: EFFECTIVENESS OF INDIVIDUALIZED AND LECTURE NSTRUCTIONAL METHODS OF TEACHING BIOLOGY AT THE SENIOR SECONDARY LEVEL OF EDUCATION

BY

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DECLARATION

I hereby declare that this thesis has been written by me and that it is a record of my own research work. It has not been presented in any previous application for a higher degree. All quotations are indicated by quotation marks or indentation, and the sources of information are specifically acknowledged by means of references.

Signature 

ALICE OLADEHINDE ABU

CERTIFICATION

This thesis entitled "The Effectiveness of Individualized and Lecture Instructional Methods of Teaching Biology at the Senior Secondary Level of Education" by Alice O. Abu (Mrs.), meets the regulations governing the award of the degree of Masters in Education (M.Ed) in Science Education of Ahmadu Bello University, and is approved for its contributions to knowledge and literary presentation.

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DEDICATION

This work is dedicated to my children for their patience and encouragement in the course of carrying out this study. May Almighty God be with them.

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ABSTRACT

This study investigated the effectiveness of individualized (LAP) and conventional (lecture) methods of teaching biology at the Senior Secondary Level of education. A total of 80 randomly selected senior secondary two (SSII) students with a mean age of 16.8 years in two secondary schools in Zaria township of Kaduna State of Nigeria constituted the subjects for this experimental study. The categorization, Pre-test and some educational determinants showed that the two schools were comparable before the administration of the treatment.

The subjects were classified as high, average and low achievers using the categorization test scores. Pre-test-post-test experimental control group design was used. One of the selected schools was made the experimental group while the other was the control group. Lecture method, lesson notes and a Learning Activity Package (LAP) were developed by the investigator. Pre/post test questions were drawn from biology concepts exposed to the students (i.e. Micro-organisms around us and Micro-organisms in action) in the lesson notes and the LAP. Both the Learning Activity Package (LAP), lecture lesson notes, pre and post test items were validated and the test items found reliable before being used in this study.

Specifically the experimental group used the package to direct their learning activities, with the teacher always available to render any assistance needed. While the

experimental group performed experiments to obtain information or gather data, the control group had the same experiments performed for them by the teacher and instruction was the normal lecture method. The duration of the study was eight weeks. The subjects exposed to the two methods were thereafter compared. Two hypotheses were formulated to direct the study. Hypothesis one was tested at 0.05 level of significance. While arithmetic mean was used to find the significant difference among the levels (i.e high, average and low achievers exposed to individualized and lecture methods in hypothesis two.

The t-test for two independent groups and the arithmetic mean revealed that the individualized instructional strategy enhanced the students performances in biology more than the conventional (lecture) method. The difference between the two methods was significant. The results so obtained have implications for the teaching of biology in senior secondary schools and these were discussed.

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DEFINITION OF TERMS

The following terms are defined as used in this study.

Effective Teaching:- This is teaching which result in improved performance by students when an achievement test is administered on the basis of the objectives of the lesson.

Learning Activity Package (LAP) - A Learning Activity Package is a form of communication between the teacher and the student that contains instruction for student activities, leading towards achieving specific objectives. The package is presented in the form of handout.

CHAPTER 1

1.1 THE PROBLEM

A glance through literature reveals that there has been active research into all aspects of science in more recent times. This shows that science continues to be an important aspect of human knowledge. Science is alleged to be an indispensable tool of nation building, especially in the various hierarchies of modern technology (Tawari, 1986). In Nigeria, great emphasis is placed on science as a school subject at all levels of education. The National Policy on Education (1981) outlines laudable aims and objectives of science teaching in the school system in Nigeria.

Biology serves as a core subject for many science disciplines among which are human medicine, veterinary medicine, agriculture, food technology, pharmacy, etc. This is further confirmed by the requirements for admission into Nigerian Universities as stated in the 1993/94 JAMB brochure. Biology is also one of the main subjects which is virtually compulsory for all candidates sitting for the senior secondary certificate examination (SSCE). Even students majoring in arts and humanities are expected to study biology as part of their education in science.

The study of biology also enables one to become more aware of one's changing environment, explore it better and be better adapted to it. Biology is therefore one of the most important science subjects for creating self awareness in the individual

as well as making the individual to contribute one's quota more effectively and meaningfully.

Despite the emphasis on teaching and learning of science subjects, evidence abounds that lends support to the claim of low level performance in science subjects in secondary schools in Nigeria (Oyanna, 1979; Teibo, 1981; and Aghenta, 1982). The SSCE results for 1991 to 1993 as published by WAEC showed that only 25.6 per cent obtained the entry requirements in Biology in 1991. In 1992, it was 28.1 per cent and 18.7 per cent in 1993 (See Appendix A). It becomes glaring that there has been no appreciable improvement in the general performance of the students that sat for Biology in the SSCE over the years. Some studies attributed the poor performance of students in SSCE biology to socio-economic background of students (Oyanna, 1979 and Tawari, 1986). Others attributed it to intelligence and aptitude and yet others to teaching methods (Teibo, 1981 and Aghenta, 1982).

Evidences from the works of Thollairathil (1972), Aminu (1978), Shuaibu (1979), Abdullahi (1981), Balogun (1982) and Akpan (1983) reveal that the prevailing teaching methods in Nigeria is the lecture method. This instructional method, according to these scholars, is mainly authoritarian in nature. Teaching methods which can help the development of reasoning, skills and processes through scientific approach are conspicuously lacking. In order to encourage the study of science, the Federal Government not only established more

science institutions but also devised an admission policy, which focused greater attention on science than the liberal arts. In section 39 of the National Policy on Education, sub-section 2b, the policy states that the ratio of science to liberal arts students in Nigerian Universities has been fixed at 60:40 during the Third National Development plan period from 1975 to 80. This ratio will continue to be reviewed in accordance with the man-power needs of the country.

This ratio is yet to be accomplished. The reason is not far-fetched. For instance, the result of Science College Kufena, Zaria in 1984 showed that only 16.67 percent obtained the entry grades in biology to go into post secondary institutions (i.e. at least C6) (Asun, 1986). At the recent times, in 1992, the result of this college showed that only 10.81 per cent (4 out of 42) that sat for biology in S.S.C.E. obtained the entry grades in biology, a minimum of credit six (C6) (ERC, 1995). Aghenta (1982) reported that out of 498 prospective candidates that sat for the school certificate examination in 1979 in ten secondary schools in Benin, only 92 (representing 18 per cent) passed with matriculation requirements and out of 529 candidates that took Biology in West African School Certificate examination (WASCE) only 131 (representing 25 percent) obtained credit level pass. Some of the problems attributed to this poor performance included teaching methods, lack of books, poor laboratory etc.

The increased awareness of the importance of education to

a successful life has intensified certain problems in the Nigeria educational scene. Students' enrolment in schools and colleges is very high. They represent a great diversity of interest, backgrounds and capacities. With all these, learning should provide a flexible situation for each student to make adjustment suited to his/her individual needs.

In order to accommodate a wide range of students, one should include a great variety of teaching techniques, and each medium must be selected for use on the basis of its effectiveness and efficiency in evoking the appropriate responses. Personal contact with teachers must be encouraged in order to enhance motivation and the interest of the students. Each activity required of the student must be well analyzed in terms of the objectives. All the works must be geared towards the interest and progress of the students. The teaching method must take into account the facts that individuals may perceive ideas and concepts through a variety of ways. The mode of knowledge dissemination must be made available in such a way that the student can pace themselves, omitting already familiar things and concentrating on necessary things to bring their education up to the level of their classmates. If goals can be well spelt out, a student arriving at these goals independently along some avenue other than that provided by the teacher should be recognized just in the same way as that obtained under an instructor. A teacher therefore, can provide guidance, facilities and motivation where the

students do the learning.

The restrictions and limitations for example allowing little or no room for students' participation and pupil-teacher interaction in the teaching learning process usually imposed by the traditional teaching approach may be modified or discarded by giving greater considerations to the needs of the individual student. That is, one should explain the course objectives, the kind of subject matter to be represented, the ways or means by which it could be best made available to students etc. The teacher should provide the students with an opportunity to those activities which are important and useful to them. This does not mean that the lecture (conventional) method should be discarded completely. It means that one develops a multi-faceted, multi-sensory approach which takes advantage of every teaching circumstance and exploits it to its utmost.

The responsibility for learning and the mechanics for scheduling are placed on the student. The teacher in many cases is freed from the business of teaching i.e. the orientation, direction, elucidation, guidance and motivation of individual students to greater efforts (Postlewaite et al., 1972). In order to accommodate a wide range of students, Postlethwaite in the same reference suggested three major ingredients necessary in the teaching approach. The approach must involve a great variety of teaching techniques and the medium must be selected for use on the basis of its effectiveness and efficiency in evoking the appropriate

responses. Secondly, communication media must be made available in such a way that the students can pace themselves, paying attention to new ideas. Thirdly, the student must have easy access to the teacher for any explanation that may be needed by individual students. Each activity meant for the student must be analyzed in terms of the objectives and all busy work which does not really contribute to the learners' progress must be detected and side tracked.

1.2 STATEMENT OF THE PROBLEM

There are many methods of teaching Biology in schools and colleges, such as the demonstration, discovery, discussion, lecture/conventional and individualized methods. The main purpose of this study is to investigate the effectiveness of the individualized (LAP) method as compared to the conventional method of instruction at the senior secondary school level of education in Nigeria. The study is designed more specifically to provide answers to the following research questions:

1. Are there differences in the effects of the two methods of instruction on high achievers, average achievers and low achievers?
2. Will there be any significant differences in the achievement gains of high achievers, average achievers and low achievers in a post-test of a selected concepts in biology, using individualize (LAP) and conventional methods?

3. Does the conventional method of instruction improve the performances of all the students offering biology at the senior secondary level? If not, can the individualized (LAP) instructional method improve the general performance of the students in biology?

1.3 RESEARCH HYPOTHESES

i. There is no significant mean difference in post-test scores between groups taught using the individualized and the lecture instructional methods.

ii. There are no significant mean differences in post-test scores among high, average and low achievers exposed to the individualized and lecture instructional methods.

1.4 SIGNIFICANCE OF THE STUDY

Instances of poor instruction abound in the schools. It is not uncommon to see classes of students idling away precious time for lack of teacher's direction or any guide whatsoever. Often times, teachers who are not sufficiently competent are employed to deliver lessons in the classrooms. Such lessons are usually delivered by the lecture method, a method which consists mainly of teacher dominated talks (collette and Thurber, 1965).

If the LAP method is shown to be as effective as the conventional method, then it can be recommended as an alternative.

One of the major concerns of a teacher is about the method of presenting the material of the lesson to a class of students. The teacher seeks the most effective and interesting presentation, but too seldom examines objectively and critically how effective the chosen method is in-comparison with others (Carpenter and Haddan, 1964). The approach in this study would sensitize teachers to examine their choices of instructional methods.

Educators, philosophers and psychologists have talked for many years about the unique nature of each human-being and the need to attune the educational system to individual difference. While advances have been made for accomplishing individualization of instruction, as for example in the Science Curriculum Improvement Study (SCIS) programme in the United States of America (USA), the potentials of individualized instruction as a teaching technique have not been fully explored in Nigeria (Eniayeju, 1978).

At the moment, Nigeria is witnessing a high population of students in her secondary schools. This was caused in part the introduction of the Universal Primary Education (UPE) in 1976. This policy made primary school education compulsory and free for school-aged children throughout the whole country. Howes (1970) had earlier suggested that individualization of instruction should begin with mass education.

At present there are several methods of individualizing instruction, some of which are programmed, personalized -

system, computer - assisted, teaching machines, learner controlled, learning activity package, etc. All individualized instructional programmes have several things in common. They allow the student to proceed at his own rate, provide knowledge of results and above all, they require mastery at every level. They are characterized by small units which take a short time to complete and they require that the learner be active, a requirement based on the premise that retention increases with involvement (Kulik and Smith, 1976). The individualized approach used in this study is the Learning Activity Package (LAP).

A LAP is a form of communication between the teacher and the student that contains instruction for student activities leading towards specified performance outcomes (Smith, 1972). A LAP has all the features of other individualized programmes and more. It provides, for a variety of modes and media, alternate learning activities and a variety of topics within any given course, thus catering more fully to the differences in learning styles, interests and goals (Carderelli, 1972; Jone, 1972; and Smith; 1972). Any approach that guarantees improved performance in the teaching - learning process of science (i.e Biology) should therefore be investigated closely for possible implementation.

On the part of the teacher, the Learning Activity Package (LAP) as an instructional strategy gives him or her freedom to move around the class, offering individual attention and

assistance to the students rather than delivering blanket lectures to the whole group of students and more objectively basing his evaluation on criterion referenced parameters. LAP acknowledges science as a practical subject, but internalized when content has relevance to the individual, to his everyday experience and his future hopes, aspirations and career.

From this viewpoint, a study of the effectiveness of LAP gainst the conventional method as in this present study is appropriate in order to find the potentials that LAP offers as a method of teaching biology in the senior secondary school in Nigeria. Unless such a study is made, the soundness of the choice of individualized (LAP) as a teaching technique cannot be defended. If the LAP proves to be equal to the conventional then it is plausible to suggest that either method could be applied to biology courses. If the LAP is less effective than the conventional it may be concluded that the LAP method is not appropriate for putting across to the students the contents of the units in this study. Besides clarifying the relative benefits of the conventional and individualized LAP methods in accomplishing desired biology objectives the results might provide guidelines for restructuring the Senior Secondary School Certificate Examination.

1.5 BASIC ASSUMPTIONS

1. It is assumed that the poor performances of students in WASC/SSCE Biology examination is closely related to the

teacher lecture method of teaching.

2. It is assumed that this lecture method of teaching does not arouse the students interest enough in biology.
3. Both lecture teaching method and individualized instructional method are appropriate for imparting the objectives and contents of the units selected for the study.
4. The student is capable of self-paced study.

1.6 SCOPE OF THE STUDY

The study is limited to Alhudahuda College and Government Secondary School (GSS) both in Zaria township, Kaduna State of Nigeria. It is conducted within a period of eight weeks. The methods of teaching under investigation are conventional (Lecture) and individualized (LAP) instruction. For instruction, the unit on micro-organisms has been selected from the National Curriculum Guide for Senior Secondary Biology syllabus, Volume III (1985). The topics are selected on the basis of continuity and sequences in the normal schemes of work for the two selected schools. The topic is treated under two sub-topics, coined micro-organisms around us and micro-organisms in action. The first sub-topic (Micro-Organisms Around Us) requires that the students should be able to:

(i) recognize the presence of micro-organisms (microbes) in the air and water,

(ii) recognize the colour, pattern of growth and the

appearance of the microbes,

(iii) recognize that micro-organism is present on human body and inside the human body (e.g. inside the mouth,

(iv) recognize the beneficial and harmful effects of micro-organisms on the human body and

(v) recognize that micro-organisms are carried by other organisms.

The second sub-topic, Micro-organisms In Action requires that the students should be able to:-

(i) recognize the colonies of micro-organisms based on their appearance, colour and growth pattern,

(ii) measure growth in micro-organisms,

iii) recognize the usefulness of micro-organisms in our daily life,

(iv) recognize the disease-causing micro-organisms,

(v) recognize ways of controlling disease causing micro-organisms.

Each of these general objectives was specifically defined through statements of behavioural objectives. Each topic was divided into units. To accomplish the objectives, each unit was split into small sub-units of specific investigative problems as would be found in Appendices J and K.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION.

Biology is one of the core subjects in secondary schools in Nigeria. Hence, an encouragement to learn biology, especially at the senior secondary school (SSS) level is of paramount importance. One way by which this can be achieved is through the use of appropriate methods of teaching.

2.2 OBJECTIVES OF BIOLOGY EDUCATION IN NIGERIA.

The Federal Government objectives of biology education, as stipulated in the core-curriculum for the Senior Secondary Level are the preparation of pupils to acquire:

i. Adequate laboratory and field skills in biology,

ii. Meaningful and relevant knowledge in biology,

iii. The ability to apply scientific knowledge to everyday life in matters of personal and community health and agriculture,

iv. The development of reasonable and functional scientific attitudes.

In accordance with the stated objectives, any biology curriculum materials intended for the Senior Secondary School must make room for individual differences and students full participation in its execution. Also, the student is to learn to work and think in a scientific manner as the first and most important consequence of his studies. There need be no

incompatibility between this and the acquisition of useful scientific knowledge. These objectives imply that, as far as possible, the work in biology classes should be child-centred; that the activities of the child should have the most important educative influence on the child. Children learn best by doing not by 'memorizing'. The teacher will recognize that there will necessarily be increasing degrees of 'organization' of material; of opportunities to 'predict' from generalization as the child's acquaintance with science increases.

These goals would seem to be enhanced by individualization rather than the conventional method of instruction. In the individualized method used in this study, the teacher serves more the role of an advisor than an instructor.

2.3 HIGH, AVERAGE AND LOW ACHIEVERS

According to Cronbach (1974), the academic achievement of students in a normal classroom is not always the same. Some students perform very well, some averagely, while others perform very poorly. Those who perform very well in tests, assignments and examinations are usually classified as high achievers, while those who perform poorly are referred to as the low achievers. The average achievers are students whose academic performances are neither high nor low. Willerman (1979) identified three major factors for the inequality in scholastic performance:

(i) those relating to home background.

(ii) those relating to facilities and curricula and

(iii) those relating to teachers characteristics.

Willerman further stated that the teacher factor is one of the most important factors that can influence the academic achievement of students. Teachers who provide good classroom conditions, good teacher-student relationship and of course apply good teaching methods may improve the academic achievement of students, thereby, motivating them to score high marks (Timothy, 1991).

Presently, research on teaching and learning indicates that no one method or curriculum finds equal success with all students (Dembo, 1977). However, the predominance of the lecture method in Nigerian Secondary Schools has been widely documented (Thollairathil, 1972; Aminu 1978; Shuaibu, 1979; Balogun, 1982; Abdullahi, 1982 and Akpan, 1983).

Some writers have suggested ways of improving the academic performance of low achievers in the classroom. Renzulli (1981) stated that "appropriate teaching method and assessment which will involve carrying out activities and the use of several sense organs may improve the academic performances of the low achievers in the classroom," suggesting that some of the pupils who seem "untalented or the low scorer might be superior performers if given a different type of instruction".

High achievers as used in this study are those students whose average scores are 60 percent and above in tests,

assignments and examinations in biology. The low achievers refer to those students whose average scores are below 40 percent. The average achievers are those with average scores of between 40 and 59 percent. In this study, an attempt has been made to find out if the use of individualized instruction (that is, LAP method) in the teaching of biology can improve the scholastic performances of the three categories of students identified above.

2.4 LECTURE METHOD

The origin of the lecture method can be traced to Athens, the rise of the theatre and Plato's Academy. Oratory was the primary mode of mass communication and control to the Greek democratic process. The tradition evolved into an instructional system in medieval European Universities. It soon became the popular method of teaching by Jewish teachers. The lecture then was the only way that the knowledge stored in books could be transmitted to a large number of students (Kozma, Belle and Williams, 1978).

