and standard deviation which was used in the present study. The dissimilarities that existed between the previous study and the present research was that, the previous study was carried out using ANCOVA as one of the techniques for data analysis while in the present study, independent t-test was used for its data analysis. The subject taught in the previous study was Further Mathematics in Jalingo Education Zone of Taraba state, Nigeria while the present study was conducted to determine the performance of students in Biology in secondary schools in Federal Capital Territory, Abuja, Nigeria

Iline (2013), conducted a research on the effectiveness of the demonstration teaching method in the teaching of the hearing impaired at a special school in Harare province in Zimbabwe. The research focus was on whether the demonstration should be augmented with other teaching methods. Focus was also on whether the teachers were knowledgeable about the demonstration method and if the resources were adequately channelled and used. A case study based on qualitative paradigm was used in this research. A sample of three teachers, ten pupils the school head and the head of department for technical subjects were used. For the purpose of triangulation, instruments used included interviews, observations, questionnaires and document analysis. The research findings revealed that the demonstration method was not effectively used. For lack of individualized Plan, the pupils did not benefit much from the lessons. The use of sign language was not properly implemented, yet there is need for collaborative use of both sign

and oral language. The need for adequate resources for the hearing impaired, also featured prominently in the research findings in order for pupils to work at their own pace.

This previous study has some similarities with the present work. The study was carried out to assess the effect of demonstration teaching method which was similar to the present study. The dissimilarities that exist between the previous study and the present research were that, the previous study used a survey research design while the present research work used an experimental research design. Another difference in the two studies was that in the previous study, the research was conducted in the teaching of the hearing impaired at a special school in Harare province in Zimbabwe, East Africa while the present study was carried out to assess the effects of Inquiry and Demonstration methods on Performance of biology students' in Secondary Schools in Federal Capital Territory, Abuja, Nigeria

2.10 Summary

This study reviewed literatures on the concept of Biology, concept of Inquiry method, concept of demonstration method and students' academic performance. Relevant theories such as Piaget's Development Theory, Bruner's Theory of Cognitive learning, Dewey's Theory and Vygotsky's Learning Theory were reviewed. Issues on Biology Education Curriculum in Secondary Schools in Nigeria were discussed. The chapter also reviewed relevant literatures on historical development of inquiry method, features of inquiry method, advantages and disadvantages of inquiry method and the influence of inquiry teaching method on students' performance in Biology. Likewise, demonstration method and its advantages and disadvantages were discussed. The chapter reviewed some relevant empirical studies and ended with the summary of the whole chapter. Hence, the study filled the gaps observed in the area of topic, population and sample size.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter examined the methodology used in this study. The chapter focused on the research design, population, sample and sampling technique, instrumentation, validity of the instrument, pilot study and reliability of the instrument, procedure for data collection, treatment of experimental group and procedure for data analysis respectively.

3.2 Research Design

The study was conducted using quasi-experimental design. Eliopoulos (2004) stated that quasi-experimental studies encompass a broad range of nonrandomised intervention studies. These designs are frequently used when it is not logistically feasible or not ethical to conduct a randomised and/or a controlled trial. This implies that, the research design used for this study was a pre-test, post-test and Quasi-experimental and control group design where intact classes (non-randomised groups) were used. According to Offor (2000) and Sambo (2005) in Martins-Omole (2015), quasi-experimental research permits the use of intact classes. Furthermore, Ali (2006) in Martins-Omole (2015), observed that among other conditions, when subjects for a study are selected and randomisations of subject are not visible, rather intact classes be used in quasi experimental research. In the design samples were first pre-tested, in order to determine the groups' equivalence (ability level). The groups were divided into experimental and control groups. The two groups (experimental and control groups) was pre-tested using Biology Inquiry and Demonstration Performance Test (BIDPT), in order to identify and determine their equivalence level. The experimental group (E1, E2 and E3) were exposed to treatment (that was, taught using Inquiry, Demonstration, Inquiry and Demonstration methods) while controlled group (C) was exposed to conventional method. The teaching of the students

lasted for ten (10) weeks. After the treatment, the two groups were then post-tested using Biology Inquiry and Demonstration Performance Test (BIDPT) to observe if there is any difference in their academic performances. The research design for the study was illustrated in the figure 9:

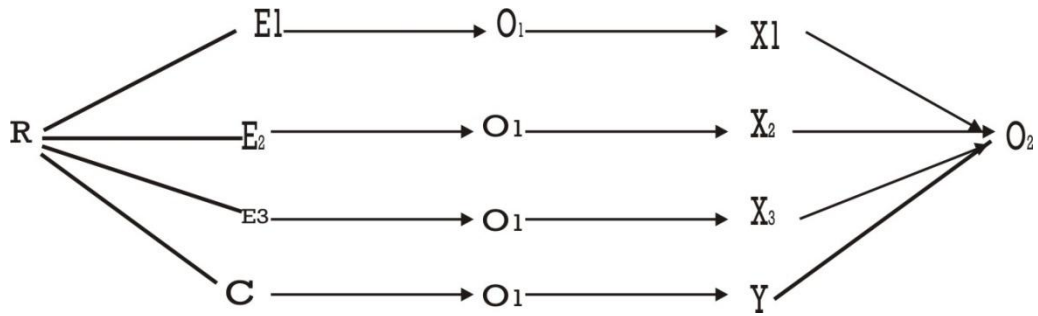


Figure 9: Research Design Illustration

The symbols represented are as follows:

- R = Research Design
- E₁ = Experimental group 1 (Inquiry Method),
- E₂ = Experimental group 2 (Demonstration Method),
- E₃ = Experimental group 3 (Inquiry and Demonstration Group),
- C = Control group (Conventional Method),
- O₁ = Pre-test,
- X₁ = Treatment using Inquiry Method,
- X₂ = Treatment using Demonstration Method,
- X₃ = Treatment using Demonstration and Inquiry Method,
- Y = No Treatment,
- O₂ = Post-test.

In this study, the research design signifies that students in both experimental groups (Inquiry, Demonstration, Inquiry and Demonstration methods) and the controlled group (Conventional method) were exposed to pre-test using the Biology Inquiry and

Demonstration Performance Test (BIDPT). After the treatment, the Biology Inquiry and Demonstration Performance Test (BIDPT) was rearranged alphabetically and administered with a post-test on both the experimental and controlled groups in their respective schools.

3.3 Population

The population of this study comprised the entire twenty three thousand, four hundred and twenty two (23,422) SSII students consisting of twelve thousand, three hundred and fifty (12,350) male students and eleven thousand and seventy two (11,072) female students offering Biology in Federal Capital Territory, Abuja for 2015/2016 session. There are fifty-six (56) secondary schools in Federal Capital Territory. This category of students have completed SSI, they are stable and familiar with the school environment, laboratories and the instructors. The students are of average age of 15-17 years. Details of the population according to the area councils in Abuja are presented in table 2:

Table 2: Population Distribution of SS II Biology Students in the Public Secondary schools in six areas council of FCT Abuja

S/N	Names of Area Councils	No. of School	Population of Male Students	Population of Female Students	Total
1	Abaji	4	461	789	1250
2	Bwari	11	1802	2332	4545
3	Gwagwalada	8	1721	1946	3867
4	Kuje	7	1363	1005	2584
5	Kwali	5	662	505	1267
6	Municipal	21	3763	4146	9909
	Total	56	11072	12350	23422

Source: FCT-Secondary Education Board (2015-2016).

3.4 Sample and Sampling Techniques

The sample size for this research comprised intact classes of three hundred and forty two (342) students offering Biology from six co-educational schools in Abuja Area council. The schools included Government Secondary School (GSS) Wuse Zone 3,

Government Secondary School (GSS) Kuje, Government Secondary School (GSS) Lugbe, Government Secondary School (GSS) Gwarinpa, Government Secondary School (GSS) Hajj Camp, Gwagwalada and Government Secondary School (GSS) Yangoji, Kwali area council in FCT, Abuja. The sample size was sufficiently large enough for the experimental study as it conforms to Fraenkel, Wallen & Hyun (2015), who recommended minimum number of 30 for an experimental research of this nature. Purposive sampling technique was used to divide the six area council into urban and rural areas. Based on the results, fifty seven (57) students from intact class formed the experimental group for inquiry method taught at Government Secondary School (GSS) Wuse Zone 3, a total of seventy eight (78) students from intact class formed the experimental group for demonstration method in Government Secondary School (GSS) Lugbe, while a total of fifty one (51) students in Government Secondary School (GSS) Kuje were taught using inquiry and demonstration method. There were three control groups in this study. Each control group represented the three experimental groups. There were a total of fifty three (53) students from intact class formed the control group for inquiry method at Government Secondary School (GSS) Hajj Camp, Gwagwalada area council, Abuja. Government Secondary School (GSS) Yangoji, Kwali area council was the school used for control group for demonstration method which comprised of fifty three (53) students while Government Secondary School (GSS) Gwarinpa was the school used for control group (inquiry and demonstration methods) which comprised of fifty (50) students. The selection was in line with Ndagi in Saleh (2003), who stated that an educational researcher should select sample by method that ensure the provision of unbiased estimate of the relevant characteristics of the population. Therefore, purposive sampling technique was used to ensure a fair representation of the various types of variable that is of interest to this study, such as school location. The purposive random sampling was also in line with CIRT (2017) who stated that a quasi-

experimental design lacks the random assignment that is a requirement of true experimental research.

The six study groups were located far apart. Three of the study groups were located in the rural area namely Government Secondary School (GSS) Yangoji, Government Secondary School (GSS) Hajj Camp and Government Secondary School (GSS) Kuje while the other three are located in the urban areas namely: Government Secondary School (GSS) Wuse Zone 3, Government Secondary School (GSS) Lugbe and Government Secondary School (GSS) Gwarinpa. This was done in order to avoid students' interaction during the treatment and administration of the research instruments which might affect the result of the study. The classification of the population into control and experimental groups are summarized in table 3.

Table 3: Sample Distribution

S/N	Sampled School	Groups	Male Students	Female Students	Total	
1	GSS Wuse Zone 3	Experimental (inquiry Group)		22	35	57
2	GSS Lugbe	Experimental (Demonstration Group)		36	42	78
3	GSS Kuje	Experimental (Inquiry and demonstration Group)		31	20	51
4	GSS Hajj Camp	Control Group for Inquiry method		25	28	53
5	GSS Yangoji	Control Group (Demonstration method)		30	23	53
6	GSS Gwarinpa	Control Group (Inquiry and Demonstration method)		22	28	50
Total				166	176	342

3.4.1 Homogeneity of Sample

A data set is homogeneous if it is made up of things (that is, people, cells or traits) that are similar to each other (Andale, 2015). Cohen and Crabtree (2006), defined homogeneous sampling as the process of selecting a small homogeneous group of subjects or units for examination and analysis. Homogeneous sampling is used when the goal of the research is to understand and describe a particular group in depth. Homogeneous sampling is a purposive sampling technique that aims to achieve a homogeneous sample; that is, a sample whose units (example are people, cases) share the same (or very similar) characteristics or traits example a group of people that are similar in terms of age, gender, background, occupation. In this respect, homogeneous sampling is the opposite of maximum variation sampling. A homogeneous sample is often chosen when the research question that is being address is specific to the characteristics of the particular group of interest, which is subsequently examined in detail (Lund Research, 2012).

Homogeneous sample should reflect a particular need of the group of students. Because students have varying strengths and areas of need, these groupings should change to reflect those needs or strengths. The students sampled for this study were from different area councils in Federal Capital territory Abuja. Their homogeneity was determined by considering the fact that the students share similar characteristics like student type (co-educational), admission requirements, having the similar school physical structures, similar subjects time table, the same syllabus, same type of textbooks and the students are taught by competent and experienced Biology teachers. Although they have varying intelligence and area of needs. This has been done in order to reduce the chances of bias, error variance with group as well as inaccurate measurement and evaluation.

3.5 Instrumentation

For this study, one instrument was used for the purpose of data collection- the multiple-choice objective tests titled “Biology Inquiry and Demonstration Performance Test” (BIDPT). With the assistance of qualified and experienced Biology teachers from the six co-educational secondary schools selected, topics like (i) Digestive system (ii) Transport system (iii) Respiratory system (iv) Excretory system (v) Nutrients cycling in nature and (vi) Ecological management was used for the study. This was coiled out from the first term SSII Biology curriculum. The need to maintain stability and order in the normal scheme of work for the sampled schools was recognized. In this study, the researcher prepared lesson plan, items for demonstration, practical works and constructed multiple-choice objective tests. The instrument consist of fifty (50) multiple-choice objective questions with four (4) options or answers to pick from; which is based on the first term SSII Biology curriculum. The Biology Inquiry and Demonstration Performance Test (BIDPT) was drawn from the past question papers of WAEC and NECO from 2009 to 2015. This pre-test was objective test given to the students before any treatment was administered to them. The tests were designed to measure students’ cognitive level and determine the performance of the students in the sample. After the treatment to the groups, a post-test was administered to the students. In the post-test, the options were rearranged to avoid possibility of guessing the answers to the question. Each question will carry 2 marks for a total of 100 marks.

3.5.1 Table of Specification

Table of specification also known as a test blueprint was designed based on the list of course objectives, the topics covered in class, the amount of time spent on these topics, the emphasis and space provided in the text. Jose (2012), stated that the purpose of a

Table of Specifications was to identify the achievement domains being measured and to ensure that a fair and representative sample of questions appear on the test. Teachers cannot measure every topic or objective and cannot ask every question they might wish to ask. The author explained that a Table of Specifications allows the teacher to construct a test which focuses on the key areas and weights those different areas based on their importance. A Table of Specifications provides the teacher with evidence that a test has content validity, that it covers what should be covered. The contents taught in the teaching and learning process in this study are specified in Table 4.

Table 4: Table of Specification

Content	*Klge	*Comp	*Appli	*Eva	*Ana	*Rec	*Syn	Resp	Total
Digestive System	1	1	3	0	1	0	0	0	6
Transport System	2	2	3	0	3	1	3	0	14
Respiratory System	1	4	1	1	0	3	0	0	10
Excretory System	0	4	0	2	2	1	1	0	10
Nutrients Cycling in Nature	0	1	1	0	2	1	1	1	7
Ecological Management	1	0	0	0	0	0	2	0	3
Total	5	12	8	3	8	6	7	1	50

*Klge means Knowledge, *Comp means Comprehension, *Appli means Application

*Eva Means Evaluation, *Ana means Analysis, *Rec means Receiving, *Syn means Synthesis, *Resp means Responding.

Table 4 was specified the plan for writing test items based on some selected aspect of cognitive domain and affective domain. The table identified the expected recalling knowledge of students, their ability to grasp meaning from the material learned, application of the content learned and the evaluation of the teaching-learning process. This agreed with the view of Akem (2006) in Alade and Omoruyi (2014), who wrote that table of specification, was a guide to assist a teacher or examiner in the evaluation system. The authors explained that the table shows the total number of items to be allocated to each instructional objectives, it also suggest what might be covered under each item, take decision on what types of items to be used. The authors added that in fact the blue print stage was the last and crucial stage in an evaluation plan since it enables the teacher to combine properly the objective and the content areas, bearing in mind the importance and the weight attached to each area.

3.5.2 Treatment Package

There are three groups in this study, the control group and two experimental groups (inquiry and demonstration methods). Inquiry method allows students to learn and experience Biology first-hand, by taking on the role of scientist. The students use the inquiry process to develop explanations from their observations (evidence) by integrating what they already know with what they have learnt (Opara, 2011).

Treatment Package for inquiry Method- In administering inquiry method in the treatment package, the following steps was followed:

Step 1: the teacher introduced the lesson using confirmation inquiry and asked the students some prior knowledge questions. The teacher made the students to perform some activities such as simple breathing exercise.

Step 2: the teacher asked the students to write down their observations and also read them out.

Step 3:the teacher asked questions on key concepts in the topic using structured inquiry method. The teacher also defined the key concepts and encouraged the students think critically to relate what they already know in their previous lessons (prior knowledge) to the new concepts.

Step 4: the teacher performed experiments in regards to the topic using guided inquiry. The teacher divided the students into six groups to perform the experiments.

Step 5: the teacher used guided inquiry and asked the students to perform their own experiments or inquiry activities to carry out their own investigations. The students were directed to focus on the processes or steps of the experiments and not the outcome. Guided inquiry method facilitated the teaching of specific skills.

Step 6: the students made well labelled diagram of their observations. They wrote down functions of some of the displayed parts of experiment. The teacher instructed the students to submit their note/drawing books for marking.

Step 7: the teacher summarised the lesson and then gave the students assignments.

Treatment package for Demonstration method- In administering Demonstration method in the treatment package, the following steps was followed:

Step 1:the teacher prepared, rehearsed the experiments under the similar condition that will prevail at the time of demonstration.

Step 2: the teacher introduced the lesson in a problematic manner and asked the students questions relating to the topic to stimulate their interest in the class.

Step 3: after the introduction of the lesson, the teacher took steps in which the subject matter was presented properly and effectively. For example when ‘Decomposition in nature’ was taught, the teacher first defined the word decomposition, then stated the types of decomposers, role of a decomposer and importance of decomposition to the students.

Step 4: the teacher used audio-visual aids for teaching Transport system, excretory system and respiratory system. The teacher also performed experiments on dissections (digestive system in a bird and longitudinal section of a kidney) in front of the students. The teacher put the work on the demonstration table in such a place that all the students can view it properly. The teacher told the students to note that the steps in experimentation work should be spaced for ease of understanding.

Step 5: the teacher also used the chalk board to write results, draw various sketches ordiagrams and mentioned their various parts.

Step 6: the students imitated the teacher by copying the information written on the chalkboard in their note books. The teacher went frequently to the seats of the individual student to ensure they copied their notes.

Step 7: the teacher summarised the topic and gave the students assignments. The teacher instructed the students to submit their note/drawing books for marking.

The demonstration method aided students to do task using sequential instructions and it also allowed the teacher to establish a good rapport with the students. Students felt motivated and inspired. This method was used in the schoolwith large number of students and the number of apparatus in the school was insufficient.

Table 5: Treatment Package

Content	Cognitive Domain						Affective Domain		Total
	*Klge	*Comp	*Appli	*Eva	*Ana	*Syn	*Rec	Resp	
Digestive System	5	8	1,4,16		2				6
TransportSystem	3,7	9,12	10,18, 39		11,21, 50	14,17, 49	13		14
RespiratorySystem	19	15,20, 24,25	26	22			23,27, 28		10
Excretory System		30,34, 35,36		33,38	32, 6	31	29		10
Nutrients Cycling in Nature		37	40		43,48	42	44	41	7
Ecological Mgt.	47					45,46			3
Total	5	12	8	3	8	7	6	1	50

*Klge means Knowledge

*Comp means Comprehension

*Appli means Application

*Eva Means Evaluation

*Ana means Analysis

*Syn means Synthesis

*Rec means Receiving

*Resp means Responding

Table 5 is a mirror of two dimensions instructional process, that is, contents and intellectual procedure. It described the topics covered by the test instrument and the number of items based on some selected aspects of cognitive and affective domain.

3.5.3 Validity of the Instrument

Validity is the ability of an instrument to measure what it is designed to measure. Face validity is the establishment of logical link between questions and answers while content validity accesses if items and questions cover the full range of the issue being measured (Shahril, 2015). To ensure both face and content validity of the instrument in this research work, the drafted lesson plans together with the Biology Inquiry and

Demonstration Performance Test (BIDPT) instrument was given to the researcher's supervisors in Curriculum and Instruction Section, Department of Educational Foundations and Curriculum, Ahmadu Bello University, Zaria and three experienced Biology teachers in Federal Capital Territory, Abuja who ascertained the appropriateness of the instrument.

3.5.4 Pilot Study

A pilot study is a standard scientific tool for 'soft' research, allowing scientists to conduct a preliminary analysis before committing to a full-blown study or experiment (Shuttleworth, 2010). A pilot study was carried out for the research work to determine the reliability of Biology Inquiry and Demonstration Performance Test (BIDPT) as study instrument. The instrument was administered twice within an interval of two weeks to thirty (30) Secondary School (SSII) Students in GSS Jabi, Abuja. The reason for using this school is that, it is within the population under study but not among the schools selected for the main study. It was chosen to determine the adequacy and effectiveness of the instrument in measuring what it is supposed to measure, and to ascertain any difficulty that the researcher may encounter when carrying out the main research work.

3.5.5 Reliability of the Instrument

The reliability of the Biology Inquiry and Demonstration Performance Test (BIDPT) was determined by statistical analysis of the data collected from the pilot study. Reliability of an instrument is the degree of accuracy or precision in measurements made by a research instrument (Shahril, 2015). Results of the trial test were recorded in terms of their overall performance on the test and re-test administered. The reliability coefficient of the test and re-test scores were computed by means of Pearson Product Moment Correlation Coefficient (PPMCC). Therefore, the instrument was considered reliable because the reliability index falls between 0.05 to positive one (+1). The reliability index for the pilot study carried out on Thirty (30) SS II students at Government Secondary

School GSS Jabi, Abuja was 0.849. This was in line with Andale (2016), who asserted that reliability coefficients (also called coefficients of stability) vary between 0 and 1, where: 1 : perfect reliability, ≥ 0.9 : excellent reliability, $\geq 0.8 < 0.9$: good reliability, $\geq 0.7 < 0.8$: acceptable reliability, $\geq 0.6 < 0.7$: questionable reliability, $\geq 0.5 < 0.6$: poor reliability, < 0.5 : unacceptable reliability, and 0: no reliability.

3.6 Procedure for Data Collection

The researcher collected a letter of introduction from the Department of Educational Foundations and Curriculum, Faculty of Education, Ahmadu Bello University, Zaria which was used to introduce the researcher to the FCT Schools Board Abuja. Data for the study was collected through the administration of pre-test and post-test with the aid of three (3) research assistants who were specially trained by the researcher. The data collection phase lasted for ten (10) weeks comprising of double period of eighty minutes per week for each group. The researcher and the trained teacher administered a pre-test to the students in experimental and control groups respectively using an instrument named Biology Inquiry and Demonstration Performance Test (BIDPT) before the commencement of the treatment. Meanwhile, the pre-test scores served as a basis for comparing students' performance in Biology test before treatment. Inquiry method (treatment 1), Demonstration methods (treatment 2), Inquiry and Demonstration method (treatment 3) were carried out for a period of ten weeks. The experimental groups were taught using inquiry, Demonstration, Inquiry and Demonstration activities, while the control groups were taught using the conventional method by their experienced Biology teachers who were trained by the researcher. After the treatment, a post-test was administered to both the experimental and the control groups. The scripts were collected, marked, scored and recorded to make comparison between the groups. This took place in the second term of 2016/2017 academic session.

3.6.1 Treatment Procedure

The experimental group was treated for ten weeks. The double period on the timetable was used for the lesson to ensure that both the explanations of the topics and teaching methods had ample time. Sequel to the commencement of the treatment, the researcher explained how Inquiry; Demonstration; Inquiry and Demonstration; and Lecture methods of teaching operates

a. Inquiry Method (Experimental Group E1)

Prior to commencement of any lesson, a pre-test was administered to the students to test their ability on the various topics to be taught during the treatment. The Biology class was a double period of Eighty minutes. In the first week, the experimental classes were taught Digestive System in mammals using Inquiry methods of teaching. The teacher asked the students questions on the topic and then gave detailed explanations on the key concepts in Digestive System (feeding in lower, higher animals and plants) stressing on the areas the students could not give correct answers. The teacher also guided the students in the dissection of a bird which took place in the School laboratory. The students were divided into six groups for the practical class in dissection. Each group had a team leader and each member of the team took part in the dissection of the bird. They exposed and displayed the alimentary canal (digestive system) of the bird. Also, a chart of the digestive system of bird picture showing different parts of alimentary system (mouth, oesophagus, stomach, pancreas, small intestine, large intestine, rectum and anus) was also displayed on the chalkboard. The students made their observations, drew the digestive system of the dissected bird in their notebooks, labelled the drawings and listed the different functions.

In the second week, the teacher taught Transport System to experimental group using Inquiry method. The teacher started the lesson by asking students some questions in regards to the topic. After their various responses, the teacher guided the students to

explain the key concepts- the definition of transport system; importance of diffusion and osmosis to transport system; transport system in large organisms (plants and animals); materials for transport structures of arteries, veins, vascular bundles were taught to the students. The teacher gave detailed explanations on the key concepts in this topic especially the areas the students did not grasp. The students were divided into two groups. The teacher guided them to set up an experiment on rate of diffusion of a coloured liquid using liquid copper sulphate. The teacher instructed and guided the students to pour clean water into a beaker (glassware) and slowly run in 25cm³ of liquid copper sulphate through a pipette into the glass of water. The students wrote down their observations from the experiment. The teacher gave the students assignments. Transport System continued in the third week with the topic 'Media of Transportation in Large Organisms' (Plants and Animals).The teacher introduced the lesson and asked the students questions in regards to the topic. The teacher defined Blood, mentioned the components of the Blood (Red blood cell, white blood cells, blood platelets, lymphocytes and the blood plasma) to the students.. The teacher guided the students to state the materials for transportation in plants (water by the root, mineral salt by the root, photosynthesis and food from the leaves) and Media of transportation in plants which are the vascular bundles (xylem and phloem). Theteachertold the students to come out of the laboratory to detach leaves from plants in front of the laboratories. The teacher instructed the students to explain their observations verbally. The teacher also instructed the students to write their observations in their note books. Assignments were given to the students at the end of the lesson.

Transport System continued into the fourth week with the Mechanism of Transportation in plants and mammals. In the class taught using inquiry method, the teacher had introduced the topic in an earlier Biology class and asked them questions in which they responded correctly. The teacher also requested that they get more information

on transport system from the internet or other sources of information. The teacher explained to the students the mechanism of transportation in lower organisms like Amoeba and Paramecium through cytoplasm and in plants through latex or cell sap. The teacher explained to the students the mechanism of transportation of blood in the mammals (Heart, Blood vessels and Lymphatic vessels). The teacher came to the class with four laptops and divided the students in the laboratory into four groups. The teacher showed the students a short video from YouTube explaining human blood circulation and heart beat in 3D from idaalearning.com. The teacher also showed the students from the laptops magnified human blood cells in three-dimensional (3D) from istockphoto.com. The teacher guided the students who drew and wrote down their observations.

In the fifth week, Respiratory system (aquatic animals) was taught to the inquiry group. The teacher asked the students questions on Respiratory system in Fish. The teacher guided the students to define Respiration, External/Internal Respiration and Respiratory system to the students. The teacher listed the characteristics of a respiratory surface, types of respiratory systems (body surface, gills, lungs in terrestrial vertebrates and mammals) to the students. The teacher guided the students to carry out an experiment on the respiratory system of Tilapia fish. The students carefully removed the respiratory organs of the dead tilapia fish and displayed them. They observed, drew and labelled the gill flaps, gill arch and gill filaments as well as their functions.

In the sixth week, the teaching of Respiratory System continued. The teacher started the lesson with questions on the Respiratory System of Mammals. After their response, the teachers defined and explain key concepts in this topic which are Exhalation, Inhalation and the Respiratory System in Man. The teacher asked the students to simply breathe in and out and requested them to write their observations. The teacher came to the class with a set of Respiratory System of a Goat purchased from the local abattoir. The

students identified (i) Trachea (ii) Bronchi (iii) Lungs. The teacher guided the students to press the trachea between their fingers to feel the cartilage ring, the teacher asked the students the importance of the cartilage ring; the students felt the texture of the lungs. The teacher asked the students to draw a well-labelled diagram of the respiratory system of a goat displayed in the class. The teacher encouraged the students to recognise, name and write down the function of the various organs that make up the Human Respiratory System (which is similar to that of a goat) in their notebooks.

Excretory system was taught during the seventh week. The students in the inquiry method were encouraged by the teacher to mention and discuss the organ of excretion in some lower animals and plants which are contractile vacuole in Amoeba and flame cells in Tape Worm. The teacher further explained the key concepts in Excretory System which are- the organ of excretion in amoeba (Contractile vacuole); tape worm (flame cells); insects (Malpighian tubules); Man (kidneys) and in the higher plants (stomata and lenticels) to the students. The teacher explained to students the mechanism of excretion in lower micro-organisms, lower & higher Plants and Man. The teacher showed the students' diagrams of an Amoeba and Tapeworm with the teaching focused on the contractile vacuole and flame cells respectively. The teacher asked the students to mention the organ of excretion in higher animals and plants. The organ of Excretion in Mammals is the Kidneys while in the higher Plants (stomata and lenticels).

The teacher came to the class with three pairs kidneys of goats. The teachers divided the class into six groups and provide them with the knives. The teacher guided the students to use the knives to carefully cut the kidneys into two equal parts longitudinally. The students were encouraged to recognise the parts of the kidney. A chart of the longitudinal section of a Human kidney was also displayed in the classroom to ease the understanding of the various parts of the kidney.

Nutrients cycling in nature were taught to the students during the eighth week. The teacher started the lesson with asking students questions on the topic. The key concepts were discussed with the students in detail. The students were led to perform an experiment by the teacher to show release of oxygen during photosynthesis. The test tube was removed from the top of the filter funnel by a student. The gas collected in the test tube was tested with the use of a glowing splint. The gas present rekindled the glowing splint which showed or confirmed the presence of oxygen. The teacher defined and discussed Carbon Cycle with the students. In the ninth week, students were taught Ecological Management (Decomposition in nature) by the teacher with emphasis on the type of decomposers-micro decomposers (bacteria, fungi) and Macro decomposers (earthworms, snails, termites). Prior to this lesson, the students were told to leave food or bread remnants in an enclosed and dark place and bring same to this class after a week. The teacher grouped the students into seven groups. They made their observations and wrote them down. The teacher gave the students assignment.

In the tenth week, the teaching of Ecological Management continued but this week, it was on Adaptation such as structural adaptation of Tadpole and Fish that live in water as well as those of vertebrates like birds. The teacher started the lesson with questions on Adaptation to the students. After their responses, the teacher then guided the students to talk on the types of association like symbiosis (mutualism), parasitism and commensalism. The students were asked by their teacher to express their view on ticks they see on cow or dogs in regards to the type of association. The teacher also asked the students if they have observed chameleon against different back ground. They should verbally explain their observations. The students were encouraged to get pictures of different organisms' adaptation to their environment. The students were required to write down their

observations. At the end of the treatment period, a post test was administered to the students.

b. Demonstration Method (Experimental Group E2)

Prior to treatment of the group, a pre-test was administered to the students to test their ability on the various topics to be taught during the treatment. The Biology class was a double period of eighty minutes. In the first week, the experimental class was taught Digestive System in mammals using Demonstration methods of teaching. The teacher asked the students questions on the feeding habits of insects and other lower animals. The teacher demonstrated and display a picture showing the modification of feeding habit such as filter feeder (mosquito larva); Fluid feeders (house fly); parasitic (tape worm) and saprophytic feeders (Hydra). In the picture, the teacher pointed out for the students that, Amoeba uses its pseudopodia to circle, engulf it to form food vacuole, enzymes are introduced to digest it intra-cellularly. The hydra ingests food particles through the mouth into the hollow stomach (ecteron) where extra-cellular digestion takes place. The teacher dissected a bird on the demonstration table in the laboratory while the students looked at the teacher with rapt attention. After dissection of the bird and display of the alimentary canal of the bird, the students came in groups to observe the alimentary canal of the bird displayed. Also, a chart of the digestive system of bird picture showing different parts of alimentary system and their functions (mouth, oesophagus, stomach, pancreas, small intestine, large intestine, rectum and anus) was also displayed on the chalkboard. The students imitated the teacher as they drew the digestive tract of the bird and then listed their functions.