According to Bello (1981) "the teacher comes to the class fully armed with a mass of facts, probably gathered from books and would start to pour out the fact". 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. During the course of the lecture, student's questions are not normally encouraged and in cases where

questions arise they are usually intended for clarification of facts and information and not for higher level discussion.

This method is good for some biological topics but some of its disadvantages have been identified by Olaitan and Agusiobo (1981) as follows:

(i) It does not develop students 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, the slow writers and the academically weak students are dragged along at a speed they cannot cope with. This may lead to loss of interest and waning of attention, usually manifested by some students sleeping or day dreaming;

(iv) Lecture method appeals mostly to the sense of hearing. This makes the method not suitable for teaching sciences at the secondary school level. Blair et al. (1975) states that "a complete learning takes place when the child uses his senses in the learning process";

(iv) Lastly, the lecture method does not develop in students the processes of enquiry and problem solving. The major drawback of the lecture is that it is essentially an unidirectional mode

of communication. The listening student in most cases has little opportunity to influence the nature and the rate and flow of information. The only control the learner can exercise is to ignore it or turn it off-blank stares and nodding heads. One-way communication offers little in the way of interaction and feedback, which are crucial for learning. If used excessively, as is too often the case in Nigeria, the lecture method encourages intellectual passivity, the opposite of learning. In order to minimize some of these drawbacks, the researcher would employ an individualized (LAP) method of instruction to enhance learning. LAP is a student-centered method of learning.

2.5 THE HISTORICAL ORIGIN OF INDIVIDUALIZED INSTRUCTION.

Individualization of instruction is believed to have been first introduced in the United States of America (USA) in the later quarter of the nineteenth century. According to Beard and Bligh (1972), individualized instruction of the programmes paradigm was known as far back as 1888. Best (1970), writing under a sub-title "The History of American Education", affirmed that individualized instructional programmes were introduced in a number of schools in the 1890s and in the final

quarter of the twentieth century. In a supporting account, Opeola (1981) stated that the first attempt at individualizing instruction was the "individual recitation" introduced in 1888 by Preston.

The history of educational programmes show that many individualized programmes have been developed by educators over the years. Significant among these programmes at the turn of the century were the Dalton and Winnetka plans. Other individualized programmes developed in recent years include programmed instruction (PI), computer assisted instruction (CAI), individually prescribed instruction (IPI) and project plan. The Lap was constituted using Romisowski (1984) model. In this model, the LAP is a booklet on a given topic, containing objectives related to this topic, diverse activities to reach these objectives and evaluations to determine if the objectives have been met. The components of LAP are: topics and sub-topics, rationale, behavioural objectives, pre-test, activities, quizzes and post-test.

(i) <u>Topic and sub-Topics</u>

The students initial introduction to a LAP is the statement of the topic and sub-topics. The extent of coverage depends on the individual teacher, the type of student using the LAP and how long he has been using such system.

(ii) <u>Rationale</u>

The topic and sub-topics are usually followed by the

rationale. This rationale is aimed at providing the student with a reason for studying this topic. The rationale can take a variety of forms: a film to stimulate interest, a large-group presentation, a challenging experiment, an explorative study or a written rationale which explains the relevance of the topic within the framework of the total curriculum of the students everyday life or his future life.

(iii) **Behavioural Objectives**

After a brief introduction to the topic, the student reads the objectives for the particular LAP. All objectives are stated behaviourally. The completeness of these objectives depends on the level of development of the student involved. Within the LAP, the function of the objectives is to communicate goals to the student and it should thus be written in a simple language.

(iv) **Pre-test**

For some LAPs, the pre-test is at the students' discretion. In such a case, when the objectives unveil a topic or concept with which the student is totally unfamiliar, his decision might well be to omit the pre-test and immediately begin the LAP. But for this study the researcher administered the pre-test to the students. The concepts in the pre-test were all unfamiliar to the student.

(v) Activities

The activities of the LAP attempt to provide the student with a multi-media, multi-model, multi-level road to reach the objectives of the LAP. The learning processes in directing the students to readings, transparencies, tapes, demonstration models etc provide for the learning style of the individual student. The various learning strategies include the flexible programme, large groups, small groups and independent activities. Individual mode of instruction provides the pupil with the opportunity to start at the base of his particular weakness. In Nigeria, most of these facilities are lacking. This study intends to contribute to the resources to be used in the future. The present study is aimed at motivating the present and future educators in Nigeria to help to develop different learning activity packages in different fields of study.

(vi) Quizzes

Frequent quizzes give the students feedback on their progress and correct their errors by re-routing them to remedial activities.

(vii) Post-Test

The post-test evaluates students fulfillment of all subjects of the LAP. The post-test to be carried out in this research is intended to be used as an instrument to measure the effectiveness of the LAP as compared with the

lecture method.

2.6 RATIONALE FOR TEACHING BIOLOGY USING A LEARNING ACTIVITY PACKAGE (LAP)

Programmed instruction applied operant conditioning principles to human learning in school settings. LAP improves classroom learning, presenting even the most difficult subject in small steps so that all the students can succeed at their own rates. The whole process of learning is student-centered. The teacher is only brought in when there is a need for it. The teacher provides considerable package in helping the students carry out some of the activities. LAP encourages students to work out the procedures themselves.

In the Learning Activity Package used in this study, the students performed the learning activities by themselves, while the teacher guided whenever the need arose.

Some of the advantages of LAP include:-

(i) breaking down material into small units;

(ii) instruction becomes student-centered (because they carry out learning activities themselves);

(iii) forcing the learners to respond to the small units;

(iv) students develop more interest in the lessons because they are actively involved. Psychological findings of Bruner, Gagne, Piaget and others, as reported by Blair and Stone (1975) have shown that students become more

enthusiastic when they carry out the learning activities themselves;

(v) LAP permits time for students to assimilate and accommodate information. Piaget, as reported by Arthur and Robert (1975), believes that "there will be no true learning unless the child mentally acts upon information and in the process, assimilates and accommodates what he encounters in his environment",

(vi) the instructional materials so programmed can be presented by means of a teaching package or booklet;

(vii) the possibilities of relieving teachers of many of their routine tasks and drill sessions exists.

It seems that this would enable them to address themselves to more complex tasks and to the guidance of individual students in an independent study.

Other advantages of learning activities package-oriented approach to the teaching of biology include:

(i) Helping students to carry out scientific processes such as the ability to experiment, observe, classify, measure, predict, describe and infer.

(ii) It builds self confidence in students. It enables the students to tackle and solve

problems through their learning experiences.

(iii) It builds scientific attitudes in students: such attitudes as open-mindedness, curiosity, determinations, skepticism and humility (Arthur and Robert, 1975).

(iv) It is a complete type of learning because it involves the use of all the senses of the learners.

(v) It results in meaningful learning because it satisfies Bloom's (1975) taxonomy of educational objectives, i.e. cognitive, affective and psychomotor domains.

From the aforementioned points, it could be seen that LAP method of learning is likely to be effective and can enhance students performances in science subjects.

2.7. RELATED STUDIES ON INDIVIDUALIZED METHOD OF INSTRUCTION

A variety of studies has investigated the effectiveness of Learning Activity Package method of instruction as it enhanced the scholastic performances of students, particularly in science subjects. In a study, Costain (1972) gave a review in which he came to the general conclusion that evidences fail to support popular derogation of the value of lectures in college and university teachings. This type of study appears to accept the lecture as a standard against which other methods can be judged and ignores the host of factors which affect and

interact with the teacher and the student in the communication process. The present researcher, in considering the typical lecture situation as a one way verbal communication, takes into account the complexity of the process because there are certain factors that may affect the teacher on one hand and the students on the other. Factors which affect the teacher include-preparation of materials, voice, board work, presence of motivation and the quality of notes given or issued. While those that can influence the students include- characteristics of individual members of the group, interaction between members of the group, composition of the group and size of the group. It is not always satisfactory that the teacher is involved in most cases in verbal and non-verbal communication whereas the student is involved mainly in non-verbal communication. All these factors vary in another dimension or dimensions, namely those of good lecturer or bad lecturer, good student or bad student.

The researcher accepts the claim that lectures can be used for three main kinds of objectives:-

(i) the acquisition of information,

(ii) the promotion of thoughts,

(iii) and changes in attitude.

Besides, one definite statement which can be made about lectures is that they can be used to display information to a large number of students at one time. But this point, like many of the earlier points concentrates on the teaching role

and says nothing about the learning process. To accept this teaching role as the sole function of the lecture would be to ignore the fact that other methods exist that can also be used to provide a framework for a course from which students can be shown methods of approaching a course, be given various sources of references and be stimulated to further works on their own. The researcher on this ground is focusing her attention in this process of learning using the LAP.

Igbanugo (1986) investigated the effectiveness of individualization of instruction through diversifying learning opportunities. The treatment was administered to twenty undergraduate students of Baruch College of the University of New York, USA who were at the time registered for a physical education course entitled, "Techniques for Lifetime Fitness". The class was made up of first, second, third and final year undergraduates students. A Learning Activity Package (LAP) for teaching Exercise Physiology to undergraduates was developed and evaluated. The LAP on Blood Pressure was developed to have the following components:

(a) concept of learning idea,

(b) rationale, which explains to the students the importance of what he or she is going to learn;

(c) pre-assessment, which points out to students the strengths and weaknesses as regards to the subject matter;

(d) objectives written in behavioural terms that tell the students what he is supposed to be able to do when he is

evaluated and the level of performance expected of him (student);

(e) learning activities which provide alternative ways of achieving the objectives;

(f) post-assessment which evaluates the students mastery of the specified objectives.

Evaluation was done in two parts. The first part involved preliminary evaluation of the contents of the package by experts. The second part involved evaluation in a field test, utilizing pre-and post-assessments to assess students achievements and an evaluative questionnaire to seek students' reactions and attitudes.

The result showed that all students attained mastery of the objectives using 80 percent attainment as the criterion for mastery. The responses from the questionnaire revealed an attitude that was favourable towards instruction with individualization.

The entire 20 undergraduate students were used as an experimental group. There was no other method of instruction to be compared with. The whole evaluation was based on the pre and post assessments. The present work is aimed at improving over Igbanugo's work. Therefore, this work is going to involve both control and experimental groups. This work will also compare LAP with another technique of instruction which is the lecture method. This will allow one to assess the relative effectiveness of individualized instruction over the lecture

method.

The researcher observed that the twenty subjects used in Igbanugo's work were from different classes. That suggests that the subjects may not have been homogeneous. This present study however, was based on a homogeneous group of students in age and class. Most of the LAP components used by Igbanugo were also used in the study. Test and retest method are to be used in this research as Igbanugo did. The fields of study are different. The subjects for the investigation in this case are secondary school pupils. They are boys against Igbanugo's whose sexes were not stated but they were more matured students and not of the same year group in the university.

Among other studies, Tawari (1986) studied the relative effectiveness of two methods of teaching science (biology) at the Junior Secondary School level of education in Nigeria. The study investigated the relative effectiveness of the individualized and the conventional (lecture method) approaches to teaching science in terms of achievement in biology at the junior secondary school level of education. One hundred and forty form III students selected from four (4) arms of class three in two secondary schools (of mixed type) in Benin-city, Edo state constituted the subjects for the study. The Pre-test-Post-test control group experimental design was used. A performance rating scale in biology, an opinionnaire, a questionnaire and multiple-choice objective type of achievement test were used. Questions were drawn from the concept taught

(mammalian skeleton), for the pre-post-tests, between which was the treatment sessions. The subjects exposed to the two approaches were compared. A factorial analysis of covariance on the raw scores revealed that the individualized instructional strategy was superior to the conventional approach in achievement in biology. The difference between the two strategies was significant.

Going through this work, both the experiment and control exercises were carried out in each of the two schools. This gives room for "contamination" since the two different groups of students (subjects) could mix. Furthermore, there was no evidence that the standards of the two classes were equal. The above lapses might have influenced the result in one way or the other.

At present, there are several methods of individualizing instruction. Tawari in her paper failed to give the actual method used in her investigation. In order to improve on some of these lapses, the present researcher decided to use a homogenous group of students. Here, all the subjects are males using only one gender school is appealing because Odubunmi and Balogun (1991) in a study carried out at the University of Ibadan, Nigeria, suggested that females receiving lectures performed better than their male counterparts. Based on the already identified problems of poor academic performance in biology, it becomes necessary to explore different methods of instruction. Hence in the present study, LAP as a form of individualized instructional system is being investigated.

Smith (1989) carried out a comparative evaluation of three teaching methods of quantitative techniques. The class structures of 22 students for Socratic dialogue method, 24 for the traditional (lecture method) and 21 subjects for personalized system (PSI) were compared. Smith used both pre-and-post-assessments as part of his instruments. The second stage of the evaluation of the three teaching methods was carried out in the field-testing situation. Students reaction and attitudes were explored through an evaluation questionnaire, which was administered on completion of the pre-and-post-assessments. PSI was viewed more positively by students on subjective ratings and performance outcomes were higher with this method. Treatments offering the multiple testing options produced more positive and higher performance ratings.

Smiths' study used three methods of instruction. The result only indicated the generally higher rating of personalized system of instruction (PSI) over the other two methods. Smith did not give the details of what happened in the two other methods individually. Rather, they seemed to have been lumped together. The researcher in this case would use LAP. The mode of teaching would probably correspond with the PSI, being a kind of individualized system of instruction.

Callahan and Smith (1990) compared two methods of instruction as follows. A group of eight gifted junior high students was presented programme units of psychology

instruction and compared to a control group which received traditional lecture format instruction. The experimental group completed the material (programmed units) in less time and scored significantly higher on the final test.

The subjects presented the programme units were gifted students. Any slight motivation or improvement would probably make them achieve mastery. Finishing the programme before time was an attribute of being gifted. In this study however, three categories of students would be involved; the high which can be classified as closest to the gifted, the average and the low achievers. This study would therefore encompass a wider range of students. This would give clearer effects of the two methods of instruction employed. This study has therefore taken care of the missing categories of students not included in Callahan and Smith's work.

Burnside (1991) carried out an investigation which involved the design, development, implementation and evaluation of a learning activity package intended to enable middle school students to view and use the computer as a tool that has application in their everyday lives. Eighth grade students in two key boarding classes used the computer as a word processing tool in the subject of language arts. Teachers worked in conjunction with computer teaching specialists to develop relevant lessons for students practice. Results of administration of the self paced course to 24 eighth grade students in Woodland Middle School, East Meadow, New York,

indicated that the learning activity package was an effective medium for presenting the concept of using computers as writing tools. Students stated that they enjoyed learning independently and felt confident that they could use word processors in future assignments.

The study did not specify whether the subjects were homogenous or equivalent. The LAP used was jointly designed by both the teachers and the computer teaching specialists. In the present investigation however, the LAP is designed solely by the investigator. This investigation would be taking place in a less sophisticated environment and the subjects have not been exposed to most modern technology. The two studies have one thing in common and that is, the programmes are students centered. The students are left to carry out the programmes at their own pace.

Burnside clearly showed that LAP can be used in the field of computer technology. The author demonstrated how the computer can be used as a writing tool. In view of this, the present investigator, though not making use of computer, would also investigate the effectiveness of LAP on the achievement of three categories (i.e. high, average and low achievers) of students in Biology.

No single method of teaching is completely adequate for learning. In view of this, Teles (1992) discussed results from studies reported from 1958 -88, examining the different methods of teaching Calculus. The methods examined included the

lecture, co-operative-learning, computer assisted instruction (CAI), mastery-learning, individualized instruction, self-paced programmed-instructional materials and discovery learning. The findings showed that alternatives to lecture presentations to supplement and enhance learning include discovery and group learning, self-paced classes, programmed materials and use of computers.

The methods discussed contained some individualized systems of instruction. The programmed material used in the discussed material did not include LAP. This present work would therefore provide additional information for future discussions. The discussion however included lecture method among others. It was demonstrated that self-paced classes and programmes materials enhanced learning.

Rapp and Gittinger (1993) in a paper presented at the Annual Conference of the League for Innovations in the Community College (10th Mashville, TM, November 14 - 17 1993) stated that learning disabilities can involve visual processing speed, short-term memory processing, fluid reasoning and long-term memory retrieval. These disorders are intrinsic to the individual and occur across the life span. Improved special education in elementary and secondary schools can lead to a substantial increase in the enrolment of learning disabled students in universities and community colleges. In the same paper, commenting on the needs of this growing non-traditional population required teachers to reconsider traditional

instructional formats. It was recommended that teachers reconsider traditional instructional formats. It was also stated that in mathematics instruction, the lecture method was not particularly effective. Additionally, Computer Assisted Instruction (CAI) increased the level of mathematics and showed some promise in meeting the needs of students with learning problems. The results obtained in the use of Computer Assisted Instruction was found to enhance better learning in mathematics. A person with a learning disability may have average or above average intelligence, but may have difficulty taking in, remembering or expressing information. LAP involves the three main domains of educational objectives. Addressing the needs of the various students required teachers to reconsider, traditional instructional formats. The present researcher therefore would investigate the effectiveness of LAP in teaching biology.

Individualized systems of instruction have been compared with some other methods of instruction. Hwong (1993) investigated the effects of co-operative and individualistic learning on prospective elementary teachers' music achievement and attitudes. A total of 43 prospective elementary music teachers was used. It was found that co-operation promoted higher achievement and that students were off-task, less frequently perceived the instructor to be more supportive and felt the grading system to be fairer. In this case individualized instruction was less superior.

In this study, though individualized instruction was found to be less superior to co-operative learning, the nature of the subject matter may have accounted for the observed difference. The nature of the subject (music) taught involves production. Biology is both theoretical and practical. Biological activity is observable. The finding in Hwong's work also shows that one instructional system may not work well for all disciplines. Music, as a subject, requires its technical method of instruction. The lecture method was not used in the study. It is difficult to know how well the individualized system employed was used as against the co-operative approach.

AI-Hilawani et al. (1993) conducted a study to explore the relationship between teaching methods and students' grades at the college level. A total of 58 undergraduate students who enrolled in two introductory education courses were organized into groups and exposed to one of two teaching methods: the lecture format and reciprocal teaching. Reciprocal teaching engaged students acting as teachers and their "students" in four activities... summarizing, clarifying, questioning, and predicting. Multiple choice pre-and-post-tests measured students' performances in both sections on the two teaching methods. It was found that 70 per cent of the participants liked the reciprocal teaching method used in the classroom. Results suggested that for this sample, there was no relationship between instructional methods and achievement using the two methods and that students' ability could be a

more important factor in learning than the teaching method employed. Results also suggested that the level of teacher effectiveness may be consistent across methods and that reciprocal teaching may be qualitatively an effective method of teaching reading comprehension. The reciprocal teaching as it was carried out in this study, has not in anyway changed the method of instruction because the students employed to take the places of their teachers were tutored before they in turn lectured the other students. This method was still essentially lecturing: the only difference was that the students assumed the role of the teacher.

In the present investigation, the LAP allows each student to have first hand information from the teacher, whose role was to guide whenever the need arose. Each student is the chief actor in the learning process. One remembers more the actions one carried out. This study has only compared the effectiveness of the lectures given by teachers against the lectures given by students.