In the Second week, the teacher taught Transport System to students. The teacher started the lesson by asking questions on Transport System. The definition of Transport System; importance of Diffusion and Osmosis to Transport System The teacher explained

and illustrated diffusion using diagrams. The students imitated the teacher by using cardboard sheets to make their own drawings and then wrote their observations beside their diagrams. Transport System continued in the third week with Media of Transportation in large organisms (Plants and Animals) was taught. The teacher started the lesson by asking students questions on the previous topic of transport system. The media for transportation such as arteries and veins in animals and also the transport system in plants (vascular bundles) were taught to the students. The teacher guided the students to mention the components of the blood (Red blood cell, White blood cells, Blood platelets, Lymphocytes and Blood plasma) which was discussed in details. The teacher asked the students to draw a cross section of a cassava leaf as illustrated in the chart displayed in front of the classroom.

Transport system continued into the fourth week with the Mechanism of Transportation in lower and higher organisms. The teacher asked the students questions on the media of transportation in plants. The teacher explained to the students the mechanism of transportation in lower organisms like amoeba and paramecium (cytoplasm) and lower plants through the cell sap or latex by osmosis. The teacher further explained that the mechanism of transportation in higher organism like Man is the Mammalian heart. The Teacher explained to the students the mechanism transport of plants which is the vascular tissues (xylem and Phloem). The teacher requested that the students make various drawings of the mammalian heart as displayed either from the laptop or the chart displayed in front of the class. The teacher requested that they get more information on transport system from the internet or biology text books. The teacher also informed them to also read about respiratory system as it is the topic to be taught the following week. Respiratory system was taught to the students in the fifth and sixth week.

In the fifth week, the teacher asked the students questions on respiratory system. The teacher defined the key concepts in respiration- definition of respiration and respiratory system; and also the types of respiratory systems (body surface in lower organisms, gills in aquatic animals, lungs in terrestrial vertebrates and mammals).The students in the demonstration group observed and listened attentively to the teacher who brought a tilapia fish to the class. The teacher showed the students the different parts of the respiratory system of the Tilapia fish which is Gills (gill arch, gill rakers and gill filaments) and encouraged the students to list the functions. The organs that make up the respiratory system were pointed out to the students. Functions of the various parts were written on the chalkboard by the researcher. The researcher ensured that the students copied same in their notebooks.

During the sixth week, the teaching of Respiratory System continued with Mechanism of Respiration. The teacher asked the students questions on respiration. After their response, the teacher defined and explained key concepts in this topic which are Exhalation, Inhalation and the Respiratory System in Man. The teacher, with the aid of a chart listed the parts that make up the human respiratory system to the students. The teacher encouraged the students to recognise, name and write down the function of the various organs that make up the human respiratory system in their notebooks.

Excretory system was taught during the seventh week. The students were encouraged by the teacher to mention and discuss the organ of excretion in lower animals and plants which are contractile vacuole in amoeba and flame cells in tape worm. The teacher showed the students diagrams of an amoeba and tapeworm with focus on the contractile vacuole and flame cells respectively with the use of a laptop and a model of the cross section of the Human Kidney. The teacher asked the students to draw well labelled diagrams of an Amoeba and the cross section of a human kidney in their note books. The

students also wrote down functions of the various parts of the human excretory organs. Nutrients cycling in nature were taught to the students during the eighth week. The teacher asked the students questions on key concepts in this topic- Water, Carbon and Oxygen cycle. After their response, the teacher explained Water, Carbon, Oxygen cycle and also Importance of nutrient cycle in nature to the students. The teacher explained and showed a diagrammatic representation of the carbon cycle and water cycle. The teacher drew the diagram of 'Recycling nutrients in ecosystem' on the blackboard. The student imitated the teacher as they also drew and labelled same.

In the ninth week, students were taught Ecological Management (Decomposition in nature) by the teacher. The teacher started the lesson by asking the students what they understand by the word 'Decomposition'. After the students' responses, the teacher explained to the students the type of decomposers- micro decomposers (bacteria, fungi) and Macro decomposers (earthworms, snails and termites), the importance of decomposition and the harmful effects of micro-organisms. The teacher displayed diagrams of Snail (Macro decomposers) and Rhizome (Micro decomposers) on the chalkboard. The students imitated the teacher as they drew the diagrams in their note books.

In the tenth week, the teaching of Ecological Management continued but this week, it was on Adaptation such as structural adaptation of tadpole and fish to life in water as well as those of vertebrates like Birds. The teacher started the lesson by asking the students questions on the last lesson. The teacher defined and explained the key concepts of this lesson- Tolerance, Adaptation, Maximum and Minimum Tolerance, factors responsible for Geographic range as well as adaptive features of aquatic plants and animals. The teacher encouraged the students to mention types of association like symbiosis (mutualism), parasitism and commensalism. The students were asked to bring pictures of different organisms' adaptation to their environment. The students wrote down their observations.

At the end of the treatment period, a post test was administered with the help of the research assistants.

c. Inquiry and Demonstration Method (Experimental Group E3)

Before the commencement of the treatment, a pre-test was administered to the students to test their ability on the various topics to be taught during the treatment. The Biology class was a double period of Eighty minutes. In the first week, the experimental class was taught Digestive System in mammals using Inquiry method. The teacher asked the students questions on the topic and then gave detailed explanations on the key concepts in Digestive System (feeding in lower, higher animals and plants) stressing on the areas the students could not give correct answers. The teacher also guided the students in the dissection of a bird which took place in the school laboratory. The students were divided into six groups for the practical class in dissection. Each student in the group took part in the dissection of the bird. They exposed and displayed the alimentary canal (digestive system) of the bird. Also, a chart of the digestive system of bird was displayed which showed different parts of alimentary system (mouth, oesophagus, stomach, pancreas, small intestine, large intestine, rectum and anus). The students made their observations, drew the digestive system of the dissected bird in their notebooks, labelled the drawings and listed the different functions.

In the second week, the teacher taught Transport System to students using Demonstration method. The teacher started the lesson by asking questions on Transport System. The definition of Transport System; importance of Diffusion and Osmosis to Transport System was explained by the teacher to the students. The teacher explained and illustrated diffusion using diagrams. The students imitated the teacher by using cardboard sheets to make their own drawings and then wrote their observations beside their diagrams. Demonstration method was used also to teach the students continuation of Transport

System in the third week. The teacher taught Media of Transportation in large organisms (Plants and Animals) to the students. The teacher started the lesson by asking students questions on the previous topic on transport system. The teacher explained the media for transportation such as arteries and veins in animals and vascular bundles in plants to the students. The teacher guided the students to mention the components of the blood (Red blood cell, White blood cells, Blood platelets, Lymphocytes and Blood plasma) which was discussed in details. The teacher asked the students to draw a cross section of a cassava leaf as illustrated in the chart displayed in front of the classroom.

Transport system continued into the fourth week with the Mechanism of Transportation in lower and higher organisms. This topic was taught using demonstration method. The teacher asked the students questions on media of transportation in plants. The teacher explained to the students the mechanism of transportation in lower organisms like amoeba and paramecium (cytoplasm) and lower plants through the cell sap or latex by means of Osmosis. The teacher further explained that the mechanism of transportation in higher organism like Man is the mammalian Heart. The Teacher explained to the students the mechanism transport of plants which is the vascular tissues (xylem and Phloem). The teacher requested that the students made various drawings of the mammalian heart as displayed from the laptop and or the chart displayed in front of the class. The teacher requested that the students get more information on transport system from the internet or biology text books. The teacher also informed them to also read about respiratory system as it's the topic to be taught the following week.

Respiratory system (aquatic animals) was taught to the students in the fifth and sixth week using Inquiry method. In the fifth week, Respiratory system was taught to the experimental group 3. The teacher asked the students questions on Respiratory system in Fish. The teacher explained the key concepts in Respiratory system which included the

definition and types. The teacher guided the students to carry out an experiment on the respiratory system of fish in the Biology laboratory. The students were divided into six groups. The students selected their team leaders for each group. The teacher guided the students to carefully remove the respiratory organs of the dead tilapia fish and displayed them on the dissecting board. They observed, draw and labelled the gill flaps, gill arch and gill filaments as well as discussed their functions.

In the sixth week, the teaching of Respiratory System continued. Respiratory system of mammals was taught by the teacher using Inquiry method. The teacher started the lesson with questions on the Respiratory System of Mammals. After their response, the teachers defined and explain key concepts in this topic which are Exhalation, Inhalation and the Respiratory System in Man. The teacher asked the students to simply breathe in and breathe out. The teacher told the students to write down their observations. The teacher came to the class with a set of Respiratory System (Lungs) of a Goat purchased from the local abattoir. The students identified (i) Trachea (ii) Bronchi (iii) Lungs. The teacher guided the students to press the trachea between their fingers to feel the cartilage ring, the teacher asked the student the importance of the cartilage ring; the students felt the texture of the lungs. The teacher asked the students to make a well labelled diagram of the respiratory system of the goat in front of them. The teacher encouraged the students to identify, name and write down the functions of the various organs that make up the Human Respiratory System (which is similar to that of a goat) in their notebooks.

Excretory system was taught during the seventh week. The teacher taught the students excretory system using Inquiry method. The students were encouraged by the teacher to mention and discuss the organs of excretion in some lower animals and plants which are contractile vacuole in Amoeba and flame cells in Tape Worm. The teacher asked the students to mention the organs of excretion in higher animals and higher plants. The

teacher further explained the key concepts in Excretory System. The organ of excretion in mammals is the kidneys while in the higher plants (stomata and lenticels). The teacher came to the class with three pairs kidneys from goats. The teacher divided the class into six groups and provided them with knives. The teacher guided the students to use the knives to carefully cut the kidneys into two equal parts longitudinally. The students were encouraged to recognise the parts of the kidney. They drew and labelled the parts in their note books.

Nutrients cycling in nature were taught to the students during the eighth week. Nutrients cycling in nature were taught by the teacher using Inquiry method. The teacher asked the students questions on key concepts in this topic- Water, Carbon and Oxygen cycle. After their response, the teacher explained Water, Carbon and Oxygen cycle; and also Importance of nutrient cycle in nature. The students were led to perform experiment by the teacher to show release of oxygen during photosynthesis. The test tube was removed from the top of the filter funnel by a student while others watched. The gas collected in the test tube was tested with the use of a glowing splint. The gas present rekindled the glowing splint which showed or confirmed the presence of oxygen. In the ninth week, students were taught Ecological Management (Decomposition in nature) by the teacher. Demonstration method was used by the teacher to teach the students Decomposition in nature. The teacher started the lesson by asking the students what they understand by the word 'Decomposition'. The teacher explained to the students the type of decomposers- micro decomposers (bacteria, fungi) and Macro decomposers (earthworms, snails and termites), the importance of decomposition and also the harmful effects of micro-organisms. The teacher displayed diagrams of Snail (Macro decomposers) and Rhizome (Micro decomposers) on the chalkboard. The students imitated the teacher as they drew the diagrams in their note books.

In the tenth week, the teaching of Ecological Management continued but this week, it was on Adaptation such as structural adaptation of Tadpole and Fish that lives in water as well as those of vertebrates like birds. The teacher used Inquiry method to teach the students this topic. The teacher started the lesson with questions on Adaptation to the students. Also types of association like symbiosis (mutualism), parasitism and commensalism were taught to students by the teacher. The students were asked to observe ticks on cow or dogs. The teacher also asked the students if they have observed chameleon against different back ground. The students verbally stated their observations. The students were encouraged to get pictures of different organisms' adaptation to their environment. The students were required to write down their observations. At the end of the treatment period, a post test was administered to the students.

d. Conventional Method (Control Group)

Prior to the administration of the Conventional method by the teacher, a pre-test was administered to the students to test their ability on the various topics to be taught during the treatment. The Biology class was a double period of eighty minutes. In the first week, the control group were taught Digestive System in mammals using conventional method. The teacher talked about the modification of feeding habit such as filter feeder (mosquito larva); Fluid feeders (house fly, mosquito and tsetse fly); parasitic and saprophytic feeders (tape worm and fungi) and feeding habits of lower animals like Protozoa and Amoeba. The teacher talked about the typical alimentary canal of vertebrates (mouth, pharynx, gullet, stomach, small & large intestine, rectum and anus).

In the second week, the teacher taught Transport System. The teacher defined 'Transportation' to the students as the movement of materials (liquid and gaseous substances) round the body. The teacher mentioned the media of transportation (cell sap, lymph and blood), and then the teacher spoke to the students on the materials for

transportation (water, digested food materials, hormones, enzymes, and waste products). The teacher then defined Diffusion and Osmosis. Transport System continued in the third week with the topic 'Media of Transportation in Large Organisms' (Plants and Animals). The teacher defined blood, mentioned the components of the blood (Red blood cell, white blood cells, blood platelets, lymphocytes and the blood plasma) to the students. The teacher stated the materials for transportation in plants (water by the root, mineral salt by the root, photosynthesis and food from the leaves) and Media of transportation in plants which are the vascular bundles (xylem and phloem).

Transport System continued into the fourth week with the Mechanism of Transportation in plants and mammals. The teacher explained to the students the mechanism of transportation in lower organisms like Amoeba and Paramecium through cytoplasm and in plants through latex or cell sap. The teacher explained to the students the mechanism of transportation of blood in the mammals (Heart, Blood vessels and Lymphatic vessels).

In the fifth week, Respiratory system was taught to the Control group. The teacher defined Respiration, External/Internal Respiration and Respiratory system to the students. The teacher listed the characteristics of a respiratory surface, types of respiratory systems (body surface, gills, lungs in terrestrial vertebrates and mammals) to the students. The teacher defined gills and its function and showed the students the different parts of gills on the chart (gill arch, gill rakers and gill filaments). The teacher explained the organ of respiration in amoeba and flatworms. The teacher also explained the difference in the modes of respiration between the lower animals and Pisces. During the sixth week, the teaching of Respiratory System continued. The teacher defined Inhalation and Exhalation to the students. The teacher asked the students to breathe in and out. They are expected to write down their observations. The Teacher listed the parts and functions of the organs that

make up the Human Respiratory System. The students copied their notes and assignment was given to them by the teacher. Excretory system was taught during the seventh week. The teacher mentioned the organ of excretion in amoeba (Contractile vacuole); tape worm (flame cells); insects (Malpighian tubules); Man (kidneys) and in the higher plants (stomata and lenticels) to the students. The teacher explained to students the mechanism of excretion in amoeba, lower & higher Plants and Man. A picture of the longitudinal section of a human kidney from Biology textbook was shown to the students by the teacher. During the Eighth week, Nutrients cycling in nature was taught to the students by the teacher. The teacher defined carbon, water and oxygen cycle to the students. The teacher explained that most available oxygen in nature comes from photosynthesis. The teacher also explained the importance of nutrients cycling in nature to plants and animals.

At the ninth week, students were taught Ecological Management (Decomposition in nature) by the teacher with emphasis on the type of decomposers-micro decomposers (bacteria, fungi) and Macro decomposers (earthworms, snails, termites). The students copied their notes and assignment was given to them by the teacher. During the tenth week, the teaching of Ecological Management continued but this week, it was on Adaptation such as structural adaptation of Tadpole and Fish to live in water as well as those of vertebrates like birds. The teacher defined and explained the key concepts of this lesson- Tolerance, Adaptation, Maximum and minimum Tolerance, factors responsible for Geographic range as well as adaptive features of aquatic plants and animals. The teacher encouraged the students to mention types of association like symbiosis (mutualism), parasitism and commensalism. At the end of the tenth week, the teacher administered a post- test to the students.

The week-by-week treatment plan for the groups covered a ten week period with the different instructional methods as summarised in Table 6:

Table 6: Treatment Plan for the Groups

S/N	Weeks	Topics	Inquiry Method	Demonstration Method	Demonstration and Inquiry Method	Convectional Method
1.	Before Treatment	Familiarisation	Familiarisation	Familiarisation	Familiarisation	Familiarisation
2.	Before Treatment	Pre-test was administered	Pre-test	Pre-test	Pre-test	Pre-test
3.	Week 1	Digestive System	Inquiry Method	Demonstration Method	Inquiry Method	Lecture Method
4.	Week 2	Transport System	Inquiry Method	Demonstration Method	Demonstration Method	Lecture Method
5.	Week 3	Transport System- media of transport	Inquiry Method	Demonstration Method	Demonstration Method	Lecture Method
6.	Week 4	Transport System - mechanism of transport	Inquiry Method	Demonstration Method	Demonstration Method	Lecture Method
7.	Week 5	Respiratory System	Inquiry Method	Demonstration Method	Inquiry Method	Lecture Method
8.	Week 6	Respiratory System	Inquiry Method	Demonstration Method	inquiry Method	Lecture Method
9.	Week 7	Excretory system	Inquiry Method	Demonstration Method	Inquiry Method	Lecture Method
10.	Week 8	Nutrients cycling in nature	Inquiry Method	Demonstration Method	Inquiry Method	Lecture Method
11.	Week 9	Ecological Management: Tolerance	Inquiry Method	Demonstration Method	Demonstration Method	Lecture Method

12.	Week 10	Ecological Management: Adaptation	Inquiry Method	Demonstration Method	Inquiry Method	Lecture Method
13.	Post-test	After treatment	Post-test	Post test	Post-test	Lecture Method

3.6.2 Control of Extraneous Variables

Extraneous variables are unwanted factors in a study that, if not accounted for, could negatively affect (that is, confound) the data subsequently collected. Such factors potentially prevent researchers from finding a direct causal effect between the manipulated independent variables (IVs) and measured dependent variables (DVs) set out in an investigation (Turner, 2015). According to Turner (2015), there are three key considerations to take when controlling extraneous variables: Participant variables – minimizing differences between participants for example, their stage of development such as age or IQ. Researcher variables – factors such as researcher behaviour, appearance or gender could affect participant responses, so should be made consistent throughout the experiment. Situational variables – control of the setting where the experiment takes place, such as keeping light, sound and temperature levels consistent.

Another way to think of this is that these are variables that influence the outcome of an experiment, though they are not the variables that are actually of interest. The control of extraneous variables in this study was done through the following procedures- Teacher variables: to control the error that might arise as a result of teacher difference on the students' performance in Biology. The regular biology teachers selected had at least 17 years working experience in the sampled schools. They were adequately trained by the researcher and used for the control group. In Instructional situation variable: The

researcher supplied instructional guides to the regular biology teachers (research assistants) in the sampled schools for control group in order to ensure that the instructional situation was the same for the three schools selected for the study. In Inter group variables: to eliminate the error of non-randomization of the subjects, data from the study was analysed using the independent t-test.

In Subject Interaction variable: the researcher ensured that the experimental groups were drawn from different schools located far apart from each other to eliminate any possibility of interaction that may arise (inter-class discussion) between the study groups. In situational variables – the researcher ensured that the setting where the experiments took place had electricity (Light) and the environment was not noisy.

3.7 Procedure for Data Analysis

Both descriptive and inferential statistical techniques were used in the analysis of data. The bio-data of the respondents was analysed with descriptive statistics which involved the use of frequencies and percentages while mean and standard deviation were used to answer the research questions. Significant variations in mean responses from all the test groups were analysed using independent sample t-test. This is because it is an appropriate statistical tool for comparing the means of two samples or treatment, even if they have different numbers of replications (Clark & Cooke, 2007). All the hypotheses were tested at 0.05 level of significance.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter presented the analysis of data collected from the field. The analysis was based on the pre-test and post-test administered on three hundred and forty two (342) students used as samples of the study. The first part of the chapter contains the description of study variables while the second segment presented the analysis of the research questions. Students' mean scores was used to answer the research questions while standard deviation was used to determine how close or otherwise are the students' mean scores. The rest of the chapter was on hypotheses testing with the discussion of findings.

4.2 Description of Study Variables

This section of the chapter described the variables of the study. Therefore, table 7 presents the frequency and percentages of the respondents based on group (that is, experimental and control).

Table 7: Respondents Based on Group

Method	Frequency	Percentage
Experimental	186	54.4
Control	156	45.6
Total	342	100

Table 7 shows that a total of one hundred and eighty six (186), that is, 54.4% students were used as experimental group, while one hundred and fifty six (156), that is, 45.6% of the respondents were used for the control group. This result shows that students in the experimental group were more represented in the study.

4.3 Analysis of Research Questions

The various research questions raised for this study were answered using mean scores while standard deviation was used to determine how close or otherwise are the students' mean scores from each other:

Research Question One:What is the performance of students taught Biology using Inquiry and those taught using conventional methods in Secondary Schools in Federal Capital Territory, Abuja?

To answer this research question, the pre-test and post-test administered on students were analysed using mean and standard deviation. The summary of the analysis is presented in Table 8:

Table 8: Performance of students taught Biology using Inquiry and Conventional methods in Secondary Schools in Federal Capital Territory, Abuja

Method	N	Pre-test Scores		Post-test Scores	
		Mean	SD	Mean	SD
Inquiry	57	33.35	11.47	42.42	11.78
Conventional	53	26.98	7.76	24.79	6.27

Table 8 revealed the performance of students taught biology using Inquiry and those taught using conventional methods in Senior Secondary Schools in Federal Capital Territory, Abuja. The mean scores as displayed shows that students taught Biology using inquiry method had a better performance mean scores in their pre-test and post-test. For instance, the mean score of students in inquiry method increased from 33.35 to 42.42 with corresponding standard deviation of 11.47 and 11.78, while the mean score of students in conventional method decreased from 26.98 to 24.79 with standard deviation of 7.76 and 6.27 respectively. These shows that the students' mean score difference is 6.37 and 17.62

in pre-test and post-test respectively. The standard deviation at each level indicates that students' performance varied widely from each other.

Research Question Two:What is the performance of students taught Biology using demonstration and those taught using conventional methods in Secondary Schools in Federal Capital Territory, Abuja?

To answer this research question, the pre-test and post-test administered on students were analysed using mean and standard deviation. The summary of the analysis is presented in Table 9:

Table 9: Performance of students taught Biology using Demonstration and Conventional methods in Secondary Schools in Federal Capital Territory, Abuja

Method	N	Pre-test Scores		Post-test Scores	
		Mean	SD	Mean	SD
Demonstration	78	33.92	9.55	55.69	16.86
Conventional	53	30.18	7.85	36.16	7.78

Table 9 revealed the performance of students taught Biology using demonstration and those taught using conventional methods in Secondary Schools in Federal Capital Territory, Abuja. The mean scores as displayed shows that students taught Biology using demonstration method had a better performance mean scores in their pre-test and post-test. For instance, the mean score of students in demonstration method increased from 33.92 to 55.69 with corresponding standard deviation of 9.55 and 16.86, while the mean score of students in conventional method increased from 30.18 to 36.16 with standard deviation of 7.85 and 7.78 respectively. These shows that the students' mean score difference is 3.74 and 19.52 in pre-test and post-test respectively. The standard deviation at each level indicates that students' performance varied widely from each other.

Research Question Three:What differences exist in the performance of students taught Biology using inquiry and demonstration compared to those taught using conventional methods inSecondary Schools in Federal Capital Territory, Abuja?

To answer this research question, the pre-test and post-test administered on students were analysed using mean and standard deviation. The summary of the analysis is presented in Table 10:

Table 10: Performance of students taught Biology using inquiry and demonstration compared to those taught using conventional method inSecondary Schools in Federal Capital Territory, Abuja

Method	N	Pre-test Scores		Post-test Scores	
		Mean	SD	Mean	SD
Inquiry and Demonstration	51	32.47	9.02	51.33	10.35
Conventional	50	31.48	9.88	31.54	6.94

Table 10 revealed the performance of students taught biology using both Inquiry and demonstration compared to those taught using conventional method in Senior Secondary Schools in Federal Capital Territory, Abuja. The mean scores as displayed shows that students taught Biology using Inquiry and demonstration methods had a better performance mean scores in their pre-test and post-test. For instance, the mean score of students in Inquiry and demonstration methods increased from 32.47 to 51.33 with corresponding standard deviation of 9.02 and 10.35, while the mean score of students in conventional method slightly increased from 31.48 to 31.54 with standard deviation of 9.88 and 6.94 respectively. These shows that the students' mean score difference is 0.99 and 19.79 in pre-test and post-test respectively. The standard deviation at each level indicates that students' performance varied widely from each other.

Research Question Four:What is the performance of students taught Digestive System in Biology using inquiry and those taught using conventional methods in secondary schools in Federal Capital Territory, Abuja?

To answer this research question, the pre-test and post-test administered on students were analysed using mean and standard deviation. The summary of the analysis is presented in Table 11:

Table 11: Performance of students taught Digestive System in Biology using inquiry and those taught using conventional methods in secondary schools in Federal Capital Territory, Abuja

Method	N	Pre-test Scores		Post-test Scores	
		Mean	SD	Mean	SD
Inquiry	57	38.00	20.41	42.14	20.20
Conventional	53	25.20	14.75	23.13	11.83

Table 11 revealed the performance of students taught Digestive System in biology using inquiry and those taught using conventional methods in senior secondary schools in Federal Capital Territory, Abuja. The mean scores as displayed shows that students taught Biology using Inquiry method had a better performance mean scores in their pre-test and post-test. For instance, the mean score of students in Inquiry method increased from 38.00 to 42.14 with corresponding standard deviation of 20.41 and 20.20, while the mean score of students in conventional method decreased from 25.20 to 23.13 with standard deviation of 14.75 and 11.83 respectively. These shows that the students' mean score difference is 12.8 and 19.01 in pre-test and post-test respectively. The standard deviation at each level indicates that students' performance varied widely from each other.

Research Question Five:What is the effect of the use of demonstration and conventional methods on academic performance of students when taught Transport system in Biology in secondary schools in Federal Capital Territory, Abuja?

To answer this research question, the pre-test and post-test administered on students were analysed using mean and standard deviation. The summary of the analysis is presented in Table 12:

Table 12: Assessment of the effect of the use of demonstration and conventional methods on performance of biology students' in secondary schools students when taught Transport system in Biology in secondary schools in Federal Capital Territory, Abuja

Method	N	Pre-test Scores		Post-test Scores	
		Mean	SD	Mean	SD
Demonstration	78	26.47	11.54	54.61	21.39
Conventional	53	26.09	10.39	35.81	9.23

Table 12 revealed the effect of the use of demonstration and conventional methods on academic performance of students when taught Transport system in biology in senior secondary schools in Federal Capital Territory, Abuja. The mean scores as displayed shows that students taught Biology using demonstration method had a better performance mean scores in their pre-test and post-test. For instance, the mean score of students in demonstration method increased from 26.47 to 54.61 with corresponding standard deviation of 11.54 and 21.39, while the mean score of students in conventional method increased from 26.09 to 35.81 with standard deviation of 10.39 and 9.23 respectively. These shows that the students' mean score difference is 0.38 and 18.80 in pre-test and post-test respectively. The standard deviation at each level indicates that students' performance varied widely from each other.

4.4 Hypotheses Testing

Independent sample t-test was used to test all the five (5) postulated null-hypotheses at 0.05% alpha level of significance. This sub-section presents the result of the test on the hypotheses.

Hypothesis One: There is no significant difference in the performance of students taught Biology using inquiry and those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja.

The post-test administered on students were marked, scored and analysed using independent sample t-test. The summary of the analysis is presented in Table 13:

Table 13: Summary of Independent sample t-test on the performance of students taught Biology using Inquiry and those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja

Method	N	Mean	SD	t-cal	df	α	t-crit	P-value	Decision
Inquiry	57	42.42	11.78	9.68	108	0.05	1.96	.000	Rejected
Conventional	53	24.79	6.27						

Table 13 revealed the performance of students taught Biology using Inquiry and those taught using conventional methods in Secondary Schools in Federal Capital Territory, Abuja. The table shows that the students taught Biology using Inquiry method had the mean score of 42.42 with the standard deviation of 11.78, while the students taught Biology using conventional method had the mean score of 24.79 with standard deviation of 6.27. The t-calculated of 9.68 is greater than the t-critical of 1.96, while the p-value is .000 ($P < 0.005$). The null-hypothesis which states that there is no significant difference in the performance of students taught Biology using inquiry and those taught using conventional methods in Secondary Schools in Federal Capital Territory, Abuja was rejected. This result therefore suggests that students taught Biology using Inquiry method performed far better than those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja.

Hypothesis Two: There is no significant difference in the performance of students taught Biology using demonstration and those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja.

The post-test administered on students were marked, scored and analysed using independent sample t-test. The summary of the analysis is presented in Table 14:

Table 14: Summary of Independent sample t-test on the performance of students taught Biology using demonstration and those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja

Method	N	Mean	SD	t-cal	df	α	t-crit	P-value	Decision
Demonstration	78	55.69	16.86	7.87	129	0.05	1.96	.000	Rejected
Conventional	53	36.16	7.78						

Table 14 revealed the performance of students taught Biology using demonstration and those taught using conventional methods in Secondary Schools in Federal Capital Territory, Abuja. The table shows that the students taught Biology using demonstration method had the mean score of 55.69 with the standard deviation of 16.86, while the students taught Biology using conventional method had the mean score of 36.16 with standard deviation of 7.78. The t-calculated of 7.87 is greater than the t-critical of 1.96, while the p-value is .000 ($P < 0.005$). The null-hypothesis which states that there is no significant difference in the performance of students taught Biology using demonstration and those taught using conventional methods in Secondary Schools in Federal Capital Territory, Abuja was rejected. This result therefore suggests that students taught Biology using demonstration method performed far better than those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja.

Hypothesis Three: There is no significant difference in the performance of students taught Biology using inquiry and demonstration compared to those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja.

The post-test administered on students were marked, scored and analysed using independent sample t-test. The summary of the analysis is presented in Table 15:

Table 15: Summary of Independent sample t-test on the performance of students taught Biology using inquiry and demonstration compared to those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja

Method	N	Mean	SD	t-cal	df	α	t-crit	P-value	Decision
Inquiry and Demonstration	51	51.33	10.35	11.32	99	0.05	1.96	.000	Rejected
Conventional	50	31.44	6.94						

Table 15 revealed the performance of students taught Biology using inquiry and demonstration compared to those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja. The table shows that the students taught Biology using inquiry and demonstration methods had the mean score of 51.33 with the standard deviation of 10.35, while the students taught Biology using conventional method had the mean score of 31.44 with standard deviation of 6.94. The t-calculated of 11.32 is greater than the t-critical of 1.96, while the p-value is .000 ($P < 0.005$). The null-hypothesis which states that there is no significant difference in the performance of students taught Biology using inquiry and demonstration compared to those taught using conventional methods in Secondary Schools in Federal Capital Territory, Abuja was rejected. This result therefore suggests that students taught Biology using Inquiry and demonstration methods performed far better than those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja.

Hypothesis Four: There is no significant difference in the performance of students when taught Digestive System in Biology using inquiry and those taught using conventional method in secondary schools in Federal Capital Territory, Abuja.

The post-test administered on students were marked, scored and analysed using independent sample t-test. The summary of the analysis is presented in Table 16:

Table 16: Summary of Independent sample t-test on the performance of students when taught Digestive System in Biology using inquiry and those taught using conventional method in secondary schools in Federal Capital Territory, Abuja

Method	N	Mean	SD	t-cal	df	α	t-crit	P-value	Decision
Inquiry	57	42.14	20.20	5.96	108	0.05	1.96	.001	Rejected
Conventional	53	23.13	11.83						

Table 16 revealed the performance of students when taught Digestive System in Biology using inquiry and those taught using conventional method in secondary schools in Federal Capital Territory, Abuja. The table shows that the students taught Digestive System in Biology using Inquiry method had the mean score of 42.14 with the standard deviation of 20.20, while the students taught using conventional method had the mean score of 23.13 with standard deviation of 11.83. The t-calculated of 5.96 is greater than the t-critical of 1.96, while the p-value is .001 ($P < 0.005$). The null-hypothesis which states that there is no significant difference in the performance of students when taught Digestive System in Biology using inquiry and those taught using conventional methods in secondary schools in Federal Capital Territory, Abuja was rejected. This result therefore suggests that students taught Digestive System in Biology using inquiry method performed far better than those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja.

Hypothesis Five: There is no significant difference in the effect of the use of demonstration and conventional methods on academic performance of students when taught Transport system in Biology in secondary schools in Federal Capital Territory, Abuja.

The post-test administered on students were marked, scored and analysed using independent sample t-test. The summary of the analysis is presented in Table 17:

Table 17: Summary of Independent sample t-test on the effect of the use of demonstration and conventional methods on academic performance of students when taught Transport system in Biology in secondary schools in Federal Capital Territory, Abuja

Method	N	Mean	SD	t-cal	df	α	t-crit	P-value	Decision
Demonstration	78	54.61	21.39	6.02	129	0.05	1.96	.000	Rejected
Conventional	53	35.81	9.23						

Table 17 revealed the effect of the use of demonstration and conventional methods on academic performance of students when taught Transport system in Biology in secondary schools in Federal Capital Territory, Abuja. The table shows that the students taught Transport system in Biology using demonstration method had the mean score of 54.61 with the standard deviation of 21.39, while the students taught using conventional method had the mean score of 35.81 with standard deviation of 9.23. The t-calculated of 6.02 is greater than the t-critical of 1.96, while the p-value is .000 ($P < 0.005$). The null-hypothesis which states that there is no significant difference in the effect of demonstration and conventional methods on academic performance of students when taught Transport system in Biology in secondary schools in Federal Capital Territory, Abuja was rejected. This result therefore suggests that students taught Transport system in Biology using

demonstration method performed far better than those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja.

4.5 Summary of Major Findings

The following findings emerged in view of the research questions in the study that:

1. Students taught Biology using Inquiry method performed far better than those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja.
2. Performance of students taught Biology using demonstration method was far better than those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja.
3. The performance of students taught Biology using inquiry and demonstration methods was far better than those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja.
4. Students taught Digestive System in Biology using inquiry method performed far better than those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja.
5. The performance of students taught Transport system in Biology using demonstration method was far better than those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja.

The following findings emerged in view of the summary of results for research hypotheses:

1. There was significant difference in the performance of students taught Biology using inquiry and those taught using conventional methods in Secondary Schools in Federal Capital Territory, Abuja.

2. There was significant difference in the performance of students taught Biology using demonstration and those taught using conventional methods in Secondary Schools in Federal Capital Territory, Abuja.
3. There was significant difference observed in the performance of students taught Biology using inquiry and demonstration methods compared to those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja.
4. There was significant difference in the academic performance of students when taught Digestive System in Biology using inquiry and conventional methods in secondary schools in Federal Capital Territory, Abuja.
5. There was significant difference in the academic performance of students when taught Transport System in Biology using demonstration and conventional methods in secondary schools in Federal Capital Territory, Abuja.

4.6 Discussions of Findings

Findings on research question one showed that performance of students taught Biology using Inquiry performed better than those taught using conventional methods in Secondary Schools in Federal Capital Territory, Abuja. Students taught using inquiry method had a mean score of 42.42 with corresponding standard deviation of 11.78 while students taught using conventional method had a mean score of 24.79 with standard deviation of 6.27 respectively. Students taught Biology using inquiry method had a higher mean score of 42.42 compared to the students taught Biology using conventional method had a mean score of 24.79. The standard deviation at each level indicates that students' performance varied widely from each other.

Findings on hypothesis one showed that the t-calculated value of 9.68 was greater than the t-critical of 1.96, while the p-value was less than 0.05 level of significance. The null-hypothesis which states that there is no significant difference in the performance of

students taught Biology using Inquiry and those taught using conventional methods in Secondary Schools in Federal Capital Territory, Abuja was rejected. This result therefore suggests that students taught Biology using Inquiry method performed far better than those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja. This finding confirmed the outcome of research works conducted by Ugwuadu (2010), Ogunbiyi (2012), Aniaku (2012); and Hashim, Ababkr and Eljack (2015) which revealed that students taught with guided inquiry outperform those taught with lecture method. It also revealed that guided inquiry has been proved to be more effective than lecture method in enhancing students' academic performance in Biology.

Findings on research question two showed that performance of students taught Biology using demonstration performed better than those taught using conventional methods in Secondary Schools in Federal Capital Territory, Abuja. The students taught Biology using demonstration method had a mean score of 55.69 with the standard deviation of 16.86, while the students taught Biology using conventional method had the mean score of 36.16 with standard deviation of 7.78 respectively. Students taught Biology using demonstration method had a higher mean score of 55.69 compared to the students taught Biology using conventional method that had a mean score of 36.16. The standard deviation at each level indicates that students' performance varied widely from each other.

Findings on hypothesis two revealed that students taught Biology using demonstration method had a better mean score compared to the students taught Biology using conventional method. It also showed that the t-calculated value of 7.87 was greater than the t-critical of 1.96, while the p-value was less than 0.05 level of significance. The null-hypothesis which states that there is no significant difference in the performance of students taught Biology using demonstration and those taught using conventional methods in Secondary Schools in Federal Capital Territory, Abuja was rejected. This result

therefore suggests that students taught Biology using demonstration method performed far better than those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja. This result supports the findings of Maizuwo (2011) and Musa (2015), that apart from remedying students' misconception, demonstration teaching method enhances academic performance. This result also supports the findings of Muhammad, Bala & Ladu (2016), that when the two methods were compared, demonstration method was more effective than conventional method in learning concepts.

Findings on research question three showed that performance of students taught Biology using inquiry and demonstration performed better than those taught using conventional methods in Secondary Schools in Federal Capital Territory, Abuja. The students taught Biology using inquiry and demonstration had the mean score of 51.33 with the standard deviation of 10.35 while the students taught Biology using conventional method had the mean score of 31.44 with standard deviation of 6.94 respectively. Students taught Biology using inquiry and demonstration methods had a higher mean score of 51.33 compared to the students taught Biology using conventional method that had a mean score of 31.44. The standard deviation at each level indicates that students' performance varied widely from each other.

Hypothesis three revealed the performance of students taught Biology using inquiry and demonstration performed better compared to those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja. The finding showed that the t-calculated value of 11.32 was greater than the t-critical, while the p-value was less than 0.05 level of significance. The null-hypothesis which states that there is no significant difference in the performance of students taught Biology using inquiry and demonstration compared to those taught using conventional methods in Secondary Schools in Federal Capital Territory, Abuja was rejected. This result therefore suggests that students taught

Biology using inquiry and demonstration methods performed far better than those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja. This result correlates the findings of Musa (2015) that demonstration method is significant, but when Inquiry and brainstorming teaching method is used concurrently the performance will be more significant. Similarly, other studies like Muhammad (2011), revealed that the exposure of students to the inquiry teaching method developed positive attitudes of students toward learning and that the use of inquiry teaching method enhances retention.

Findings on research question four showed that performance of students taught Digestive System in Biology using inquiry method performed better than those taught using conventional methods in secondary schools in Federal Capital Territory, Abuja. This is evident in their mean scores which show that students taught Digestive System in Biology using Inquiry method had a better performance mean scores of 42.14 with corresponding standard deviation compared to the mean score of students taught using conventional method with a mean score of 23.13 and standard deviation 11.83 respectively. The standard deviation at each level indicates that students' performance varied widely from each other.

Findings on hypothesis four showed that the performance of students taught Digestive System in Biology using Inquiry method was better than their counterparts taught using conventional method. Finding showed that the t-calculated value of 5.96 was greater than the t-critical, while the p-value was less than 0.05 level of significance. The null-hypothesis which states that there is no significant difference in the performance of students when taught Digestive System in Biology using inquiry and those taught using conventional methods in secondary schools in Federal Capital Territory, Abuja was rejected. This result therefore suggests that students taught Digestive System in Biology using inquiry method performed far better than those taught using conventional method in

Secondary Schools in Federal Capital Territory, Abuja. Studies (such as Ifeanyi-Uche & Ejabukwa, 2013; Aliyu, Guga & Yusuf, 2015; &Unogu, 2015), have confirmed that students taught using guided inquiry method performed better than those taught using lecture method. This result is in line with the findings of Nwagbo and Chukelu (2011), who revealed that practical activity (inquiry) method was more effective in fostering students' acquisition of science process skills than the lecture method. This therefore implies that the use of inquiry method can be said to be effective especially when teaching the practical aspect of Biology. Research work of Ghumdia (2016), which is also in line with the present study recommends amongst other that inquiry strategy should be adapted as viable strategy for studying abstract concepts in Biology as it enables students to be problem solvers, thereby leading to improvement in their performance in Biology.

Findings on research question five showed that performance of students taught Transport system in Biology using demonstration performed better than students taught Biology using conventional methods. The mean scores shows that students taught Transport system in Biology using demonstration method had a better performance mean scores of 54.61 with corresponding standard deviation of 21.39, while the mean score of students taught Transport system in Biology using conventional method had a lower mean score of 35.81 with standard deviation of 9.23 respectively. The standard deviation at each level indicated that students' performance varied widely from each other.

Findings on hypothesis five showed that the students taught Transport system in Biology using demonstration method had a better performance compared to their counterparts taught using conventional method. The finding showed that the t-calculated value of 6.02 was greater than the t-critical, while the p-value was less than 0.05 level of significance. The null-hypothesis which states that there is no significant difference in the effect of the use of demonstration and conventional methods on academic performance of

students when taught Transport system in Biology in secondary schools in Federal Capital Territory, Abuja was rejected. This result therefore suggests that students taught Transport system in Biology using demonstration method performed far better than those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja. In line with the findings of this study, the results obtained from the research conducted by Ameh and Dantani (2012), also confirmed the fact that students tend to perform better when taught using the demonstration method as compared to the lecture method. Research work of Daluba (2015), revealed that demonstration method had significant effect on students' achievement than those taught with the conventional lecture method which is in line with the present study.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

This study assessed the effects of Inquiry and Demonstration methods on Performance of Biology Students' in Secondary Schools in Federal Capital Territory, Abuja, Nigeria.

The study was conducted with five objectives which are to; determine the performance of students taught Biology using Inquiry and those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja; investigate the performance of students taught Biology using demonstration and those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja; compare the performance of students taught Biology using inquiry and demonstration compared to those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja; find out the academic performance of students when taught Digestive System in Biology using inquiry and those taught using conventional method in secondary schools in Federal Capital Territory, Abuja; and ascertain the effect of the use of demonstration and conventional methods on academic performance of students when taught Transport system in Biology in secondary schools in Federal Capital Territory, Abuja. Also, five research questions and five null hypotheses were postulated in line with the stated objectives. Relevant literatures were reviewed on the key variables of the study.

The study adopted Quasi-experimental design. The target population of the study comprised of twenty three thousand, four hundred and twenty-two (23,422) SSII students. A sample of three hundred and forty two (342) SSII students from six intact classes were purposively sampled and used in the study. The instrument used for data collection in the study was a multiple-choice objective test titled "Biology Inquiry and Demonstration Performance Test (BIDPT)". The instrument was validated by the researcher's supervisors

in Curriculum and Instruction Section, Department of Educational Foundations and Curriculum, Ahmadu Bello University, Zaria and three experienced Biology teachers in Federal Capital Territory, Abuja. The reliability of the instrument was determined through trial test. The reliability coefficient of the test/re-test scores was computed by means of Pearson Product Moment Correlation Coefficient (PPMCC) which indicated a reliability value of 0.849.

The data gathered through the administration of pre-test and post-test were collected, marked, scored and recorded to make comparison between the groups. The bio-data of the respondents was analysed using descriptive statistics which involves frequencies and percentages while mean and standard deviation were used to answer the research questions. Significant variations in mean responses from all the test groups were analysed using independent sample t-test at 0.05% level of significance. Findings of the study showed that students taught Biology using Inquiry method performed far better than those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja (.000 <0.005). The performance of students taught Biology using demonstration method was far better than those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja (.000 <0.005). Also, the performance of students taught Biology using inquiry and demonstration methods was better than those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja (.000 <0.005). Students taught Digestive System in Biology using inquiry method performed far better than those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja (.001 <0.005). And the performance of students taught Transport system in Biology using demonstration method was far better than those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja (.000 <0.005).

5.2 Conclusion

As teaching method and not the teacher that is the key to the learning of science, this study concluded that, effective learning takes place when the interactive process is one that is best suited to the individual students in terms of learning styles. Students tend to learn concepts in Biology and skills and how to solve problems using practical method. Inquiry based learning require the student to do more than just report on a topic. Inquiry method enables the study go beyond the simple memorization of facts and regurgitation of information and into the realm of creating new and deeper understanding through identification and subsequent application of solutions to a specific topic. The study also concluded that demonstration method of teaching has been proved to be effective as it shows the learners how to do a task using sequential instructions with the end goal of having learners perform the tasks independently. This was evident as the finding from this study showed that students taught Biology using inquiry, demonstration or inquiry and demonstration methods performed far better than those taught using conventional method in Secondary Schools in Federal Capital Territory, Abuja.

5.3 Recommendations

The following recommendations were made based on the findings from this study that:

1. Teachers should use guided inquiry in teaching Biology more than unguided inquiry since the method has proved effective in enhancing students' academic performance in Biology.
2. Teachers should also use inquiry methods in teaching and learning of Biology as it will help to achieve the national curriculum objectives which is designed to promote students inquiry spirit and construction of a life-long knowledge needed for national development.

3. Demonstration method should be adopted by Biology teachers when teaching practical aspect of Biology as this enhances retention.
4. Government should ensure adequate provision of science instructional materials like specimen, charts, chemicals and so forth that could aid effective teaching of the practical and abstract aspect of Biology in schools.
5. The Federal and State ministries of education should encourage Biology textbook writers to write and publish Biology textbooks based on the inquiry and demonstration method.
6. Ministry of Education and relevant academic and professional bodies like Science Teachers Association of Nigeria (STAN) and Teachers Registration Council of Nigeria (TRCN) should enlighten teachers on the use of inquiry and demonstration teaching methods through organized in-service trainings, workshops and seminars.
7. Biology teachers should be regularly sponsored to attend on-the-job training and re-training in order to improve on teaching methods in the teaching and learning of Biology in the classroom.

5.4 Contribution to Knowledge

This study made contribution to knowledge as it provided teaching-learning method and the procedures that teachers of Biology could adopt so that students in their classes will benefit maximally; thereby meeting the needs of individual students in the class. The result of the study also forms a different dimension of innovations in the teaching and learning of Biology. It also has positive effect on students as the teaching methods motivated them to achieve excellent performance in Biology which will have a ripple effect in their performance in other subjects as a result of increased confidence.

Another contribution of this study to the body of knowledge is that, it helps students improve their understanding of the abstract concepts of Biology. Also, this study

will assist the Biology textbook writers to focus on inquiry and demonstration method for their write-ups, especially on the practical aspects. Moreover, the study also exposed the curriculum planners to suggest relevant methods for teaching different topics in the Biology curriculum.

5.5 Suggestions for Further Study

The study suggested the following topic for further research:

1. Comparative effect of guided and unguided discovery method on students' performance in Biology.
2. Assessment of the Teaching methods and their effect in correcting misconception among Biology students.
3. The relative effectiveness of the demonstration and lecture methods on the cognitive achievement of Science students in Biology.
4. Further study could be carried out to assess the effects of guided and unguided inquiry on students' achievement and retention of biological concepts.
5. The study should be replicated in other science subjects such as in Chemistry, Mathematics, Agricultural Science and Physics.

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APPENDIX A

LESSON PLAN FOR EXPERIMENTAL GROUP 1 (INQUIRY METHOD)

(Structured and Guided Inquiry)

Week 1 lesson 1

School	-	GSS Wuse Zone 3
Date	-	01/2017
Class	-	SS II
No. of Students	-	57
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	3rd
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Digestive System
Sub-topic	-	Digestion in Invertebrates
Reference Books	-	(i) Essential Biology by Michael, M.C(ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.(iv) Ideal Practical Biology by Onwuzulume, C.N.
Instructional Materials	-	A cardboard showing chart of digestive system of Amoeba, Earthworm and freshly killed Cockroaches.
Previous Knowledge	-	The students are familiar with eating and digestion of food substances as a normal routine in life.
Behavioural Objectives	-	At the end of the lesson, students were able to: i. Discuss modification of feeding habits. ii. Discuss the process of feeding in invertebrate animals.
Introduction	-	The teacher began the lesson by introducing the topic of the day- Digestion in Invertebrates.
Presentation	-	The lesson is presented in the following steps:

Step I - The teacher used both structured (students to follow set process) and guided (the students will be provided with questions) inquiry to teach this topic. The teacher gave clue to the students and asks if they are familiar with modification of feeding habit such as filter feeder (mosquito larva); Fluid feeders (house fly, mosquito, tsetse fly and so forth); parasitic and saprophytic feeders (tape worm and fungi and so forth). The teacher hung two different charts on the wall that illustrated digestion in amoeba and digestive system in earthworm; and asks the students to observe the different charts, note and wrote down their observations.

Students' activities - The students observed the charts, described their observations, asked questions for further clarifications. As students listened to the clue, the teacher asked the student to discuss the feeding habit in protozoa (such as Amoeba P.) and in hydra. After some seconds of wait, the teacher called on a student who says "Amoeba uses Pseudopodia to circle, engulf it to form food vacuole, enzymes are introduced to digest it intra-cellularly".

The teacher also called on another student who says "The hydra ingest food particles into the mouth into the hollow stomach (enteron) where extra-cellular digestion take place".

Summary- The teacher summarised the lesson to the students
Evaluation - As the student explained, the teacher asked other Students to:

- i. Define Digestion and Digestive system.
- ii. Describe the mouth part of filter feeders and fluid feeders.
- iii. Mention the parts of alimentary canal and their functions.

Assignment - Students were given assignment to differentiate between feeding methods of protozoa and hydra. In closure, the teacher instructed the students to consult relevant textbooks as they will be learning on digestive system of vertebrate animals in their next class.

**Lesson Plan for Experimental Group 1
(Confirmation, Structured and Guided Inquiry Method)
Week 1 lesson plan 2**

School	-	GSS Wuse Zone 3
Date	-	01/2017
Class	-	SS IIA
No. of Students	-	57
Average age of Students	-	16 years
Sex	-	male and female
Period	-	4th
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Digestive System
Sub-topic	-	Digestion in Vertebrates
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.(iv) Ideal Practical Biology by Onwuzulume, C.N.
Instructional Materials	-	A chart showing digestive system of vertebrate animals, dissecting kit, Six Birds and Dissecting boards.
Previous Knowledge	-	The students are familiar with eating and digestion of food substances as a normal routine in life.
Behavioural Objectives	-	At the end of the lesson, students were able to: i. Discuss modification of feeding habits.

Introduction	-	<p>ii. Describe the human alimentary canal and its functions.</p> <p>The teacher began the lesson by introducing the topic of the day- Digestion in Vertebrates.</p>
Presentation Step I	-	<p>The lesson is presented in the following steps:</p> <p>The teacher used both structured (students to follow set process) and guided (the students will be provided with questions) inquiry to teach this topic. The teacher asked the students to define and discuss the vertebrate alimentary system and the modification of alimentary system. As the students respond to the question, another student was asked to mention the parts of alimentary system and their functions (mouth, oesophagus, stomach, pancreas, small intestine, large intestine, rectum and anus).</p>
Step II	-	<p>Experiment to show the Alimentary Tracts of a Bird</p>
Teacher's activity:		<p>The teacher divided the students into six groups and provided each group with a dissecting kit, a freshly slaughtered Bird(Chicken), dissecting board and a dissecting guide/manual written on the board. The teacher guided the students to dissect and observe the dissected alimentary canals.</p>
Students' activities:		<p>The students in their various groups appointed a group leader. Each of the group leader and their members under the guidance of the teacher dissected the birds to expose the alimentary canal. Members of each group observed the alimentary tracts/canal and drew same in their notebooks.</p>
Step III	-	<p>Functions of digestive organs in the Alimentary Canal of Insects and Birds</p>

- Teacher's activity:** - The teacher asked the students to state out the functions of the different parts of the alimentary tract of a bird.
- Students' activities:** - The students wrote the functions of the dissected parts of the alimentary canal in their note books. Compare and contrast the alimentary canal of a Cockroach and that of a Bird. State the modification in the alimentary canal and relate it to their different feeding habits.
- Summary** - The teacher summarised the whole lesson to the Students.
- Evaluation** -The teacher reviewed the lesson by asking the students to:
- i. Define Digestion and Digestive system.
 - ii. Mention the parts of alimentary canal and their functions.
- Assignment** - Students were given assignment to differentiate between Monogastric animals and Polygastric animals. In conclusion, the teacher asked the students to consult relevant textbooks as their next class will be on transport system (Diffusion).

**Lesson Plan for Experimental Group 1
(Confirmation, Structured and Guided Inquiry Method)
Week 2 lesson plan 1**

- School** - GSS Wuse Zone 3
- Date** - 01/2017
- Class** - SS II
- No. of Students** - 57
- Average age of Students** - 16 years
- Sex** - Male and female

Period	-	3rd
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Transport system
Sub-topic	-	Diffusion
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.(iv) Onwuzulume, C.N (2015). Ideal Practical Biology. Enugu: Onwuzusons Publishers.
Instructional Materials	-	A chart showing of diffusion in liquid and gaseous state.
Previous Knowledge	-	The students are aware of heart beat and the flow of blood through their veins.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ol style="list-style-type: none"> 1. Define transport system and mention the media of transportation and the materials for transportation. 2. Define and mention the importance of diffusion.
Introduction	-	The teacher began the lesson by introducing the topic of the day- Diffusion to the students.
Presentation	-	The teacher used both structured (students to follow set process) and guided (the students will be provided with questions) inquiry to teach this topic. The lesson is presented in the following steps:
Step I	-	The students were given clue on the topic. Thereafter, the students were asked to define transport system. After some seconds, a student defines it as the movement of materials (liquid and gaseous substances) round the body. The teacher also asked the students to mention the medium of transportation (cell sap, lymph and blood), and the teacher also asked the students to mention the materials for

transportation (water, digested food materials, hormones, enzymes, and waste products).

Step II-

As the student defined transportation, the teacher asked who can define diffusion. After some seconds of wait time the teacher calls on a student who says “diffusion is the movement of molecules of substances from the region of higher concentration to the region of lower concentration until equilibrium is reached”. The teacher asked another student to discuss the process of diffusion and mention the importance of diffusion. An experiment to demonstrate liquid diffusion will be set up by the teacher with assistance from the students.

Teacher’s Activity-

The teacher came into the class with the following apparatus rain water, copper sulphate, pipette and a glass cup.

Students’ Activity-

The teacher guided the students to pour rain water into a tall glass of water and slowly run in 25cm³ of copper sulphate through a pipette into the glass of water. The students wrote down their observations.

Summary -

The teacher summarised the whole lesson to the Students.

Evaluation-

Teacher reviewed the lesson by asking the students to:

- i. Define transportation and transport system.
- ii. Define and then describe diffusion in both the liquid and gaseous state.

Assignment-

Students were given assignment to: 1. Define Diffusion. 2. Describe diffusion diagrammatically. In closure, the teacher advised the students to consult relevant textbooks as they will be treating transportation system (Osmosis) in their next class.

**Lesson Plan for Experimental Group 1
(Confirmation, Structured and Guided Inquiry Method)
Week 2 lesson plan 2**

School	-	GSS Wuse Zone 3
Date	-	01/2017
Class	-	SS II
No. of Students	-	57
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	4th
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Transport system
Sub-topic	-	Osmosis
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.(iv) Ideal Practical Biology by Onwuzulume, C.N.
Instructional Materials	-	A cardboard showing demonstration of osmosis using cellophane material. Yam tuber, trough, knife and sugar solution
Previous Knowledge	-	The students are aware of heart beat and the flow of blood through their veins.
Behavioural Objectives	-	At the end of the lesson, students were able to: i. Define transport system and ii. Define, discuss and mention the importance of Osmosis.
Introduction	-	The teacher begins the lesson by introducing the topic of the day- Osmosis.
Presentation	-	The lesson is presented in the following steps:
Step I		The teacher used confirmation (re-enforcement of prior knowledge), structured (students to follow set

		process) and guided (the students will be provided with questions) inquiry to teach this topic.
Step II	-	As the lesson proceeds further, the teacher asked the student to define osmosis and discuss the process of Osmosis in plants and animal. The teacher also asked who can mention the importance of Osmosis to plants and animals.
Teacher Activity-		The teacher brought the following apparatus to the class yam tuber, trough and knife and sugar solution to demonstrate osmosis using a living tissue (yam)
Students' Activities-		The teacher instructed the students to (i) Cut the yam tuber into halves (ii) peel the yam and make a hole in the centre (iii) a small quantity of sugar solution is added into the cavity (iv) place in a trough of distilled water (v) a control experiment is set up alongside with boiled yam with nothing added in the centre. The students wrote down their observations and submit as an assignment.
Summary	-	The teacher summarised the whole lesson to the Students
Evaluation	-	Teacher reviewed the lesson by asking the students to: <ul style="list-style-type: none"> i. Define transportation and transport system. ii. Describe the mouth part of filter feeders and fluid feeders. iii. Mention the parts of alimentary canal and their functions.
Assignment	-	Students were given assignment to: 1. Define Osmosis. 2. Differentiate between Osmosis and Diffusion. In conclusion, the teacher asked the students to consult relevant textbooks on treating transportation system for the next lesson(Blood as a media of transport in mammals) in their next class.

Lesson Plan for Experimental Group 1
Inquiry Method
(Confirmation, Structured and Guided Inquiry Method)
Week 3 Lesson Plan 1

School	-	GSS Wuse Zone 3
Date	-	01/2017
Class	-	SS II
No. of Students	-	57
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	3rd
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Transport system (Cont'd) - Media of transportation
Sub-topic	-	Blood as a media of transportation in mammals
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.(iv) Ideal Practical Biology by Onwuzulume, C.N.
Instructional Materials	-	A picture chart showing media of transportation in mammals (the blood cells).
Previous Knowledge	-	The students are familiar with the topic which has been introduced in the previous lesson.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ul style="list-style-type: none"> i. mention the media of transportation in mammals ii. define blood and mention the components of blood iii. Describe red blood cells, white blood cells and mention their functions.

Introduction	-	The teacher began the lesson by introducing the topic of the day-Blood as a medium of transportation in mammals to the students.
Presentation-		The teacher used confirmation (re-enforcement of prior knowledge), structured (students to follow set process) and guided (the students will be provided with questions) inquiry to teach this topic.
Step I	-	<p>The lesson is presented in the following steps:</p> <p>The teacher asked the students to recall the last lesson on osmosis and diffusion? The teacher started the lesson by asking the students to define blood. After some seconds of wait time the teacher calls on a student who says “blood is the liquid tissues found in the body”. The teacher asked another student to mention the components of the blood and discuss it (Red blood cell, white blood cells, blood platelets lymphocytes and the blood plasma).</p>
Step II	-	The teacher asked if there is any student who can describe red blood cells and white blood cells and blood platelets.
Step III-		The teacher told the students about lymph which is another medium of transport in the body of an animal.
Students’ activity-		The students were asked by the teacher to (i) make a well labelled diagram of the blood cells (ii) the teacher divides the students into groups to discuss and write down the function of the lymph.
Summary	-	The teacher summarised the whole lesson to the Students.
Evaluation	-	<p>The teacher reviewed the lesson by asking if there is any student who can:</p> <ol style="list-style-type: none"> i. Mention the media of transportation in mammals. ii. Define blood and mention the components of blood.

iii. Describe red, white blood cell and blood Platelets and also to list out their functions.

Assignment

- Students were given assignment to:
 1. Mention the media of transportation in mammals.
 2. Mention the characteristics of red blood cells.

In conclusion, the teacher instructed the students to consult relevant textbooks as they will be treating transportation system (Media of transportation in Plants) in their next class.

**Lesson Plan for Experimental Group 1
Inquiry Method
(Confirmation, Structured and Guided Inquiry Method)
Week 3 lesson plan 2**

School	-	GSS Wuse Zone 3
Date	-	01/2017
Class	-	SS II
No. of Students	-	57
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	4 th
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Transport system (Cont'd) - Media of transportation
Sub-topic	-	Media of transportation in Plants
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.(iv) (2015). Ideal Practical Biology by Onwuzulume, C.N.
Instructional Materials	-	A picture chart showing media of transportation in plants (transverse section of a root and stem).

Previous Knowledge	-	The students are familiar with the topic which has been introduced in the previous lesson.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ul style="list-style-type: none"> i. Mention the materials for transportation in plants. ii. List the vascular bundles and their functions in plants. iii. Explain transpiration in plants.
Introduction	-	The teacher began the lesson by introducing the topic of the day- media of transportation in plants to the students.
Presentation	-	The teacher used confirmation (re-enforcement of prior knowledge), structured (students to follow set process) and guided (the students were provided with questions) inquiry to teach this topic. The lesson is presented in the following steps:
Step I	-	The teacher asked the students to briefly summarise the last lesson on transport system in mammals. The teacher also asked the students to explain the materials for transportation in plants(water by the root, mineral salt by the root, photosynthesis food from the leaves and excretory waste products).
Step II	-	The teacher called on a student to explain what vascular bundles (xylem and phloem) are and their function in the transport system in plants.
Students' activity	-	The teacher instructed the students to explain transpiration by detaching the leaves of pawpaw and cassava to observe and make inference on the materials of the plants detached.
Summary	-	The teacher summarised the whole lesson to the Students
Evaluation	-	The teacher reviewed the lesson by asking the student to: <ul style="list-style-type: none"> i. Mention the media of transportation in plants.

ii. List the vascular bundles and their functions in plants.

iii. Explain transpiration in plants.

Assignment -

Students were given assignment to explain the major difference between the mechanism of transport in mammals and plants.