Rodriquez (1993) sought to describe graduate students' opinions of selected learning activities encountered in large-group, teacher-led instructional contexts. The subjects, 40 graduate students of instructional technology at a major western university completed a questionnaire. The instrument asked subjects to rate each of ten alternative learning activities along five dimensions: frequency of the activity as encountered, interest in the activity, effectiveness of the

activity as a learning tool, motivational appeal of the activity, and lastly, desire for greater exposure to the given activity. Results indicated that the lecture was the most frequently encountered activity, while also the least motivating and effective. This study suggests that the lecture method may be the most frequently used learning process, least motivating and effective in institutions of learning.

This observation was part of the problems hypothesized for the general low performance of students in biology in secondary schools in Nigeria. It should be noted that the lecture method does not provide for observable student activity nor is it tailored to meet the needs of the individual pupil. It is felt that it does not promote meaningful learning of science because it appeals only to the sense of hearing. The individualized system of instruction is not only an innovation on its own, it probably motivates students since each student is directly involved. Further, subjects indicated a strong preference for greater exposure to more active and challenging activities such as problem solving. The introduction of LAP would provide an avenue for greater students' participation.

2.8. SUMMARY

Since the time of Socrates, educators have advocated a type of teaching that does more than impart knowledge and teach skills. Such teaching would help students use their knowledge and skills to understand, appreciate and grapple with important

ideas as they develop a depth of understanding for a wide range of issues and questions.

The cultural setting for much of the earlier attempts were mostly foreign. The present investigator felt that biology teachers should not just assume that their pupils' achievements will be favourable towards the new instructional method without some empirical research results obtained from investigations carried out in the Nigerian setting.

Within the context in which this review has been covered, the investigations which had been carried out did not specify conclusively one method as being the best one for all courses. The teaching learning strategy for a course should be selected by the teacher on the basis of all available information.

Capdepont (1993) noted that for an effective learning to take place, students motivations and learning paths require a new, more learner-centered approach to instruction. It was also stated that alternative ways of organizing the learning experiences should include modular curricula, individualized instruction and guided independent study. In view of this, the researcher decided to investigate the effectiveness of the LAP method of teaching biology in secondary schools in Nigeria.

CHAPTER 3

METHODOLOGY

3.1 DESIGN OF THE STUDY

A pre-test-post-test experimental control group design was used in this study. There are two methods (individualized LAP and lecture) used on two groups (i.e. experimental and control) at three levels (i.e. high, average and low achievers) among the students. Students are simultaneously exposed to many learning factors during their school period. A student's response to any single factor may vary with the level of the other factors. Single factor experiments are often criticized for their narrowness. Indeed the result of a single factor experiment is, strictly speaking, applicable to the particular level in which the other factors are maintained in the trial.

3.2 POPULATION

The actual study was conducted using SSII students in two arms selected from two secondary schools in Zaria township of Kaduna State, Nigeria. Senior Secondary II students were used as the subjects for the study primarily because they already have three years of integrated science (at the Junior Secondary School Level) which introduced them to science and a full one year biology study at the SSI. One of the schools is located in Zaria-city while the other is in Tukur-Tukur, Zaria. The two schools are separated physically by a distance of about 4 kilometers. Each school has at least three arms of SSII

students with a total enrolment of 259 students. The breakdown is as follows: Alhudahuda Secondary School Zaria-city has 42 students of SSII in Sc1, 45 students in Sc2 and 43 students in Sc3, making a total of 130 students.

Government Secondary School (GSS) Tukur-Tukur Zaria has 40 students in SC1, 45 students in Sc2 and 44 students in Sc3, making a total of 129 students. These students constituted the target sample from which experimental and control groups were drawn. A total of 40 subjects were randomly selected, from the three arms of each selected schools using random number tables (White, Yeats and Skipworth, 1974). A total of 80 subjects with a mean age of 16.8 years constituted the sample size for the study. These students participated fully in the study by sitting for the categorization and pre-tests. They attended classes regularly and also sat for the post-test.

3.3 SAMPLE AND SAMPLING PROCEDURE.

School selection was restricted to state owned secondary schools in Zaria. The two schools selected were Alhudahuda Secondary School and Government Secondary School (GSS) both located in Zaria, Kaduna State, Nigeria. The researcher selected these schools in order to have subjects with similar educational backgrounds. The considerations for comparable educational standards were (i) teachers were recruited by the same body using set down criteria by the state Ministry of Education (ii) the same Government funds and supplies science

equipments and other teaching resources to the schools on an equitable basis, and (iii) students were admitted by the same body throughout the state using a set of criteria which included high performance in state administered entrance examinations for selecting candidates for admission.

There were three biology teachers in each of the schools. All the biology teachers hold at least the B.Sc. (Ed) biology degree with at least 5 years teaching experience. The SSII students in both schools have gone through essentially the same experiences having sat for the same Junior Secondary School III common examination. The results of the categorization test was used to confirm the comparability of the two groups. The results established that the two groups constituted a homogeneous in age and academics group before the commencement of the experiment. The decision as to which of the schools will receive treatment was made on a random basis. A coin was flipped. The tail was slated for the control group while the head was for the experimental group. Based on the results, Alhudahuda college became the control group while Government Secondary School (GSS) became the experimental group.

3.4 INSTRUMENTATION

3.4.1 Measuring Devices Utilized in the Study

Two instruments, the Multiple-choice Assessment tests and Pre/post treatment tests were used for the study. The Multiple-choice Assessment test (used for categorization and

comparison) was a 25-item multiple choice general test based on the basic concepts taught at the JSS level. These 25 biology multiple choice items were randomly drawn from the Kaduna State standardized JSSIII integrated science examination questions bank (see Appendix F pages 90 to 96). The test was designed to measure subjects cognitive level, find out if the two schools were comparable and to also group subjects into achievement levels (i.e. High, Average and Low Achievers). In order to test, the achievement of subjects in biology, ten objectives questions, ten fill in the blanks, two essay questions and one alternative to practical question were constructed and used (see Appendix H pages 98 to 100). The face validity of the instrument was carried out as discussed on page 54.

3.4.2 THE LEARNING MATERIALS

After due consultation with the biology teachers in the selected schools topics were chosen for the study because they were in the SS curriculum for the second term of the year during when the study was conducted. The need to maintain continuity and sequence in the normal scheme of work for the schools was recognized. The teachers and the researcher agreed on the chosen topics (a) Micro-organisms around us and (b) Micro-organisms in action.

3.4.3 VALIDATION OF THE LEARNING MATERIALS

The LAP package is contained in Appendix J, pages 104 to 130. It was intended that the instructional package be as easy to understand and as readable as possible. Before use, the package was validated by a panel of two secondary school biology teachers, one university biologist and two biology educators, to ascertain their appropriateness for the study. The learning materials, the pre/post-test marking scheme, as well as the lesson notes for the control group were examined for content validity and appropriateness for the two groups. The materials were revised in line with the corrections and recommendations made before they were used in the selected schools. The vetting sequence suggested by Campbell and Milne (1972) was used for validating the pre-/post-test questions that constituted the assessment instrument. Content validity was established by comparing the objectives of the biology syllabus with the contents of the assessment instrument.

3.4.4 RELIABILITY OF THE LEARNING MATERIALS (TEST-ITEMS)

The reliability of the test items were established before administering the test to the subjects. This was carried out by using students in the school that had been exposed to the topics. Reliability in this context was in line with Nunnually and Robert (1975). "The reliability of a test concerns the extent to which measurements are repeated by the same individual using different measures of the same attribute or by

different persons using the same measure of an attribute". The reliability test was carried out before the pilot study. It was carried out in the month of September 1995. A test-retest method was used. The test was administered to the groups on the first occasion and re-administered to them after two weeks interval under the same condition. The school used was Government Secondary School Bomo in Samaru. The total number of students in the two groups were 90. Only 84 of the subjects sat for the test on the two occasions. The results of these 84 students were then used for the computation. On each occasion of the test administration one hour and thirty minutes ($1^1/_2$ hrs) was given for the subjects to complete the test.

Marking of the scripts was also undertaken. (Here only the achievement of each of the subjects was sorted for). The reliability co-efficient was then computed using Pearson Product moment correlation method. This gave an r = 0.98. This value of 0.98 showed that the test was reliable and as such would test what it was out to test. The table in Appendix C, pages 84 to 87 represents the scores of the students.

3.4.5 ORGANIZATION OF THE STUDY

The lessons for the control group were taught by the researcher. The researcher also administered the LAP to the experimental group and was available for consultation with the students whenever there was the need for it. The learning materials was administered both for the control and

experimental groups for a period of six (6) weeks. After another period of two (2) weeks, the post-test was administered because some students may remember specific answers to some items thereby influencing the result. The total contact sessions for the experiment lasted eight (8) weeks. The first week was used for orientation to enable the students get familiar and adjusted to the new situation. During this period, categorization and pre-tests were administered to both groups. The delayed post-test was done during the eighth week. The actual exercise was carried out between the months of January and March, during the second term of the 1995/96 academic session.

The lessons were taught during the normal biology periods in the two selected schools. Each lesson lasted 40 minutes, while double lessons lasted 80 minutes. For each lesson, the experimental group had one or more activities to carry out. But for the control group, the researcher carried out these activities and also lectured the subjects.

3.4.6 CATEGORIZATION OF SUBJECTS INTO HIGH, AVERAGE AND LOW ACHIEVERS.

A class is usually a mixture of students of different academic abilities, when the class is not set up according to the students' academic capabilities. Some students will perform highly, others averagely and yet others poorly in a standard examination. The test given to find out the subjects level of understanding biology was used to categorize the

subjects into high, average and low achievers. The text contains past biology questions drawn randomly from JSS III integrated science, final examinations conducted by the Educational Resource Centre (ERC) of kaduna state Ministry of Education. These questions constitute a bank from which questions have been drawn annually. The test was also used to find out if the two schools were comparable.

The categorization questions have been established as reliable for graduating JSS III students in the state secondary schools. Their reliability and validity have been confirmed by 'experts' for the purpose of the JSS III examination and these explain why they were stored in the questions' bank. All the students that scored between zero and thirty -nine (0 - 39) percent on the test were regarded as low achievers, between forty and fifty-nine (40 - 59) percenters were regarded as average achievers while over sixty percenters (60 - 100) were regarded as high achievers. The students' numbers were compiled and their scores recorded against the numbers (see Appendices M and N). This procedure was carried out for each school. The three levels of students were established for both the experimental and control groups. The distribution of the subjects according to the different achievement levels are as contained in Table 3.1 below.

Table 3.1 Distribution of Subjects According to the Different Achievement Levels in the Categorization Test.

	G.S.S. Tukur-Tukur Zaria. (Experimental Group)	Alhudahuda Secondary School, Zaria-City (Control Group)	Total
High Achievers	2	2	4
Average Achievers	13	12	25
Low Achievers	25	26	51
Total	40	40	80

3.4.7 PRE-TEST SESSIONS

Before the commencement of the main treatment, the achievements test was administered to both the subjects in the experimental and control groups. The achievement test questions were based on the teaching topics selected for the experiment. The achievement test was designed for a period of one hour and thirty minutes. The head of biology of each of the school assisted in administering the test. The purpose of the pre-test was to determine students initial knowledge of the material they would learn later. It was also used to determine the comparability of the two groups with respect to their achievements in the pre-test scores before the treatment. The researcher marked the scripts of the subjects in the experimental and control groups. The records of their performances were kept for further use.

3.4.8 MAIN TREATMENT (TEACHING SESSIONS)

In the schools used for the study, biology was allocated four lesson periods of forty minutes each week (see Appendix L). Thus, the total time for biology lessons was one hundred and sixty minutes, per week for each group. The treatment for this study lasted six weeks of teaching. Therefore, each group (i.e experiment or control) received twenty-four lessons which worked out to be nine hundred and sixty minutes (16hrs).

Some two sub-topics were selected and taught for 18 lesson periods, according to the school's scheme of work. The two sub-topics chosen for the study were (a) Micro-organisms around us and (b) Micro-organisms in action. The nine units prepared from the two sub-topics were as follows:

Unit :1 - Micro-organisms in Air,

Unit :2 - Micro-organisms in water,

Unit :3 - Micro-organisms in our body,

Unit :4 - Micro-organisms in our food,

Unit :5 - Insects that carry micro-organisms,

Unit :6 - Growth of micro-organisms,

Unit :7 - Micro-organisms beneficial to man,

Unit :8 - Disease causing micro-organisms ,

Unit :9 - Control of disease causing Micro-organisms and infections.

The researcher herself taught the sub-units to the control group using the conventional (lecture) method. The details of the method (lecture) are given on pages 17 to 19. All the activities involved in the sub-units were carried out by the

researcher for the subject in the control group. The lesson notes used for the teaching can be found in appendix K, pages 131 to 167. The subjects in the experimental group were taught the same units using the LAP (See Appendix J, pages 104 to 130. The package which placed the responsibility for learning on the students, consisted of a set of explicitly printed students guides. These materials were designed to communicate to the students what they were to do and what equipment they needed. They also provided the students with helps in interpreting their observations and in answering the questions that followed each activity. How rapidly they progressed was left essentially to each student. This was the implementation of the self-paced concept. Nevertheless, the researcher tried to encourage the students who were abnormally slow to work faster. Those who paced through their works too rapidly for comprehension were advised to proceed more carefully. The researcher made it a point of duty to have a one to one conference with each of the subjects. Two weeks after the completion of the treatment, both the subjects in the experimental and control groups wrote the same post-test. The test was the same as was used for the pre-test. Sufficient time was provided to allow all students to complete the test. The completion time ranged between 60 - 90 minutes (1hr to 1hr, 30 minutes).

3.5 THE PILOT STUDY

The pilot study was carried out between October and November of the first term of the 1995/96 academic session. The exercise was carried out in two secondary schools in Zaria township, Kaduna State. One of the schools is located in Sabon-Gari while the other is in Basawa, near Samaru. The two schools are separated physically by a distance of about eight (8) kilometers. Both schools used the prescribed senior secondary biology curriculum (1985). The school located at Basawa had two arms of SSII students while the school located at Sabon-gari had four arms of SSII students. Each class of the two selected schools had not less than forty students. The researcher taught the two arms of the school located at Basawa. For the school located at Sabon-Gari, two arms were randomly sampled out of four arms. These two arms had a total enrolment of 80 subjects. The researcher taught these two arms.

Before the administration of the measuring devices and the learning material utilized in these arms, the researcher randomly selected 20 subjects in each of the two arms of each school used for the study. A total of forty subjects were thus randomly selected from each school. These constitute the subjects used for the pilot study. The school located in Basawa served as the experimental group while the school located in Sabon-Gari served as the control group. This decision was based on a toss of arm coin. The experimental group was subjected to the Learning Activity Package (LAP) programme. The lecture method which is teacher centered was

used in teaching the control group. The aims of this pilot study were to find out:

(a) How feasible this study would be via the conduct of a trial session;

(b) How appropriate the items of the instruments were (see Appendix H pages 98 to 100;

(c) The estimated time which would be required to teach and examine the student;

(d) The effects of the conventional method on the control group and the individualized instruction (LAP) on the experimental group in respect of their achievement levels;

(e) How comparable were these schools were.

The outcome of the pilot study indicated that:-

(A) The sub-topics taught (see Appendices J and K) were considered appropriate and teachable even by the regular teachers.

(B) The test items were found appropriate without any amendment.

(C) The two schools chosen for the pilot study were similar in their pre-test performances because the mean of each student's score was close.

(D) The use of the individualized instructional strategy affected students achievement in biology, irrespective of their previous achievement levels.

(E) The individualized instructional strategy proved a better approach to teaching biology.

(F) The duration of six weeks used for the treatment and another two weeks before the post test administration to both the control and the experimental groups were adequate for the study. The analysis of scores in the pilot study informed the final form of the instructional materials and the test items.

3.6 MAIN STUDY

3.6.1 PROCEDURE OF THE STUDY

The study involved the use of two method of instruction (conventional and individualized) with two groups i.,e experimental and control, grouped into three levels of achievement (i.e. high, average and low achievers). The learning units/topics used for the study were selected after consultation with the biology teachers in the two schools selected for the actual study. The learning materials were developed by the researcher into Learning Activity Package (LAP) and teaching lesson notes. Pre- and post-test items as well as the marking scheme were similarly developed from the topics. The validity of the Learning Activity Package, lesson notes, test-items for pre/post tests and the marking scheme were established. The reliability of the test items (pre/post-tests) were also established. These were found as appropriate. Biology multiple - choice questions were randomly drawn from Kaduna state JSS III integrated science examination bank. The multiple-choice items were first administered to the subjects

in the experimental and control group for categorization and comparison of the two groups. This was later followed by the pre-test before teaching and then the post-test after teaching. These procedures were carried out both in the pilot and actual study.

The researcher made two visits to the two schools selected for the actual study. The two schools were state owned secondary schools, both of them were male schools. One of the schools is located in Tukur-tukur Zaria while the other school is located in Zaria-city. The actual study was carried out for six - weeks during which the treatment was given. There was another two-weeks waiting period before the post-test was administered. This step was taken to minimise the threats to external validity, as discussed on page 44. The whole exercise took place between the months of January and March of the second term of the 1995/96 academic session. The subjects were SSII students. Some 40 students were randomly selected from three arms in each of the two selected schools, making a total of 80 subjects. The subjects had a mean age of 16.8 years. One of the schools served as the experimental school, while the other, as control group.

Before the commencement of the main treatment, the categorization test, and the pre-post test were administered to both subjects in the experimental and control groups. The categorization test was used to group the subjects of both experimental and control groups into the three achievement

levels (i.e. High, Average and Low). The pre-test further confirmed the categories and also revealed the initial knowledge of the subjects on the selected topics. Each group received sixteen teaching hours during the teaching sessions. The experimental group was subjected to individualized instruction i.e. the Learning Activity Package, while the control group was taught by the researcher using the information contained in the lesson notes. The post-test was later administered. The scores of the pre and post tests and the categorization test were later analyzed. The post-test scores were used to establish the effectiveness of the LAP and the lecture method.

3.6.2 Experimental Group

The experimental group was subjected to the Learning Activity Package (LAP) programmes. This group was made up of three categories of students, that is; high, average and low achievers. The LAP used for this study took Romiszowkis (1984) format with some slight modifications by the researcher. Most of the activities of the LAP were of a laboratory work type.

The package contained various activities which had been itemized for the subjects to carry out. The main objectives were clearly spelt out for each topic. The subjects were given the LAP programme. Each subject was required to carry out the activities on his own using the concept of self-pacing. Subjects were advised to consult the researcher whenever

necessary to discuss difficulties relating to the concept studied (but only when necessary). The researcher made it a point of duty to have a one-to-one conference with each of the subjects attending to their problems but not teaching. But those who had problems before it was their turn for the conference were attended to accordingly. The area concentrated on by each subject depended on the behavioural objectives stated for the sub-unit. The LAP was made up of nine sub-units. Each sub-unit contained the Learning activity/activities per week. Each sub-unit was followed by some questions which were answered by every subject in the activity or activities. The LAP package is contained in Appendix J, pages 104 to 130.