In conclusion, the teacher instructed the students to consult relevant textbooks on transportation system (Mechanism of transportation in small organisms) in their next class.

**Lesson Plan for Experimental Group 1
Inquiry Method
(Confirmation, Structured and Guided Inquiry Method)
Week 4 lesson plan 1**

School	-	GSS Wuse Zone 3
Date	-	02/2017
Class	-	SS II
No. of Students	-	57
Average age of Students	-	16 years
Sex	-	Male and Female
Period	-	3 rd
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Transport system (Cont'd) - Mechanism of transportation
Sub-topic	-	Mechanism of transportation in small organisms
Reference Book	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C. (iv) Ideal Practical Biology by Onwuzulume, C.N.

Instructional Materials	-	A picture chart showing mechanism of transportation in paramecium and transverse section of a plant.
Previous Knowledge	-	The students are familiar with the topic because it has been introduced in the previous lesson. The students are aware of heart beat and the flow of blood through their veins.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ul style="list-style-type: none"> i. Mention the mechanism of transportation in small organisms. ii. Define mechanism in relation to transport system.
Introduction	-	The teacher began the lesson by introducing the topic of the day- mechanism of transportation in small organisms to the students.
Presentation	-	The teacher used confirmation (re-enforcement of prior knowledge), structured (students to follow set process) and guided (the students will be provided with questions) inquiry to teach this topic. The lesson is presented in the following steps:
Step I	-	The teacher asked the students to recall the last lesson and name the constituents of vascular bundle in plants, summarise the mechanism of transportation in lower organisms like amoeba and paramecium (cytoplasm).
Step II	-	The teacher also asked the students to explain the mechanism transport in lower plants through the cell sap or latex by osmosis.
Step III	-	Another student asked to mention the differences in transport system mechanism between the lower organisms and plants.
Teacher activity	-	The teacher brought the microscope and slides of amoeba to the class.
Students' Activities-		The teacher guided the students to mount the slides of amoeba or paramecium. They should make a diagram of what they have observed and submit to the teacher.

Evaluation-

The teacher reviewed the lesson by asking the students to:

- i. Define transportation and transport system.
- ii. Describe the mode of transportation in lower Organisms.
- iii. Explain the mechanism of transportation in plants.

Assignment

- Students were given assignment to:
 1. Mention the functions vascular bundles in plants.
 2. Differentiate between transportation mechanism between amoeba and cassava plant.

In conclusion, the teacher instructed the students to consult relevant textbooks as they will be treating transportation system (Mechanism of transportation in higher animals) in their next class.

**Lesson Plan for Experimental Group 1
Inquiry Method
(Confirmation, Structured and Guided Inquiry)
Week 4 lesson plan 2**

School	-	GSS Wuse Zone 3
Date	-	02/2017
Class	-	SS II
No. of Students	-	57
Average age of Students	-	16 years
Sex	-	Males and Females
Period	-	4 th
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Transport system (Cont'd) - Mechanism of transportation
Sub-topic	-	Mechanism of transportation in higher animals
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B. O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii)

Comprehensive Practical Biology by Obidiwe, J.O.C.(iv) Onwuzulume, C.N (2015). Ideal Practical Biology. Enugu: Onwuzusons Publishers.

Instructional Materials - A picture chart showing mechanism of transportation in the mammalian heart.

Previous Knowledge - The students are familiar with the topic because it has been introduced in the previous lesson. The students are aware of media of transport in plants and animals.

Behavioural Objectives - At the end of the lesson, students were able to:

- i. Mention what the transport system of higher animals is made up of.
- ii. Describe the mammalian heart.

Introduction- The teacher began the lesson by introducing the topic of the day-Mechanism of transportation in higher animals to the students.

Presentation-The teacher used confirmation (re-inforcement of prior knowledge), structured (students to follow set process) and guided (the students will be provided with questions) inquiry to teach this topic.

The lesson is presented in the following steps:

Step I - The teacher called on a student to recall the last lesson and mention the media of transport in plants.

Step II - The teacher called on a student to explain the mechanism of transportation of blood in the mammalian heart.

Step III - Another student was asked to explain the mechanism transport of blood in birds and reptiles.

Step VI - The teacher also called on another student to describe the differences in transport system mechanism between the Mammals and Birds.

Students' Activity - The teacher asked the students to form six groups and write down the differences in transport system mechanism between the mammals and birds.

Summary	-	The teacher summarised the whole lesson to the students.
Evaluation-		The teacher reviewed the lesson by asking the students to: <ol style="list-style-type: none"> i. Mention what the components of transport system in mammals. ii. Describe the mode of transportation of blood in the mammalian Heart. iii. Explain the difference in mechanism between a mammal and a bird.
Assignment-		Students were given assignment to make a well labelled diagram of the mammalian heart. The teacher ended the lesson by instructing the students to read onrespiratory system, characteristics and types of respiratory system in their next class.

**Lesson Plan for Experimental Group 1
(Structured and Guided Inquiry)
Week 5 lesson plan 1**

School	-	GSS Wuse Zone 3
Date	-	02/2017
Class	-	SS II
No. of Students	-	57
Average age of Students	-	16 years
Sex	-	Males and females
Period	-	3 rd Period
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Respiratory System
Sub-topic	-	Characteristics and types of Respiratory systems.
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe,

J.O.C(iv) Ideal Practical Biology by Onwuzulume, C.N.

- Instructional Materials** - A picture chart showing the respiratory organ of higher and lower animal.
- Previous Knowledge** - The students are familiar with the breathing in and breathing out.
- Behavioural Objectives** - At the end of the lesson, students were able to:
 - i. Define respiration and respiratory system.
 - ii. List the characteristics of respiratory surface.
 - iii. Mention the types of respiratory systems.
- Introduction** - The teacher began the lesson by introducing the topic of the day-characteristics and types of respiratory systems to the students.
- Presentation** - The teacher used structured (students to follow set process) and guided (the students were provided with questions) inquiry to teach this topic. The lesson is presented in the following steps:
 - Step I** - The teacher asked the students to define and discuss respiration and respiratory system with the students.
 - Step II** - The teacher listed the characteristics of a respiratory surface.
 - Step III** - The teacher called on a student to mention the types of respiratory systems and discussed it with the students (body surface, gills, lungs in terrestrial vertebrates and lungs in mammals, external and internal respiration).
- Students' activity** - The teacher asked the students to write down names of organisms that use body surface as a respiratory system.
- Summary** - The teacher summarised the whole lesson to the students
- Evaluation** - The teacher reviewed the lesson by asking the students to:
 - i. Define respiration and respiratory system.

- ii. List the characteristics of a respiratory surface.
- iii. Describe the types of respiratory systems.

Assignment -

Students were given assignment to explain the respiratory organs of fish. In conclusion, the teacher instructed the students to consult relevant textbooks on respiratory system (respiratory system in lower animals and Pisces) for their next class.

**Lesson Plan for Experimental Group 1
Inquiry Method
(Confirmation, Guided and Structured Inquiry Method)
Week 5 lesson plan 2**

School	-	GSS Wuse Zone 3
Date	-	02/2017
Class	-	SS II
No. of Students	-	57
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	4 th Period
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Respiratory System Continued
Sub-topic	-	Respiratory system in lower animals and Pisces
Reference Book	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.(iv) Ideal Practical Biology by Onwuzulume, C.N.
Instructional Materials	-	A picture chart showing the respiratory system of a fish and head of 6 Tilapia fish.
Previous Knowledge	-	The students are familiar with the breathing in and breathing out
Behavioural Objectives	-	At the end of the lesson, students were able to:

		<ul style="list-style-type: none"> • Define gills and its function. • Name the different parts of the gills and its function. • Mention and describe the organ of respiration of lower animals
Introduction	-	The teacher began the lesson by introducing the topic of the day-Respiratory system in lower animals and Pisces to the students.
Presentation	-	The teacher used confirmation (re-enforcement of prior knowledge), structured (students to follow set process) and guided (the students were provided with questions) inquiry to teach this topic. The lesson was presented in the following steps:
Step I	-	the teacher asked the student to recall the last lesson and mention the types of respiratory system.
Step II	-	the teacher asked the student explain the organ of respiration in amoeba and flatworms.
Step III	-	The teacher asked a student to define gills and its function as respiratory system in tilapia fish.
		Experiment on the respiratory organs of Tilapia fish
Teacher Activity	-	The teacher brought six tilapia fish head and knives to the class.
Students' Activity-		The teacher instructed the student to form 6 groups. With the help of the teacher, the student dissected the head of the tilapia fish and exposed the respiratory organs (the gills). The teacher pointed out the different part of the fish to the students. Also, another student was called on to explain the functions of different parts of the gills (gill arch, gill rackers and gill filaments).
Step VI	-	The teacher also called on students to explain the difference in the modes of respiration between the lower animals and Pisces.

Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	The teacher reviewed the lesson by asking the students to: <ul style="list-style-type: none"> i. Define Gills and its function. ii. Mention different parts of the gills and its function. iii. Describe the respiratory organ of amoeba and flat worms.
Assignment	-	Students were given assignment to differentiate between the respiratory organs in fish and Ameoba. The teacher concluded the lesson and instructed the students to consult relevant textbooks on respiratory system (Mechanism of Respiration) for their next class.

**Lesson Plan for Experimental Group 1
(Confirmation, Structured and Guided Inquiry Method)
Week 6 lesson plan 1**

School	-	GSS Wuse Zone 3
Date	-	02/2017
Class	-	SS II
No. of Students	-	57
Average age of Students	-	Age 16
Sex	-	Males and females
Period	-	3 rd
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Respiratory System Continued
Sub-topic	-	Mechanism of Respiration
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe,

J.O.C.(iv) Ideal Practical Biology by Onwuzulume, C.N.

- Instructional Materials** - A picture chart showing the respiratory organ of higher and lower animals.
- Previous Knowledge** - The students are familiar with the breathing in and breathing out
- Behavioural Objectives** - At the end of the lesson, students were able to:
i. Define and explain inhalation.
ii. Define and explain exhalation.
- Introduction** - The teacher began the lesson by introducing the topic of the day-mechanism of respiration to the students.
- Presentation** - The teacher used confirmation (re-enforcement of prior knowledge), structured (students to follow set process) and guided (the students were asked questions) inquiry to teach this topic.
The lesson is presented in the following steps:
- Step I** - The teacher asked the student to recall the last lesson and mention the parts of the respiratory system in tilapia fish.
- Step II** - The teacher gave a clue on the topic after which a student was called to define and discuss the inhalation. After eight seconds of wait time a student responded by saying “Inhalation simply means breathing in. The teacher called on another student to discuss the process of inhalation with his fellow students.
- Step III** - Another student was asked to define the process of exhalation. After some seconds of wait time the student says “Exhalation simply means breathing out, the teacher guided the students to discuss the mechanism of exhalation.
- Students’ Activity-** The teacher then asked the students to breathe in and out. They wrote down their observations of the ventilation movement in a tabular form.

- Summary** - The teacher summarised the whole lesson to the students.
- Evaluation** - The teacher reviewed the lesson by asking the students to:
- Describe the process of inhalation in named vertebrate.
 - Describe the process of exhalation in a man.
- Assignment** - Students were given assignment to:
- Explain why it is convenient for fish to breathe in the water than on land.
 - Describe inhalation and exhalation in fish.
- In closure, the teacher instructed the students to consult relevant textbooks on respiratory system (Respiration in Man) for their next class.

Lesson Plan for Experimental Group 1
Inquiry Method
(Confirmation, Structured and Guided Inquiry Method)
Week 6 lesson Plan 2

- School** - GSS Wuse Zone 3
- Date** - 02/2017
- Class** - SS II
- No. of Students** - 57
- Average age of Students** - Age
- Sex** - Males and females
- Period** - 4th
- Duration** - 40 minutes
- Subject** - Biology
- Topic** - Respiratory System Continued
- Sub-topic** - Respiration in Man
- Reference Books** - (i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.(iv) Ideal Practical Biology by Onwuzulume, C.N.

- Instructional Materials** - A picture chart of the human respiratory system with the Respiratory system of a goat and the lungs of a goat.
- Previous Knowledge** - The students are familiar with the breathing in and breathing out. They have also learnt the mechanism of respiration in the previous lesson.
- Behavioural Objectives** - At the end of the lesson, students were able to:
- Identify the parts that make up the human respiratory system.
 - Explain the function of each of the parts of the human respiratory system.
- Introduction** - The teacher began the lesson by introducing the topic of the day-Respiration in Man to the students.
- Presentation** - The teacher used confirmation (re-enforcement of prior knowledge), structured (students to follow set process) and guided (the students were asked questions) inquiry to teach this topic.
- The lesson is presented in the following steps:
- Step I** - the teacher asked the student to recall the last lesson and briefly the mechanism of respiration.
- Step II** - The teacher called on a student to list the parts that make up the human respiratory system.
- Step III** - Another student was asked to discuss the function of each of the parts of the human respiratory system.

Experiment on the respiratory system of a goat

Teacher's Activity- the teacher came to the class with a set of respiratory system of a goat gotten from the local abattoir.

Students' Activities- The students were expected to identify (i) Trachea (ii) Bronchi (iii) Lungs. The teacher guided the students to press the trachea between their fingers to feel the cartilage ring, the teacher asked the student the importance of the cartilage ring; the students felt the texture of the lungs. The teacher asked the students to make a well labelled diagram of the respiratory system of the goat in front of them.

- Summary** - The teacher summarised the whole lesson to the students.
- Evaluation** - The teacher reviewed the lesson by asking the student to:
- Mention the parts that make up the human respiratory system.
 - Describe the function of each of the parts of the human respiratory system.
- Assignment** - Students were given assignment to explain (i) to explain the respiration mechanism in toad. The teacher concluded the lesson by instructing the students to consult relevant textbooks on excretory System (excretory system in lower animals and plants) for their next lesson.

**Lesson Plan for Experimental Group 1
Inquiry Method
(Structured and Guided Inquiry Method)
Week 7 lesson plan 1**

- School** - GSS Wuse Zone 3
- Date** - 02/2017
- Class** - SS II
- No. of Students** - 57
- Average age of Students** - 16 years
- Sex** - Male and female
- Period** - 3rd
- Duration** - 40 Minutes
- Subject** - Biology
- Topic** - Excretory System
- Sub-topic** - Excretory system in lower animals and plants
- Reference Books** - (i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C. (iv) Ideal Practical Biology by Onwuzulume, C.N.

Instructional Materials	-	A picture showing the excretory organs of flatworms and the malphigian tubules of a cockroach.
Previous Knowledge	-	The students are familiar with passing out liquid and gaseous substances
Behavioural Objectives	-	At the end of the lesson, students were able to: <ul style="list-style-type: none"> i. Mention organ of excretion in flatworms, paramecium and cockroach. ii. Describe the mechanism of excretion in Cockroach. iii. Describe the mechanism of excretion in lower plants (paramecium or Ameoba).
Introduction	-	The teacher began the lesson by introducing the topic of the day-Excretory system in lower animals and plants to the students.
Presentation	-	The teacher used structured (students to follow set process) and guided (the students were asked questions) inquiry to teach this topic. The lesson is presented in the following steps:
Step I	-	The teacher asked if any of the student can mention and discuss the organ of excretion in lower animals and plants. The organ or excretion in amoeba (Contractile vacuole); tape worm (flame cells) and cockroach (malphigian tubules).
Step II	-	The teacher called on a student to describe and discuss the mechanism of excretion in amoeba and tape worm.
Step III	-	The teacher called on another student to vividly discuss the mechanism of excretion in Cockroach (insect).
Teacher's Activity-		The teacher came to the class with a microscope and some slides containing the micro-organism- paramecium.
Students' Activities-		The students are expected to identify (i) Contractile vacuole. The teacher guided the students to mount the

slide, manipulate the lens until they can see the organism clearly. The teacher asked the students to make a well labelled diagram of the paramecium and they wrote down the function of the contractile vacuole in their Biology drawing book.

- Summary** - The teacher summarised the whole lesson to the students.
- Evaluation** - The teacher reviewed the lesson by asking the student to:
- i. Mention the organ of excretion of Paramecium or Euglena
 - ii. Briefly explain the excretory process of a Paramecium
 - iii. Briefly explain the excretory process of a tape worm
- Assignment** - Students were given assignment to make a large and well labelled diagram of the malpighian tubules of the cockroach. The students wrote down the functions of these parts in their Biology drawing book. In conclusion, the teacher instructed the students to consult relevant textbooks on excretory system (excretory system in higher animals and plants) for their next class.

**Lesson Plan for Experimental Group 1
(Confirmation, Structured and Guided Inquiry Method)
Week 7 lesson plan 2**

- School** - GSS Wuse Zone 3
- Date** - 02/2017
- Class** - SS II
- No. of Students** - 57
- Average age of Students** - 16 years
- Sex** - Male and female
- Period** - 4th

Duration	-	40 Minutes
Subject	-	Biology
Topic	-	Excretory System
Sub-topic	-	Excretory system in higher animals and plants
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.(iv) Ideal Practical Biology by Onwuzulume, C.N.
Instructional Materials	-	A picture chart of the longitudinal section of a human kidney, 3 pairs of kidney (goat) and a picture also showing lenticels on the bark of a tree.
Previous Knowledge	-	The students are familiar with excretion in lower animals and mammals.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ol style="list-style-type: none"> 1. Mention organ of excretion in man and plants 2. Describe the mechanism of excretion in man 3. Describe the mechanism of excretion in higher plants.
Introduction	-	The teacher began the lesson by introducing the topic of the day-Excretory system in higher animals and plants to the students.
Presentation	-	The teacher used confirmation (re-inforcement of prior knowledge), structured (students to follow set process) and guided (the students will be provided with questions) inquiry to teach this topic.
Step I-		The lesson is presented in the following steps: The teacher called on a student to recall the last lesson and mention the organ of excretion in flatworms and cockroach.
Step II	-	The teacher called on a student to mention and discuss the organ of excretion in higher animals and higher plants. The organ of excretion in mammals

(kidneys) and in the higher plants (stomata and lenticels).

Step III - The teacher called on another student to describe and discuss the mechanism of excretion in man (filtration process and selective reabsorption).

Step III - Another student was asked to vividly discuss the mechanism of excretion in plants which is through the stomata.

Experiment on the excretory system of a goat

Teacher's Activity - The teacher came to the class with a the kidney of a goat which is similar to that of humans and a knife to cut the kidney into halves

Students' Activities- the students were expected to identify the kidney as the main excretory organ of man. The teacher asked the students to form two groups. The teacher asked the students to make a well labelled diagram of the kidney with assistance of the chart of the longitudinal section of a mammalian kidney displayed in the front of the class

Summary - The teacher summarised the whole lesson to the students.

Evaluation - The teacher reviewed the lesson by asking the students to:

- i. Describe how man passes out the water he drinks during meal.
- ii. Briefly explain excretion in plants.

Assignment - Students were given assignment to explain in detail why we remove waste products from our body. The teacher concluded the lesson by instructing the students to consult relevant textbooks as their next class will be on nutrient cycle in nature (Photosynthesis in plants).

Lesson Plan for Experimental Group 1
Inquiry Method
(Structured and Guided Inquiry Method)
Week 8 lesson plan 1

School	-	GSS Wuse Zone 3
Date	-	03/2017
Class	-	SS II
No. of Students	-	57
Average age of Students	-	Age
Sex	-	Male and Female
Period	-	3 rd
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Nutrient Cycle in Nature
Sub-topic	-	Carbon and water Cycle in nature
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.(iv) Ideal Practical Biology by Onwuzulume, C.N.
Instructional Materials	-	A cardboard chart showing carbon and water cycle in nature was displayed in the class.
Previous Knowledge	-	The students are familiar with the topic because they breathe in oxygen and witness rainfall.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ul style="list-style-type: none"> • Define and discuss carbon cycle in nature. • Describe the water cycle
Introduction	-	The teacher began the lesson by introducing the topic of the day- nutrient cycling in nature (carbon and water cycle in nature).
Presentation	-	The teacher used confirmation (re-enforcement of prior knowledge), structured (students to follow set

process) and guided (the students were asked questions) inquiry to teach this topic.

The lesson is presented in the following steps:

Step I	-	The teacher defined and discussed carbon cycle with the students. They are defined as the circulation of carbon, oxygen and water in nature.
Step II	-	with the aid of diagrams, the teacher discussed with the students the process of natural water cycle.
Students' Activity	-	The teacher divided the students into groups to discuss other importance of oxygen in nature not earlier mentioned. The students were told to write down their answers.
Summary-		The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: <ol style="list-style-type: none">1. Mention three ways carbon is returned back to the atmosphere.2. Describe the process of natural water cycle.
Assignment	-	Students were given assignment to make a labelled diagram of the carbon cycle and water cycle. The teacher concluded the lesson by instructing the students to consult relevant textbooks as their next class will be on importance of nutrient cycling in nature.

**Lesson Plan for Experimental Group 1
(Confirmation, Structured and Guided Inquiry Method)
Week 8 lesson plan 2**

School	-	GSS Wuse Zone 3
Date	-	03/2017
Class	-	SS II
No. of Students	-	57
Average age of Students	-	Age
Sex	-	Male and Female
Period	-	4 th
Duration	-	40 minutes

Subject	-	Biology
Topic	-	Nutrient Cycle in Nature
Sub-topic	-	Oxygen cycle and Importance of nutrient cycle in nature
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C. (iv) Ideal Practical Biology by Onwuzulume, C.N.
Instructional Materials	-	A cardboard chart showing Oxygen cycle in nature, Water plant (water lily), filter funnel , Beaker, Water and Test-tube
Previous Knowledge	-	The students are familiar with the topic, they have studied water and carbon cycle in the last class.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ol style="list-style-type: none"> 1. Define and discuss oxygen cycle in nature. 2. Mention the importance of nutrient cycle in nature.
Introduction	-	The teacher began the lesson by introducing the topic of the day-Nutrient Cycling in Nature(Oxygen cycle and the importance of the nutrients cycling in nature).
Presentation	-	The teacher used confirmation (re-enforcement of prior knowledge), structured (students to follow set process) and guided (the students were asked questions) inquiry to teach this topic. The lesson is presented in the following steps:
Step I	-	The teacher called on a student to recall the last lesson and briefly describe the water cycle.
Step II	-	The teacher discussed with the process of, oxygen cycling in nature and made the student to understand that most available oxygen in nature comes from photosynthesis.

Step III	-	The teacher guided the students to mention the importance of nutrients cycling in nature to plants and animals.
Teachers' Activity		The teacher set up the experiment earlier in the day because it took 3-4 hours to see results. The teacher brought the set up experiment to the laboratory.
Students' Activity-		The teacher led students to perform experiment to show release of oxygen during photosynthesis. The test tube was removed from the top of the filter funnel by a student. The gas collected in the test tube was tested with the use of a glowing splint. The gas present rekindled the glowing splint which showed or confirmed the presence of oxygen.
Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: <ol style="list-style-type: none"> 1. Mention two ways oxygen is returned back to the atmosphere. 2. Mention three ways oxygen is removed from the atmosphere. 3. Mention two importance each of Carbon, oxygen and water cycle.
Assignment	-	Students were given assignment to briefly explain mention five importance of water to plants and animals. In conclusion, the teacher instructed the students to consult relevant textbooks on 'decomposition in nature' (Types of micro-organisms) for their next class.

Lesson Plan for Experimental Group 1
Inquiry method
(Confirmation, Structured and Guided Inquiry Method)
Week 9 lesson plan 1

School - GSS Wuse Zone 3

Date	-	03/2016
Class	-	SS II
No. of Students	-	57
Average age of Students	-	16 years
Sex	-	Female
Period	-	3 rd
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Decomposition in nature
Sub-topic	-	Types of micro organisms
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C. (iv) Ideal Practical Biology by Onwuzulume, C.N.
Instructional Materials	-	A picture chart showing images of dead decaying animals and refuse dump.
Behavioural Objectives	-	At the end of the lesson, students were able to: i. Define decomposition in nature. ii. Mention the types of micro organism.
Introduction	-	The teacher began the lesson by introducing the topic of the day- Types of micro-organism to the students.
Presentation	-	The teacher used structured (students to follow set process) and guided (the students were asked questions) inquiry to teach this topic. The lesson is presented in the following steps:
Step I	-	The teacher asked the students to define and discuss the decomposition in nature. After some seconds of wait time a student defines “Decomposition as the elimination of dead bodies of living things from the environment by saprophytes”.
Step II	-	The teacher asked another student to mention and discuss the types of decomposers – i Micro decomposers (bacteria, fungi) ii Macro decomposers (earth worms, snails, termites and so forth).
Evaluation	-	The teacher reviewed the lesson by asking the students to: i. Define decay and briefly explain it.

- ii. Mention the types of decomposer and give five examples each.
- Assignment** - Students were given assignment to mention 10 harmful effects of micro-organisms. The teacher concluded by instructing the students to consult relevant textbooks on Decomposition in nature (Importance and role of a decomposer) in their next class.

Lesson Plan for Experimental Group 1
Inquiry Method
(Confirmation, Structured and Guided Inquiry Method)
Week 9 lesson plan 2

School	-	GSS Wuse Zone 3
Date	-	03/2017
Class	-	SS II
No. of Students	-	57
Average age of Students	-	16 years
Sex	-	Female
Period	-	4 th period
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Decomposition in nature
Sub-topic	-	Importance and role of a decomposer
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive practical Biology by Obidiwe, J.O.C. (iv) Ideal Practical Biology by Onwuzulume, C.N.
Instructional Materials	-	A picture chart showing images of dead decaying animals and refuse dump.
Previous Knowledge	-	The students are having observed some form of decomposition in their environment.
Behavioural Objectives	-	At the end of the lesson, students were able to: 1. Mention and explain the role decomposer. 2. Importance of decomposition in nature.

Introduction	-	The teacher began the lesson by introducing the topic of the day-Decomposition in nature (importance and role of a decomposer).
Presentation	-	The teacher used confirmation (re-inforcement of prior knowledge), structured (students to follow set process) and guided (the students were provided with questions) inquiry to teach this topic.
		The lesson is presented in the following steps:
Step I	-	The teacher called on a student to recall the last lesson and briefly describe the types of decomposers and one example each.
Step II	-	The teacher called a student to identify the gases released during decomposition.
Step III	-	Another student was asked to describe the limit to tolerance.
Step VI	-	The teacher asked another student to mention and explain the role of decomposer in an ecosystem.
Students' Activity	-	The teacher told the students to carry their jotter and writing materials. The teacher took the students to the school rubbish bin. The students were asked to observe and jot their observations in relation to the topic.
Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: <ul style="list-style-type: none"> i. Mention five roles of decomposers to a farmer. ii. Importance of decomposition.
Assignment	-	Write a short note on Tolerance. In conclusion, the teacher instructed the students to consult relevant textbooks on Ecological management (Tolerance) for their next class.

Lesson Plan for Experimental Group 1
Inquiry Method
(Confirmation, Structured and Guided inquiry Method)
Week 10 lesson Plan 1

School	-	GSS Wuse Zone 3
Date	-	03/2017

Class	-	SSS II
No. of Students	-	57
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	3 rd
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Ecological management
Sup-topic	-	Tolerance
Reference Books	-	(i)Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive PracticalBiology by Obidiwe, J.O.C.. (iv)Ideal Practical Biology by Onwuzulume, C.N.
Instructional Materials	-	A picture chart showing images of dead animals and refuse dump
Previous Knowledge	-	The students were given an assignment last week to write a brief note on tolerance.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ul style="list-style-type: none"> i. Define tolerance ii. Define and explain the concept of maximum and minimum tolerance iii. Discuss geographic range
Introduction	-	The teacher began the lesson by introducing the topic of the day-Ecological management (tolerance) to the students.
Presentation -		The teacher used Confirmation inquiry(recall of last lesson on Adaptation), Structured (students to follow set process) and Guided (the students were provided with questions) inquiry to teach this topic.
		The lesson is presented in the following steps:
Step I	-	The teacher defined and discusses with the students what tolerance is- Tolerance is the ability of an

		organism to withstand unfavourable conditions in their environment and survive it.
Step II	-	The teacher guided the students to discuss the maximum and minimum range an organism can survive in a habitat.
Students' Activity-		The teacher guided the students to discuss the geographical range that is, an area where organism can be found within the limit of its tolerance. Having known the definition, the teacher asked the students to mention some geographical range of some animals, plants or birds they know.
Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: 1. Define Tolerance. 2. What do you understand by the term maximum and minimum tolerance? 3. Mention five factors responsible for geographic range.
Assignment	-	Briefly explain how rainfall and temperature affect the distribution of plants and animals .In conclusion, the teacher instructed the students to consult relevant textbooks on the topic Ecological management (Adaptation) for their next class.

Lesson Plan for Experimental Group 1
Inquiry Method
(Structured, Guided and Confirmation Inquiry Method)
Week 10 lesson plan 2

School	-	GSS Wuse Zone 3
Date	-	03/2017
Class	-	SS II
No. of Students	-	48
Average age of Students	-	16 years

Sex	-	Male and female
Period	-	4 th period
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Ecological management
Sub-topic	-	Adaptation
Reference Book	-	(i) Essential Biology by Michael, M.C (ii) Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C. (iv) Ideal Practical Biology by Onwuzulume, C.N.
Instructional Materials	-	A picture chart showing terrestrial and aquatic adaptation of plants(cactus and water lily) and animals (bird and fish).
Previous Knowledge	-	The students were taught tolerance of various organisms last week.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ol style="list-style-type: none"> 1. Define adaptation 2. Mention and explain adaptation of animals and plants to aquatic habitat 3. Mention and discuss the adaptation of plants and animals to terrestrial habitats 4. Discuss special adaptation of some organism.
Introduction	-	The teacher began the lesson by introducing the topic of the day- Adaptations (ecological management).
Presentation	-	The teacher used confirmation (re-enforcement of prior knowledge), structured (students to follow set process) and guided (the students were provided with questions) inquiry to teach this topic. The lesson is presented in the following steps:
Step I	-	the teacher asked a student to recall the last lesson by defining tolerance. In view of the chart displayed in the classroom showing images of various adaptations of plants (cactus and water lily) and animals (bird and

fish), the teacher calls a student to define and discuss adaptation. After some seconds of wait, the student defined it “Adaptation as the ability of an organism to live successfully in a habitat as a result of its structure, appearance or behaviour.

Step II	-	Another student was called to mention and discuss adaptation of plants and animals in aquatic habitat.
Step III	-	The teacher also called another student to mention and discuss the adaptation of plants and animals to terrestrial habitat.
Student Activity-		The teacher then guided the students to mention and discuss adaptation of plants and animals in both terrestrial and aquatic habitat.
Summary	-	The teacher summarised the whole lesson to the students
Evaluation	-	Teacher evaluated the students by asking them to: 1. Define adaptation. 2. Mention three adaptive features of aquatic plants and animals. 3. Mention five adaptive features of terrestrial plants and animals.
Assignment	-	Students were given assignment to write short note on the adaptation of the following animals (i) Chameleon (ii) Tape worm(iii)Bird. In Conclusion, at the end of the term, the teacher revised the different topics taught to the students in preparation for the Biology Objective post-test quiz.