3.6.3 CONTROL GROUP

The lecture method, which was teacher centered, was used in teaching the control class. The major difference between the experimental and control groups lies in the fact that while one used an instructional method which stressed individualization, which had been programmed and self-paced with students' conferences, the other did not involve all these. Instead, teacher selection, same pacing and general class discussions obtained. The control group was taught according to the behavioural objectives specified in each sub-units. The detailed lesson plan can be found in Appendix K, pages 131 to 167.

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3.6.4 ADMINISTRATION OF POST-TEST.

The post-test was used to measure the effectiveness of the methods under investigation. The test was conducted with the assistance of the class teacher in each school. The test comprised of ten objective questions, ten fill in the blanks, two essay questions and one alternative to practical question. It should be noted that the post-test was given to the experimental and control groups before the commencement of the treatment as pre-test. Tuckman (1978) however, gave the disadvantages of this procedure.

> *The effect of taking this pre-test may increase the likelihood that individuals will do better on the subsequent post-test, particularly when it is identical to the pre-test. This is most likely to be so when the test follows immediately after the treatment has been administered.*

Lyman (1978) also suggested a way of overcoming this problem, especially when the pre-and post-tests are in the form of a test re-test (i.e. retaking the same test) as in this case. According to Lyman, if the second administration i.e. post-test is administered very shortly after the first one i.e pre-test, some people may remember specific items and thus will influence the result. But if the time interval between testing is very long, real changes may have occurred in the examiners and test scores should be different.

If Lyman's view is anything to reckon with, two weeks after the administration of the treatment a total of eight weeks interval between the pre- and post-tests was considered

adequate for the administration of the post-test to both the experimental and the control groups. This strategy was therefore used. The marking of the post-test was carried out by the researcher alone.

3.6.5 Method of analyzing the Data

The information collected from the tests were scored. Means for the categorization test and pre-test were computed and compared using t-test statistical method while the post-test were analyzed using the t-test and arithmetic mean. These methods were used to test the hypotheses stated earlier in this report. The first hypothesis was tested at $P< 0.05$ level of significance and arithmetic ean was used to find the significant difference of the second hypothesis.

CHAPTER 4

4. DATA PRESENTATION AND ANALYSIS

4.1 INTRODUCTION.

Pre-test-post-test Experimental control group design was used to carry out the investigation. A total of 80 senior-secondary two(SSII) students randomly selected and with a mean age of 16.8 years constituted the subjects of the investigation. They were selected from two state-owned secondary schools in Zaria, Kaduna State. These two schools were male schools. One school provided the experimental group while the other school provided the control group. There were 40 subjects in the control group and 40 subjects in the experimental group. These students were all available for the categorization test, pre-test and post-test. All the students attended all sessions.

For the purpose of finding out if the subjects of the two groups were comparable, the categorization test score-means were used. If they are equivalent then there will be no significant difference between the two groups at the end of the analysis. The categorization test consisted of 25 biology multiple-choice items drawn from the Kaduna State standardized JSSIII integrated science examination questions bank. The categorization test was marked according to the marking scheme. The scores were used to group the subjects into three achievement levels as stated earlier, that is, high 60 - 100 per cent, average 40 - 59 per cent and low 0 - 39 percent

achievers respectively. The raw data for the categorization can be found in Appendices M and N, pages 169 to 172.

The same pre-test was administered as post-test in order to find out the excess of post-test scores over the pre-test (i.e. mean gain scores). The main pre-test/post-test items were drawn from the topics which were exposed to the subjects during the treatment. The pre-test was to determine the subjects initial knowledge of the material used in this research. The pre-test also served the purpose of establishing their knowledge of the selected topics before the treatment. The pre/post tests consisted four sections. Section A had ten objective multiple choice questions, Section B had ten fill-in the blanks questions, Section C had two essay questions while Section D had one alternative to practical question. The test scripts for the pre-and post-tests were marked according to the self-designed marking scheme. The data for the pre-and post-tests were analyzed. These information were used to test the hypothesis stated earlier. A probability level of less than or equal to 0.05 was considered to be significant. The raw data for both the pre-and post-tests can be found in Appendices O, P, Q and R at pages 173 to 180.

4.2 ANALYSIS OF THE CATEGORIZATION-TEST SCORES FOR THE EXPERIMENTAL AND CONTROL GROUPS.

The categorization test scores obtained from the subjects of the two selected schools were analyzed using the t-test comparisons. The t-test was used in order to determine the

significance of the difference between means for the two separate groups. The result is presented in Table 4.1 below.

TABLE 4.1 t-Test on the Categorization Scores of Experimental and Control Groups

Group	Subjects (N)	Mean	Std.Dev.	T	DF	P
Experimental	40	35.450	14.247	0.047	78	0.963
Control	40	35.300	14.376			

* Significant at $P < 0.05$

From Table 4.1 above, the result suggests that G.S.S. (i.e. the experimental Group) and Alhudahuda secondary school (the control group) were similar because the calculated t-value of 0.05 was less than the critical t-value of 1.99 at 0.05 alpha level of significance. Table 4.1 also shows the means and standard deviations of scores for the JSSIII examination items of the two schools. It could be seen from the table that the mean of 35.450 with the standard deviation of 14.247 for G.S.S. was close to the means of 35.300 with the standard deviation of 14.376 of Alhudahuda secondary school. It can be argued therefore that the two schools are comparable for all practical purposes.

4.3 ANALYSIS OF THE PRE-TEST SCORES FOR THE EXPERIMENTAL AND THE CONTROL GROUPS.

The pre-test scores obtained from the experimental and the control groups were analyzed using the t-test for two independent groups. t-test statistic was used in order to

determine the difference in mean scores of the two groups. The result is presented in Table 4.2 below.

TABLE 4.2 t-test Pre-test Scores of the Experimental and control groups

Method	Subjects (N)	Mean	Std.Dev	T	DF	P
Experimental	40	10.900	7.805	0.135	78	0.893*
Control	40	10.675	7.040			

* Significant at P < 0.05

From Table 4.2 above, the result suggests that the experimental and control groups were similar because the calculated t-value of 0.135 was less than the critical t-value of 1.99 at 0.05 alpha level of significance. Table 4.2 also shows the means and standard deviations of scores for the pre-test scores of the experimental and control groups. It could be seen from the table that the mean of 10.900 with the standard deviation of 7.805 for the experimental group was close to the mean of 10.675 with the standard deviation of 7.040 of the control group. On the whole therefore the two groups may be described as coming from the same parent population, for all practical purposes.

4.4 ANALYSIS OF THE HYPOTHESES

In all, two null hypotheses were stated for the study.

4.4.1 HYPOTHESIS 1

There is no significant mean difference between the groups taught using individualized method and the lecture

instructional methods. To test this hypothesis, the t-test statistic was employed. The t-test was used in order to determine the significance of the difference between means for the two separate groups treated differently. The result of the t-test is shown in Table 4.3 below.

TABLE 4.3 t-test Post-test Scores of the Individualized (LAP) and Lecture method groups

Method	Subjects (N)	Mean	Std.Dev	T	DF	P
Individualized	40	39.500	17.360	4.437	78	0.000*
Lecture	40	22.435	16.537			

* significant at P< 0.05.

In Table 4.3 above, the result indicates a significant difference between individualized (LAP) and lecture methods. This is significant because the calculated t-value of 4.437 is greater than the critical t-value of 1.99 at P< 0.05. It can be seen from Table 4.3 above that the mean score of 39.500 for the individualized (LAP) instructional method is higher than the mean score of 22.435 for the lecture method. Individualized (LAP) method is therefore adjudged as more effective than the lecture method. It can be concluded that there is a significant difference between the group exposed to the individualized (LAP) method and the conventional method, in their achievements in biology.

The hypothesis that there is no significant mean

difference between the individualized (LAP) instructional method group and the lecture method group is rejected.

4.4.2 HYPOTHESIS 2

There are no significant mean differences in post-test scores among high, average and low achievers exposed to individualized instructional method and the lecture method. To test this hypothesis the means of the post test scores for each level (i.e high, average and low achievers) of the experimental and control subjects were analysed per level or group using arithmetic average. The arithmetic average was used because it represents concise description of the performances of each level or group as a whole. It allows the comparison of two or more levels or groups in terms of typical performance. Table 4.4 below shows the summary of the means of the post test scores for each level of the individualized and lecture methods.

TABLE 4.4 SUMMARY OF THE MEAN SCORES IN THE POST-TEST FOR THE THREE LEVELS IN INDIVIDUALIZED (LAP) AND LECTURE METHODS.

Subjects (N)	Method	High	Average	Low
Experimental	Individualized (LAP)	69.00	46.00	27.50
Control	Lecture	60.00	50.29	15.16

The data in Table 4.4 above suggest that there are difference among the means of the high, average and low

achievers of the experimental group as well as the means of the high, average and low achievers of the control group. As one can see in table 4.4 above, the result indicates that the high achiever in the experimental group had a higher mean of 69.00 than the high achievers of the control group with a mean of 60.00. While the average achievers in the experimental group had a mean of 46.00 the average achievers in the control group hsf s mrsn og 50.29.

Table 4.4 also indicates a significant difference between the low achievers in the experimental and the low achievers in the control groups. From the table, it could be seen that the low achievers in the experimental group had a higher mean of 27.50 than the low achievers of the control group with a mean of 15.16. The result suggests that there is a difference among the different levels of achievers (i.e high, average and low achievers) and instructional methods (i.e Individualized and lecture). The hypothesis that there is no significant mean difference in post-test scores among high, average and low achievers exposed to individualized instructional method is not likely to be sustained.

4.5 DISCUSSION

Based on the result of this study, it is logical to attribute the superior performance of students in the individualized group to individualized teaching and learning. Since the two groups were exposed to the same concepts during

the study, one expects the two groups to perform about the same level when given the same examination. This is because the subjects in the two groups were taught under the same conditions. That is, the two schools had similar educational backgrounds. The same State Government funds and supplies science equipment and other teaching resources to the schools on an equitable basis. The two schools are located in the same environment (Zaria -town). School records have also shown that the students in the two schools were admitted by the same body. In addition, the results of the categorization and pre-test scores suggest that the two schools were similar before the commencement of the treatment.

From the findings of the study, it is evident that the use of the individualized instructional method enhanced the students' achievement in biology, irrespective of their previous academic standings. The difference between the two methods of instruction was significant at the chosen probability level favouring the group taught with individualized instructional method.

In effect, the individual instructional method was a more effective method in teaching biology than the conventional lecture method. The activities were carried out by students themselves in the LAP method, at their own pace that is during and after the school periods. But this method was in contrast to the conventional method where the teacher did most of the work for the students. The earlier method should arouse

greater students interest going by psychological theories. These findings have led to the rejection of the first and second hypotheses stated in this study. Also the individualized instructional method (LAP) involved the use of several sense organs. Psychological researchers have shown that learning is enhanced when more than one sense organ is involved during the learning process (Blair and Stone, 1975). The finding tallies with the studies by Ramsey and Howe (1969); Callahan and Clark (1977); Opeola (1981); Oriafo (1983); Igbanugo (1986); Tawari (1986) and Smith (1987), that an individualized method is superior to the conventional method of instruction. But these findings did not agree with the studies by Olarinoye (1978) which found no significant difference between three methods of teaching physics in a Nigerian Secondary School. The Individualized (LAP) method was not used in that study.

CHAPTER 5

5. SUMMARY, CONCLUSIONS, IMPLICATIONS, LIMITATIONS AND RECOMMENDATIONS

In this chapter, the summary, conclusions from the findings and their implications are discussed. The discussion encompasses the problems encountered during the course of the investigation. Some recommendations on how to improve the teaching of biology in the Senior Secondary Schools in Nigeria are also stated.

5.1 SUMMARY.

This study was designed to determine the effectiveness of the individualized and lecture instructional methods of teaching biology at the senior secondary level of education in Nigeria. The subjects used for the research were 80 SSII students with an average age of 16.8 years, from two state-owned secondary schools in Zaria, Kaduna State of Nigeria. These subjects were randomly sampled from two male schools separated by a distance of four kilometres. There were 40 subjects in one school which served as the control group and 40 subjects in the second school which served as the experimental group.

At the start of the experiment, it was established that the subjects from the two schools were similar, based on the categorization test scores, pre-test scores and other determinants of comparable educational standards. The data collected from the categorization test and the pre-test were

analyzed by employing t-test of two independent groups. The result of the t-test for the categorization scores showed no significant difference between the two schools as shown in Table 4.1 above. Also, the result of the t-test for the pre-test scores showed no significant difference between the experimental and the control groups (see Table 4.2).

The treatments, were then administered to the two groups, the experimental and control groups. Individualized (LAP) instruction was used in teaching the subjects in the experimental group. The group used the Learning Activity Package (LAP) to direct their learning throughout the teaching sessions. The conventional method was used in teaching the subjects in the control group. The experimental group carried out their own experiments or activities thereby getting information first hand. The control group had the same experiments or activities performed for them by the teacher.

A post-test was later administered to the two groups. The data collected from the post-test were analyzed by employing the t-test of two independent groups. The result of the t-test indicated a significant difference between the individualized and the lecture methods in their effect on the achievement of subjects at the different levels. The results are presented (see Table 4.3). The null hypothesis which stated that there is no significant mean difference among the high, average and low achievers exposed to individualized method and the lecture method was rejected. There were differences between the mean

scores of the high, average and low achievers of the experimental group and the high, average and low achievers of the control group in the two methods used in this study. This result as contained in Table 4.4 have shown that the second hypothesis had to be equally rejected.

5.2 CONCLUSIONS

Based on the findings obtained in this study, it can be concluded that the individualized and lecture methods were not equal in improving the academic performances of these students in biology. Even though, the subjects in the experimental and control groups were equated initially in terms of pre-test and categorization scores, there were differences in performances of the subjects taught with the individualized and conventional methods. The individualized method of instruction appeared to have enhanced the students performances more than the lecture method, when used in teaching biology.

5.3 IMPLICATIONS OF THE STUDY

Among the educational problems responsible for the general poor performance of students in biology at the Senior Secondary Certificate Examination (SSCE) is the substandard method of instruction. The poor achievement in biology has severally been attributed to teaching methods among the Nigerian School population (Tawari, 1986). This study has indicated that the individualized (LAP) method of instruction enhanced students

achievements in biology more than the conventional method.

It is therefore necessary for teachers of science, particularly biology to review their approaches and method of teaching. The individualized (LAP) approach is an active approach in which teacher pupil interaction is enhanced and pupils' problems may be closely observed, so that adequate help can be provided. What the student earnestly wants and seeks is probably the opportunity for learning experiences which are meaningful to him (the student), in which the student is meaningfully engaged with the teacher and the subject matter. These qualities are provided in the LAP method. Science teachers should teach students the skills for investigation rather than telling them all the fact in science, Students should be made to discover Scientific facts for themselves. As an method which requires the student to work hard and consistently, there is no doubt that as in the case of the present study, it will continuously yield higher achievement in Biology and possibly in other science subjects.

It is possible for educational reforms in this country to be oriented towards improving teaching as in individualizing instruction. If progress is to be made along the Learning Activity Package (LAP) model, well defined sequences of progressive, behaviourally stated objectives in the subject area must be established as guidelines for setting up a student's programme of study. Student achievements should then be defined by his position along this progression of

achievement.

5.4 LIMITATIONS OF THE STUDY

1. This study was only confined to two schools in Zaria, because of the nature of its design. The researcher could not reach other schools outside Zaria. Thus, this limits generalizing the findings of the two methods used in this study. Despite that, the result of the findings showed the effectiveness of individualized (LAP) over conventional method in teaching biology in the selected schools.

2. It was not possible to carry out the treatments throughout the whole term of the year. It was limited to a duration of six weeks only.

3. The sample used was limited to a total number of eighty students i.e. forty students from the school taught with individualized (LAP) method and forty from the school taught by the conventional method. The outcome of the results proved that the subjects taught with individualized (LAP) method performed better than subjects taught with the conventional method. Working through the Learning Activity Package (LAP) required the learner to pay attention to every step of his work. The approach required the student to do his work and in doing so he did more reading. He probably in the process of doing more reading, encountered more problem solving exercises as compared to the conventional students who depended solely on the teacher to give problem - solving assignments.

5.5. RECOMMENDATIONS

On the basis of the above findings, the following recommendations are made:

1. Since the individualized (LAP) instructional strategy has been found to be more effective and has enhanced performance, there is need to emphasis the use of individualized instruction in the Senior Secondary Schools especially in the teaching of biology.
2. Individualized method of teaching science cannot be successfully implemented without adequate science facilities and laboratories. There is the need for the government, Parent Teachers Associations, voluntary organizations and philanthropists to join hands in procuring necessary facilities in Senior Secondary Schools.
3. Teacher trainers should themselves try to develop individualized methods in the teachers-to-be, so that these teachers could transfer same into their regular classroom practices.
4. There is also the need to employ the services of experts in individualized method for the training of Nigeria science teachers. If possible, workshops can be organized for teachers already in the teaching profession to improve their teaching approaches.
5. The researcher also recommends that curriculum planners in science education in Nigeria should emphasize

individualized method in the curriculum of primary, junior secondary school (JSS) Senior Secondary (SS) and even the tertiary institutions of learning.

If the above recommendations are taken into consideration, there may be some improvement in students' academic achievements in the senior secondary certificate examinations (SSCE).

For further studies

1. It is recommended that (LAP) should be used to teach biology to students throughout the year or the three years in senior secondary school level of education, so as to assess the effects the LAP has on the SSCE results.
2. A study of this kind may also be carried out in other science subject areas such as Chemistry and Physics.

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APPENDIX A

Analysis of Results of students Performance in Biology Subject in the May/June Senior secondary Examination (SSCE) for three Years (1991 - 93).

	Total	Total Sat	Credit and above						pass					Fail
			1	2	3	4	5	6	1-6	7	8	7-8	1-8	9
Year 1991	291313	285690	41	315	7064	7664	12524	45380	72988	36669	45601	822715	52581	502432
Percentage		98.1	0.0	0.1	2.5	2.7	4.4	15.9	25.6	12.8	15.9	28.7	54.3	45.7
Year 1992	361667	355582	74.2	2347	19323	12296	18363	46979	100050	52704	57567	110271	210321	145261
Percentage		98.3	0.2	0.7	5.4	3.4	5.2	13.2	28.1	14.8	16.2	31.0	59.1	40.9
Year 1993	491700	481034	4.8	303	6144	7377	13904	62254	90035	68587	91099	159686	249721	231313
Percentage		97.8	0.0	0.1	1.3	1.5	2.9	12.9	18.7	14.3	18.9	32.2	51.9	48.1

Key 1 - 6 Credit and above

7 - 8 Pass

9 Fail

Source; West African Examination Council, Yaba Lagos (Statistics Section)

APPENDIX B

Letter to a Panel of Educators for Validation of the Learning Activity Packages (LAP), Lecture Method Plan and Lesson Notes, Pre/Post-test Questions and the Marking Scheme.

Department of Education,
Faculty of Education,
Ahmadu Bello University,
Zaria.
August, 1995.

_____
_____
_____

Dear Sir/Madam,

I am undertaking a research study on two techniques of teaching biology at the senior secondary (SS) level. The title of the project is "The Effectiveness of Individualized and Lecture Instructional Methods of teaching Biology at the Senior Secondary level of Education". This work is for my M.ED. thesis in Science Education, Ahmadu Bello University, Zaria. The units of the curriculum chosen for instruction are Micro-organisms around us and Micro-organisms in action. These units, will be taught for a period of six weeks.