APPENDIX B
LESSON PLAN FOR EXPERIMENTAL GROUP 2
(DEMONSTRATION METHOD)
Week 1 lesson plan 1

School	-	GSS Lugbe
Date	-	01/2017
Class	-	SS II
No. of Students	-	78
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	3rd
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Digestion
Sub-topic	-	Digestion in Invertebrates
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A cardboard showing chart of digestive system of invertebrate (cockroach)
Previous Knowledge	-	The students are familiar with eating and digestion of food substances as a normal routine in life.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ul style="list-style-type: none"> i. Discuss modification of feeding habits. ii. Discuss the process of feeding in invertebrate animals. iii. Describe the human alimentary canal and its functions.
Introduction	-	The teacher began the lesson by introducing the topic of the day- Digestion in Invertebrates.
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher demonstrated and display a picture showing themodification offeeding habit such as

filter feeder (mosquito larva); Fluid feeders (house fly, mosquito, tsetse fly and so forth); parasitic and saprophytic feeders (tape worm and fungi and so forth).

Step II	-	The teacher presented to the students a picture showing feeding habit in protozoa (such as Amoeba P.) and in hydra. In the picture, the researcher pointed out for the students that, Amoeba uses Pseudopodia to circle, engulf it to form food vacuole, enzymes are introduced to digest it intracellularly. The hydra ingest food particles into the mouth into the hollow stomach (ecteron) where extra-cellular digestion take place.
Students' Activity:		The students were asked to look at the picture of feeding parts of the hydra. They are expected to make a well labelled diagram
Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	The teacher evaluated the lesson by asking the students to: <ol style="list-style-type: none">i. Define digestion and digestive system.ii. Describe the mouth part of filter feeders and fluid feeders.iii. Mention the parts of alimentary canal and their functions.
Assignment	-	Differentiate between feeding methods of protozoa and hydra. In conclusion, the teacher instructed the students to consult relevant textbooks on Digestion in Vertebrates for the next lesson.

**Lesson Plan for Experimental Group 2
(Demonstration Method)
Week 1 lesson Plan 2**

School	-	GSS Lugbe
Date	-	02/2017
Class	-	SS II
No. of Students	-	78
Average age of Students	-	16 years
Sex	-	male and female
Period	-	4th
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Digestion
Sub-topic	-	Digestion in Vertebrates
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	a dissected Bird and a chart showing the digestive system of vertebrate animals(Bird)
Behavioural Objectives	-	At the end of the lesson, students were able to: iii. Discuss modification of feeding habits. iv. Describe the human alimentary canal and its functions.
Previous Knowledge	-	The students are familiar with eating and digestion of food substances as a normal routine in life.
Introduction	-	The teacher began the lesson by introducing the topic of the day- Digestion in Vertebrates to the students.
Presentation	-	The lesson is presented in the following steps:
Step I		The teacher dissected a bird on the demonstration table in the laboratory while the students looked at the teacher with rapt attention. The students came in groups around the table where the alimentary canal of the bird was displayed. Also, a chart of the digestive system of bird was also displayed on the chalkboard.

		The teacher presented a picture showing different parts of alimentary system and their functions (mouth, oesophagus, stomach, pancreas, small intestine, large intestine, rectum and anus).
Step II	-	The teacher discussed with the students some modification of alimentary canal as found in birds, humans and sheep.
Students Activities	-	The students imitated the teacher by drawing the digestive tract of the bird and then list their functions. The students mentioned the parts of alimentary system and their functions (mouth, oesophagus, stomach, pancreas, small intestine, large intestine, rectum and anus). The teacher asked the students to make a large labelled diagram of the picture chart of the alimentary canal of a bird.
Summary	-	The teacher summarized the whole lesson to the students.
Evaluation	-	Teacher asked the students to: i. Define digestion and digestive system. ii. Mention the parts of alimentary canal and their functions
Assignment	-	Differentiate between monogastric animals and polygastric animals. In conclusion, the teacher instructed the students to consult relevant textbooks on the next topic- Transport System (Diffusion).

**Lesson Plan for Experimental Group 2
(Demonstration Method)
Week 2 lesson Plan 1**

School	-	GSS Lugbe
Date	-	01/2017
Class	-	SS II
No. of Students	-	78
Average age of Students	-	16 years
Sex	-	Male and female

Period	-	3rd
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Transport system
Sub-topic	-	Diffusion
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A cardboard showing chart of transport diffusion.
Previous Knowledge	-	The students are aware of heart beat and the flow of blood through their veins.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ul style="list-style-type: none"> • Define transport system and mention the media of transportation and the materials for transportation. • Define, discuss and mention the importance of diffusion.
Introduction-		The teacher began the lesson by introducing the lesson of the day- diffusion.
Presentation-		The lesson is presented in the following steps:
Step I	-	The teacher demonstrated and explained transportation as the movement of materials (liquid and gaseous substances) round the body, the teacher also guided the students to mention the media of transportation (cell sap, lymph and blood), and the teacher also guided the students to mention the materials for transportation (water, digested food materials, hormones, enzymes, and waste products).
Step II-		The teacher demonstrated and defined diffusion as the movement of molecules of substances from the region of higher concentration to the region of lower concentration until equilibrium is reached.

The teacher demonstrated the process of diffusion and mentions the importance of diffusion.

Student activities-

The teacher guided the students to imitate by making a well labelled diagram the picture of diffusion of liquid that is displayed in the classroom. The students were asked by the teacher to write down in their Biology note book the importance of diffusion.

Summary -

The teacher summarised the whole lesson to the students

Evaluation -

Teacher evaluated the students by asking them to:

- i. Define transportation and transport system.
- ii. Describe the mouth part of filter feeders and fluid feeders.
- iii. Mention the parts of alimentary canal and their functions.

Assignment-

The teacher asked the students to: i. Define Diffusion.ii. Describe diffusion diagrammatically.In conclusion, the teacher instructs the students to consult relevant textbooks on the topic Transport System (Osmosis).

**Lesson Plan for Experimental Group 2
(Demonstration Method)
Week 2 lesson Plan 2**

School	-	GSS Lugbe
Date	-	01/2017
Class	-	SS II
No. of Students	-	78
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	4th
Duration	-	40 minutes
Subject	-	Biology

Topic	-	Transport system
Sub-topic	-	Osmosis
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A cardboard showing demonstration of osmosis using cellophane.
Previous Knowledge	-	The students have discussed diffusion in the last lesson.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ul style="list-style-type: none"> i. Define Osmosis. ii. Discuss Osmosis in plant cells and their biological importance.
Introduction	-	The teacher began the lesson by introducing the topic of the day- Osmosis to the students.
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher demonstrated and defined Osmosis as the movement of materials (liquid and gaseous substances) round the body, the teacher also guided the students to mention the media of transportation (cell sap, lymph and blood), and the teacher guided the students to mention the materials for transportation (water, digested food materials, hormones, enzymes, and waste products).
Step II	-	The teacher defined osmosis and demonstrated the process of Osmosis in plants and animal. The teacher also aided the students to mention the importance of osmosis to plants and animals.
Students' Activity-		The teacher aided the students to make a diagram of osmosis in plants and labelled the parts.
Summary	-	The teacher summarized the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to:

- i. Define Osmosis
- ii. Discuss Osmosis in plant cells and their biological importance.

Assignment -

The teacher asked the students to:

- i. Define Osmosis
- ii. Differentiate between Osmosis and Diffusion. In conclusion, the teacher instructs the students to consult relevant textbooks on the topic Blood as a medium of transportation in Animals.

**Lesson Plan for Experimental Group 2
(Demonstration Method)
Week 3 lesson Plan 1**

School	-	GSS Lugbe
Date	-	01/2017
Class	-	SS II
No. of Students	-	78
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	3rd
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Transport system (Cont'd) - Media of transportation
Sub-topic	-	Blood as a media of transportation in mammals
Reference Books	-	(i)Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A picture chart showing media of transportation in mammals
Previous Knowledge	-	The students are familiar with the topic which has been introduced in the previous lesson.
Behavioural Objectives	-	At the end of the lesson, students were able to:

- i. Mention the media of transportation in mammals.
- ii. Define blood and mention the components of blood.
- iii. Describe red and white blood cell and mention their functions.

Introduction-

The teacher began the lesson by introducing the topic of the day-Blood as a medium of transportation in mammalsto the students

Presentation -

The lesson is presented in the following steps:

Step I -

The teacher presented a picture showing media of transportation and blood cells and defines blood as the liquid tissues found in the body. The teacher guided the students to mention the components of the blood and discuss it (Red blood cell, white blood cells, blood platelets lymphocytes and the blood plasma).

Step II -

The teacher guided the students to describe red blood cells and white blood cells and blood platelets.

Students' activity -

The students were asked by the teacher to make a well labelleddiagram of the blood cells.

Summary -

The teacher summarized the whole lesson to the students.

Evaluation -

Teacher evaluated the lesson by asking the students to:

- i. Mention the media of transportation in mammals.
- ii. Define blood and mention the components of blood.
- iii. Describe red ,white blood cell and blood platelets and also to list out their functions.

Assignment -

- i.Mention the media of transportation in mammals.
- ii. Mention the characteristics of red blood cells.

In conclusion, the teacher asked the students to consult relevant textbooks on blood as a medium of transportation in Plants.

**Lesson Plan for Experimental Group 2
(Demonstration Method)
Week 3 lesson Plan 2**

School	-	GSS Lugbe
Date	-	01/2017
Class	-	SS II
No. of Students	-	78
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	4 th period
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Transport system (Cont'd) - Media of transportation
Sub-topic	-	Media of transportation in Plants
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive practical Biology by Obidiwe, J.O.C..
Instructional Materials	-	A picture chart showing media of transportation in plants (transverse section of a root and stem).
Previous Knowledge	-	The students are familiar with the topic which has been introduced in the previous lesson.
Behavioural Objectives	-	At the end of the lesson, students were able to: i. Mention the materials for transportation in plants. ii. List the vascular bundles and their functions in plants. iii. explain transpiration in plants
Introduction	-	The teacher began the lesson by introducing the topic of the day- medium of transportation in plants to the students.

Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher demonstrated and explained the materials for transportation in plants (water and mineral salt by the root, photosynthesis food from the leaves and excretory waste products).
Step II	-	The teacher explained and demonstrated to the students what vascular bundles (xylem and phloem) are and their function in the transport system in plants.
Step III	-	The teacher explained and demonstrated transpiration to the students. Instructed students to detach the leaves of pawpaw and cassava to observe and make inference on the materials of the plants detached.
Students Activity	-	Instruct students to detach the leaves of pawpaw or cassava to observe and make inference on the materials of the plants detached.
Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the lesson by asking the students to: <ul style="list-style-type: none"> i. Mention the media of transportation in plants. ii. List the vascular bundles and their functions in plants. iii. Explain transpiration in plants
Assignment-		Explain the major difference between the mechanisms of transport in mammals and higher plants. In conclusion, the teacher asked the students to consult relevant textbooks on ‘mechanism of transportation in small organisms’ for their next lesson.

**Lesson Plan for Experimental Group 2
(Demonstration Method)**

Week 4 lesson plan 1

School	-	GSS Lugbe
Date	-	02/2017
Class	-	SS II
No. of Students	-	78
Average age of Students	-	16 years
Sex	-	Male and Female
Period	-	3 rd
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Transport system (Cont'd) - Mechanism of transportation
Sub-topic	-	Mechanism of transportation in small organisms
Reference Books	-	(i)Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A andChukwuka, K.S(iii) Comprehensive PracticalBiology by Obidiwe, J.O.C.
Instructional Materials	-	A picture chart showing mechanism oftransportation in paramecium and transverse section of a plant
Previous Knowledge	-	The students are familiar with the topic because it has been introduced in the previous lesson. The students are aware of heart beat and the flow of blood though their veins.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ol style="list-style-type: none">1. Mention the mechanism of transportation in small organisms2. Define mechanism in relation to transport system.
Introduction -		The teacher began the lesson by introducing the topic of the day- mechanism of transportation in small organismsand lowerplants to the students
Presentation	-	The lesson is presented in the following steps:

Step I	-	The teacher explained and demonstrated to the students mechanism of transportation in lower organisms like amoeba and paramecium (cytoplasm).
Step II	-	The teacher demonstrated and explained to the students the mechanism transport in lower plants through the cell sap or latex by osmosis.
Step III	-	The teacher guided the students to mention the differences in transport system mechanism between the lower organisms and plants.
Students' Activity	-	The teacher explained to the students the mechanism transport in lower plants through the cell sap or latex by osmosis.
Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	<p>Teacher evaluated the students by asking them to:</p> <ol style="list-style-type: none"> i. Define transportation and transport system. ii. Describe the mode of transportation in lower organisms. iii. Explain the mechanism of transportation in plants.
Assignment	-	<ol style="list-style-type: none"> i. Mention the functions vascular bundles in plants. iii. Differentiate between transportation mechanism between amoeba and cassava plant. <p>In conclusion, the teacher asked the students to consult relevant textbooks on mechanism of transportation in higher animals for their next lesson.</p>

**Lesson Plan for Experimental Group 2
(Demonstration Method)
Week 4 lesson Plan 2**

School	-	GSS Lugbe
Date	-	02/2017
Class	-	SS II
No. of Students	-	78
Average age of Students	-	16 years
Sex	-	Males and Females
Period	-	4 th
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Transport system (Cont'd) - Mechanism of transportation
Sub-topic	-	Mechanism of transportation in higher Organisms
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B. O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A picture chart showing mechanism of transportation in the mammalian heart and transverse section of a root.
Previous Knowledge	-	The students are familiar with the topic because it has been introduced in the previous lesson. The students are aware of heart beat and the flow of blood through their veins.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ol style="list-style-type: none"> 1. Mention what the transport system of higher organisms are made up of. 2. Describe the mammalian heart.
Introduction-		The teacher began the lesson by introducing the topic of the day Mechanism of Transportation in the higher organisms to the students.
Presentation	-	The lesson is presented in the following steps:

Step I	-	The Teacher explained and demonstrated to the students the mechanism of transportation of blood is the mammalian heart.
Step II	-	The Teacher explained to the students the mechanism transport of plants which is the vascular tissues (xylem and Phloem).
Step III	-	The Teacher guided the students to mention the differences in transport system mechanism between the Mammals and plants.
Students' Activity	-	The Teacher guided the students to make a well labelled diagram of the mammalian heart..
Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the lesson by asking the students to: <ul style="list-style-type: none"> i. Mention what the mechanism of transport system in mammals. ii. Mention what the mechanism of transport system in plants. iii. Explain the difference in mechanism between a mammal and a plants
Assignment-		The teacher gavethe student an assignment to mention the differences in transport system mechanism between the Mammals and Birds. In conclusion, the teacher told the students to browse the internet or use their text books to read about the lesson for next week– Respiratory System

Lesson Plan for Experimental Group 2

(Demonstration Method)

Week 5 lesson plan 1

School	-	GSS Lugbe
Date	-	02/2017
Class	-	SS II
No. of Students	-	78
Average age of Students	-	16 years
Sex	-	Males and females
Period	-	3 rd
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Respiratory System
Sub-topic	-	Characteristics and types of Respiratory system.
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A picture chart showing the respiratory organ of higher and lower animal
Previous Knowledge	-	The students are familiar with the breathing in and breathing out
Behavioural Objectives	-	At the end of the lesson, students were able to: i. Define respiration and respiratory system. ii. List the characteristics of respiratory surface. iii. Mention the types of respiratory systems. iv. Mention the types of respiratory systems.
Introduction	-	The teacher began the lesson by introducing the topic of the day- characteristics and types of respiratory system to the students
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher demonstrated and discussed respiration and respiratory system with the students.

Step II	-	The teacher listed the characteristics of a respiratory surface.
Step III	-	The teacher mentioned the types of respiratory systems and discusses it with the students (body surface, gills, lungs in terrestrial vertebrates and lungs in mammals, external and internal respiration)
Students' Activity	-	The teacher asked the students to write down names of organisms that use body surface as a respiratory system and then make a drawing of the gill of a fish as shown in the chart displayed.
Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the lesson when she asked the students to: <ul style="list-style-type: none"> i. Define respiration and respiratory system. ii. List the characteristics of a respiratory surface. iii. Describe the types of respiratory systems.
Assignment	-	In conclusion, the teacher gives the student an assignment to write a short note on the mode of respiration in Amoeba.

Lesson Plan for Experimental Group 2

(Demonstration Method)

Week 5 lesson plan 2

School	-	GSS Lugbe
Date	-	02/2017
Class	-	SS II
No. of Students	-	78
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	4 th
Duration	-	40 minutes
Subject	-	Biology

Topic	-	Respiratory System Continued
Sub-topic	-	Respiratory system in lower animals and Pisces
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A picture chart showing the respiratory system of a fish.
Previous Knowledge	-	The students are familiar with breathing in and breathing out. They have learnt the types of respiratory system and characteristics of respiratory surface.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ul style="list-style-type: none"> i. Define gills and its function. ii. Name the different parts of the gills and its function. iii. mention and describe the organ of respiration of lower animals
Introduction	-	The teacher began the lesson by introducing the topic of the day-Respiratory system in lower animals and Pisces (fish) to the students.
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher defined gills and its function as respiratory system in tilapia fish with the students.
Step II	-	The teacher brought a tilapia fish to the class and showed the students the different parts of the respiratory system which is gills (gill arch, gill rakers and gill filaments) and encouraged the students to list the functions.
Step III	-	The teacher showed and explained to the students the organ of respiration in amoeba and flatworms. The teacher also explained the difference in the modes of respiration between the lower animals and Pisces.
Students' Activity-	-	The teacher asked the students to make a well

		labelled diagram of the gills from the tilapia fish shown to them by the teacher.
Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the lesson when she asked the students to: <ol style="list-style-type: none"> i. Define gills and its function. ii. Mention different parts of the gills and its function. iii. Describe the respiratory organ of amoeba and flat worms.
Assignment	-	The teacher gave the student assignment to differentiate between the respiratory organs in fish and Amoeba. In conclusion the teacher asked the student to read their text books, the topic of next week- Respiratory System (Mechanism of Respiration).

Lesson Plan for Experimental Group 2

(Demonstration Method)

Week 6 lesson plan 1

School	-	GSS Lugbe
Date	-	02/2017
Class	-	SS II
No. of Students	-	78
Average age of Students	-	Age 16
Sex	-	Males and females
Period	-	3 rd
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Respiratory System Continued
Sub-topic	-	Mechanism of Respiration
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A;

		Ala, A; Olaniran, A & Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A picture of the Human Lungs
Previous Knowledge	-	The students are familiar with respiratory system in lower animals and tilapia.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ul style="list-style-type: none"> i. Define and explain inhalation. ii. Define and explain exhalation.
Introduction	-	The teacher began the lesson by introducing the topic of the day-mechanism of respiration in higher organisms to the students.
Presentation	-	The lesson is presented in the following steps:
Behavioural Objectives	-	At the end of the lesson, students were able to: <ul style="list-style-type: none"> i. Define and explain inhalation. ii. Define and explain exhalation.
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher defined and demonstrated inhalation with the students. Inhalation simply means breathing in. The teacher discussed the process of inhalation with the students.
Step II	-	The teacher defined and demonstrated the process of exhalation with the students. Exhalation simply means breathing out, the teacher guided the students to discuss the mechanism of exhalation.
Students' Activity-		the teacher asked the students to breathe in and out. They were expected to write down their observations in a tabular form.
Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the lesson when she asked the students to: <ul style="list-style-type: none"> i. Describe the process of inhalation in named vertebrate. ii. Describe the process of exhalation in a man

- Assignment** - The teacher gave the student assignment on
- i. Why is convenient for fish to breathe in the water than on land?
 - ii. Describe Inhalation and Exhalation in Fish.

Lesson Plan for Experimental Group 2

(Demonstration Method)

Week 6 lesson plan 2

- School** - GSS Lugbe
- Date** - 02/2017
- Class** - SS II
- No. of Students** - 78
- Average age of Students** - Age
- Sex** - Males and females
- Period** - 4th
- Duration** - 40 minutes
- Subject** - Biology
- Topic** - Respiratory System Continued
- Sub-topic** - Respiration in Man
- Reference Books** - (i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A & Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
- Instructional Materials** - A picture chart showing the Human Respiratory System
- Previous Knowledge** - The students are familiar with the breathing in and breathing out
- Behavioural Objectives** - At the end of the lesson, students were able to:
- i. Identify the parts that make up the human respiratory system.
 - ii. Explain the function of each of the parts of the human respiratory system.
- Introduction** - The teacher began the lesson by introducing the topic of the day-Respiration in Man to the students.
- Presentation** - The lesson is presented in the following steps:
- Step I** - The teacher listed and shows the parts that make up the human respiratory system with the students.
- Step II** - The teacher discussed the function of each of the parts of the human respiratory system.

Students' Activity-		The teacher asked the students make a well labelled diagram of the human lungs as displayed in the chart at the front of the classroom.
Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: <ol style="list-style-type: none"> i. Mention the parts that make up the human respiratory system. ii. Describe the function of each of the parts of the human respiratory system.
Assignment	-	In Conclusion, the teacher asked the students to read up about the ExcretorySystem from their text books.

**Lesson Plan for Experimental Group 2
(Demonstration Method)
Week 7 lesson Plan 1**

School	-	GSS Lugbe
Date	-	02/2017
Class	-	SS II
No. of Students	-	78
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	3 rd
Duration	-	40 Minutes
Subject	-	Biology
Topic	-	ExcretorySystem
Sub-topic	-	Excretory system in lower animals and plants
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive PracticalBiology by Obidiwe, J.O.C.
Instructional Materials	-	A picture chart showing the excretory organs insects.
Previous Knowledge	-	The students are familiar with passing out liquid and gaseous substances

Behavioural Objectives	-	<p>At the end of the lesson, students were able to:</p> <ol style="list-style-type: none"> i. Mention organ of excretion in lower animals and plants. ii. Describe the mechanism of excretion in lower animals. iii. describe the mechanism of excretion in lower plants
Introduction	-	The teacher began the lesson by introducing the topic of the day-Excretory system in lower animals and plants to the students.
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher encouraged the student to define key excretory system. The teacher mentioned and showed the organ of excretion in lower animals and plants. The organ of excretion in amoeba (Contractile vacuole); tape worm (flame cells).
Step II	-	The teacher guided the students to describe and discuss the mechanism of excretion in amoeba.
Step III	-	The teacher guided the students to vividly discuss the mechanism of excretion in lower plants.
Students' Activity-		The teacher asked the students make a well labelled diagram of the excretory system of a cockroach.
Summary -		The teacher summarised the whole lesson to the students
Evaluation	-	<p>Teacher evaluated the lesson when she asked the students to:</p> <ol style="list-style-type: none"> i. mention the organ of excretion of Paramecium, Euglena and Amoeba. ii. Briefly explain excretion in Ameoba. iii. Briefly explain excretion in tape worm.
Assignment	-	The teacher gave the students assignment to explain in detail why the need of removal of waste products from all organisms.

Lesson Plan for Experimental Group 2

(Demonstration Method)

Week 7 lesson Plan 2

School	-	GSS Lugbe
Date	-	02/2017
Class	-	SS II
No. of Students	-	78
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	4 th
Duration	-	40 Minutes
Subject	-	Biology
Topic	-	ExcretorySystem
Sub-topic	-	Excretory system in higher animals and plants
Reference Book	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A picture chart showing the longitudinal section of a human kidney(excretory organ).
Previous Knowledge	-	The students are familiar with excretion in lower animals.
Behavioural Objectives	-	At the end of the lesson, students were able to: i. Mention organ of excretion in higher animals and plants. ii. Describe the mechanism of excretion in higher animals. iii. Describe the mechanism of excretion in higher plants.
Introduction	-	The teacher began the lesson by introducing the topic of the day-Excretory system in higher animals (humans)andplants to the students.

Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher mentioned and displayed the organ of excretion in higher animals and higher plants. The organ of excretion in mammals (kidneys) and in the higher plants (stomata and lenticels).
Step II	-	The teacher guided the students to describe and discuss the mechanism of excretion in man.
Step III	-	The teacher guided the students to vividly discuss the mechanism of excretion in plants.
Students' Activity-		the teacher asked the student to bring a small stem or branch to the class. They should make a diagram of the stem or branch of a tree and write down their observations.
Summary -		The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: <ul style="list-style-type: none"> i. Describe how man passes out the water he drank during meal. ii Describe the mechanism of excretion in plants.
Assignment	-	the teacher gave the students assignment to read on the next topic- Nutrients Cycle in Nature.

**Lesson Plan for Experimental Group 2
(Demonstration Method)
Week 8 lesson Plan 1**

School	-	GSS Lugbe
Date	-	03/2017
Class	-	SS II
No. of Students	-	78
Average age of Students	-	Age
Sex	-	Male and Female
Period	-	3 rd
Duration	-	40 minutes
Subject	-	Biology

Topic	-	Nutrient Cycle in Nature
Sub-topic	-	Carbon and Water cycle
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A cardboard chart showing carbon and water cycle in nature.
Previous Knowledge	-	The students are familiar with the topic because they breathe in oxygen and witness rainfall.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ul style="list-style-type: none"> i. Define and discuss nutrient cycle in nature. ii. describe the water and carbon cycle
Introduction	-	The teacher began the lesson by introducing the topic of the day-Nutrient Cycling in Nature (carbon and water cycle).
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher demonstrated and discusses with students the carbon cycle, oxygen cycle and water cycle. They are defined as the circulation of carbon, oxygen and water in nature.
Step II	-	The teacher demonstrated to the students the absorption of carbon dioxide and release of oxygen during photosynthesis.
Students' Activity -	-	The teacher asked the students to imitate the drawing of carbon and water cycle on the board. Pictures of the carbon and water cycle were shown to the students. Theylabelled the parts.
Summary -	-	The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: <ul style="list-style-type: none"> i. Mention three ways carbon is returned back to the atmosphere. ii. Describe the process of photosynthesis in plants.

Assignment - The teacher concluded the lesson and asked the students to read up on the next topic-Importance of nutrients cycling in nature.

**Lesson Plan for Experimental Group 2
(Demonstration Method)**

Week 8 lesson Plan 2

School	-	GSS Lugbe
Date	-	03/2017
Class	-	SS II
No. of Students	-	78
Average age of Students	-	Age
Sex	-	Male and Female
Period	-	4 th
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Nutrient Cycle in Nature
Sub-topic	-	Oxygen cycle and Importance of nutrient cycle in nature
Reference Book	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A cardboard chart showing oxygen cycle in nature and also a diagram of Recycling of nutrients in ecosystem drawn on the chalkboard.
Previous Knowledge	-	The students are familiar with the topic, they have studied water and carbon cycle in the last class.
Behavioural Objectives	-	At the end of the lesson, students were able to: i. Define and discuss nutrient cycle in nature. ii. Mention the importance of nutrient cycle in nature.

Introduction	-	The teacher began the lesson by introducing the topic of the day-Nutrient Cycling in Nature(Oxygen cycle and the importance of the nutrients cycling in nature) to the students.
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teachers defined, displayed and discussed the process of oxygen cycling in nature and make them understand that most available oxygen in nature comes from photosynthesis.
Step II	-	The teacher guided the students to mention the importance of carbon oxide, oxygen and water to plants and animals
Step III	-	The teacher drew the diagram of Recycling nutrients in ecosystem on the blackboard. The teacher guided the students to mention the importance of nutrients cycling in nature to plants and animals.
Students' Activity	-	The teacher divided the students into groups to discuss other importance of oxygen in nature not earlier mentioned. The student imitated the teacher as they also drew the diagram of Recycling nutrients in ecosystem that the teacher drew on the chalkboard.
Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: <ul style="list-style-type: none"> i. Mention three ways carbon is returned back to the atmosphere. ii. Mention three ways oxygen is removed from the atmosphere. iii. Mention five importance of water to plants and animals.
Assignment	-	Briefly explain how oxygen and carbon IV oxide is balanced in nature. The teacher concluded the lesson by asking the students to read up Types of Micro-organisms.

**Lesson Plan for Experimental Group 2
(Demonstration Method)
Week 9 lesson plan 1**

School	-	GSS Lugbe
Date	-	03/2017
Class	-	SS II
No. of Students	-	78
Average age of Students	-	16 years
Sex	-	Female
Period	-	3 rd
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Decomposition in Nature
Sub-topic	-	Types of micro organisms
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A picture of a Rhizome (Micro decomposer) and that of a Snail (macro decomposer) and also
Previous Knowledge	-	The students have observed some form of decomposition in their environment.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ul style="list-style-type: none"> i. Define decomposition in nature. ii. Mention the types of micro-organism.
Introduction	-	The Teacher began the lesson by introducing the topic of the day-Decomposition in nature (types of micro- organisms).
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher displayed pictures of a Rhizome (Micro decomposer) and that of a Snail (macro decomposer).The teacher defined Decomposition as the elimination of dead bodies of living things from the environment by saprophytes.

Step II	-	The teacher guided the students to mention and discuss the types of decomposers – i. Micro decomposers (bacteria, fungi) ii. Macro decomposers (earth worms, snails, termites and so forth).
Students' Activity –		With the guidance of the teacher, the students mentioned and wrote down other products of decomposition not mentioned in the class.
Summary -		The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: • Define Decay and briefly explain it. • Mention the Types of Decomposer and give five examples each.
Assignment	-	Mention five harmful effects of micro-organisms.

**Lesson Plan for Experimental Group 2
(Demonstration Method)
Week 9 lesson Plan 2**

School	-	GSS Lugbe
Date	-	03/2017
Class	-	SS II
No. of Students	-	78
Average age of Students	-	16 years
Sex	-	Female
Period	-	4 th period
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Decomposition in nature
Sub-topic	-	Importance and Role of a Decomposer
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A;

		Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A picture chart showing images of dead decaying animals and refuse dump.
Previous Knowledge	-	The students are having observed some form of decomposition in their environment.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ul style="list-style-type: none"> • Mention and explain the role decomposer. • Importance of decomposition in nature.
Introduction	-	The teacher began the lesson by introducing the topic of the day- Decomposition in nature (importance and role of a decomposer).
Presentation-		The lesson is presented in the following steps:
Step I-		The Teacher guided the students to identify the gases released during decomposition.
Teacher's Activity-		The teacher guided the students to perform experiment showing limit to tolerance.
Students' Activity -		The teacher guided the students mention and explain therole of decomposer in an ecosystem.
Summary-		The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: <ol style="list-style-type: none"> i. Mention five roles of decomposers to a farmer. ii. Importance of decomposition.
Assignment	-	write a short note on Tolerance.