Attached are the following:

(a) An instructional package on Learning Activity for the experimental group.

(b) Lecture plan and lesson notes on the same units for the control group. The LAP for the experimental group has been developed by the researcher as a learning instrument for the study. Please go through them and feel free to give me your comments and suggestions for improvement.

(c) The Pre/post test questions with its marking scheme are also attached.
Your comments and criticisms would also be appreciated.

Thank you for your anticipated co-operation.

Yours Sincerely,

A.O. Abu (Mrs).

APPENDIX C

TABLE Test-Retest Results Analysis

STUDENT	TEST A	TEST B	INPUT COLUMN
01	19.00	19.00	
02	19.00	21.00	
03	23.00	24.00	
04	29.00	31.00	
05	30.00	31.00	
06	28.00	29.00	
07	25.00	24.00	
08	29.00	30.00	
09	24.00	25.00	
010	28.00	30.00	
011	24.00	25.00	
012	39.00	38.00	
013	43.00	44.00	
014	34.00	33.00	
015	42.00	42.00	
016	24.00	25.00	
017	40.00	41.00	
018	31.00	32.00	
019	29.00	27.00	
020	25.00	27.00	
021	30.00	32.00	
022	28.00	30.00	
023	36.00	38.00	

024	29.00	30.00
025	22.00	23.00
026	23.00	23.00
027	25.00	26.00
028	32.00	34.00
029	21.00	22.00
030	22.00	24.00
031	25.00	25.00
032	32.00	33.00
033	23.00	24.00
034	25.00	23.00
035	31.00	32.00
036	26.00	26.00
037	26.00	25.00
038	34.00	32.00
039	26.00	25.00
040	23.00	24.00
041	19.00	22.00
042	30.00	30.00
043	24.00	22.00
044	26.00	25.00
045	25.00	25.00
046	40.00	42.00
047	19.00	22.00
048	34.00	33.00
049	28.00	30.00

050	23.00	24.00
051	36.00	35.00
052	30.00	31.00
053	43.00	44.00
054	26.00	28.00
055	28.00	28.00
056	25.00	24.00
057	27.00	28.00
058	30.00	31.00
059	19.00	20.00
060	32.00	34.00
061	25.00	25.00
062	28.00	29.00
063	24.00	23.00
064	23.00	22.00
065	24.00	26.00
066	25.00	27.00
067	20.00	23.00
068	31.00	30.00
069	28.00	29.00
070	26.00	25.00
071	30.00	32.00
072	20.00	21.00
073	22.00	22.00
074	27.00	26.00
075	26.00	27.00

076	34.00	35.00
077	24.00	23.00
078	32.00	32.00
079	23.00	25.00
080	24.00	26.00
081	29.00	28.00
082	22.00	23.00
083	20.00	22.00
084	28.00	28.00

Correlation Matric

	Test A	Test B
Test A	1.000	.975
Test B	.975	1.000

84 observations were used in this computation.

APPENDIX D

Department of Education
Ahmadu Bello University
Zaria.

January, 1996

The Zonal Director
Ministry of Education
Zaria - Zone.

Dear Sir,

COLLECTION OF RESEARCH DATA

The bearer Mrs. Alice O. Abu is conducting a research in Science Education for the degree of M.Ed Science Education (Biology).

The title of the research is THE EFFECTIVENESS OF INDIVIDUALIZED AND LECTURE INSTRUCTIONAL METHODS OF TEACHING BIOLOGY AT THE SENIOR SECONDARY LEVEL OF EDUCATION.

The Department of Education will be grateful if you can permit her to collect her data from the following schools:

1. Alhudahuda Secondary School, Zaria-City.
2. Government Secondary School Tukur-Tukur, Zaria.

Thank you for your continued co-operation with us.

Yours sincerely,

Prof. M.J. Shuaibu,
Supervisor and Head of Department.

APPENDIX E

Faculty of Education,
Department of Science Education,
Ahmadu Bello University,
Zaria.

.....1996.

The Principals,
Alhudahuda Secondary School, Zaria.
G.S.S. Tukur-Tukur, Zaria.

Through
The Zonal Director,
Ministry of Education,
Zaria Zone,
Kaduna State.

Dear Sir,

REQUEST FOR PERMISSION TO TEACH SSII STUDENTS.

The bearer of this letter is Mrs. Alice O. Abu, an M.Ed candidate in Science Education. She is currently carrying out research for her M.Ed Thesis under my supervision. Her research is geared towards finding out The Effectiveness of Individualized and Lecture Instructional Methods of Teaching Biology at the Senior Secondary level of Education.

I shall be grateful if you could kindly permit her to teach the above students for a maximum of eight weeks.

Any assistance you can give in this matter will be highly appreciated.

Thank you.

Yours sincerely,

Prof. M.J. Shuaibu,
Supervisor and Head of Department.

APPENDIX F

CATEGORIZATION TEST Questions.

Subject - Biology

Instructions: Attempt all the questions. No.....

1. Write your number in the space at the top.
2. Each question is followed by five options lettered A-E. Find out the correct option to the question and circle it. Give an answer to each question.

Time Allowed: 30 minutes.

Class:.....

1. Which of the insects has incomplete metamorphosis?
   - A. Butterfly
   - B. Mosquito
   - C. Housefly
   - D. Tse-Tse fly
   - E. Cockroach
2. Which of the following organisms can both live on land and water?
   - A. Goat
   - B. Toad
   - C. Parrot
   - D. Tilapia
   - E. Rat
3. Maize ⟶ Rabbit ⟶ Snake ⟶ Hawk

   The relationship above is explained by

   - A. Trophic level

B. Community

C. Population

D. Food chain

E. Food web

4. The process by which plants produce their food is called

A. Excretion

B. Photosynthesis

C. Transpiration

D. Translocation

E. Respiration

5. Tse-Tse fly is a vector responsible for transmitting a disease known as:-

A. Malaria

B. River blindness

C. Sleeping Sickness

D. Cholera

E. Dysentery

6. In a Community of organisms, bacteria are referred to as

A. Consumers

B. Decomposers

C. Producers

D. Parasites

E. Commensals

7. The following characters are inherited except

A. rolling of the tongue

B. Statue

C. Blood group

D. Colour blindness

E. Sickle cell anaemia

8. Excess carbohydrate in the body is stored as

A. Glycogen

B. Fat

C. Glycerol

D. Starch

E. Lipid

9. What is the most outstanding feature of a plant cell that distinguishes it from animal cell?

A. Vacuole

B. Cytoplasm

C. Chloroplast

D. Mitochondria

E. Nucleus

10. Which of these diseases is transmitted by housefly?

A. Malaria

B. Cholera

C. Elephantiasis

D. Sleeping Sickness

E. River Blindness

11. Identify the movement associated with tadpoles.

A. Wriggling

B. Floating

C. Swimming

D. Gliding

E. Drifting

12. Where does absorption of food take place in the digestive system?

A. Large Intestine

B. Stomach

C. Mouth

D. Small Intestine

E. Appendix

13. A process by which a sperm unite with an ovum is called

A. Fermentation

B. Fertilization

C. Gestation

D. Pregnancy

E. Cell division.

14. Liquid waste materials disposed from industrial plants are referred to as

A. Refuse

B. Spillage

C. Sewage

D. Water

E. Oil

15. Through which of the following organs does human embryo receive nourishment?

A. Placenta

B. Uterus

C. Oviduct

D. Ureter

E. Urethra

16. The ability of living things to increase in size is known as

A. Fertility

B. Locomotion

C. Reproduction

D. Growth

E. Insect

17. What is the gestation period of an elephant

A. 7 months

B. 9 months

C. 12 months

D. 18 months

E. 24 months

18. What is the nutrients obtained in bean called?

A. Carbohydrate

B. Fat

C. Vitamins

D. Protein

E. Mineral

19. The enzyme responsible for converting starch to maltose in the mouth during digestion is called?

A. Renin

B. Ptyalin

C. Pepsin

D. Lipase

E. Trypsin

20. Where does fertilization take place in mammals?

A. Uterus

B. Placenta

C. Oviduct

D. Urethra

E. Vagina

21. A boy bitten by a black fly is likely to develop which of the following diseases?

A. Elephantiasis

B. Tuberculosis

C. Colour blindness

D. River blindness

E. Sleeping sickness

22. $6Co_2 + 6H_2O \xrightarrow[\text{Chlorophyll}]{\text{Light}} C_6 H_{12} O_6 + 6O_2$

Identify the statement which is represented by the above equation.

A. Respiration in animal

B. Manufacture of food by plants

C. Excretion of nitrogenous wastes

D. Respiration in plants

E. Fermentation process

23. Which of the following organs is referred to as an osmoregulator?

A. Kidney

B. Lung

C. Heart

D. Skin

E. Brain

24. The gene that exerts its influence over the other is known as

A. Recessive

B. Genotype

C. Phenotype

D. Variation

E. Dominant

25. Which type of response is shown by a boy who picked a hot object?

A. Voluntary action

B. Nervousness

C. Sensory reception

D. Conscious action

E. Reflex action

APPENDIX G

MARKING SCHEME FOR Categorization Test Questions

1. E
2. B
3. D
4. B
5. C
6. B
7. D
8. A
9. C
10. B
11. C
12. D
13. B
14. C
15. A
16. D
17. E
18. D
19. B
20. C
21. D
22. B
23. A
24. E
25. E

25 x 4 = 100 marks.

APPENDIX H

BIOLOGY (PRE/POST TEST) Questions.

Time Allowed 1hr. 30 minutes

Class .....

Name:.....

How Old are you?.....

Sections A

Instruction: Answer all the questions in this section.
Put a circle round the correct answer.

1. Use the following list to answer the next question. Only one of the following really belongs to micro-organisms:
a) all bacteria 2. Mosses 3. All fungi 4. All protozoa. 5. All algae 6. Worms and 7 all viruses.
a. 1. 5 b. 1. 7 c. 2, 3 d. 3, 4 e, 5, 6.
2. Which of the following groups of organism can be used to produce antibiotics.
a. protozoa b. Algae c. fungi d. viruses e. worms.
3. Which of the following groups of organism does not at all contain micro-organisms?
a. bacteria b. algae c. fungi d. viruses e. mosses
4. One of the following insect is a carrier of danger us micro-organisms (fungi and bacteria).
a. housefly b. termite c. bee d. Ant e. Mosquito.
5. Cholera is a disease.
   a. That brings about pains in the limbs
   b. Whose pathogen is a virus carried by mosquitoes
   c. Which causes high body temperature
   d. Whose pathogen is introduced into water of food
   e. That has nothing to do with microtus but is completely hereditary.
6. Which of the following groups of micro-organisms live in only living tissue or organism.
a. bacteria b. fungi c. virus d. algae e. protozoa.
7. Which of the following pathogens causes poliomyelitis?
a. Virus v. bacterium c. plasmodium d. fungus

b. trypanosome.

8. Freshly prepared soup X. is sweeter than four days old soup Y because.
   a. Y contains far more micro-organisms
   b. X has not yet undergone fermentation
   c. the alcoholic content of Y is not high
   d. water content of Y is higher
   e. more carbon dioxide has been lost to form X.

9. Which of the following micro-organisms are used in the Industry?
   Bakery Industry?
   a. algae b. penicillium c. yeast d. fungi
   c. bacteria.

10. Use this list to answer, the following question:
   1. Penicillin; 2. dettol 3. hydrogen peroxide;
   4. iodine tincture 5. camphor 6. saline solution
   Only one of the following groups are antiseptics.
   a. 1, e b. 1, 3 c. 1. 4 d. 6. 5 e. 1.

Section B: Instructions: Answer all the questions, write the answer on the question paper. Fill in the blanks.

A group or clump of micro-organisms is known as (1)..... The common types of micro-organisms are the protozoa (2)..... The growing of micro-organisms in the laboratories is referred to as (3)..... The micro-organisms commonly found on food are 4..... and.....5..... Like all living things, micro-organisms can multiply. This growth is exhibited in the form of increase in 6 ..... and 7 ..... Contacting of disease through the droplets of moisture from nose, mouth, throat and lung during the infection is described as 8..... Some micro-organisms cause disease bilharziasis, blood with urine or blood with urine or blood and mucus with faeces-with pain while (9)..... or defecating. Antiseptics and disinfectants are used to (10)..... the possibility of infection.

Section C

INSTRUCTIONS: Answer all the questions in this section.

1. Discuss different ways by which diseases transmitted by vectors can be prevented.
2. Write a short note on the micro-organisms beneficial to man.

Section D

INSTRUCTIONS: ANSWER THE question in this section.

1. Prove by a simple experiment that the housefly is a carrier of microbes.

APPENDIX I

MARKING SCHEME FOR BIOLOGY PRE/POST TEST QUESTIONS

SECTION A

1.	B	6.	C
2.	C	7.	A
3.	E	8.	B
4.	A	9.	C
5.	D	10.	D

10 x 1 = 10

SECTION B

1. Colony
2. Bacteria
3. Culture
4. Bacteria/fungi
5. Fungi/Bacteria
6. Size/Number
7. Number/Size
8. Droplet infection
9. Urinating
10. Minimize/reduce

Note: Spellings must be correct to score 10 x 1 = 10.

Question 1 of section C.

The vector, transmits the disease causing micro-organisms/pathogens. Use insecticides, to kill mosquito/files/fleas etc.

Trap(s), and cats can be used to kill rats, insects vectors can be prevented by use of nets/mosquito nets use of insect repellant cream/drug on our skin.

Destruction/killing of the developmental stages, prevents mosquito from breeding, e.g. use of fish in ponds, use of oil on the surface of water, the oil blocks the respiratory tubes/prevent breathing of the larvae and pupae, use of medicine/drugs by man, before they develop into harmful stage, e.g. malaria can be prevented by taking daraprim/chloroquine etc. regularly. Any 5 x 2 = 10

SECTION C

Question No. 2

- Micro-organisms in the air, which are responsible for the curdling of milk.
- acidity favours, the growth, of these micro-organisms.
- in industries like bakery, brewery, and cheese making, the beneficial effects of the activity of micro-organisms are applied.
- also in the production of antibiotics.
- Penicillin retards, the growth of bacteria in the same medium.
- Penicillin and other antibiotics are used extensively to cure diseases caused by bacterias/micro-organisms,
- micro-organisms enrich, the nitrate content of soil, e.g. bacteria in root-nodules.

Any 5 x 2 = 10 mks.

SECTION D

Experiment to show that the housefly is a carrier of microbes on its head, wing and leg.

Materials required:- Broom, - a housefly,

- a pair of forceps, - four sterilized petri-dishes containing culture medium.

Procedure

- kill a housefly - with a broom.
- remove a wing, - a leg, - and the head from the housefly.
- transfer each of these parts, into a separate petri-dish containing a medium, - cover the petri-dishes.
- and set them aside in a safe place.
- the fourth petri-dish is left as the control, - observe after three days.

Observation:- After three days, different colonies of micro-organisms i.e. bacteria - and fungi have grown

- in the three culture media in the petri-dishes.
- there was no microbes on the fourth culture plate/petri-dish.

Conclusion:- This shows that the housefly carries microbes on different parts of the body, - since there was no growth on the control plate.

Any 10 x 1 = 10

Note: Total marks = 10 + 10 + 10 + 10 + 10 = 50 marks.
Overall total obtained from 50 marks should be multiplied by 2. This gives a total mark of 100 (i.e. 50 x 2) = 100 marks.

APPENDIX J

LEARNING ACTIVITY PACKAGE (LAP)

This course is specially designed to expose you to certain topics in biology in your senior secondary school two (SS2). You will be provided with all necessary information. You will read through the course content step by step at your own pace. You will be required to complete each learning activity/activities and make your own observations.

You will also be required to carry out the activity or activities on your own. You are free to meet the teacher for guidance during the lesson periods whenever there is an obstacle.

Each student will be provided with a booklet containing the programme (i.e LAP). This LAP is made of two major sub topics namely:

i. Micro-organisms around us and

ii. Micro-organisms in action. These two broad sub topics are broken down into six units. These units are as follows:

Unit 1 - Micro-organisms in air and water,

Unit 2 - Micro-organisms in our bodies and food,

Unit 3 - Carriers of micro-organisms,

Unit 4 - Growth of micro-organisms,

Unit 5 - Beneficial effects of micro-organisms,

Unit 6 - Harmful effects of micro-organisms,

The above units are further broken down into nine sub-units which are also used to form the eighteen lesson periods. The sub-units are as follows:

Sub-unit 1: Micro-organisms in Air,

Sub-unit 2: Micro-organisms in water,

Sub-unit 3: Micro-organisms in our body,

Sub-unit 4: Micro-organisms in our food,

Sub-unit 5: Insect that carries micro-organisms,

Sub-unit 6: Growth of micro-organisms,

Sub-unit 7: Micro-organisms beneficial to man,

Sub-unit 8: Disease causing micro-organisms,

Sub-unit 9: Control of disease causing micro-organisms.

The objectives of each sub-unit are stated at the beginning of each lesson. You will be expected to keep a good record of your work. You will be tested at the end of the programme.

INTRODUCTION

A micro-organism is a unicellular (single celled) organism. The existence of very minute living organisms, or micro-organisms came to be known only after the discovery of the microscope.

The study of these micro-organisms revealed that there are millions of minute plants and animals which, together, are also known as microbes or germs. the following people have worked on microbes - Leeuwenhook, Pasteur, Kock, Robert Hooks, Lister and Alexander Fleming.

These microbes are widely distributed in nature. Some are found in the air, on the land, on the body, inside our body and animals.

Lessons One and Two

Topic 1: Micro-organisms around us

Unit 1: Micro-organisms

Sub-unit: Title 1 Micro-organisms in air

Rationale: Air is a medium in which many - things move about.

The micro-organisms do not possess locomotory parts. It is necessary to understand that the air carries some microbe. Some rely on the air for their distribution from one place to another and a times from one organism to the other.

Behavioural objectives of the lessons: Students will be able after performing the following activities to:

1. note any change in colour, appearance and pattern of growth in different culture media.
2. compare the observations of each petri-dish in different locations.
3. explain the differences.

Micro-organisms in the Air

There are a lot of minute things moving in the air. Some are living while some are ordinary dust particles. The very minute living things are known as micro-organisms. Each of these micro-organisms (microbes) are unicellular and therefore can only be seen with the aid of a microscope. The micro-

organisms are of different types. There are about five groups - bacteria, viruses, fungi, algae and protozoa.

Some of the micro-organisms can easily be grown in the medium, when it is grown in a petri-dish, it is called culture medium. The growing of micro-organism in the laboratories is referred to as culturing. when the medium is exposed to some micro-organisms each type grow into a particular clump which may differ in shape and colour. When they grow in clumps or colonies they can be seen with unaided eye. Each clumps known as a colony. Each is made up of numerous ones of the same type. Different types may grow in one petri-dish. This depends on the types of micro-organisms present in the air at that place.

Activity 1

In the following activity you shall find out whether micro-organisms exist in air.