**Lesson Plan for Experimental Group 2
(Demonstration Method)
Week 10 lesson Plan 1**

School	-	GSS Lugbe
Date	-	03/2017
Class	-	SSS II
No. of Students	-	78
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	3 rd period
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Ecological management
Sup-topic	-	Tolerance
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	Pictures of cactus tree and lizard
Previous Knowledge	-	The students were given an assignment last week to write a brief note on tolerance.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ul style="list-style-type: none"> i. Define tolerance. ii. Define and explain the concept of maximum and minimum tolerance. iii. discuss Geographic range - graph
Introduction	-	The teacher began the lesson by introducing the topic of the day-Ecological management (tolerance).
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher displayed the picture of an amoeba in an unfavourable condition. The teacher asked students questions in regards to the displayed picture. After their responses, the teacher defined Tolerance as the

		ability of an organism to withstand an unfavourable conditions in their environment and survive it.
Step II	-	The teacher explained the maximum and minimum range an organism can survive in a habitat.
Step III	-	The teacher illustrated the geographical range that is, an area where organism can be found within the limit of its tolerance.
Students' Activity-		The teacher guided the students to discuss the geographical range that is, an area where organism can be found within the limit of its tolerance. Having known the definition, the teacher asked the students to mention some geographical range of some animals, plants or birds they know.
Summary-		The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: <ul style="list-style-type: none"> i. Define Tolerance. ii. What do you understand by the term maximum and minimum Tolerance? iii. Mention Five factors responsible for Geographic range.
Assignment	-	The teacher gave the student an assignment to briefly explain how Rainfall and Temperature affect the distribution of Plants and Animals.

**Lesson Plan for Experimental Group 2
(Demonstration Method)
Week 10 lesson plan 2**

School	-	GSS Lugbe
Date	-	03/2017
Class	-	SS II
No. of Students	-	78
Average age of Students	-	16 years
Sex	-	Male and female

Period	-	4 th period
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Ecological management
Sub-topic	-	Adaptation
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	Pictures chart on Terrestrial and Aquatic adaptation of plants (cactus and water lily) and animals (Bird and Fish).
Previous Knowledge	-	The students were taught tolerance of various organisms last week.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ul style="list-style-type: none"> i. Define Adaptation. ii. Mention and explain adaptation of animals and plants to aquatic habitat. iii. Mention and discuss the adaptation of plants and animals to terrestrial habitats. iv. Discuss special adaptation of some organism.
Introduction	-	The Teacher began the lesson by introducing the topic of the day- Adaptations (ecological management).
Presentation -		The lesson is presented in the following steps:
Step I	-	The Teacher defined and discussed adaptation with the students: Adaptation is the ability of an organism to live successfully in a habitat as a result of its structure, appearance or behaviour.
Step II	-	The Teacher displayed the adaptation of plants and animals in aquatic habitat.
Step III	-	The Teacher showed and mentioned the adaptation of plants and animals to terrestrial habitat.

Student Activity-

The teacher then guided the students to mention and discuss adaptation of plants and animals in both terrestrial and aquatic habitat.

Summary-

The teacher then summarised the whole lesson to the students

Evaluation-

Teacher evaluated the students by asking them to:

- i. Define adaptation.
- ii. Mention three adaptive features of aquatic plants and animals.
- iii. Mention five adaptive features of terrestrial plants and animals.

Assignment -

The teacher asked the students to write short note on the adaptation of the following animals (i) Chameleon (ii) Tape worm(iii)Bird.

In Conclusion, the teacher came to the end of the term. The different topics were revised with the students in preparation for the Biology objective post-test quiz which took place the next day.

APPENDIX C
LESSON PLAN FOR EXPERIMENTAL GROUP E3
(INQUIRY and DEMONSTRATION METHOD)

Week 1 lesson Plan 1

School	-	GSS Kuje
Date	-	01/2017
Class	-	SS II
No. of Students	-	51
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	3rd
Duration	-	40 minutes (1 st Period)
Subject	-	Biology
Topic	-	Digestive System
Sub-topic	-	Digestion in Invertebrates
Teaching Method:	-	Inquiry Method
Reference Books	-	(i) Essential Biology by Michael, M.C(ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.(iv) Ideal Practical Biology by Onwuzulume, C.N.
Instructional Materials	-	A picture chart of digestive system of Amoeba and Earthworm
Previous Knowledge	-	The students are familiar with eating and digestion of food substances as a normal routine in life.
Behavioural Objectives	-	At the end of the lesson, students were able to: iii. Discuss modification of feeding habits. iv. Discuss the process of feeding in invertebrate animals.
Introduction	-	The teacher began the lesson by introducing the topic of the day- Digestion in Invertebrates.
Presentation	-	The lesson is presented in the following steps:

Step I

-

The teacher used both structured and guided inquiry to teach this topic. The teacher gave clue to the students and asks if they are familiar with modification of feeding habit such as filter feeder (mosquito larva); Fluid feeders (house fly, mosquito, tsetse fly and so forth); parasitic and saprophytic feeders (tape worm and fungi and so forth).The teacher hung two different charts on the wall that illustrated digestion in amoeba and digestive system in earthworm; and asked the students to observe the different charts and they wrote down their observations.

Students' activities -

The students observed the charts, described their observations, asked questions for further clarifications. As students listened to the clue, the teacher asked the student to discuss the feeding habit in protozoa (such as Amoeba P.) and in hydra. After some seconds of wait, the teacher called on a student who says "Amoeba uses Pseudopodia to circle, engulf it to form food vacuole, enzymes are introduced to digest it intra-cellularly".

The teacher also called on another student who says "The hydra ingest food particles into the mouth into the hollow stomach (ecteron) where extra-cellular digestion take place".

Summary-

The teacher summarised the lesson to the students

Evaluation-

As the student explained, the teacher asked other Students to:

- iv. Define Digestion and Digestive system.
- v. Describe the mouth part of filter feeders and fluid feeders.
- vi. Mention the parts of alimentary canal and their functions.

Assignment - Students were given assignment to differentiate between feeding methods of protozoa and hydra. In closure, the teacher instructed the students to consult relevant textbooks as they will be learning on digestive system of vertebrate animals in their next class.

**Lesson Plan for Experimental Group E3
(Inquiry and Demonstration method)**

Week 1 lesson Plan 2

School	-	GSS Kuje
Date	-	01/2017
Class	-	SS IIA
No. of Students	-	51
Average age of Students	-	16 years
Sex	-	male and female
Period	-	4th
Duration	-	40 minutes (2 nd Period)
Subject	-	Biology
Teaching Method:	-	Inquiry Method
Topic	-	Digestive System
Sub-topic	-	Digestion in Vertebrates
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.(iv) Ideal Practical Biology by Onwuzulume, C.N.
Instructional Materials	-	A chart showing digestive system of vertebrate animals, dissecting kit, Six Birds and Dissecting boards.
Previous Knowledge	-	The students are familiar with eating and digestion of food substances as a normal routine in life.
Behavioural Objectives	-	At the end of the lesson, students were able to:

		v. Discuss modification of feeding habits.
		vi. Describe the human alimentary canal and its functions.
Introduction	-	The teacher began the lesson by introducing the topic of the day- Digestion in Vertebrates.
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher used both structured and guided inquiry to teach this topic. The teacher asked the students to define and discuss the vertebrate alimentary system and the modification of the alimentary system. As the students respond to the question, another student was asked to mention the parts of alimentary system and their functions (mouth, oesophagus, stomach, pancreas, small intestine, large intestine, rectum and anus).
Step II	-	Experiment to show the Alimentary Tractsof a Bird
Teacher's activity:		The teacher divided the students into six groups and provided each group with a dissecting kit, a freshly slaughtered Bird (Chicken), dissecting board and a dissecting guide/manual written on the board. The teacher guided the students to dissect and observe the dissected alimentary canals.
Students' activities:		The students in their various groups appointed a group leader. Each of the team leader and their members under the guidance of the teacher dissected the birds to expose the alimentarycanal. Members of each group observed the alimentary tracts/canal and drew same in their notebooks.
Step III	-	Functions of digestive organs in the Alimentary Canal of Insects and Birds.
Teacher's activity:	-	The teacher asked the students to state the functions of the different parts of the alimentary tract of a bird.
Students' activities:	-	The students wrote the functions of the dissected parts of the alimentary canal in their note books.

Compare and contrast the alimentary canal of a Cockroach and that of a Bird. State the modification in the alimentary canal and relate it to their different feeding habits.

Summary - The teacher summarised the whole lesson to the Students.

Evaluation -The teacher reviewed the lesson by asking the students to:

iii. Define Digestion and Digestive system.

iv. Mention the parts of alimentary canal and their functions.

Assignment - Students were given assignment to differentiate between Monogastric animals and Polygastric animals. In conclusion, the teacher asked the students to consult relevant textbooks as their next class will be on transport system (Diffusion).

Lesson Plan for Experimental Group E3 (Inquiry and Demonstration method)

Week 2 lesson plan 1

School - GSS Kuje
Date - 01/2017
Class - SS IIA
No. of Students - 51
Average age of Students - 16 years
Sex - male and female
Period - 4th
Duration - 40 minutes (2nd Period)
Subject - Biology
Teaching Method: - Demonstration Method

Subject	-	Biology
Topic	-	Transport system
Sub-topic	-	Diffusion
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A cardboard showing chart of transport diffusion.
Previous Knowledge	-	The students are aware of heart beat and the flow of blood through their veins.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ul style="list-style-type: none"> • Define transport system and mention the media of transportation and the materials for transportation. • Define, discuss and mention the importance of diffusion.
Introduction-		The teacher began the lesson by introducing the lesson of the day- diffusion.
Presentation-		The lesson is presented in the following steps:
Step I	-	The teacher demonstrated and explained transportation as the movement of materials (liquid and gaseous substances) round the body, the teacher also guided the students to mention the media of transportation (cell sap, lymph and blood), and the teacher also guided the students to mention the materials for transportation (water, digested food materials, hormones, enzymes, and waste products).
Step II-		The teacher demonstrated and defined diffusion as the movement of molecules of substances from the region of higher concentration to the region of lower concentration until equilibrium is reached. The teacher demonstrated the process of diffusion and mentions the importance of diffusion.

Student activities	-	The teacher guided the students to imitate by making a well labelled diagram the picture of diffusion of liquid that is displayed in the classroom. The students were asked by the teacher to write down in their Biology note book the importance of diffusion.
Summary	-	The teacher summarised the whole lesson to the students
Evaluation	-	Teacher evaluated the students by asking them to: iii. Define transportation and transport system. ii. Describe the mouth part of filter feeders and fluid feeders. iii. Mention the parts of alimentary canal and their functions.
Assignment	-	The teacher asked the students to: i. Define Diffusion.ii. Describe diffusion diagrammatically.In conclusion, the teacher instructs the students to consult relevant textbooks on the topic Transport System (Osmosis).

**Lesson Plan for Experimental Group E3
(Inquiry and Demonstration method)**

Week 2 lesson Plan 2

School	-	GSS Kuje
Date	-	01/2017
Class	-	SS II
No. of Students	-	51
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	4th
Duration	-	40 minutes
Teaching Method:	-	Demonstration Method
Subject	-	Biology

Topic	-	Transport system
Sub-topic	-	Osmosis
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A cardboard showing demonstration of osmosis using cellophane.
Previous Knowledge	-	The students have discussed diffusion in the last lesson.
Behavioural Objectives	-	At the end of the lesson, students were able to: iii. Define Osmosis. iv. Discuss Osmosis in plant cells and their biological importance.
Introduction	-	The teacher began the lesson by introducing the topic of the day- Osmosis to the students.
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher demonstrated and defined Osmosis as the movement of materials (liquid and gaseous substances) round the body, the teacher also guided the students to mention the media of transportation (cell sap, lymph and blood) and the teacher guided the students to mention the materials for transportation (water, digested food materials, hormones, enzymes, and waste products).
Step II	-	The teacher defined osmosis and demonstrated the process of Osmosis in plants and animal. The teacher also aided the students to mention the importance of osmosis to plants and animals.
Students' Activity-		The teacher aided the students to make a diagram of osmosis in plants and labelled the parts.
Summary	-	The teacher summarized the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to:

- iii. Define Osmosis
- iv. Discuss Osmosis in plant cells and their biological importance.

Assignment -

The teacher asked the students to:

- i. Define Osmosis
 - ii. Differentiate between Osmosis and Diffusion.
- In conclusion, the teacher instructs the students to consult relevant textbooks on the topic Blood as a medium of transportation in Animals.

Lesson Plan for Experimental Group E3

(Inquiry and Demonstration method)

Week 3 lesson Plan 1

School	-	GSS Kuje
Date	-	01/2017
Class	-	SS II
No. of Students	-	51
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	3rd
Duration	-	40 minutes
Subject	-	Biology
Teaching Method:	-	Demonstration Method
Topic	-	Transport system (Cont'd) - Media of transportation
Sub-topic	-	Blood as a media of transportation in mammals
Reference Books	-	(i)Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A picture chart showing media of transportation in mammals
Previous Knowledge	-	The students are familiar with the topic which has been introduced in the previous lesson.
Behavioural Objectives	-	At the end of the lesson, students were able to:

- iv. Mention the media of transportation in mammals.
- v. Define blood and mention the components of blood.
- vi. Describe red and white blood cell and mention their functions.

Introduction-

The teacher began the lesson by introducing the topic of the day-Blood as a medium of transportation in mammalsto the students

Presentation -

The lesson is presented in the following steps:

Step I -

The teacher presented a picture showing media of transportation and blood cells and defines blood as the liquid tissues found in the body. The teacher guided the students to mention the components of the blood and discuss it (Red blood cell, white blood cells, blood platelets lymphocytes and the blood plasma).

Step II -

The teacher guided the students to describe red blood cells and white blood cells and blood platelets.

Students' activity -

The students were asked by the teacher to make a well labelleddiagram of the blood cells.

Summary -

The teacher summarized the whole lesson to the students.

Evaluation -

Teacher evaluated the lesson by asking the students to:

- iv. Mention the media of transportation in mammals.
- v. Define blood and mention the components of blood.
- vi. Describe red ,white blood cell and blood platelets and also to list out their functions.

Assignment -

- i.Mention the media of transportation in mammals.
- iv. Mention the characteristics of red blood cells.

In conclusion, the teacher asked the students to consult relevant textbooks on blood as a medium of transportation in Plants.

**Lesson Plan for Experimental Group E3
(Inquiry and Demonstration method)**

Week3 lesson Plan 2

School	-	GSS Kuje
Date	-	01/2017
Class	-	SS II
No. of Students	-	51
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	4 th period
Duration	-	40 minutes
Subject	-	Biology
Teaching Method:	-	Demonstration Method
Topic	-	Transport system (Cont'd) - Media of transportation
Sub-topic	-	Media of transportation in Plants
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A picture chart showing media of transportation in plants (transverse section of a root and stem).
Previous Knowledge	-	The students are familiar with the topic which has been introduced in the previous lesson.
Behavioural Objectives	-	At the end of the lesson, students were able to: iv. Mention the materials for transportation in plants. v. List the vascular bundles and their functions in plants. vi. explain transpiration in plants

Introduction	-	The teacher began the lesson by introducing the topic of the day- medium of transportation in plants to the students.
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher demonstrated and explained the materials for transportation in plants (water and mineral salt by the root, photosynthesis food from the leaves and excretory waste products).
Step II	-	The teacher explained and demonstrated to the students what vascular bundles (xylem and phloem) are and their function in the transport system in plants.
Step III	-	The teacher explained and demonstrated transpiration to the students. Instructed students to detach the leaves of pawpaw and cassava to observe and make inference on the materials of the plants detached.
Students Activity	-	Instruct students to detach the leaves of pawpaw or cassava to observe and make inference on the materials of the plants detached.
Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the lesson by asking the students to: <ul style="list-style-type: none"> iv. Mention the media of transportation in plants. v. List the vascular bundles and their functions in plants. iii. Explain transpiration in plants
Assignment-		Explain the major difference between the mechanisms of transport in mammals and higher plants. In conclusion, the teacher asked the students to consult relevant textbooks on ‘mechanism of transportation in small organisms’ for their next lesson.

Lesson Plan for Experimental Group E3

(Inquiry and Demonstration method)

Week 4 lesson plan 1

School	-	GSS Kuje
Date	-	02/2017
Class	-	SS II
No. of Students	-	51
Average age of Students	-	16 years
Sex	-	Male and Female
Period	-	3 rd
Duration	-	40 minutes
Subject	-	Biology
Teaching Method:	-	Demonstration Method
Topic	-	Transport system (Cont'd) - Mechanism of transportation
Sub-topic	-	Mechanism of transportation in small organisms
Reference Books	-	(i)Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A andChukwuka, K.S(iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A picture chart showing mechanism of transportation in paramecium and transverse section of a plant
Previous Knowledge	-	The students are familiar with the topic because it has been introduced in the previous lesson. The students are aware of heart beat and the flow of blood through their veins.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ol style="list-style-type: none">3. Mention the mechanism of transportation in small organisms4. Define mechanism in relation to transport system.

Introduction -	The teacher began the lesson by introducing the topic of the day- mechanism of transportation in small organisms and lower plants to the students
Presentation -	The lesson is presented in the following steps:
Step I -	The teacher explained and demonstrated to the students mechanism of transportation in lower organisms like amoeba and paramecium (cytoplasm).
Step II -	The teacher demonstrated and explained to the students the mechanism transport in lower plants through the cell sap or latex by osmosis.
Step III -	The teacher guided the students to mention the differences in transport system mechanism between the lower organisms and plants.
Students' Activity -	The teacher explained to the students the mechanism transport in lower plants through the cell sap or latex by osmosis.
Summary -	The teacher summarised the whole lesson to the students.
Evaluation -	Teacher evaluated the students by asking them to: <ul style="list-style-type: none"> iv. Define transportation and transport system. v. Describe the mode of transportation in lower organisms. vi. Explain the mechanism of transportation in plants.
Assignment -	<ul style="list-style-type: none"> i. Mention the functions vascular bundles in plants. vi. Differentiate between transportation mechanism between amoeba and cassava plant. <p>In conclusion, the teacher asked the students to consult relevant textbooks on mechanism of transportation in higher animals for their next lesson.</p>

Lesson Plan for Experimental Group E3

(Inquiry and Demonstration method)

Week 4 lesson Plan 2

School	-	GSS Kuje
Date	-	02/2017
Class	-	SS II
No. of Students	-	51
Average age of Students	-	16 years
Sex	-	Males and Females
Period	-	4 th
Duration	-	40 minutes
Subject	-	Biology
Teaching Method:	-	Demonstration Method
Topic	-	Transport system (Cont'd) - Mechanism of transportation
Sub-topic	-	Mechanism of transportation in higher Organisms
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B. O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A picture chart showing mechanism of transportation in the mammalian heart and transverse section of a root.
Previous Knowledge	-	The students are familiar with the topic because it has been introduced in the previous lesson. The students are aware of heart beat and the flow of blood through their veins.
Behavioural Objectives	-	At the end of the lesson, students were able to: 3. Mention what the transport system of higher organisms are made up of. 4. Describe the mammalian heart.

Introduction-		The teacher began the lesson by introducing the topic of the day Mechanism of Transportation in the higher organisms to the students.
Presentation	-	The lesson is presented in the following steps:
Step I	-	The Teacher explained and demonstrated to the students the mechanism of transportation of blood is the mammalian heart.
Step II	-	The Teacher explained to the students the mechanism transport of plants which is the vascular tissues (xylem and Phloem).
Step III	-	The Teacher guided the students to mention the differences in transport system mechanism between the Mammals and plants.
Students' Activity	-	The Teacher guided the students to make a well labelled diagram of the mammalian heart..
Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the lesson by asking the students to: <ul style="list-style-type: none"> iv. Mention what the mechanism of transport system in mammals. v. Mention what the mechanism of transport system in plants. vi. Explain the difference in mechanism between a mammal and a plants
Assignment-		The teacher gavethe student an assignment to mention the differences in transport system mechanism between the Mammals and Birds. In conclusion, the teacher told the students to browse the internet or use their text books to read about the lesson for next week– Respiratory System

Lesson Plan for Experimental Group E3

(Inquiry and Demonstration method)

Week 5 lesson plan 1

School	-	GSS Kuje
Date	-	02/2017
Class	-	SS II
No. of Students	-	51
Average age of Students	-	16 years
Sex	-	Males and females
Period	-	3 rd Period
Duration	-	40 minutes
Subject	-	Biology
Teaching Method	-	Inquiry Method
Topic	-	Respiratory System
Sub-topic	-	Characteristics and types of Respiratory systems.
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C (iv) Ideal Practical Biology by Onwuzulume, C.N.
Instructional Materials	-	A picture chart showing the respiratory organ of higher and lower animal.
Previous Knowledge	-	The students are familiar with the breathing in and breathing out.
Behavioural Objectives	-	At the end of the lesson, students were able to: iv. Define respiration and respiratory system. v. List the characteristics of respiratory surface. vi. Mention the types of respiratory systems.
Introduction	-	The teacher began the lesson by introducing the topic of the day-characteristics and types of respiratory systems to the students.

- Presentation** - The teacher used structured (students to follow set process) and guided (the students were provided with questions) inquiry to teach this topic. The lesson is presented in the following steps:
- Step I** - The teacher asked the students to define and discuss respiration and respiratory system with the students.
- Step II** - The teacher listed the characteristics of a respiratory surface.
- Step III** - The teacher called on a student to mention the types of respiratory systems and discussed it with the students (body surface, gills, lungs in terrestrial vertebrates and lungs in mammals, external and internal respiration).
- Students' activity** - The teacher asked the students to write down names of organisms that use body surface as a respiratory system.
- Summary** - The teacher summarised the whole lesson to the students
- Evaluation** - The teacher reviewed the lesson by asking the students to:
- iv. Define respiration and respiratory system.
 - v. List the characteristics of a respiratory surface.
 - vi. Describe the types of respiratory systems.
- Assignment** - Students were given assignment to explain the respiratory organs of fish. In conclusion, the teacher instructed the students to consult relevant textbooks on respiratory system (respiratory system in lower animals and Pisces) for their next class.

Lesson Plan for Experimental Group E3

(Inquiry and Demonstration method)

Week 5 lesson plan 2

School	-	GSS Kuje
Date	-	02/2017
Class	-	SS II
No. of Students	-	51
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	4 th Period
Duration	-	40 minutes
Subject	-	Biology
Teaching Method	-	Inquiry Method
Topic	-	Respiratory System Continued
Sub-topic	-	Respiratory system in lower animals and Pisces
Reference Book	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.(iv) Ideal Practical Biology by Onwuzulume, C.N.
Instructional Materials	-	A picture chart showing the respiratory system of a fish and head of 6 Tilapia fish.
Previous Knowledge	-	The students are familiar with the breathing in and breathing out
Behavioural Objectives	-	At the end of the lesson, students were able to: <ul style="list-style-type: none">• Define gills and its function.• Name the different parts of the gills and its function.• Mention and describe the organ of respiration of lower animals

Introduction	-	The teacher began the lesson by introducing the topic of the day-Respiratory system in lower animals and Pisces to the students.
Presentation	-	The teacher used confirmation (re-enforcement of prior knowledge), structured (students to follow set process) and guided (the students were provided with questions) inquiry to teach this topic. The lesson was presented in the following steps:
Step I	-	the teacher asked the student to recall the last lesson and mention the types of respiratory system.
Step II	-	the teacher asked the student explain the organ of respiration in amoeba and flatworms.
Step III	-	The teacher asked a student to define gills and its function as respiratory system in tilapia fish.
		Experiment on the respiratory organs of Tilapia fish
Teacher Activity	-	The teacher brought six tilapia fish head and knives to the class.
Students' Activity-		The teacher instructed the student to form 6 groups. With the help of the teacher, the student dissected the head of the tilapia fish and exposed the respiratory organs (the gills). The teacher pointed out the different part of the fish to the students. Also, another student was called on to explain the functions of different parts of the gills (gill arch, gill rakers and gill filaments).
Step VI	-	The teacher also called on students to explain the difference in the modes of respiration between the lower animals and Pisces.
Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	The teacher reviewed the lesson by asking the students to: iv. Define gills and its function.

- v. Mention different parts of the gills and its function.
- vi. Describe the respiratory organ of amoeba and flat worms.

Assignment - Students were given assignment to differentiate between the respiratory organs in fish and Ameoba. The teacher concluded the lesson and instructed the students to consult relevant textbooks on respiratory system (Mechanism of Respiration) for their next class.

**Lesson Plan for Experimental Group E3
(Inquiry and Demonstration method)**

Week 6 lesson plan 1

School	-	GSS Kuje
Date	-	02/2017
Class	-	SS II
No. of Students	-	51
Average age of Students	-	Age 16
Sex	-	Males and females
Period	-	3 rd
Duration	-	40 minutes
Subject	-	Biology
Teaching Method	-	Inquiry Method
Topic	-	Respiratory System Continued
Sub-topic	-	Mechanism of Respiration
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.(iv) Ideal Practical Biology by Onwuzulume, C.N.
Instructional Materials	-	A picture chart showing the respiratory organ of higher and lower animals.

Previous Knowledge	-	The students are familiar with the breathing in and breathing out
Behavioural Objectives	-	At the end of the lesson, students were able to: iii. Define and explain inhalation. iv. Define and explain exhalation.
Introduction	-	The teacher began the lesson by introducing the topic of the day-mechanism of respiration to the students.
Presentation	-	The teacher used confirmation (re-enforcement of prior knowledge), structured (students to follow set process) and guided (the students were asked questions) inquiry to teach this topic. The lesson is presented in the following steps:
Step I	-	The teacher asked the student to recall the last lesson and mention the parts of the respiratory system in tilapia fish.
Step II	-	The teacher gave a clue on the topic after which a student was called to define and discuss the inhalation. After eight seconds of wait time a student responded by saying “Inhalation simply means breathing in. The teacher called on another student to discuss the process of inhalation with his fellow students.
Step III	-	Another student was asked to define the process of exhalation. After some seconds of wait time the student says “Exhalation simply means breathing out, the teacher guided the students to discuss the mechanism of exhalation.
Students’ Activity-		The teacher then asked the students to breathe in and out. They wrote down their observations of the ventilation movement in a tabular form.
Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	The teacher reviewed the lesson by asking the students to:

- Describe the process of inhalation in named vertebrate.
 - Describe the process of exhalation in a man.
- Assignment** - Students were given assignment to:
- Explain why it is convenient for fish to breathe in the water than on land.
 - Describe inhalation and exhalation in fish.
- In closure, the teacher instructed the students to consult relevant textbooks on respiratory system (Respiration in Man) for their next class.

Lesson Plan for Experimental Group E3

(Inquiry and Demonstration method)

Week 6 lesson Plan 2

School	-	GSS Kuje
Date	-	02/2017
Class	-	SS II
No. of Students	-	51
Average age of Students	-	16
Sex	-	Males and females
Period	-	4 th
Duration	-	40 minutes
Subject	-	Biology
Teaching Method	-	inquiry Method
Topic	-	Respiratory System Continued
Sub-topic	-	Respiration in Man
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.(iv) Ideal Practical Biology by Onwuzulume, C.N.
Instructional Materials	-	A picture chart of the human respiratory system with the Respiratory system of a goat and the lungs of a goat.

Previous Knowledge	-	The students are familiar with the breathing in and breathing out. They have also learnt the mechanism of respiration in the previous lesson.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ul style="list-style-type: none"> • Identify the parts that make up the human respiratory system. • Explain the function of each of the parts of the human respiratory system.
Introduction	-	The teacher began the lesson by introducing the topic of the day-Respiration in Man to the students.
Presentation	-	The teacher used confirmation (re-enforcement of prior knowledge), structured (students to follow set process) and guided (the students were asked questions) inquiry to teach this topic. The lesson is presented in the following steps:
Step I	-	the teacher asked the student to recall the last lesson and briefly the mechanism of respiration.
Step II	-	The teacher called on a student to list the parts that make up the human respiratory system.
Step III	-	Another student was asked to discuss the function of each of the parts of the human respiratory system.
Experiment on the respiratory system of a goat		
Teacher's Activity-		the teacher came to the class with a set of respiratory system of a goat gotten from the local abattoir.
Students' Activities-		The students were expected to identify (i) Trachea (ii) Bronchi (iii) Lungs. The teacher guided the students to press the trachea between their fingers to feel the cartilage ring, the teacher asked the student the importance of the cartilage ring; the students felt the texture of the lungs. The teacher asked the students to make a well labelled diagram of the respiratory system of the goat in front of them.
Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	The teacher reviewed the lesson by asking the

student to:

- Mention the parts that make up the human respiratory system.
- Describe the function of each of the parts of the human respiratory system.

Assignment - Students were given assignment to explain (i) to explain the respiration mechanism in toad. The teacher concluded the lesson by instructing the students to consult relevant textbooks on excretory System (excretory system in lower animals and plants) for their next lesson.

Lesson Plan for Experimental Group E3

(Inquiry and Demonstration method)

Week 7 lesson plan 1

School	-	GSS Kuje
Date	-	02/2017
Class	-	SS II
No. of Students	-	51
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	3 rd
Duration	-	40 Minutes
Subject	-	Biology
Teaching Method	-	Inquiry method
Topic	-	Excretory System
Sub-topic	-	Excretory system in lower animals and plants
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C. (iv) Ideal Practical Biology by Onwuzulume, C.N.
Instructional Materials	-	A picture of the excretory organs of flatworms and the malphigian tubules of a cockroach.

Previous Knowledge	-	The students are familiar with passing out liquid and gaseous substances
Behavioural Objectives	-	At the end of the lesson, students were able to: <ul style="list-style-type: none"> iv. Mention organ of excretion in flatworms, paramecium and cockroach. v. Describe the mechanism of excretion in Cockroach. vi. Describe the mechanism of excretion in lower plants (paramecium or Ameoba).
Introduction	-	The teacher began the lesson by introducing the topic of the day-Excretory system in lower animals and plants to the students.
Presentation	-	The teacher used structured (students to follow set process) and guided (the students were asked questions) inquiry to teach this topic. The lesson is presented in the following steps:
Step I	-	The teacher asked if any of the students can mention and discuss the organ of excretion in lower animals and plants. The organ of excretion in amoeba (Contractile vacuole); tape worm (flame cells) and cockroach (malphigian tubules).
Step II	-	The teacher called on a student to describe and discuss the mechanism of excretion in amoeba and tape worm.
Step III	-	The teacher called on another student to vividly discuss the mechanism of excretion in Cockroach (insect).
Teacher's Activity-		The teacher came to the class with a microscope and some slides containing the micro-organism- paramecium.
Students' Activities-		The students are expected to identify (i) Contractile vacuole. The teacher guided the students to mount the slide, manipulate the lens until they can see the organism clearly. The teacher asked the students to

- make a well labelled diagram of the paramecium and they wrote down the function of the contractile vacuole in their Biology drawing book.
- Summary** - The teacher summarised the whole lesson to the students.
- Evaluation** - The teacher reviewed the lesson by asking the student to:
- iv. Mention the organ of excretion of Paramecium or Euglena
 - v. Briefly explain the excretory process of a Paramecium
 - vi. Briefly explain the excretory process of a tape worm
- Assignment** - Students were given assignment to make a large and well labelled diagram of the malpighian tubules of the cockroach. The students wrote down the functions of these parts in their Biology drawing book. In conclusion, the teacher instructed the students to consult relevant textbooks on excretory system (excretory system in higher animals and plants) for their next class.