Materials for the Lesson 1

Sterilized petri-dishes containing a culture medium (it is a medium for microbes to grow in).

INSTRUCTION

You will carry out the experiment using three different locations (A, B, and C). A - classroom/laboratory; B - lavatory (Toilet) and C - control.

PROCEDURE

Step 1 Remove the cover of the petri-dish and expose the medium to the air in the given area for about ten minutes.

Label your petri-dish A after covering it. Place in a safe place. Repeat the same for B. The control plate will contain the medium but will not be exposed to any of the locations.

Step 2 After three days, observe the medium for any changes.

Step 3 Now Answer the following questions.

1. What do you notice? Describe what you have seen in your own words, noting the colour, appearance and pattern of growth.
2. Compare what you observe in the petri-dish exposed in the class/laboratory and lavatory (toilet) with what you observe in petri-dish "C" (control).
3. Is there any difference?
4. If there is a difference can you explain it?

Lessons Three and four

Topic 1 Micro-organisms around us.

Unit 1 Micro-organisms in air and water

Sub-unit Title 2. Micro-organisms in water

Rationale Water is an essential substance in life. Many micro-organisms are present in the water. It is necessary to understand that there are many microbes in the water.

Behavioural objectives of the lesson: Students will be able after performing the following activities to:

1. Note any changes in the petri-dishes which you inoculated with different water samples?

2. State the differences in colour, appearance and pattern of growth.
3. Compare the size, of colonies of micro-organisms in the petri-dish from tap-water with that of gutter and well water.
4. Compare the sizes of the colonies.
5. Explain the cause of the difference.

Micro-Organisms in the Water: Water is a good habitat for some micro-organisms. The common types are the protozoa, bacteria and algae. The algae are green unicellular plants which cannot be grown in culture medium. Atimes some fungal spores are present in the water.

The amount of micro-organisms in water vary according to the type of water. Dirty water is very rich in micro-organisms. A good drinking water, must be free from disease causing micro-organisms. The degree of microbes in different kinds of water can be observed through the number and size of the colonies in a culture medium.

The pattern of growth and colour of colonies also vary e.g. the germinating fungal spores may form a massive irregular shapes structure. The bacteria will form different shapes colour and also pattern of growth.

Activity 2: In the following activity you shall find out whether micro-organisms exist in water.

Materials required for the Lesson: Sterilized petri-dishes containing culture medium. Tap water, gutter water, well

water, dropping pipette.

Procedure: You will be provided with sterilized petri-dishes containing culture medium.

Step 1: With a pipette or a dropper take a few drops of the sample of water provided in the bottles. Drop the water from each sample into the culture medium. The lid of the petri-dish is to be opened just enough to let the pipette in.

Step 2: Replace the cover of the petri-dish immediately to prevent contamination from the air.

Step 3: Place the petri-dish in a safe place and leave for about three days. Label the dish e.g. A, B and C.

Step 4: Set up the control D. The culture medium will not be inoculated with any water.

Step 5: After three days observe your experiment for any changes in colour, appearance and pattern of growth.

Step 6: Now answer the following questions

1. Did you observe any changes in the petri-dishes which you inoculated with water?
2. From your observations, state the differences in colour, appearance and pattern of growth.
3. Compare the size of colonies of micro-organisms in the petri-dish from tap-water with that of gutter and well/borehole water.
4. Is there any difference in the size of the colonies?
5. Can you explain the cause of the difference, if any.

Lessons Five and Six

Topic 1: Micro-organisms around us

Unit 2: Micro-organisms in our body and food

Sub-Unit Title 3: Micro-organisms in our body

Rationale: The human body is a complex structure. Some micro-organisms live in different parts of the body. It is necessary to understand that the micro-organisms in the body cavity of man differ from those on the body.

Behavioural Objectives; Students will be able after performing the following activities to:

1. note different micro-organisms cultured from different parts of our body.
2. note the size of growth and number of colonies in the petri-dishes.
3. account for difference in growth.

MICRO-ORGANISMS IN OUR BODY: Micro-organisms are found in different parts of our body e.g. mouth and alimentary tract, under our nails and even on our skin, when we fail to wash and scrub our body regularly. They occupy different body cavities and inside us. Some live on the outside body. These micro-organisms are different in number, growth pattern and size. There are usually many in some dirty materials in or on the body, e.g. the mouth, nostril passage, the head hairs and feet. This is why it is important that we keep our bodies clean, teeth should be brushed and mouth washed thoroughly after meals, nails should be cut short.

Some micro-organism like bacteria or fungi are blown into the air along with tiny drops of moisture from the mouth, nose, throat and lungs, when infected animals and humans breathe, sneeze, cough or blow their noses. Healthy people within the reach of such microbes can then inhale, or swallow them and become infected. That is why open and unchecked spitting, sneezing, coughing and blowing of noses are dangerous habits one should not develop such.

Activity: In the following activities you shall detect whether micro-organisms are present on the teeth, in expired air and from dirts under the nail.

Materials Required for the lessons: Sterilized petri-dishes containing culture medium, tooth pick or matchstick, expired air and dirts from a finger nail.

Procedure: You will be provided with sterilized petri-dishes each containing a culture medium.

Activity (1): Micro-organisms from the teeth.

Step 1: Collect the material from your teeth (scraps of food left after meals, using a matchstick or tooth pick to collect the materials)

Step 2: Open the petri-dish slightly

Step 3: Drop the tooth dirts scraped into the culture medium in the petri-dish.

Step 4: Replace the lid of the petri-dish immediately

Step 5: Label it A (micro-organisms from teeth)

Step 6: Leave it in a safe place.

Activity (2): Micro-organisms from expired air.

Step 1: Open the petri-dish holding the lower dish close to your mouth

Step 2: Breathe into the dish and close the petri-dish immediately

Step 3: Label it B (micro-organisms from expired air).

Step 4: Leave it next to petri-dish A.

Activity (3): Micro-organisms from dirts undernail.

Step 1: Collect the dirt from under neath your finger nail using matchstick or a tooth pick

Step 2: Drop the dirty material into the culture medium

Step 3: Replace the lid of the petri-dish culture medium

Step 4: Label it C (Micro-organisms from dirty nail.

Step 5: Leave it next to petri-dish B.

Activity (4): Control

Step 1: Leave a petri-dish with culture medium covered

Step 2: Label it F (control)

Step 3: Leave it next to petri-dish C.

After two or three days record your observation and (look for colour, area and nature of growth).

Now answer these questions

1. Are there micro-organisms in all the petri-dishes?
2. Which one has the greatest size of growth and number of colonies?
3. Does F show any growth?

Can you account for the different variation in growth.

Lessons Seven and Eight

Topic 1: Micro-organisms around us

Unit 2: Micro-organisms in our body and food

Sub-unit title 4: Micro-organisms in our food

Rationale: Food is very necessary to keep one alive. Just as man needs food to grow so micro-organisms too. Different micro-organisms grow on the food.

Behavioural objectives: Students will be able after performing the following activities to:

1. note different types of micro-organisms on different types of food.
2. note changes in the appearance of food if exposed for few days
3. note bad odour produced on the food because of the microbial activities.

Micro-organisms in our Food: Food can be divided into three classes, namely - carbohydrate, protein and fat.

The food provides good nutrients for the growth of micro-organisms. They multiply very fast on food. The micro-organism commonly found on food are - bacteria and fungi. Food when exposed to air are accessible to micro-organisms. Food left for a long time may become unfit for eating because the food may be attacked by both bacteria and fungi. Moisture hastens the growth of micro-organisms. In some cases when a pot of soup is left for some days without warming on the fire or not properly warmed, bacteria can settle on it and start to

feed and digest the soup. This is accompanied with bad odour, later the soup will lose its tastes and becomes sour.

In most cases we have been eating micro-organisms with our food because when we think of the money we spend on preparing the soup we would not want to pour it away. But as nature will have it, when we eat these micro-organisms, our body helps to attack them so that they will do little or no harm to us. For example the Gastric juice secreted by the glands of the stomach wall contains hydrochloric acid. This hydrochloric acid kills most of the micro-organisms e.g. bacteria, fungi etc. But some dangerous ones are not killed e.g. those causing cholera, typhoid fever etc.

Activity (1): In the following activity you shall detect the growth of micro-organisms on our food.

Materials Required: A clean plate with a lid, blotting paper, ripe fruit, cooked yam, corn flour etc some quantity of water.

Activity Step 1: Line a dish with damp blotting paper

Step 2: Put a slice of orange, slice of banana, a slice of moistened bread and add scraps of food - yam etc.

Step 3: Cover with a lid

Step 4: Keep in a cupboard or a safe place

Step 5: Examine after 3 - 5 days

Now answer these questions

1. Do you see any changes in the different types of food after the experiment? Do they smell?
2. Are there any changes in appearance?

3. Is there anything common in your observation?
4. Describe the appearance of the colonies
5. Do your observations prove that micro-organisms may be found in our foods?
6. What would happen to them if you would have left them longer?
7. Why is it that micro-organism do not grow in us?

Lessons Nine and Ten

Topic 1: Micro-organisms around us

Unit 3: Carriers of micro-organisms

Sub-unit title 5: Insect that carries micro-organisms

Rationale: Micro-organisms are widely distributed in nature. They do not have wings, legs, or any organ of locomotion yet, they are found in different places. Insects and some other living organisms apart from man can also carry the micro-organisms about.

Behavioural objectives: Students will be able after performing the following activities to:

1. Detect the presence of micro-organisms in different parts of an insect
2. Note different types of micro-organisms
3. Describe the different colours, pattern of growth and appearance of micro-organisms
4. State why there was no growth in the control petri-dish

Insects that carries micro-organism: Micro-organisms are carried in and on the bodies of animals like the housefly,

cockroach etc. These micro-organisms are being distributed about by the insects. Some of these insects carry them on their bodies without knowing. They are mostly responsible for transmitting the microbes to our food and body.

Activity: In the following activity you shall detect the presence of micro-organisms in the following parts of an housefly-wing, leg and head.

Materials required: Broom, a housefly, a pair of forceps four sterilized petri-dishes containing culture medium.

Activity Step 1: Kill a housefly with a broom

Step 2: Using a pair of forceps, remove a wing, a leg and the head from the housefly.

Step 3: Transfer each of these parts into a separate petri-dish containing a medium.

Step 4: Cover the petri-dishes and set them aside in a safe place.

Step 5: The fourth petri-dish is left as the control

Step 6: After 3 days record your observations in your notebook.

Answer the following questions

1. Are there micro-organisms in all the dishes?
2. Describe their colour, pattern of growth and appearance.

Lessons Eleven and Twelve

Topic 2: Micro-organisms in action

Unit 4: Growth of micro-organisms

Sub-unit title 6: Growth of micro-organisms

Rationale: Micro-organisms can grow in a culture medium both by increase in number as well as by increase in colony size and number. Growth is gradual in micro-organisms.

Behavioural objectives: Students will be able after performing the following activity to:

1. Notice the gradual increase in the size of the colony after a given period.
2. Measure the rate of growth of the micro-organisms with respect to increase in the size of the colony.

Growth of Micro-Organisms

In the earlier exercises we found that colonies of micro-organism became visible after they have been left in culture medium. In this, you will find out what was actually happening between the time you drop the micro-organism on the medium and the time they became visible.

Like all living things, micro-organisms can multiply. This growth is exhibited in the form of increase in size and number. They grow because they use food materials around them for building their bodies. The culture medium is a source of food for micro-organisms grown in the laboratory. The more nutrients they get from the culture medium the more they grow or increase in size.

Activity: In the following activity you shall inoculate a culture medium with micro-organisms. You will be required to observe and carry out certain instructions.

Materials required: A sterilized petri-dish containing culture

medium, inoculating loop, squared cellophane or transparent paper/and a burner.

Activity Step 1: Sterilize the loop end of the inoculating loop in the blue part of the flame for a few seconds.

Step 2: Remove the cover of petri-dish

Step 3: Using the sterilizing inoculating loop, transfer a bit of the prepared culture into petri-dish. Cover the dish back and place in a safe place. Label your dish and note date and time of the experiment.

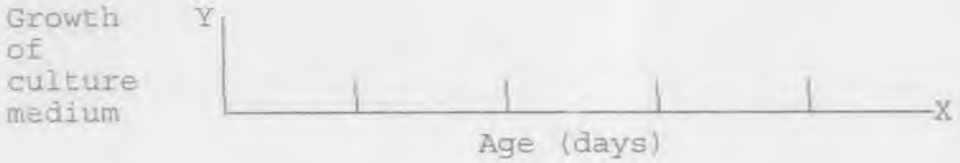
Step 4: After 24 hours, look at the medium for any changes. As any colony appears begin to measure.

Step 5: Measurement (using squared cellophane or transparent paper), place the cellophane/transparent paper on top of the dish cover and count the number of squares directly covering the selected colony. Repeat the counting and record the average of three readings in your note-book using the table below. Mark that particular colony.

1st day	2nd day	3rd day	4th day	5th day	6th day
Growth size (number of squares)					

Step 6: Take reading every twenty four hours for 6 days.

Step 7: From your readings, plot a graph of Age against growth



Answer the following questions:

1. Did you notice any gradual increase in the size of the colony during the sixth day?
2. If so, what will you call this process?
3. Can you interpret from your graph the rate at which your culture grows in area?

Lessons Thirteen and Fourteen

Topic 2: Micro-organisms in Action

Unit 5: Beneficial effects of micro-organisms

Sub-unit title 7: Micro-organisms are beneficial to men

Rationale: Some micro-organisms are beneficial to man. Some fungi are used in the production of drug e.g. penicillin (an antibiotic). Yeast is useful in the production of bread and alcohol. Bacteria are used for the production of yogurt and cheese.

Behavioural objectives:

Students will be able after performing the following activities to:

1. Notice that micro-organisms are used in the fermentation process of alcohol
2. Notice that micro-organisms are responsible for the odour produced during fermentation process.

Micro-organisms beneficial to man: There are micro-organisms

in the air which are responsible for the curdling of milk. Activity favours the growth of these micro-organisms.

In industries like bakery, brewery and cheese making, the beneficial effects of the activity of micro-organisms are applied. The beneficial effect of micro-organisms is applied in the production of antibiotics. Sir Alexander Fleming discovered that when Penicillium (fungus) and bacteria are cultured together the growth of the bacteria is retard. Today Penicillin and other antibiotics are used extensively to cure diseases caused by bacteria.

Another beneficial effect of micro-organisms is the enriching of the nitrate content of depleted soil by certain species of bacteria found in root-nodules.

Activity: In the following activity you shall detect that micro-organisms are responsible for the fermentation of organic materials. Through the activity of micro-organisms on our food, bad odour can be produced.

Materials required: Glucose, yeast, distilled water, and measuring cylinder, test tubes, sterilized watch glass beaker; and ethyl alcohol in a bottle.

Activity Step 1: Weigh 10g of glucose in a sterilized watch glass.

Step 2: Measure $90cm^3$ of distilled water in a measuring cylinder.

Step 3: Pour the water into a $250cm^3$ beaker

Step 4: Add the glucose and stir to dissolve it

Step 5: Pour the solution into two test-tubes A and B until they are three-quarters full

Step 6: Add some yeast culture to test-tube A

Step 7: Set up B as control (Glucose only)

Step 8: Observe after twenty-four hours.

Answer the following question:

1. Do you smell anything in the test-tube A?
2. Go to the teacher's table and smell the ethyl alcohol in a bottle
3. Do they have the same smell?
4. State any other beneficial aspects of micro-organism?

Lessons fifteen and sixteen

Topic 2 Micro-organisms in Action

Unit 6 Harmful effects of micro-organisms

Sub-unit title 8 Disease causing micro-organisms

Retionele: Most common diseases like malaria, common cold, cholera, measles are caused by micro-organisms. The micro-organisms involved include bacteria, viruses and protozoa. These microbes also cause diseases not only in man but also in animals and plants.

Behavioural Objectives: Students will be able after performing the following activities to:

1. recognise the micro-organisms which are responsible for ill-health of human being
2. recognise the diseases that affect human beings of all ages.

Disease Causing Micro-Organisms

A large number of disease carrying organisms, e.g. bacteria and virus, find their way into the air from dust, soil, excreta and air expired by infected people. These micro-organisms are passed out in droplets of moisture from nose, mouth, throat and during sneezing, coughing and deep breathing by an infected person. If a healthy person breathe in these droplets he may contract the disease. Diseases like common cold, influenza, measles, pneumonia, tuberculosis, etc which are transmitted in this way are known as air-borne diseases. Contracting these diseases through the droplets is described as droplet infection. Therefore, spitting is not only dirty and unpleasant but also dangerous because the mucus spat out may contain disease-carrying bacteria and viruses. Apart from bacteria and protozoa, viruses are also disease causing micro-organisms associated with water. For example, the liver-infecting virus causes a liver disease called infectious hepatitis, while the polio virus causes polio-myelitis. Besides, there are diseases with pain while urinating or defecating. This disease is caused by a flat-worm called schistosoma.

Water is very essential to the welfare of organisms, including human beings. Is used for drinking, cooking, washing and bathing. Therefore, it is necessary to keep water pure before consumption.

Activity: You will be provided with two tables showing the

diseases caused by micro-organisms in the air and diseases through micro-organisms in drinking water.

Step 1 Study tables 1 and 2 carefully and answer the following questions

1. From the information provided in Tables 1 and 2 which groups of micro-organisms would you say are mainly responsible for ill-health of human beings?
2. Which of the diseases affect human beings of all ages? After-studying the table, answer the following question: What kind of micro-organism is the major causative agent of water-borne diseases?

(Table 1) Diseases caused by Micro-Organisms - in the air.

Disease	Causative Macro-Organism	Host	Incubation	Main Symptoms
Common	Virus	Human-beings (all ages)	2 days	Fever, headache and secretions from nose
Influenza	Virus	Human-beings (all ages)	1 - 4 days	Chill, rising temperature headache and general pains
Measles	Virus	Usually children	10 - 4 days	Sharp cough head cold and rash
Meningitis (cerebro-spinal)	Bacteria	Children, young adults	1 - 5 days	Acute fever, headaches stiffness of the neck
Pneumonia	Bacteria	Birds, Pigs, cows, human beings (all ages)	Exact time not known but short	Rapid respiration, pain in the chest, tight cough.
Tubercu-losis	Bacteria	Cow, human beings (all ages)	Not known	Resistant dry cough, light sweats

(Table 2)
Disease Through Micro-Organisms in Drinking Water

Disease	Causative Micro-Organism	Host	Incubation	Main symptoms
Amoeba dysentery	Protozoa	Human beings (all ages)	2 - 8 days	Heavy, vomiting and diarrhoea
Bacillic dysentery	Bacterium	Human beings (all ages)	2 - 8 days	High temperature
Cholera	Bacterium	Human beings (all ages)	1 - 5 days	Mild to very sauce diarrhoea, with vomiting
Diphtheria	Bacterium (in throat)	Human beings (all ages)	2 - 10 days	Pain in limbs
Typhoid fever	Bacterium	Human beings (all ages)	7 - 21 days	High temperature with diarrhoea or constipation

Lessons seventeen and eighteen

Topic 2 Micro-organism in Action

Unit 6 Harmful effect of micro-organisms.