Lesson Plan for Experimental Group E3

(Inquiry and Demonstration method)

Week 7 lesson plan 2

- School** - GSS Kuje
- Date** - 02/2017
- Class** - SS II
- No. of Students** - 51
- Average age of Students** - 16 years
- Sex** - Male and female
- Period** - 4th
- Duration** - 40 Minutes

Subject	-	Biology
Teaching Method	-	Inquiry
Topic	-	Excretory System
Sub-topic	-	Excretory system in higher animals and plants
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.(iv) Ideal Practical Biology by Onwuzulume, C.N.
Instructional Materials	-	A picture chart of the longitudinal section of a human kidney, 3 pairs of kidney (goat) and a picture also showing lenticels on the bark of a tree.
Previous Knowledge	-	The students are familiar with excretion in lower animals and mammals.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ol style="list-style-type: none"> 4. Mention organ of excretion in man and plants 5. Describe the mechanism of excretion in man 6. Describe the mechanism of excretion in higher plants.
Introduction	-	The teacher began the lesson by introducing the topic of the day-Excretory system in higher animals and plants to the students.
Presentation	-	The teacher used confirmation (re-inforcement of prior knowledge), structured (students to follow set process) and guided (the students will be provided with questions) inquiry to teach this topic.
Step I-		The lesson is presented in the following steps: The teacher called on a student to recall the last lesson and mention the organ of excretion in flatworms and cockroach.
Step II	-	The teacher called on a student to mention and discuss the organ of excretion in higher animals and higher plants. The organ of excretion in mammals

(kidneys) and in the higher plants (stomata and lenticels).

Step III - The teacher called on another student to describe and discuss the mechanism of excretion in man (filtration process and selective reabsorption).

Step III - Another student was asked to vividly discuss the mechanism of excretion in plants which is through the stomata.

Experiment on the excretory system of a goat

Teacher's Activity - The teacher came to the class with a the kidney of a goat which is similar to that of humans and a knife to cut the kidney into halves

Students' Activities- the students were expected to identify the kidney as the main excretory organ of man. The teacher asked the students to form two groups. The teacher asked the students to make a well labelled diagram of the kidney with assistance of the chart of the longitudinal section of a mammalian kidney displayed in the front of the class

Summary - The teacher summarised the whole lesson to the students.

Evaluation - The teacher reviewed the lesson by asking the students to:

iii. Describe how man passes out the water he drinks during meal.

iv. Briefly explain excretion in plants.

Assignment - Students were given assignment to explain in detail why we remove waste products from our body. The teacher concluded the lesson by instructing the students to consult relevant textbooks as their next class will be on nutrient cycle in nature (Photosynthesis in plants).

Lesson Plan for Experimental Group E3

(Inquiry and Demonstration method)

Week 8 lesson plan 1

School	-	GSS Kuje
Date	-	03/2017
Class	-	SS II
No. of Students	-	51
Average age of Students	-	Age
Sex	-	Male and Female
Period	-	3 rd
Duration	-	40 minutes
Subject	-	Biology
Teaching method	-	Inquiry
Topic	-	Nutrient Cycle in Nature
Sub-topic	-	Carbon and Water Cycle in nature
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.(iv)Ideal Practical Biology by Onwuzulume, C.N.
Instructional Materials	-	A cardboard chart showing carbon and water cycle in nature was displayed in the class.
Previous Knowledge	-	The students are familiar with the topic because they breathe in oxygen and witness rainfall.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ul style="list-style-type: none">• Define and discuss carbon cycle in nature.• Describe the water cycle
Introduction	-	The teacher began the lesson by introducing the topic of the day- nutrient cycling in nature (carbon and water cycle in nature).
Presentation	-	The teacher used confirmation (re-enforcement of prior knowledge), structured (students to follow set

process) and guided (the students were asked questions) inquiry to teach this topic.

Step I	-	The lesson is presented in the following steps: The teacher defined and discussed carbon cycle with the students. They are defined as the circulation of carbon, oxygen and water in nature.
Step II	-	with the aid of diagrams, the teacher discussed with the students the process of natural water cycle.
Students' Activity	-	The teacher divided the students into groups to discuss other importance of oxygen in nature not earlier mentioned. The students were told to write down their answers.
Summary-		The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: <ol style="list-style-type: none">1. Mention three ways carbon is returned back to the atmosphere.2. Describe the process of natural water cycle.
Assignment	-	Students were given assignment to make a labelled diagram of the carbon cycle and water cycle. The teacher concluded the lesson by instructing the students to consult relevant textbooks as their next class will be on importance of nutrient cycling in nature.

Lesson Plan for Experimental Group E3

(Inquiry and Demonstration method)

Week 8 lesson plan 2

School	-	GSS Kuje
Date	-	03/2017
Class	-	SS II
No. of Students	-	51
Average age of Students	-	Age 16
Sex	-	Male and Female
Period	-	4 th

Duration	-	40 minutes
Subject	-	Biology
Teaching method	-	Inquiry
Topic	-	Nutrient Cycle in Nature
Sub-topic	-	Oxygen cycle and Importance of nutrient cycle in nature
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C. (iv) Ideal Practical Biology by Onwuzulume, C.N.
Instructional Materials	-	A cardboard chart showing Oxygen cycle in nature, Water plant (water lily), filter funnel , Beaker, Water and Test-tube
Previous Knowledge	-	The students are familiar with the topic, they have studied water and carbon cycle in the last class.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ol style="list-style-type: none"> 1. Define and discuss oxygen cycle in nature. 2. Mention the importance of nutrient cycle in nature.
Introduction	-	The teacher began the lesson by introducing the topic of the day-Nutrient Cycling in Nature(Oxygen cycle and the importance of the nutrients cycling in nature).
Presentation	-	The teacher used confirmation (re-enforcement of prior knowledge), structured (students to follow set process) and guided (the students were asked questions) inquiry to teach this topic. The lesson is presented in the following steps:
Step I	-	The teacher called on a student to recall the last lesson and briefly describe the water cycle.
Step II	-	The teacher discussed with the process of, oxygen cycling in nature and made the student to understand that most available oxygen in nature comes from photosynthesis.

Step III	-	The teacher guided the students to mention the importance of nutrients cycling in nature to plants and animals.
Teachers' Activity		The teacher set up the experiment earlier in the day because it took 3-4 hours to see results. The teacher brought the set up experiment to the laboratory.
Students' Activity-		The teacher led students to perform experiment to show release of oxygen during photosynthesis. The test tube was removed from the top of the filter funnel by a student. The gas collected in the test tube was tested with the use of a glowing splint. The gas present rekindled the glowing splint which showed or confirmed the presence of oxygen.
Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: <ol style="list-style-type: none"> 1. Mention two ways oxygen is returned back to the atmosphere. 2. Mention three ways oxygen is removed from the atmosphere. 3. Mention two importance each of Carbon, oxygen and water cycle.
Assignment	-	Students were given assignment to briefly explain mention five importance of water to plants and animals. In conclusion, the teacher instructed the students to consult relevant textbooks on 'decomposition in nature' (Types of micro-organisms) for their next class.

Lesson Plan for Experimental Group E3

(Inquiry and Demonstration method)

Week 9 lesson plan 1

School	-	GSS Kuje
Date	-	03/2017
Class	-	SS II
No. of Students	-	51
Average age of Students	-	16 years
Sex	-	Female
Period	-	3 rd
Duration	-	40 minutes
Subject	-	Biology
Teaching method	-	Demonstration
Topic	-	Decomposition in Nature
Sub-topic	-	Types of micro organisms
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A picture of a Rhizome (Micro decomposer) and that of a Snail (macro decomposer) and also
Previous Knowledge	-	The students have observed some form of decomposition in their environment.
Behavioural Objectives	-	At the end of the lesson, students were able to: iii. Define decomposition in nature. iv. Mention the types of micro-organism.
Introduction	-	The Teacher began the lesson by introducing the topic of the day-Decomposition in nature (types of micro- organisms).
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher displayed pictures of a Rhizome (Micro decomposer) and that of a Snail (macro decomposer).The teacher defined Decomposition as

		the elimination of dead bodies of living things from the environment by saprophytes.
Step II	-	The teacher guided the students to mention and discuss the types of decomposers – iii. Micro decomposers (bacteria, fungi) iv. Macro decomposers (earth worms, snails, termites and so forth).
Students' Activity	–	With the guidance of the teacher, the students mentioned and wrote down other products of decomposition not mentioned in the class.
Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: <ul style="list-style-type: none"> • Define Decay and briefly explain it. • Mention the Types of Decomposer and give five examples each.
Assignment	-	Mention five harmful effects of micro-organisms.

**Lesson Plan for Experimental Group E3
(Inquiry and Demonstration method)**

Week 9 lesson Plan 2

School	-	GSS Kuje
Date	-	03/2017
Class	-	SS II
No. of Students	-	51
Average age of Students	-	16 years
Sex	-	Female
Period	-	4 th period
Duration	-	40 minutes
Teaching method	-	Demonstration
Subject	-	Biology
Teaching method	-	Demonstration
Topic	-	Decomposition in nature

Sub-topic	-	Importance and Role of a Decomposer
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A picture chart showing images of dead decaying animals and refuse dump.
Previous Knowledge	-	The students are having observed some form of decomposition in their environment.
Behavioural Objectives	-	At the end of the lesson, students were able to: <ul style="list-style-type: none"> • Mention and explain the role decomposer. • Importance of decomposition in nature.
Introduction	-	The teacher began the lesson by introducing the topic of the day- Decomposition in nature (importance and role of a decomposer).
Presentation -		The lesson is presented in the following steps:
Step I-		The Teacher guided the students to identify the gases released during decomposition.
Teacher's Activity-		The teacher guided the students to perform experiment showing limit to tolerance.
Students' Activity -		The teacher guided the students mention and explain therole of decomposer in an ecosystem.
Summary-		The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: <ul style="list-style-type: none"> iii. Mention five roles of decomposers to a farmer. iv. Importance of decomposition.
Assignment	-	write a short note on Tolerance.

Lesson Plan for Experimental Group E3

(Inquiry and Demonstration method)

Week 10 lesson Plan 1

School	-	GSS Kuje
Date	-	03/2017
Class	-	SSS II
No. of Students	-	51
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	3 rd
Duration	-	40 minutes
Subject	-	Biology
Teaching method	-	Inquiry
Topic	-	Ecological management
Sup-topic	-	Tolerance
Reference Books	-	(i)Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.. (iv)Ideal Practical Biology by Onwuzulume, C.N.
Instructional Materials	-	A picture chart showing images of dead animals and refuse dump
Previous Knowledge	-	The students were given an assignment last week to write a brief note on tolerance.
Behavioural Objectives	-	At the end of the lesson, students were able to: iv. Define tolerance v. Define and explain the concept of maximum and minimum tolerance vi. Discuss geographic range
Introduction	-	The teacher began the lesson by introducing the topic of the day-Ecological management (tolerance) to the students.

Presentation -	The teacher used Confirmation inquiry (recall of last lesson on Adaptation), Structured (students to follow set process) and Guided (the students were provided with questions) inquiry to teach this topic. The lesson is presented in the following steps:
Step I -	The teacher defined and discusses with the students what tolerance is- Tolerance is the ability of an organism to withstand unfavourable conditions in their environment and survive it.
Step II -	The teacher guided the students to discuss the maximum and minimum range an organism can survive in a habitat.
Students' Activity-	The teacher guided the students to discuss the geographical range that is, an area where organism can be found within the limit of its tolerance. Having known the definition, the teacher asked the students to mention some geographical range of some animals, plants or birds they know.
Summary -	The teacher summarised the whole lesson to the students.
Evaluation -	Teacher evaluated the students by asking them to: 1. Define Tolerance. 2. What do you understand by the term maximum and minimum tolerance? 3. Mention five factors responsible for geographic range.
Assignment -	Briefly explain how rainfall and temperature affect the distribution of plants and animals .In conclusion, the teacher instructed the students to consult relevant textbooks on the topic Ecological management (Adaptation) for their next class.

Lesson Plan for Experimental Group E3

(Inquiry and Demonstration method)

Week 10 lesson plan 2

School	-	GSS Kuje
Date	-	03/2017
Class	-	SS II
No. of Students	-	51
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	4 th period
Duration	-	40 minutes
Subject	-	Biology
Teaching Method	-	Inquiry
Topic	-	Ecological management
Sub-topic	-	Adaptation
Reference Book	-	(i) Essential Biology by Michael, M.C (ii) Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C. (iv) Ideal Practical Biology by Onwuzulume, C.N.
Instructional Materials	-	A picture chart showing terrestrial and aquatic adaptation of plants(cactus and water lily) and animals (bird and fish).
Previous Knowledge	-	The students were taught tolerance of various organisms last week.
Behavioural Objectives	-	At the end of the lesson, students were able to: 1. Define adaptation 2. Mention and explain adaptation of animals and plants to aquatic habitat 3. Mention and discuss the adaptation of plants and animals to terrestrial habitats 4. Discuss special adaptation of some organism.
Introduction	-	The teacher began the lesson by introducing the topic of the day- Adaptations (ecological management).

Presentation	-	<p>The teacher used confirmation (re-enforcement of prior knowledge), structured (students to follow set process) and guided (the students were provided with questions) inquiry to teach this topic.</p> <p>The lesson is presented in the following steps:</p>
Step I	-	<p>the teacher asked a student to recall the last lesson by defining tolerance. In view of the chart displayed in the classroom showing images of various adaptations of plants (cactus and water lily) and animals (bird and fish), the teacher calls a student to define and discuss adaptation. After some seconds of wait, the student defined it “Adaptation as the ability of an organism to live successfully in a habitat as a result of its structure, appearance or behaviour.</p>
Step II	-	<p>Another student was called to mention and discuss adaptation of plants and animals in aquatic habitat.</p>
Step III	-	<p>The teacher also called another student to mention and discuss the adaptation of plants and animals to terrestrial habitat.</p>
Student Activity-		<p>The teacher then guided the students to mention and discuss adaptation of plants and animals in both terrestrial and aquatic habitat.</p>
Summary	-	<p>The teacher summarised the whole lesson to the students</p>
Evaluation	-	<p>Teacher evaluated the students by asking them to:</p> <ol style="list-style-type: none"> 1. Define adaptation. 2. Mention three adaptive features of aquatic plants and animals. 3. Mention five adaptive features of terrestrial plants and animals.
Assignment	-	<p>Students were given assignment to write short note on the adaptation of the following animals (i) Chameleon (ii) Tape worm (iii) Bird.</p>

In Conclusion, at the end of the term, the teacher revised the different topics taught to the students in preparation for the Biology Objective post-test quiz.

APPENDIX D

LESSON PLAN FOR CONTROL GROUP (CONVENTIONAL METHOD)

Week 1 lesson plan 1

School	-	GSS Gwarinpa, Yangoji and Hajj Camp Abuja
Date	-	01/2017
Class	-	SS II A
No. of Students	-	156
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	3rd
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Digestion
Sub-topic	-	Digestion in Invertebrates
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	Picture of digestive system of invertebrates in biology textbook
Previous Knowledge	-	The students are familiar with eating and digestion of food substances as a normal routine in life.
Behavioural Objectives	-	At the end of the lesson, students should be able to: i. Discuss modification of feeding habits ii. Discuss the process of feeding in invertebrate animals.
Introduction	-	The teacher began the lesson by introducing the topic of the day- Digestion in Invertebrates to the students.
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher talked about the modification of feeding habit such as filter feeder (mosquito larva); Fluid feeders (house fly, mosquito, tsetse fly); parasitic and saprophytic feeders (tape worm and fungi).

Step II	- The teacher talked about feeding habit in protozoa (such as Amoeba P.) and in hydra. Amoeba uses Pseudopodia to circle, engulf it to form food vacuole, enzymes are introduced to digest it intra-cellularly. The hydra ingests food particles into the mouth into the hollow stomach(enteron) where extra-cellular digestion takes place.
Students' Activities	- (i) the students mentioned the feeding habits.
Summary	- The teacher summarised the whole lesson to the students.
Evaluation	- Teacher asked the students to: <ol style="list-style-type: none"> i. Define digestion and digestive system. ii. Describe the mouth part of filter feeders and fluid feeders. iii. Mention the parts of alimentary canal and their functions.
Assignment	- Differentiate between feeding methods of protozoa and hydra.

Lesson Plan for Control Group (Conventional Method)

Week 1 lesson plan 2

School	- GSS Gwarinpa, Yangoji and Hajj Camp Abuja
Date	- 01/2017
Class	- SS IIA
No. of Students	- 156
Average age of Students	- 16 years
Sex	- Male and Female
Period	- 4th
Duration	- 40 minutes
Subject	- Biology
Topic	- Digestion
Sub-topic	- Digestion in Vertebrates
Reference Books	- (i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	- Picture of digestive system of vertebrate (bird) from their textbook.

Previous Knowledge	-	The students are familiar with eating and digestion of food substances as a normal routine in life.
Behavioural Objectives	-	At the end of the lesson, students should be able to: <ul style="list-style-type: none"> i. Discuss modification of feeding habits ii. Describe the human alimentary canal and its functions
Introduction	-	The teacher began the lesson by introducing the topic of the day- Digestion in Vertebrates to the students.
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher talked about the typical alimentary canal of vertebrates (mouth, pharynx, gullet, stomach, small & large intestine, rectum and anus).
Step II	-	The teacher told the students some modification of alimentary canal as found in birds, humans and sheep.
Students Activities	-	The students mention the parts of alimentary system and their functions (mouth, oesophagus, stomach, pancreas, small intestine, large intestine, rectum and anus).
Summary	-	The teacher summarised the lesson to the students.
Evaluation	-	Teacher asked the students to: <ul style="list-style-type: none"> i. Define Digestion and Digestive system. ii. Mention the parts of alimentary canal and their functions
Assignment	-	Differentiate between monogastric animals and polygastric animals

**Lesson Plan for Control Group (Conventional Method)
Week 2 lesson plan 1**

School	-	GSS Gwarinpa, Yangoji and Hajj Camp Abuja
Date	-	01/2017
Class	-	SS II
No. of Students	-	156
Average age of Students	-	16 years
Sex	-	Male and female

Period	-	3rd
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Transport system
Sub-topic	-	Diffusion
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	Picture of diffusion in liquid from their textbook.
Previous Knowledge	-	The students are aware of heart beat and the flow of blood through their veins.
Behavioural Objectives	-	At the end of the lesson, students should be able to: <ul style="list-style-type: none"> i. Define transport system and mention the media of transportation and the materials for transportation. ii. Define and mention the importance of diffusion.
Introduction	-	The teacher began the lesson by introducing the topic of the day- Diffusion to the students.
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher defined transportation as the movement of materials (liquid and gaseous substances) round the body, the teacher mentioned the media of transportation (cell sap, lymph and blood), and then the teacher spoke on the materials for transportation (water, digested food materials, hormones, enzymes, and waste products).
Step II-		The teacher defined diffusion as the movement of molecules of substances from the region of higher concentration to the region of lower concentration until equilibrium is reached.
Students' Activity	-	The teacher asked the students about the process of diffusion and then the teacher mentioned the importance of diffusion.
Summary	-	The teacher summarised the whole lesson to the

students.

- Evaluation** - Teacher evaluated the students by asking them to:
- Assignment** -
- i. Define transportation and transport system.
 - ii. Define Diffusion.
 - iii. Describe diffusion diagrammatically.

Lesson Plan for Control Group (Conventional Method)
Week 2 lesson plan 2

- School** - GSS Gwarinpa, Yangoji and Hajj Camp Abuja
- Date** - 01/2017
- Class** - SS II
- No. of Students** - 156
- Average age of Students** - 16 years
- Sex** - Male and Female
- Period** - 4th
- Duration** - 40 minutes
- Subject** - Biology
- Topic** - Transport system continued
- Sub-topic** - Osmosis
- Reference Books** - (i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
- Instructional Materials** - Picture of Osmosis in the textbook.
- Previous Knowledge** - The students have discussed diffusion in the last lesson.
- Behavioural Objectives** - At the end of the lesson, students should be able to:
- v. Define Osmosis.
 - vi. Discuss Osmosis in plant cells and their biological importance.
- Introduction** - The teacher began the lesson by introducing the topic of the day- Osmosis to the students.
- Presentation** - The lesson is presented in the following steps:

Step I		The teacher defined osmosis as the movement of solvent molecules from a region of lower concentration to a region of higher concentration through a semi permeable membrane
Step II	-	The teacher then described the process of Osmosis in plants and animal.
Students' Activity		The teacher asked the students to copy their notes.
Summary		The teacher summarised the whole lesson to the students.
Evaluation		Teacher evaluated the students by asking them to: <ul style="list-style-type: none"> ii. Define osmosis iii. Discuss Osmosis in plant cells and their biological importance.
Assignment	-	<ul style="list-style-type: none"> i. Define Osmosis ii Differentiate between Osmosis and Diffusion.

Lesson Plan for Control Group (Conventional Method)
Week 3 lesson plan 1

School	-	GSS Gwarinpa, Yangoji and Hajj Camp Abuja
Date	-	01/2017
Class	-	SS II
No. of Students	-	156
Average age of Students	-	16 years
Sex	-	Male and Female
Period	-	3rd
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Transport system (Cont'd) - Media of transportation
Sub-topic	-	Blood as a medium of transportation in mammals
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.

Instructional Materials	-	A picture that showed the media of transportation in mammals (the blood cells) from a Biology textbook.
Previous Knowledge	-	The students are familiar with the topic which has been introduced in the previous lesson.
Behavioural Objectives	-	At the end of the lesson, students should be able to: <ul style="list-style-type: none"> i. Mention the media of transportation in mammals ii Define blood and mention the components of blood iii Describe red blood cells,white blood cells and mention their functions.
Introduction		-The teacher began the lesson by introducing the topic of the day-Blood as a medium of transportation in mammals to the students
Presentation	-	The lesson was presented in the following steps:
Step I	-	The teacher defined blood as the liquid tissues found in the body. The teacher also mentioned the components of the blood (Red blood cell, white blood cells, blood platelets, lymphocytes and the blood plasma).
Step II	-	The teacher asked the students to describe red blood cells and white blood cells and blood platelets.
Students' activity-		The teacher asked the students to copy their notes.
Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: <ul style="list-style-type: none"> i. Mention the media of transportation in mammals. ii Define blood and mention the components of blood. iii. Describe red, white blood cell and blood platelets and also to list out their functions.
Assignment	-	<ul style="list-style-type: none"> i. Mention the media of transportation in mammals. ii. Mention the characteristics of red blood cells.

Lesson Plan for Control Group (Conventional Method)
Week 3 lesson plan 2

School	-	GSS Gwarinpa, Yangoji and Hajj Camp Abuja
Date	-	01/2017
Class	-	SS II
No. of Students	-	156
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	4 th
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Transport system (Cont'd)- Media of transportation
Sub-topic	-	Media of transportation in higher plants
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A picture of transportation in plants (transverse section of a root and stem) from Biology textbook.
Previous Knowledge	-	The students are familiar with the topic which has been introduced in the previous lesson.
Behavioural Objectives	-	At the end of the lesson, students should be able to: vii. Mention the materials for transportation in plants. viii. List the vascular bundles and their functions in plants. ix. Explain transpiration in plants
Introduction	-	The teacher began the lesson by introducing the topic of the day- medium of transportation in plants to the students.
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher stated the materials for transportation in plants (water by the root, mineral salt by the

		root, photosynthesis and food from the leaves; and excretory waste products).
Step II	-	The teacher explained to the Students, what vascular bundles (xylem and phloem) are and their function in the transport system in plants.
Step III	-	The teacher explained transpiration to the students.
Students Activity-		The teacher asked the students to copy their notes.
Summary	-	The teacher summarised the lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: <ol style="list-style-type: none"> i. Mention the media of transportation in plants. ii. List the vascular bundles and their functions in plants. iii. Explain transpiration in plants.
Assignment	-	Explain the major difference between the mechanism of transport in mammals and higher plants.

Lesson Plan for Control Group (Conventional Method)
Week 4 lesson Plan 1

School	-	GSS Gwarinpa, Yangoji and Hajj Camp Abuja
Date	-	02/2017
Class	-	SS II
No. of Students	-	156
Average age of Students	-	16 years
Sex	-	Male and Female
Period	-	3 rd period
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Transport system (Cont'd)-Mechanism of transportation
Sub-topic	-	Mechanism of transportation in small organisms and plants.

Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A picture of Paramecium in a biology textbook is shown to the Students.
Previous Knowledge	-	The students are familiar with the topic because it has been introduced in the previous lesson.
Behavioural Objectives	-	At the end of the lesson, students should be able to: <ul style="list-style-type: none"> i. Mention the mechanism of transportation in small organisms ii. Define mechanism in relation to transport system.
Introduction	-	The teacher began the lesson by introducing the topic of the day- mechanism of transportation in small organisms and lower plants to the students
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher explained to the students' mechanism of transportation in lower organisms like amoeba and paramecium (cytoplasm).
Step II	-	The teacher asked the students to mention the differences in transport system mechanism between the lower organisms and plants.
Students' Activity-		The teacher asked the students to copy their notes..
Summary	-	The teacher summarized the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: <ul style="list-style-type: none"> i. Define transportation and transport system. ii. Describe the mode of transportation in lower organisms. iii. Explain the mechanism of transportation in plants.
Assignment		i. Mention the functions vascular bundles in plants.

- ii. Differentiate between transportation mechanism between amoeba and cassava plant.

Lesson Plan for Control Group (Conventional Method)
Week 4 Lesson Plan 2

School	-	GSS Gwarinpa, Yangoji and Hajj Camp Abuja
Date	-	02/2017
Class	-	SS II
No. of Students	-	156
Average age of Students	-	16 years
Sex	-	Males and Females
Period	-	4 th
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Transport system (Cont'd) - Mechanism of transportation
Sub-topic	-	Mechanism of transportation in higher animals
Reference Book	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A picture of mammalian heart from the biology text book.
Previous Knowledge	-	The students are familiar with the topic because it has been introduced in the previous lesson. The students are aware of heart beat and the flow of blood through their veins.
Behavioural Objectives	-	At the end of the lesson, students should be able to: <ul style="list-style-type: none"> 1. Mention what the transport system of higher animals is made up of. 2. Describe the mammalian heart.
Introduction	-	The teacher began the lesson by introducing the

		topic of the day- mechanism of transportation in the mammalian heart to the students
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher explained to the students' mechanism of transportation of blood in the mammals (heart, blood vessels and lymphatic vessels).
Step II	-	The teacher explained to the students the mechanism of transportation of blood in birds and reptiles.
Students' Activity-		The teacher asked the students to copy their notes.
Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: <ul style="list-style-type: none"> i. Mention what the components of transport system in mammals. ii. Describe the mode of transportation of blood in the mammalian Heart. iii. Explain the difference in mechanism between a mammal and a bird.
Assignment	-	Make a well labelled diagram of the mammalian Heart.

Lesson Plan for Control Group (Conventional Method)
Week 5 lesson plan 1

School	-	GSS Gwarinpa, Yangoji and Hajj Camp Abuja
Date	-	02/2017
Class	-	SS II
No. of Students	-	156
Average age of Students	-	16 years
Sex	-	Males and females
Period	-	3 rd
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Respiratory System
Sub-topic	-	Characteristics and types of Respiratory system.

Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A picture of the gills of a fish.
Previous Knowledge	-	The students are familiar with breathing in and breathing out
Behavioural Objectives	-	At the end of the lesson, students should be able to: <ul style="list-style-type: none"> i. Define respiration. ii. List five the characteristics of respiratory surfaces. iii. Mention the types of respiratory systems.
Introduction	-	The teacher began the lesson by introducing the topic of the day- characteristics and types of respiratory system to the students
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher defined respiration and respiratory system to the students.
Step II	-	The teacher listed the characteristics of a respiratory surface.
Step III-		The teacher mentioned the types of respiratory systems to the students (body surface, gills, lungs in terrestrial vertebrates and lungs in mammals, external and internal respiration.
Students' activity-		The teacher asked the students to copy their notes.
Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: <ul style="list-style-type: none"> i. Define respiration. ii. List four characteristics of a respiratory surface. iii. Describe the types of respiratory systems.
Assignment	-	Explain the respiratory organs of fish.

Lesson Plan for Control Group (Conventional Method)
Week 5 lesson plan 2

School	-	GSS Gwarinpa, Yangoji and Hajj Camp Abuja
Date	-	02/2017
Class	-	SS II
No. of Students	-	156
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	4 th
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Respiratory System (Continued)
Sub-topic	-	Respiratory system in lower animals and Pisces (fish)
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A picture of the respiratory system of a fish was shown to the students
Previous Knowledge	-	The students are familiar with breathing in and breathing out. They have learnt the types of respiratory system and characteristics of respiratory surface.
Behavioural Objectives	-	At the end of the lesson, students should be able to: <ol style="list-style-type: none"> 1. Define gills and its function. 2. Name the different parts of the gills and their functions. 3. Mention and describe the organ of respiration of lower animals.
Introduction	-	The teacher began the lesson by introducing the topic of the day-Respiratory system in lower animals and Pisces (fish) to the students
Presentation	-	The lesson is presented in the following steps:

Step I	-	The teacher defined gills and its function in respiratory system by the use of tilapia fish to the students.
Step II	-	The teacher showed the students the different parts of gills on the chart (gill arch, gill rakers and gill filaments).
Step III	-	The teacher talked to the students about the organ of respiration in amoeba and flatworms. The teacher also explained the difference in the modes of respiration between the lower animals and Pisces.
Students Activity-		The teacher asked the students to copy their notes.
Summary	-	The teacher summarised the whole lesson.
Evaluation	-	Teacher evaluated the students by asking them to: <ul style="list-style-type: none"> i. Define gills and its function. ii. Mention different parts of the gills and its function. iii. Describe the respiratory organ of amoeba and flat worms.
Assignment	-	Differentiate between the respiratory organs in fish and Amoeba.

**Lesson Plan for Control Group (Conventional Method)
Week 6 lesson plan 1**

School	-	GSS Gwarinpa, Yangoji and Hajj Camp Abuja
Date	-	02/2017
Class	-	SS II
No. of Students	-	48
Average age of Students	-	Age 16
Sex	-	Male and female
Period	-	3 rd
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Respiratory System (Continued)
Sub-topic	-	Mechanism of Respiration

Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo,B.O; Gbenro,A; Ala, A;Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A picture of human lungs was shown.
Previous Knowledge	-	The students are familiar with respiratory system in lower animals and tilapia.
Behavioural Objectives	-	At the end of the lesson, students should be able to: iii. Define and explain inhalation. iv. Define and explain exhalation.
Introduction	-	The teacher began the lesson by introducing the topic of the day-mechanism of respiration in higher organisms to the students.
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher defined inhalation to the students. Inhalation simply means breathing in. The teacher spoke about the process of inhalation with the students.
Step II	-	The teacher defined the process of exhalation with the students. Exhalation simply means breathing out.
Students' Activity-		The teacher asked the students to breathe in and out. They are expected to write down their observations.
Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: i. Describe the process of inhalation in named vertebrate. ii. Describe the process of exhalation in a man.
Assignment.		Why is convenient for fish to breathe in the water than on land. ii. Describe inhalation and exhalation in fish.