Sub-unit title 9 Control of disease causing micro-organs and infection.

Rationale: Micro-organisms can cause diseases, decay our food and waste our resources. Some disease are water-borne, food-borne and air-borne. Some insects are responsible for the transmition of the micro-organisms.

Behavioural Objectives: Students will be able after performing the following activity to

1. apply some disinfectants and antibiotic
2. control some micro-organisms

3. prevent infection of man by micro-organisms

4. control some vectors.

Control of disease causing micro-organisms and infection

Penicillin, as an antibiotic from Penicillium, destroys or inhibits the growth of disease-causing bacteria and fungi. There are other substances called antiseptics which kill or inhibits the growth of diseases causing bacteria and viruses. Examples are iodine tincture, hydrogen peroxide (especially fresh one), detol, izal.

Potassium permangante, camphor, even common salt. Antiseptics are generally applied directly to wounds to stop them from going bad (septic), by killing the harmful micro-organisms. They also minimise the possibility of infection. Antiseptics generally, all the pathogens without damaging the tissues of the host. However, there are other substances which kill disease causing micro-organisms (pathogens) but are too strong to use in direct treatment. These are the disinfectants. They are used to sterilize clothing, instruments, sickrooms etc. Examples are phenol solution, formaldehyde, lysol etc all in solution. On the whole, disinfectants are more powerful than antiseptics.

Heating to a high temperature or freezing to low temperature, or applying large quantity of salt can be used to kill or to inhibit the growth of harmful micro-organism. We use these methods to prevent and cure diseases, that are spread by air, by coughing or sneezing, or by contact with dishes,

towels, bed-clothing, or food. For example, antibiotic (penicillin, terramycine, streptomycin, etc) are used to combat typhoid fever, dysentary, preumonia, tuberculosis and syphilis. Antiseptics and disinfectants are used to minimise the possibility of infection. Good personal hygiene and body cleanliness can lid to reduce the number of harmful micro-organisms on the body and clothing. We should drink clean and treat water, wash our hands before eating, wash fruits and vegetables before eating them.

Prevention of diseases transmitted by vectors can be achieved by

1. Killing the adult vectors. The vector transmits the disease-causing micro-organisms (pathogens). Use insecticides to spray the house. Is good for killing mosquitoes, flies, fleas etc. Rats can be controlled by poisoning. Traps and cats can be used to kill rats.
2. Preventing the vectors from biting us. Insects can be prevented by the use of nets e.g mosquito nets. Use of insect repellant creams on our skin.
3. Killing the developmental stages of the vectors. This is good for preventing mosquito from breeding. For example use of fish in ponds, use of oil on the surface water. This oil blocks the respiratory tubes of the larvae and pupae.
4. Using medicines to kill the micro-organisms in the human body before they develop to harmful stage e.g malaria can

be prevented by taking anti-malaria drugs as Daraprim, chloroquine and norolon regularly.

Activity In the following activity you shall inoculate four petri-dishes containing culture media with micro-organisms. You will be required to observe and carryout certain instructions.

Materials Required

A culture medium, four sterilized petri-dishes each containing a culture medium, detol, penicillin and saline water. (Common salt in water).

Activity Step 1: Inoculate the culture medium, in four petri-dishes provided, with a bit from the grown culture medium supplied, label the petri-dishes A,B,C, and D.

Step 2 **Pour some Dettol on the culture medium of dish A and leave in a safe place.**

Step 3 **Into dish B pour some solution of penicillin on the culture medium and keep in a safe place.**

Step 4 **Into dish C pour some saline solution and keep in a safe place.**

Step 5 **Dish D should be kept in a safe place - this will be the control.**

Step 6 **At the end of the experiment you should write your observation into your note book as follows:**

Culture Plates	DAILY OBSERVATION					
	1	2	3	4	5	6
With Detol A						
" Penicillin B						
" Saline C						
" Control D						

Answer the following questions

1. Is there any difference between the treated and control?
2. What are the effects of applying Dettol, penicillin and salt solution?

Home work

Look for a stagnant water or a container with water around your house in which mosquitoes are breeding. Observe very closely. If there are larvae and pupae, then apply some kerosine to the surface of the water. Observe again after ten minutes. What do you see?

APPENDIX K

Lecture Method Lesson Notes for the Control Group (Teacher's Note).

Below are nine sub-unit title lessons for the control group. These lessons are organised in a lecture form. The researcher will teach these lessons herself and also carry out the activities specified for the various lessons. The format for these lecture oriented lessons is that propounded by Abdullahi (1982) with some modifications by the researcher. The lessons are prepared for the students in senior secondary two (form five).

These nine lectures are to be taught for eighteen lesson periods. The sub topics for these lessons are Mirco-organisms around us and Micro-organisms in action. These topics are extracted from the third term scheme of work in biology for the senior secondary two students as it is stated in the National curriculum for the senior secondary school (Biology syllabus 1985).

These two sub topics are further broken down into six units. The units are as follows:

Unit 1 - Micro-organisms in air and water,

Unit 2 - Micro-organisms in our bodies and food,

Unit 3 - Carriers of micro-organisms,

Unit 4 - Growth of micro-organisms,

Unit 5 - Beneficial effects of micro-organisms,

Unit 6 - Harmful effects of micro-organisms.

The sub-units are as follows:

Sub-Unit 1 - Micro-organisms in Air,

Sub-Unit 2 - Micro-organisms in water,

Sub-Unit 3 - Micro-organisms in our body,

Sub-Unit 4 - Micro-organism, in food,

Sub-Unit 5 - Insects that carry micro-organisms,

Sub-Unit 6 - Growth of micro-organisms,

Sub-Unit 7 - Micro-organisms beneficial to man,

Sub-Unit 8 - Disease causing micro-organisms,

Sub-Unit 9 - Control of disease causing micro-organisms and infection.

The students would be asked to answer some question on each sub-unit title taught.

Notes will also be given to the students at the end of these lessons. After the completion of these lessons the students would be made to write an examination on what was taught.

Lesson 1 and 2

Group - Control

Class - SS2

Duration of the lessons Two periods of 40 minutes per period.

Topic: Micro-organisms in the Air

Materials for the lessons: Three Sterilized petri-dishes containing culture medium. Three different locations i.e 'A' Classroom/Laboratory, 'B' Toilet/Lavatory and C control (A clean environment).

Behavioural objectives: By the end of the lesson students should be able to:-

1. note any change in colour, appearance and pattern of growth in different culture media.

2. Compare the observation of each petri-dish in different locations
3. Explain why the differences.

Presentation Step 1 (10 mins)

Teacher introduces the lessons by giving the students a brief summary of micro-organisms.

Thus: the teacher gives the following points:-

Micro-organism is a unicellular (single celled) organism. The existence of micro-organisms came to be known only after the discovery of the microscope. Leeuwenhook, Pasteur, Kock, Alexander (Fleming etc are few examples that have worked on microbes. Some of these microbes (micro-organisms) are found in the air, in the land, on the body and inside our body and animals.

Step 2 (5 mins) The teacher explains to the students that: There are lot of minute living things moving in the air. Some are living while some are not. The very minute living ones are called micro-organisms or microbes. They can be seen with the aid of microscope. But when we culture them we need not to use a microscope to see it. They will form clumps or colonies. This we shall find out in the next activity.

Step 3 (5mins) The teacher will tell the students that this activity will make us understand that the air consists of different micro-organisms which form colonies or clumps. The teacher arranges the students in a semi-circular pattern. The apparatus for the demonstration are arranged on the teacher's table.

Step 4 (20mins) The teacher will demonstrate, the activity: Thus:- the following procedures are followed.

a) Remove the cover of both the sterilized Petri-dish and the culture medium and expose it to the air in the classroom/Laboratory for about ten minutes. Label the dish "A" after covering it. Place in a safe place.

b) Repeat for B and expose to the air in the lavatory for ten minutes. Label the dish 'B' after covering it. Place also in a safe place.

c) For the control the petri-dish will not be open to any air location but kept also in a safe place.

d) Then After 3 three days we shall observe the medium for any changes.

Step 5 (15mins) After the third day the student and the teacher observed the petri-dishes. The teacher then explains the Table 1 below to the students as the results of the activities carried out.

Table 1

Location	Growth of micro-organisms	colour	Appearance	Pattern of growth
A. Classroom	Yes	white and yellow colonies	circular inshape	very few colonies
Laboratory	Yes	Black and white	circular	very big circular colonies scattered
Lavatory	Yes	Green cream white redish black and yellow	circular green surrounded with different colonies	very large irregular colonies.
Control (not exposed) to any location	No growth	No colour	No appearance	No pattern of growth.

The teacher will tell the student that there was no growth in the control petri-dish, because it was a sterile medium without any contamination.

Step 6 (5mins) The teacher will explain to the students further that:- When micro-organism grow in clumps or colonies they can be seen with unaided eye. Each clump is known as a colony. Each colony is made up of numerous ones of the same type. Different types may grow in one petri-dish, but this depends on the types of micro-organisms present in that place.

Student Activities (10mins) The teacher will ask the students the following question.

1. What do you notice after the three days when you observed the medium. Describe what you have seen in your own words,

nothing the colour, appearance and pattern of growth.

2. Compare what you observed in the petri-dish exposed in the class/laboratory and lavatory with what you observed in Petri-dish C (control).
3. Is there any difference?
4. If there is a difference, can you explain it?

CONCLUSION (10mins) The teacher writes or gives each student the typed notes which could have been written on the board for them.

Lessons - Three and Four

Group - Control

Class - SS2

Duration of the lesson: Two periods of 40 minutes per period.

Topic: Micro-organisms around us

Sub-Unit title: Micro-organisms in the water.

Materials for the lessons: Sterilized Petri-dishes containing culture medium, Tap-water, Gutter water, well water, Dropping pipette.

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

1. Note any changes in the Petri-dishes which was inoculated with different water samples.
2. State the differences in colour, appearance and pattern of growth.
3. Compare the size of colonies of micro-organisms in the petri-dish of tap-water, with that of Gutter and well water.
4. Compare the sizes of the colonies.

5. Explain the cause of the differences.

Previous knowledge: Students have learnt about micro-organisms in the air.

Introduction: (5mins) The teacher will ask the students the following questions.

1. What did you observe in the petri-dish exposed to the air in the lavatory (toilet).
2. Was there any growth of micro-organisms in the control petri-dish? Give reasons.
3. State the pattern of growth in the petri-dish exposed to the air in the classroom.

Presentation:

Step 1 (5 mins) The teacher will present the topic: Thus:- Water is a good habitat for some micro-organisms. The algae are green unicellular plants which cannot be grown in culture medium. Atimes some fungal spores are present in the water. The amount of micro-organisms in water vary according to the type of water. We shall carry out an activity to show micro-organisms in water.

Step 2 (20 minutes): The teacher will arrange the students in a semi-circular manner while she demonstrates the activity to the students. Thus the teacher carries out the following procedures.

(a) With a pipette or dropper take some few drops of the sample of water provided in the bottles. Drop the water from each sample into the culture medium in each petri dish respectively.

(b) Replace the cover of the petri-dish immediately to prevent contamination from the air.

(c) Place the petri-dish in a safe place and leave for about three days. Label the dish e.g. A, B and C.

(d) Set up the control D. The culture medium will not be inoculated with any water.

(e) After three days both the teacher and student observe the experiment for any changes in colour, appearance, and pattern of growth.

Step 3 (10mins): After the third day we observed that there were changes in all the petri-dish inoculated with samples of water while no change in the control petri-dish. Table 2 below give the summaries of the difference in colour, appearance,
and pattern of growth of micro-organism in the samples of water used.

Table 2

Source of water	Colour	Appearance	Pattern of growth
Tap	white colony milky few colonies	Circular and tiny only one large white colony and massive irregular shape	Scattered.
Well	white, orange, yellow and milky colours	circular irregular mass	Scattered some small and some large circular structures
Gutter	white, yellow red, pink and milky.	circular	Scattered but closer to the point of inoculation
Control no water Inoculated	no colour	no appearance	No pattern of growth.

Step 4 (6 mins)

The teacher will further explain to the students that: It was also discovered that the size of the colonies of the tap water were very tiny (i.e small) and few in numbers as compared to those of well water.

Also the number and sizes of the colonies of the micro-organisms in the well far exceed those of the tap water. This is because the well is not well protected from pollution. Also there is no filtration and chemical treatment for the well water as we have in tap water.

Step 5 (6 mins): The teacher further explain that: Dirty water is very rich in micro-organisms. A good drinking water must be free from disease causing micro-organisms. The degree of microbes in

different kinds of water can be observed through the number and size of the colonies in the culture medium as we can see from the result of the activities.

Step 6 (6 mins): The teacher explains that: Also from the result one can understand that the pattern of growth and colour of colonies also vary for example the germinating fungal spores may form a massive irregular shaped structure. The bacteria will form different shapes, colours and also pattern of growth. Step 7 (12mins) (students activities)

The teacher will ask the student the following questions

1. Did you observe any changes in the petri-dishes which was inoculated with water after the third day?
2. From your observations, state the differences in colour, appearance and pattern of growth.
3. Compare the size of colonies of micro-organisms in the petri-dish from tap-water with that of the gutter and well water.
4. Is there any difference in the size of the colonies?
5. Can you explain the cause of the difference if any:

Conclusion (10 mins) The teacher will either write the notes on the blackboard for the student or give individual student a copy of the typed note.

Lessons five and six

Group - Control

Class SS2

Duration of the lessons: Two periods of 40 minutes per period.

Topic: Micro-organisms around us.

Sub-Unit title: Micro-organisms in our body

Materials for the lessons: Sterilized petri-dishes containing culture. Medium, tooth pick or match stick, expired air and dirt from a finger nail.

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

1. note different micro-organisms cultured from different parts of our body.
2. note the size of growth and number of colonies in the petri-dishes
3. account for difference in growth.

Previous Knowledge: Students have learnt about micro-organisms in the Air and Water.

Introduction: (10mins) The teacher will ask the students these questions.

1. Was there growth of micro-organisms in the culture - medium exposed to the air in the laboratory?
2. What was the pattern of growth of the micro-organisms found in the culture medium exposed to the air in the lavatory?
3. State the difference between the size of micro-organisms in the petri-dish of tap water with that of the well water.
4. Can you explain the cause of the difference if any?

Presentation:

Step1 (5mins)

The teacher will explain to the students that: Micro-organisms are found in different parts of our body e.g mouth and

alimentary tract, under our nails and even on our skin when we fail to wash and scrub our body regularly. They occupy different body cavities and inside us. Some micro-organisms live on the outside body. These micro-organisms are different in number, growth pattern and size. This we shall find out through this activities.

Step 2 (25 minutes)

The teacher will arrange the students in semi circular pattern while she demonstrates the activities: Thus the teacher follow these procedures.

For Activity 1: Micro-organism from the teeth: The teacher:

a. Collects the scraps material from the teeth using a match stick or tooth pick.
b. Open the Petri-dish slightly and drop the tooth scraps into the culture medium
c. Replace the lid of the petri-dish immediately.
d. Label it A (Micro-organisms from the teeth) and leave it in a safe place.

For Activity 2: Micro-organisms from expired air:

The teacher:

a. Open the Petri-dish by holding the lower dish close to the mouth.
b. Breathe into the dish and close the petri-dish immediately.
c. Label it B (micro-organism from expired air)
d. leave it next to petri-dish A.

For Activity 3 - Micro-organisms from dirt under the nail. The teacher:

a. Collect the dirt from underneath the finger nail using match stick or a tooth pick.

b. Drop the dirt material into the culture medium and replace the lid of the petri-dish immediately.

c. Leave it next to petri-dish B.

For Activity 4 Control: The teacher:-

a. Leave a petri-dish with culture medium covered

b. Label if F (control)

c. Leave it next to petri-dish (c)

d. After two or three days record the observation and (look for colour, area and nature of growth.

Step 3 (5minutes) The teacher will discuss the results of the activities with the students: That micro-organisms grew in the culture medium containing the scraps from the teeth, dirts from the nail and breathe Air from the mouth. It was also found that the greatest size of growth and number of colonies came from the culture-medium containing the dirts from the nail.

Step 4 (5 minutes) The teacher explains further that: In regards to the control there was no growth of micro-organisms in the petri-dish containing the culture medium because it was sterilized and no any contermination. Also that the difference in growth could be as a result of different micro-organisms occupying different places. It is not possible for a particular micro-organisms to live successfully in all the habitats.

Step 5 (5 minutes) The teacher continue with her explanation that one should also note that there are usually many micro-organisms in

some dirty material in or on our body e.g the hair and feet etc. That is why it is important that we keep our bodies clean, teeth should be brushed and mouths washed thoroughly after meals. Nails should also be cut short.

Step 6 (5 minutes) The teacher further explain Thus:

Some micro-organism like bacteria, or fungi are blown into the air along with tiny drops of moisture from the mouth, nose, throat and lungs when infected animal and human breathe, sneeze, cough or blow their noses.

Step 7 (5minutes) The explanation continues: Thus:- Healthy people within the reach of such microbes can then inhale, or swallow them and become infected. This is why open and unchecked spitting, sneezing, coughing and blowing of noses are dangerous habits, and should not develop such.

Step 8 (10 mins) (Students Activities)

The teacher will ask the following questions from the students

1. Are there micro-organism in all the petri-dishes?
2. Which one has the greatest size of growth and number of colonies?
3. Does F show any growth if not why?
4. Can you account for the differences (variation) in growth.

Conclusion: (5 mins)

The teacher distributes the typed notes to each students as the black-board notes/ or give the student a blackboard note summary.

Lessons seven and eight

Group Control

Class: SS2

Duration of the lessons: Two periods of 40 minutes per period.

Topic: Micro-organisms in Action.

Sub-Unit title: Micro-organisms in our food

Materials for the lessons A clean plate with a lid, blotting paper, ripe fruit, cooked yam, corn flour, etc and some quantity of water.

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

1. note different types of micro-organisms on different types of food.
2. note changes in the appearance of food if exposed for few days
3. note different colonies on the food
4. note bad odour produced from the food because of the microbial activities.

Previous knowledge: Students have learnt about micro-organisms in our body, Air, and water.

Introduction (5mins) (Students activities)

Teacher introduces the lesson by asking the following questions, based on the topic to be taught.

1. What happen to the food that is exposed to the air
2. What is the effect of moisture or water in the growth of micro-organisms.
3. What will happen to the food that is not preserved.

Presentation

Step 1 (5 mins) The teacher explains to the students that: Food is very necessary to keep one alive. Just as man needs food to grow so micro-organisms too; Food can be divided into three classes namely carbohydrate, protein and fat. The food provides good nutrients for the growth of micro-organisms. They multiply very fast on food. The micro-organisms commonly found on food are bacteria and fungi. Food when exposed to air are accessible to micro-organisms. Now lets find out this if exposed foods are accessible to micro-organisms.

Step 2 (20mins) In this activity the teacher will carry out the activity for the students to see. The teacher thus follow these procedures.

a. Line a dish with damp blotting paper
b. put a sliced orange, a sliced banana, sliced moistened bread and add scraps of food e,g cooked yam.
c. cover the plate with a lid
d. keep in a cupboard or a safe place
e. examine after 3-5 days.