Lesson Plan for Control Group (Conventional Method)
Week 6 lesson plan 2

School	-	GSS Gwarinpa, Yangoji and Hajj Camp Abuja
Date	-	02/2017
Class	-	SS II
No. of Students	-	156
Average age of Students	-	Age
Sex	-	Male and female
Period	-	4 th
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Respiratory System (Continued)
Sub-topic	-	Respiration in Man
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A picture of the human respiratory system from the biology textbook
Previous Knowledge	-	The students are familiar with the breathing in and breathing out
Behavioural Objectives	-	At the end of the lesson, students should be able to: <ol style="list-style-type: none"> 1. Identify parts that make up the human respiratory system. 2. Explain the function of each of the parts of the human respiratory system.
Introduction	-	The teacher began the lesson by introducing the topic of the day-Respiration in Man to the students.
Presentation	-	The lesson is presented in the following steps:
Step I	-	The Teacher listed the parts that make up the human respiratory system with the students.
Step II	-	The teacher spoke about the function of each of the parts of the human respiratory system.
Students' Activity-	-	The teacher asked the students to copy their notes.
Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: <ol style="list-style-type: none"> i. Mention the parts that make up the human respiratory system.

- ii. Describe the function of each of the organ of the human respiratory system.
- Assignment** - Why is convenient for fish to breathe in the water than on land.

Lesson Plan for Control Group (Conventional Method)
Week 7 lesson plan 1

- School** - GSS Gwarinpa, Yangoji and Hajj Camp Abuja
- Date** - 02/2017
- Class** - SS II
- No. of Students** - 156
- Average age of Students** - 16 years
- Sex** - Male and female
- Period** - 3rd
- Duration** - 40 Minutes
- Subject** - Biology
- Topic** - Excretory System
- Sub-topic** - Excretory system in lower animals and plants
- Reference Books** - (i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
- Instructional Materials** - Picture of Excretory System in the Biology Textbook
- Previous Knowledge** - The students are familiar with passing out liquid and gaseous substances
- Behavioural Objectives** - At the end of the lesson, students should be able to:
- i. Mention some organs of excretion in lower animals and plants.
 - ii. Describe the mechanism of excretion in insects
 - iii. Describe the mechanism of excretion in flatworms
- Introduction** - The teacher began the lesson by introducing the topic of the day-Excretory system in lower animals and plants.
- Presentation** - The lesson was presented in the following steps:

Step I	-	The teacher mentioned the organ of excretion in lower animals and plants. The organ of excretion in amoeba (Contractile vacuole); tape worm (flame cells); insects (malphigian tubules).
Step II	-	The teacher explained to students the mechanism of excretion in amoeba.
Step III	-	The teacher mentioned the mechanism of excretion in lower plants.
Students' Activity-		The students copied their notes.
Summary	-	The teacher summarised the whole lesson to the students
Evaluation	-	Teacher evaluated the students by asking them to: <ul style="list-style-type: none"> i. Mention the organ of excretion of Paramecium, Euglena and Amoeba. ii. Briefly explain mode of excretion in amoebae. iii. Briefly explain mode of excretion in tapeworm.
Assignment	-	Explain the need of removal of waste products from all organisms.

**Lesson Plan for Control Group (Conventional Method)
Week 7 lesson plan 2**

School	-	GSS Gwarinpa, Yangoji and Hajj Camp Abuja
Date	-	02/2017
Class	-	SS II
No. of Students	-	156
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	4 th Period
Duration	-	40 Minutes
Subject	-	Biology
Topic	-	Excretory System
Sub-topic	-	Excretory system in higher animals and plants

Reference Book	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A picture of the longitudinal section of a human kidney from a biology textbook.
Previous Knowledge	-	The students are familiar with excretion in lower animals.
Behavioural Objectives	-	At the end of the lesson, students should be able to: <ol style="list-style-type: none"> 1. Mention organs of excretion in higher animals and plants. 2. Describe the mechanism of excretion in man. 3. Describe the mechanism of excretion in higher plants.
Introduction	-	The teacher began the lesson by introducing the topic of the day-Excretory system in higher animals(humans) and plants
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher mentioned the organ of excretion in higher animals and higher plants. The organ of excretion in mammals (kidneys) and in the higher plants (stomata and lenticels).
Step II	-	The teacher explained to the students the mechanism of excretion in man.
Step III	-	The teacher guided the students to discuss the mechanism of excretion in plants
Students' Activity-		The teacher asked the students to copy their notes.
Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: <ol style="list-style-type: none"> i. Describe how man passes out the water he drank during meal. ii. Describe the mechanism of excretion in plants.
Assignment	-	i. Explain in detail why we remove waste products from our body.

Lesson Plan for Control Group (Conventional Method)
Week 8 lesson plan 1

School	-	GSS Gwarinpa, Yangoji and Hajj Camp Abuja
Date	-	03/2017
Class	-	SS II
No. of Students	-	156
Average age of Students	-	Age
Sex	-	Male and Female
Period	-	3 rd
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Nutrient Cycling in Nature
Sub-topic	-	Carbon and water cycle
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	Picture of carbon and water cycle in nature from a biology textbook.
Previous Knowledge	-	The students are familiar with the topic because they breathe in oxygen and witness rainfall.
Behavioural Objectives	-	At the end of the lesson, students should be able to: <ul style="list-style-type: none"> i. Define and discuss carbon cycle in nature. ii. Describe the water cycle
Introduction	-	The teacher began the lesson by introducing the topic of the day-Nutrient Cycling in Nature (carbon and water cycle).
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher defined carbon cycle to the students. They are defined as the circulation of carbon, oxygen and water in nature.
Step II	-	with the aid of diagrams, the teacher explained to the students the process of natural water cycle.
Students' Activity	-	The teacher asked the students to copy their notes.

Summary	-	The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: <ol style="list-style-type: none"> i. Mention three ways carbon is returned back to the atmosphere. ii. Describe the process of natural water cycle.
Assignment	-	<ol style="list-style-type: none"> i. Make a diagram of the carbon cycle and water cycle.

Lesson Plan for Control Group (Conventional Method)
Week 8 lesson plan 2

School	-	GSS Gwarinpa, Yangoji and Hajj Camp Abuja
Date	-	03/2017
Class	-	SS II
No. of Students	-	156
Average age of Students	-	Age
Sex	-	Male and Female
Period	-	4 th
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Nutrient Cycling in Nature
Sub-topic	-	Oxygen cycle and Importance of nutrient cycle nature
Reference Book	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro,A; Ala, A;Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A cardboard chart showing oxygen cycle in nature
Previous Knowledge	-	The students are familiar with the topic, they have studied water and carbon cycle in the last class.
Behavioural Objectives	-	At the end of the lesson, students should be able to: <ol style="list-style-type: none"> i. Define and discuss oxygen cycle in nature.

- ii. Mention the importance of nutrient cycle in nature.
- Introduction** - The teacher began the lesson by introducing the topic of the day-Nutrient Cycling in Nature (Oxygen cycle and the importance of the nutrients cycling in nature).
- Presentation** - The lesson is presented in the following steps:
- Step I** - The teacher explained with the process of, oxygen cycling in nature and make them understand that most available oxygen in nature comes from photosynthesis.
- Step II** - The teacher explained the importance of nutrients cycling in nature to plants and animals.
- Students' Activity** - The teacher asked the student to mention other importance of oxygen in nature not earlier mentioned. They should write down their answers.
- Summary** - The teacher summarised the whole lesson to the students.
- Evaluation** -Teacher evaluated the students by asking them to:
 - i. Mention ways oxygen is returned back to the atmosphere.
 - ii. Mention ways oxygen is removed from the atmosphere.
 - iii. Mention two importance each of Carbon, oxygen and water cycle.
- Assignment** - Briefly explain how oxygen and carbon dioxide is balanced in nature.

Lesson Plan for Control Group (Conventional Method)
Week 9 lesson plan 1

School	-	GSS Gwarinpa, Yangoji and Hajj Camp Abuja
Date	-	03/2017
Class	-	SS II
No. of Students	-	156
Average age of Students	-	16 years
Sex	-	Female
Period	-	3 rd
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Decomposition in nature
Sub-topic	-	Types of micro organisms
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro,A; Ala, A;Olaniran, A and Chukwuka, K.S (iii) Comprehensive practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A picture was shown of dead decaying animals and refuse dump.
Previous Knowledge	-	The students are have observed some form of decomposition in their environment.
Behavioural Objectives	-	At the end of the lesson, students should be able to: <ul style="list-style-type: none"> i. Define decomposition in nature. ii. Mention the types of micro-organism.
Introduction	-	The teacher began the lesson by introducing the topic of the day-Decomposition in nature(types of micro-organisms)
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher defined decomposition. Decomposition is the breakdown of complex organic matter in dead bodies of plants and animals.
Step II	-	The teacher mentioned the types of decomposers – i. Micro-decomposers(bacteria, fungi)ii. Macro

		decomposers (earth worms, snails, termites and so forth).
Students' Activity-		The teacher asked the students to copy their notes.
Summary-		The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: <ol style="list-style-type: none"> i. Define decomposition and briefly explain it. ii. Mention the types of decomposer and give five examples each.
Assignment	-	Mention five harmful effects of micro-organisms.

Lesson Plan for Control Group (Conventional Method)
Week 9 lesson plan 2

School	-	GSS Gwarinpa, Yangoji and Hajj Camp Abuja
Date	-	03/2017
Class	-	SS II
No. of Students	-	156
Average age of Students	-	16 years
Sex	-	Female
Period	-	4 th
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Decomposition in Nature
Sub-topic	-	Importance and role of a decomposer
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comp - rehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A picture was shown of dead decaying animals and refuse dump.
Previous Knowledge	-	The students are having observed some form of decomposition in their environment.
Behavioural Objectives	-	At the end of the lesson, students should be able to: <ol style="list-style-type: none"> i. Mention and explain the role decomposer.

		ii. Importance of decomposition in nature.
Introduction	-	The teacher began the lesson by introducing the topic of the day-Decomposition in nature (importance and role of a decomposer).
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher mentioned the gases released during decomposition.
Step II	-	The teacher talked about the limit to tolerance.
Students' Activity-		The teacher asked the students to copy their notes.
Summary-		The teacher summarised the whole lesson to the students.
Evaluation	-	Teacher evaluated the students by asking them to: iii. Mention five roles of decomposers to a farmer. iv. Importance of decomposition.
Assignment	-	Write a short note on Tolerance.

**Lesson Plan for Control Group (Conventional Method)
Week 10 lesson plan 1**

School	-	GSS Gwarinpa, Yangoji and Hajj Camp Abuja
Date	-	03/2017
Class	-	SSS II
No. of Students	-	156
Average age of Students	-	16 years
Sex	-	Male and female
Period	-	3 rd
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Ecological management
Sup-topic	-	Tolerance
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro,A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	Nil

Previous Knowledge	-	The students were given an assignment last week to write a brief note on tolerance.
Behavioural Objectives	-	At the end of the lesson, students should be able to: <ul style="list-style-type: none"> vii. Define# tolerance viii. Define and explain the concept of maximum and minimum tolerance ix. discuss geographic range - graph
Introduction	-	The teacher began the lesson by introducing the topic of the day-Ecological management (tolerance).
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher defined tolerance to the students- Tolerance is the ability of an organism to withstand an unfavourable conditions in their environment and survive it.
Step II	-	The teacher explained the maximum and minimum range an organism can survive in a habitat.
Students' Activity-		The teacher asked the students to copy their notes.
Summary	-	The teacher summaries the whole lesson to the students.
Evaluation	-	Teacher evaluates the students by asking them to: <ul style="list-style-type: none"> i. Define tolerance. ii. What do you understand by the term maximum and minimum tolerance? iii. Mention five factors responsible for geographic range.
Assignment-		Briefly explain how rainfall and temperature affect the distribution of plants and animals.

Lesson Plan for Control Group (Conventional Method)
Week 10 lesson plan 2

School	-	GSS Gwarinpa, Yangoji and Hajj Camp Abuja
Date	-	03/2017
Class	-	SS II
No. of Students	-	156

Average age of Students	-	16 years
Sex	-	Male and female
Period	-	4 th
Duration	-	40 minutes
Subject	-	Biology
Topic	-	Ecological management
Sub-topic	-	Adaptation
Reference Books	-	(i) Essential Biology by Michael, M.C (ii) Macmillan Progressive Biology by Odaibo, B.O; Gbenro, A; Ala, A; Olaniran, A and Chukwuka, K.S (iii) Comprehensive Practical Biology by Obidiwe, J.O.C.
Instructional Materials	-	A picture of aquatic adaptation of plants (cactus and water lily)
Previous Knowledge	-	The students were taught tolerance of various organisms last week.
Behavioural Objectives	-	At the end of the lesson, students should be able to: <ul style="list-style-type: none"> i. Define adaptation ii. Mention and explain adaptation of animals and plants to aquatic habitat iii. Mention and discuss the adaptation of plants and animals to terrestrial habitats iv. Discuss special adaptation of some organism.
Introduction	-	The teacher began the lesson by introducing the topic of the day- Adaptations (ecological management).
Presentation	-	The lesson is presented in the following steps:
Step I	-	The teacher defined adaptation to the students: Adaptation is the ability of an organism to live successfully in a habitat as a result of its structure, appearance or behaviour.
Step II	-	The teacher described adaptation of plants and animals to aquatic habitat to the students
Step III	-	The teacher described adaptation of plants and animals to terrestrial habitat to the students.

Student Activity-		The teacher asked the students to copy their notes
Summary-		The teacher summaries the whole lesson to the Students
Evaluation	-	Teacher evaluated the students by asking them to: <ul style="list-style-type: none"> i. Define adaptation. ii. Mention three adaptive features of aquatic plants and animals. iii. Mention five adaptive features of terrestrial plants and animals.
Assignment	-	Write short note on the adaptation of the following animals (i) Chameleon (ii) Tape worm (iii) Bird.

APPENDIX E

(RESEARCH INSTRUMENT)

BIOLOGY INQUIRY AND DEMONSTRATION PERFORMANCE TEST (BIDPT)

BIOLOGY TEST FOR CONTROL AND EXPERIMENTAL GROUP

Name of School

Sex: Male [] Female [] Duration: 30 minutes

Instruction: Answer all the questions and Tick (✓) against the correct options only

Biology Objectives Questions

1. Two digestive enzymes that work in an acidic medium are (a) maltose and trypsin (b) pepsin and renin (c) lipases and rennin (d) amylopsin and pepsin
2. In saprophytes, the digestive enzymes are located in the (a) mycelium (b) hyphae (c) tip of hyphae (d) leaves
3. Carbohydrates are stored in animals as (a) cellulose (b) starch (c) glycogen (d) glucose
4. The mouth parts of insects that are modified to form a coiled tube are called—(a) mandible (b) maxillae (c) proboscis (d) labrum.
5. Which of these is an example of polygastric animal (a) rabbit (b) man (c) monkey (d) donkey?
6. The rate of transpiration can be measured in the laboratory by using – (a) respirator (b) potometer (c) transporter (d) potentiometer.
7. Oxygen carrying blood is called – (a) haemoglobin (b) oxygenated blood (c) erythrocyte (d) oxyhaemoglobin.
8. In hydra extra-cellular digestion takes place in (a) enteron (b) endoderm (c) ectoderm (d) mesoglea
9. The red blood cell have the following characteristics except—(a) biconcave (b) nucleated (c) denuded (d) bigger than platelets
10. The phloem tube transports the following except—(a) food (b) sugar (c) amino acid (d) water.
11. All arteries carry oxygenated blood except – (a) dorsal aorta (b) hepatic artery (c) pulmonary artery (d) subcravian artery.
12. The medium of transportation in plant is – (a) latex (b) water (c) root (d) xylem vessel
13. The valve between the right auricle and the right ventricle is called (a) bicuspid valve (b) tricuspid (c) mitral valve (d) monocuspid valve
14. Which of these is not transported through the process of osmosis? (a) Red blood cells (b) glucose (c) water (d) mineral salt.

15. Oxygen is transported through (a) the blood plasma (b) the blood (c) lymph (d) veins
16. The digested food materials is transported through (a) the blood plasma (b) the red blood cells (c) the white blood cells (d) the blood platelets
17. The following are the characteristics of an artery except – (a) it carries blood away from the heart (b) presence of elastic fibers (c) pulse is present (d) valves are present.
18. The following are media of transportation in organisms except -- (a) cytoplasm (b) lymph (c) water (d) blood
19. Fishes exchange air in the ----- (a) trachea (b) body surface (c) gills (d) lungs.

Knowledge

20. The stomata in plant open when the guard cells are --- (a) forced (b) flaccid (c) weak (d) turgid.
21. Which of these is not a difference between an artery and a vein (a) arteries have valves and veins have no valves (b) vein is larger than the artery (c) vein operates at low pressure while arteries at high (d) the muscular wall of an artery is thicker than the veins
22. The following are the features of mammalian respiratory system except --- (a) highly vascularised (b) small surface area ratio (c) moisturized surface (d) thin surface.
23. Under normal circumstances, a healthy person breathe in and out ----- times in a minute (a) 16 (b) 25 (c) 90 (d) 12
24. In arthropods, oxygen is circulated through the (a) tracheal system (b) respiratory system (c) Transport system (d) digestive system
25. In insects the spiracles are found in the (a) membranous wings (b) prothorax (c) mesothorax (d) abdomen
26. In Tilapia ----- serves as organ of smell (a) buccal cavity (b) gill filaments (c) operculum (d) nostril
27. The lungs of a healthy adult can hold an average air of about ---- (a) 6 litres (b) 5.5 litres (c) 7.3 litres (d) 12 litres.
28. The following are organs concerned with inhalation and exhalation except -- (a) alveoli (b) bronchi (c) diaphragm (d) esophagus.
29. Which of these is the excretory organ of earthworm? (a) Liver (b) kidney (c) Nephridium (d) Malpighian tubule.
30. The flame cell is the excretory organ of (a) Tape worm (b) Earthworm (c) Ascaris (d) ring worm.
31. The excretory organ of unicellular organisms is the (a) body surface (b) contractile vacuole (c) flame cell (d) anus
32. Which of the following is not an excretory product in plants (a) gum (b) alkaloid (c) mucilage (d) uric acid
33. Calcium oxalate as a waste product in plants is removed through (a) falling of leaves (b) falling of branches (c) falling of fruits (d) decay of roots
34. Which of the following is not an excretory product of animal? (a) Ammonia (b) Urine (c) anthocyanin (d) Carbon iv oxide

35. The excretory unit of the kidney is refer to as the --- (a) Nephron (b)pelvis (c) pyramid (d) cortex
36. Which of the following is not a kidney disease (a) Nephritis (b) hepatitis (c) gall bladder(d) diuresis
37. Carbon cycle involve the following except ---- (a) respiration (b) transpiration (c) combustion (d) photosynthesis
38. Lenticular transpiration is found in the following except (a) avocado pear (b)stem of herbaceous plant (c) stem of Iroko tree (d) leaves of bryophyllum plant
39. Which of the following blood vessels carries oxygenated blood to the heart?(a) pulmonary vein (b) anterior vena cava (c) pulmonary artery(d) posterior vena cava
40. Water molecules returnsto the atmosphere through the following except--- (a) perspiration (b) respiration (c) decaying(d) clouding
41. Which one of the following is the reservoir of carbon iv oxide(a) the sea (b) the atmosphere (c) the soil (d) plants
42. Which of the following statement about energy flow is NOT correct? (a) During conversion of energy by organisms, some lost as heat (b) living things are energy converter (c) energy flows in multidirectional in an ecosystem (d) only quarter of the energy absorbed by primary producers is converted into chemical energy.
43. Carbon iv oxide is remove from the atmosphere through (a)respiration (b) photosynthesis (c) decomposition (d) breathing
44. Water is added to the atmosphere through the following except(a) transpiration (b) evaporation(c) dew (d) perspiration
45. Xerophytes are adapted to the arid landby possessing (a) large leaves (b) soft and slim stem (c) deep roots (d) shallow roots
46. Association between two organisms where one benefits and the other is either loose or harm is called (a) symbiosis (b) parasitism (c) commensalism(d)mutualism
47. At what level of organization is amoeba?(a) tissue (b) organ(c) cellular (d) filament
48. Which of the following is used to measure the rate of water uptake in plants?(a) potometer(b) hydrometer(c) hydrometer (d) aspirator
49. The function of the red blood cell is to..... (a) engulf invading bacteria (b) aid in protein formation (c) transport oxygen to the cell (d) control blood glucose levels
50. The medium of gaseous exchange between organisms is essentially by(a) osmosis (b) inhalation (c) diffusion(d) Exhalation

APPENDIX F

TEST BLUE PRINT FOR BIOLOGY OBJECTIVE QUESTIONS

WEEKTOPICSNO OF QUESTIONS

1. Digestive system	6
2. Transport system	5
3. Transport system (continue)	5
4. Transport system (continue)	4
5. Respiratory system	5
6. Respiratory system (continue)	5
7. Excretory system	10
8. Nutrient cycling in nature	7
9. Adaptation	3
TOTAL	50

APPENDIX G
MARKING SCHEME

1. B
2. B
3. C
4. C
5. D
6. C
7. D
8. A
9. C
10. D
11. C
12. A
13. A
14. A
15. A
16. A
17. D
18. A
19. C
20. D
21. A
22. A
23. B
24. A
25. D
26. D
27. A
28. D
29. C
30. A
31. B

- 32. D
- 33. A
- 34. C
- 35. A
- 36. B
- 37. B
- 38. D
- 39. A
- 40. D
- 41. D
- 42. D
- 43. B
- 44. C
- 45. C
- 46. B
- 47. C
- 48. A
- 49. C
- 50. C

APPENDIX H

Reliability Result: Case Processing Summary

		N	%
Valid		30	100.0
Cases Excluded ^a		0	.0
Total		30	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

	Value	30 ^a
Part 1	N of Items	30 ^b
Cronbach's Alpha	Value	.849 ^a
Part 2	N of Items	1 ^c
	Total N of Items	2
Correlation Between Forms		.849
Spearman-Brown Coefficient	Equal Length	.919
	Unequal Length	.919

a. The item is: Scores

b. The item is: Group

Summary Item Statistics

		Mean	Minimum	Variance	N of Items	Maximum	Range	Group Reliability
Item Means	Part 1	8.582	8.582	.000	30 ^a			
	Part 2	1.468	1.468	.000	30 ^b			
	Both Parts	5.025	1.468	25.30	2	8.582	7.114	5.845
Inter-Item Correlations	Part 1	.000	1.798E+30	.000	1 ^a			
	Part 2	.000	1.798E+30	.000	1 ^b			
	Both Parts	.849	.849	.000	2	.849	.000	.849

a. The item is: Scores

b. The item is: Group

The reliability index is 0.849

APPENDIX I

Guidelines for Research Assistants (RAs)

This research work was on two teaching methods namely inquiry and demonstration methods used in teaching Biology in SS II students in FCT Abuja. The researcher selected three research assistants and trained them on the teaching methods to be employed in this research work. A research assistant is a researcher employed, often on a temporary contract, by a university or a research institute, for the purpose of assisting in academic research. Research assistants are not independent and not directly responsible for the outcome of the research and they are only responsible to a supervisor or principal investigator. For this research work, the research assistants are experienced Biology teachers who are university graduates from the selected schools under study.

Procedure for the Research Work

- The researcher met with the Biology teachers of the schools selected for the study. The researcher then selected the research assistants after a brief introduction of themselves and then a subsequent short interview took place. The aim of the short interview was to select Biology teachers based on competence as research assistants.
- After the selection of three researcher assistants, the researcher provided an overview of the research work at the beginning of the session, detailing what was expected of them from the research, the timeline, meeting regularly with the students during the lesson period.
- The researcher explained from the onset the use of the lesson plan, the multiple objective test that was administered at the beginning of the research work and also at the end of the research work.

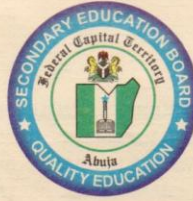
- The researcher further explained to the three (3) research assistants that the data for the study was collected through the administration of pre-test and post-test of 50 multiple choice objective tests. The data collection phase lasted for ten weeks comprising of double period of eighty minutes per week for each group. Before the treatment, students in both experimental and control group were exposed to a pre-test.
- The researcher and the trained research assistant administered a pre-test to the students in experimental groups (Inquiry and Demonstration) and control group respectively using an instrument named Biology Inquiry and Demonstration Performance Test (BIDPT) before the commencement of the treatment.
- The researcher with the help of trained research assistants taught the students as outlined in the lesson plan for a period of ten weeks.
- The researcher taught the experimental groups using Inquiry and Demonstration teaching methods, while the control group was taught with the Conventional method by their experienced Biology teachers.
- After the treatment, a post-test was administered to both the experimental groups and the control group by the researcher with the help of the research assistants.
- The scripts were collected, marked, scored and recorded to make comparison between the groups with the help of the research assistant.
- The three groups were taught using the same content selected from Secondary II curriculum under the same conditions in their different schools.
- After the treatment, the students in experimental and control group were exposed to post-test in order to determine their performance.
- The researcher met regularly with the research assistants.

Expectations from the Research Assistants

The research assistants approached the research assistantship as a learning experience, seeking clarification as to the expectations and benefits of research work.

- RAs were responsible for the accuracy, validity and integrity of the research on which they are working on. They were reliable, communicable, self-starter and they asked for help when they get lost
- The RAs, at the end of the treatment period (ten weeks) assisted in administering the post-test to the students.
- The RAs collated the answer script and handed over to the researcher.
- The RAs assisted in marking the scripts and recording their scores.

APPENDIX J



**FCT - SECONDARY EDUCATION BOARD
EDUCATION SECRETARIAT**

P.M.B. 151, Garki, Abuja. Tel: 09-2341148

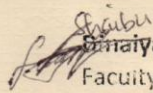
Block 3, Area 3,
Garki, Abuja.

Our Ref:.....

14th March, 2016

Your Ref:.....

Date:.....


Emamiya Surauja Tukura
Faculty of Education
Dept. of Curriculum & Instruction
A.B.U. – Zaria
Kaduna State.

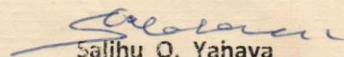
REQUEST FOR SS2 BIOLOGY STUDENTS POPULATION

Yours on the above subject refers.

Please find below the information you requested for:-

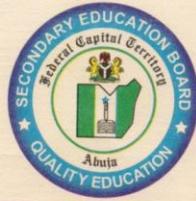
- (i) Total number of Government Senior Secondary School in the FCT – Abuja is fifty-six (56) only.
- (ii) Total number of Biology students (Boys) in SS2 is twelve thousand, three hundred and fifty (12,350) only.
- (iii) Total number of Biology students (Girls) in SS2 is eleven thousand and seventy-two (11,072) only.
- (iv) Secondary Education Board, Area 3, Garki – Abuja is the source of information.

2. Thank you.


Salihu O. Yahaya
Deputy Director (SS)
For: Director (SEB)



APPENDIX K



**FCT - SECONDARY EDUCATION BOARD
EDUCATION SECRETARIAT**

P.M.B. 151, Garki, Abuja. Tel: 09-2341148

Block 3, Area 3,
Garki, Abuja.

Our Ref:.....

Your Ref:.....

10/10/2016

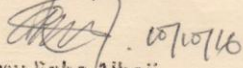
Date:.....

The Principal
.....
.....

LETTER OF INTRODUCTION

I am directed to introduce **Suraiya Tukura Shaibu** a Ph.D student of Ahmadu Bello University Zaria, Department of Curriculum and Instruction.

2. She is currently carrying out a research on Teachings Methods in Biology
2. Please accord her all the necessary assistance she may required.
3. Thank you.


Adamu Gaba Alhaji
HOD/DD (School Services)
For: Ag. Director (SEB)



**APPENDIX L
FIELD WORK EXPERIENCE**



AT GSS HAJJ CAMP, GWAGWALADA



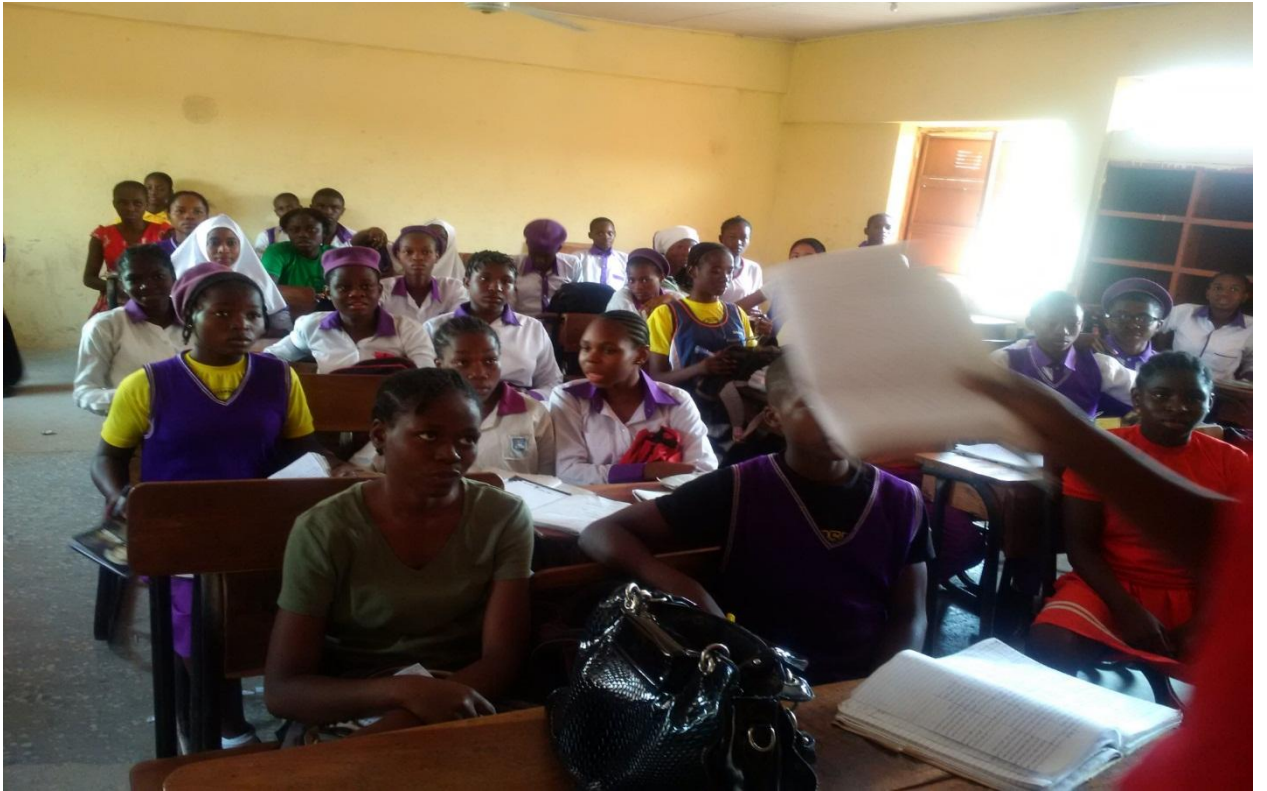
AT GSS YANGOJI, KWALI, ABUJA



DISSECTION OF BIRD AT GSS, KUJE



AT GSS WUSE ZONE III, ABUJA



AT GSS LUGBE, AIRPORT RD, ABUJA