Step 3 (5minutes) After the 3 to 5 days the teacher will make the students observe the result. Students could see that variety of moulds of colonies growing on these foods.

The food also changed colour and appearance: For example the piece of cooked yam turned orange and the bread became greenish - black. Also white fluffy mass of silky white thread and even greenish dust were seen on these food scraps.

Step 4 (10 minutes) The teacher will explain further that: The food left for a long time may become unfit for human consumption. This is because this, food have been partly digested and their nutritive contents has degenerated. For example if a pot of soup is left or not properly warmed, micro-organisms can settle on it and start to feed and digest the soup. Sooner or later bubbles will start developing on this soup. This is accompanied with bad odour or smell and the soup will lose its taste and finally becomes sour and tasteless.

Step 5 (10 minutes) The teacher further explains that: In most cases we have been eating micro-organisms with our food because when we think of the money or labour we use in preparing that food, we would not want to pour it away. But as nature will have it, when we eat these micro-organisms along with our food our body helps to fight it so that it will cause little or no harm to us. For example, the Gastric juice secreted by the glands of the stomach wall contains hydrochloric acid. This hydrochloric acid kills most of the micro-organisms in the food e.g bacteria, fungi etc.

Step 6 (5 mins) The teacher explains further that: Food that contain little or more moisture is quickly adaptable for the growth of micro-organisms for example the sliced orange or banana, and moistened bread etc. Food with moisture but kept free from micro-organisms will not grow. For example, covering and also preserving such food in a refrigerator or warming it on the fire regularly, etc. Food which does not contain moisture or water lasts longer,

without getting spoilt.

Step 7 (10 minutes) The teacher will ask the students the following questions.

1. Do you see any changes in the different types of food after the experiment? Do they smell?
2. Are there any changes in appearance?
3. Is there anything common in your observation?
4. Describe the appearance of the colonies
5. Do your observations prove that micro-organisms may be found in our foods?
6. What would happen to them if you would had left them longer?
7. Why is it that micro-organisms do not grow in us.

Conclusion: 15 minutes The teacher will write the notes on the blackboard for the students to copy.

Lessons Nine and Ten

Group: Control

Class: SS2

Duration of the lessons: Two periods of 40 minutes per period.

Topic: Micro-organisms around us

Sub-Unit title: Insect that carries micro-organisms

Materials for the lessons: Broom, housefly, a pair of forceps, sterilized petri-dishes containing culture medium, an house-fly.

Behavioural objectives: By the end of the lessons the students should be able to:

1. detect the presence of micro-organisms in different parts of an insects.
2. describe the different colours, pattern of growth and appearance of micro-organisms.
3. State why there was no growth in the control petri-dish.

Previous knowledge: Students have learnt about micro-organisms in our food.

Introduction: 5 minutes (Student activities)

The teacher will ask the students the following questions

1. What is the effect of moisture on the growth of micro-organism?
2. What would happen to the food that is kept for a long time?
3. Why is it that micro-organism do not grow in us.

Presentation

Step 1: (10 minutes) The teacher will explain to the students that:

Micro-organisms are widely distributed in nature, they do not have wings, legs or any organ of locomotion yet, they are found in different places. Insects and some other living organisms apart from man can also carry the micro-organisms about.

One way in which micro-organisms could be carried from place to place is by certain insects whose hairy or spine-packed bodies unknowingly carry the microbes. Example of such insects called carriers are houseflies tsetse flies, cockroaches etc.

Step 2: (5 minutes) The teacher further explain that: Houseflies and cockroaches live in latrines mostly. Some can also be found in the kitchen, dirty environment etc. Most of the parts of an housefly habour micro-organisms. The following activities will detect if the parts of an house fly carry micro-organisms.

Step 3: (10 minutes) The teacher will arrange the students in semi-circular, manner while she carries out the activities.

Thus the teacher will follow these procedures.

a. Using a pair of forceps, remove a wing, a leg and the head from an housefly.
b. Transfer each of these parts into a separate petri-dish containing a medium.
c. Cover the petri-dish and set them aside in a safe place.
d. The fourth petri-dish is left as the control.
e. After 3 days record their observation.

Step 4 (10 minutes) After the third day each petri-dishes would be observed by the students. It was discovered that micro-organisms grew only on all those sterilized culture media with the parts of fly. But the culture medium that do not contain any part of the fly did not show any sign of growth of micro-organisms. This is because the medium is sterilized and not contaminated. The parts in the different petri-dishes containing culture media do not only grow micro-organisms but there was an effect in the colour, pattern of growth and appearance on each of these parts. For example the wings and legs showed pink, milky colours and filled up with mould.

For the head, there were very large grey irregular colonies seen. There was also one large white and irregular shape appearance of these colonies. Also we also discovered that there were different micro-organisms occupying different places. This was because it was not possible for a particular micro-organisms to live successfully in all habitats.

Step 5 (5 minutes) The teacher will further explain to the students that: The carrier (i.e fly) pick up the microbes and bring them to the exposed human foods on which they themselves normally feed. As the fly's body and legs are covered with fine hairs, bacteria are easily transferred to anything including human food which it walks on after feeding.

Step 6 (5 minutes) The teacher will tell the students that while the fly is feeding on human food it may defecate and pass out bacteria in its faeces. While feeding the fly will pour out a drop of saliva through the mouth parts which may contain harmful bacteria obtained during earlier feeds on infected matter.

Step 7: (5 mins) The teacher will explain to the students that: In the course of feeding some of these dangerous microbes are emptied from the body of the carrier into the food and may be eaten by you or me. Such foods are full of micro-organisms, which can make one suffer from a disease example of such disease is cholera etc.

To avoid this, it will be good to cover our food, keep our environment clean always in order to prevent these carriers in getting contact with anything we put in our mouth.

Step 8: 5 minutes (Students activities)

The teacher will ask the students to give answers to the following questions.

1. Are there micro-organisms in all the dishes?
2. Describe their colour, pattern of growth and appearance.

Conclusion: 20 minutes. The teacher will give the students a short note to copy in their exercise books.

Lesson Eleven and Twelve

Group: Control

Class: SS2

Duration of the lessons: Two periods of 40 minutes per period.

Topic: Micro-organisms in action

Sub-Unit title: Growth of micro-organisms

Materials for the lessons:

A sterilized petri-dish containing culture medium, inoculating loop, squared cellophane or transparent paper and a burner.

Behavioural objectives: By the end of the lessons the students should be able to:

1. notice the gradual increase in the size of the colony after a given period
2. measure the rate of growth of the micro-organisms with respect to increase in the size of the colony

Previous knowledge:

The students have learnt about insect that carries micro-organisms.

Introduction: The teacher will ask the students some questions on

insect that carries micro-organisms. (5 minutes)

Students activities

1. Do micro-organisms grow in the petri-dishes that contain the parts of the fly.
2. What explanation can you give for the absence of micro-organisms in the control - petri-dish?

Presentation (10 minutes): The teacher will explain to the students by telling them that: Like all living things, micro-organisms grow, increase and multiply in number. The growth is exhibited in the form of increase in size and number. They grow because they use the nutrient in the culture medium. Now we shall set up an activity to find out the growth of micro-organisms.

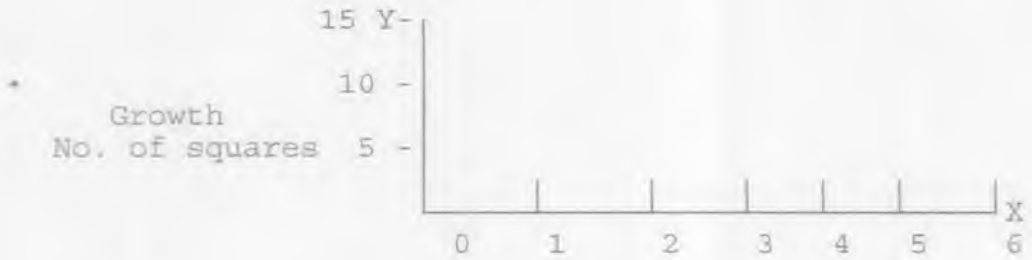
Step 2 (10 minutes): The teacher will tell the students that to measure, it will take this form, i.e. place the cellophane transparent paper on top of the dish-cover and count the number of squares directly covering the selected colony. Repeat the counting and record the average of three reading and note it down.

Using the table 3 below

Table 3

1st day	2nd day	3rd day	4th day	5th day	6th day
Growth size (number of squares)					

Step 4: (15 minutes) The teacher will further explain that: Readings are taken every - twenty four hours for 6 days. Then from the readings, we plot a graph of Age against Growth see example below.



Growth of culture medium

Step 5 (10 minutes): The teacher will further explain that in the activity on growth of micro-organisms, we discovered that there were several growth of micro-organisms colonies or clumps after twenty four hours. They later became more as they got nutrients from the medium. Also we discover that when the population was high the amount of nutrients in the culture medium became too small for these micro-organism to survive on as such the growth did not continue. Instead some micro-organism started to die off. When these readings were plotted on the graph sheet a curved shaped nature of graph was got.

Step 6 (10 minutes): The teacher will ask the students these question

1. Did you notice any gradual increase in the size of the colony during the sixth day?

2. If so, what will you call this process?
3. Can you interpret from your graph the rate which your culture grows in area?

Conclusion (20 minutes): The teacher will conclude the lesson by writing a short note on the blackboard for the students to copy in their exercise books.

Lessons thirteen and Fourteen

Group: Control

Class SS2

Duration of the lessons: Two periods of 40 minutes per period.

Topic: Micro-organisms in Action

Sub-Unit title Micro-organisms beneficial to man

Materials for the lessons: Glucose, Yeast, water, test-tubes and measuring cylinder, lever arm balance.

Behavioural objectives: By the end of the lessons the students should be able to

1. notice that micro-organisms are used in the fermentation process of alcohol
2. notice that micro-organisms are responsible for the odour produced during fermentation process.

Previous knowledge

Students have learnt about the growth of micro-organisms.

Introduction: (5 minutes) The teacher will ask the students these questions

1. What can you call the gradual increase in the size of the colony of micro-organisms
2. Did the increase continue for long. Why?

Step 1 (10 minutes) The teacher will explain to the students that some micro-organisms are beneficial to man. Some fungi are used in the production of drug. e.g penicillin (an antibiotic). Yeast is useful in the production of yogurt and cheese.

There are micro-organisms in the air which are responsible for the curdling of milk. Acidity favours the growth of these micro-organisms. In industries like baking, brewing and cheese making, the beneficial effects of the activity of micro-organisms are applied.

Step 2 (25 minutes) The teacher will explain to the students that, Yeast is useful in the production of alcohol. Now we shall find out the effect of yeast on glucose through this activity that will be carried out.

The teacher will arrange the students in a semi-circular manner: She then follow these procedures to demonstrate the activity to the students.

a. Weigh 10g of glucose in a sterilized watch glass
b. Measure $90cm_3$ of distilled water in a measuring cylinder.
c. Pour the water into a $250cm_3$ beaker
d. Add the glucose and stir to dissolve it
e. Pour the solution into two test-tubes A and B until they are three-quarters full
f. Add some yeast culture to test-tube A

g. Set up B as control (Glucose only)

h. Observe after twenty-four hours.

Step 3 (10 minutes) The teacher will explain to the students that after the twenty - four hours we discovered that, the content have fermented and becomes alcohol. The content also smells like alcohol. The teacher makes the student smell the ethyl alcohol that was on the teachers table. The students discovered that the prepared content smells like the ethyl alcohol. When the students further smells the control which was only glucose there was no smell of alcohol.

Step 4 (10 minutes) The teacher will explain further that:

Yeast is useful in the production of alcohol, as we have also seen that the production of the alcohol was a result of fermentation and this fermentation was caused by micro-organisms.

The beneficial effects of micro-organisms is applied in the production of antibiotics. Sir Alexander Fleming discovered that when penicillium (a fungus and bacteria are cultured together the growth of the bacteria is retarded.

Step 5 (5minutes) The teacher goes further to tell the students that: Today Penicillin and other antibiotics are used extensively to cure diseases caused by bacteria. Also micro-organisms helps in the enriching of the nitrate content of depleted soil by certain species of bacteria from the-modules.

Step 6 (5 minutes) The teacher will ask the students these questions.

1. Do you smell anything in the test-tube A
2. Go to the teacher's table and smell the ethyl alcohol in a bottle.
3. i) Do they have the same smell
   ii) Describe the smell
4. a) Smell the control (test tube B)
   b) Does it smell like test tube A
5. State any other beneficial aspects of micro-organisms.

Conclusion: (10 minutes) The teacher will give the students the notes on the blackboard to copy in their exercises books/or give them the typed note individually.

Lessons fifteen and Sixteen

Group: Control

Class: SS2

Duration of the lessons: Two periods of 40 minutes per period

Topic: Micro-organisms in Action

Sub-Unit title: Disease causing micro-organism

Materials for the lessons: Tables showing diseases caused by micro -organisms in the air and through drinking water.

Behavioural objectives: By the end of the lessons the students should be able to.

1. recognise the micro-organisms which are responsible for ill-health of human beings.
2. recognise some of the diseases that affect only human beings.
3. recognise the diseases that affect human beings of all ages.

Previous knowledge: The students have been taught insect that

carries micro-organisms, beneficial effects of micro-organisms, micro-organisms in our food etc.

Introduction: (5 minutes)

The student will answer the following questions:

1. State one beneficial effect of micro-organisms.
2. What is the effect of eating food that has grown micro-organisms?

Step 1 (10 minutes) The teacher will explain to the students that, A large number of disease-carrying organisms e,g bacteria and virus find their way into the air from dust, soil, excreta and air expired by infected people. These micro-organisms are passed out in droplets of moisture from nose, mouth, throat and lungs during sneezing, coughing and deep breathing by infected person. If a healthy person breathe in these droplets he may contact the disease.

Step 2 (10 minutes) The teacher will further explain that: Diseases like common cold, influenza, measles, pneumonia, tuberculosis, etc. which are transmitted in this way are, known as air-borne disease. Contracting these disease through the droplets is described as droplet infection. Therefore, spitting is not only dirty and unpleasant but also dangerous because the mucus spat out may contain disease causing bacteria and virus.

Step 3 (10 minutes) The teacher will go on to explain further that: most of the diseases caused by micro-organisms in the air cause ill-health to human beings and also attack human beings of all ages. The teacher gives the students a table showing the

diseases caused by micro-organisms in the air.

Step 4 (10 minutes) The teacher will explain to the students that:

Apart from bacteria and protozoa, viruses, are also disease causing micro-organisms associated with water. For example, the liver-infecting virus causes a liver disease called infectious hepatitis, while the polio virus causes poliomyelitis.

Besides, there are diseases like bilharziasis, blood with urine or blood and mucus with faeces, with pain while urinating or defecating. this disease is caused by a flat-worm called Schistosoma.

Step 5 (10 minutes) The teacher will further explain that: Water is very essential to the welfare of organisms, including human-beings. Water is used for drinking, cooking, washing and bathing.

Therefore it is necessary to keep water pure before consumption: The teacher will give the students a table (1) page 193 showing the diseases spread through drinking water.

Step 6 (10 minutes) The teacher will ask the students the following questions.

From an information provided in the table (1) showing the diseases caused by micro-organism in the air.

1. Which groups of micro-organisms would you say are mainly responsible for ill-health of human beings?
2. Which of the disease affect human beings of all ages?

After studying table 2 (1) answer the following question.

What kind of micro-organisms is the major causative agent of water borne-diseases?

Conclusion: (15 minutes) The teacher will write the notes on the blackboard for the students to copy into their exercise books.

Table 1: Disease caused by micro-organisms in the air

Disease	Causative micro-organisms	Host	Incubation period	Main symptoms
Common cold	Virus	Human beings (all ages)	2 days	Fever, headache and secretions from nose
Influenza	Virus	Human beings (all ages)	1-4 days	Chill, rising temperature headache and general pains
Measles	Virus	Usually children	10-14 days	Sharp cough, head cold and rash
Meningitis (cerebrospinal fever)	Bacteria	Children, young adults	1-5 days	Acute fever, headache, stiffness of the neck
Pneumonia	Bacteria	Birds, pigs, cows, (all ages)	Exact time not known, but short	Rapid respiration, pain in the chest, tight cough
Tuberculosis	Bacteria	Cow, human-beings (all ages)	Not known	Persistent dry cough, night sweats

Table 2: Diseases through micro-organisms in drinking water.

Amoebic dysentery	Protozoan	Human beings (all ages)	2 - 8 days	Heavy vomiting and diarrhoea
Bacillic dysentery	Bacterium (carried by flies)	Human beings (all ages)	2 - 8 days	High temperature
Cholera	Bacterium	Human beings (all ages)	1 - 5 days	Mild to very severe diarrhoea with vomiting
Diphtheria	Bacterium (in throat)	Human beings (all ages)	2 - 10 days	Pain in limbs
Typhoid fever	Bacterium	Human beings (all ages)	7 - 21 days	High temperature with diarrhoea or constipation.

Lessons seventeen and eighteen

Group Control

Class SS2

Duration of the lessons: Two periods of 40 minutes per period.

Topic: Micro-organisms in action

Sub-Unit title: Control of disease causing micro-organisms and infection

Materials for the lessons: Sterilized culture medium, petri-dishes, Detol, solution of penicillin, soline solution and a safe place e.g a clear cupboard.

Behavioural objectives: By the end of the lesson the student should be able to:

1. apply some disinfectants and antibiotic
2. control some micro-organisms

3. prevent infection of man by micro-organisms

4. control some vectors.

Previous knowledge: Student have learnt about micro-organism that cause diseases

Introduction (5 minutes) The teacher will ask the students the following questions.

1. Name any two micro-organisms which is the major causative agent of water-borne disease?

2. Mention any two diseases that could be contracted through air.

Presentation: Step 1 (5 minutes)

The teacher will explain to the students that: Penicillin, as an antibiotic from penicillium destroys or inhibits the growth of disease-causing bacteria and fungi. There are other substances called antiseptics which kill or inhibit the growth of disease-causing bacteria and viruses. Examples are iodine tincture, hydrogen peroxide (especially fresh one), detol, izal potassium permanganate, camphor, and even common salt.

Step 2 (5 minutes) The teacher will go further to explain that: Antiseptics are generally applied directly to wounds to stop them from going bad (septic) by killing the harmful micro-organisms. They also minimise the possibility of infection. Antiseptics generally kill the pathogens without damaging the tissues of the host. However, there are other substances which kill disease causing micro-organisms (pathogens) but are too strong to use in direct treatment. These are disinfectants. They are used to sterilize clothing, instruments, sickrooms etc. Examples are

phenol solution, formaldehyde, lysol etc all in solution on the whole, disinfectants are more powerful than antiseptics.

Step 3 (10 minutes) The teacher will explain to the students that in this activity we shall want to discover the effect of detol, penicillin, saline solution on culture media with micro-organisms.

Note: The teacher follow these procedures

a. Inoculate the culture medium in four Petri-dishes provided with a bit from the grown culture supply. Label the petri-dishes A,B,C, and D.

b. Pour some Dettol on the culture medium of dish A and leave in a safe place.

c. Into dish B pour some solution of penicillin on the culture medium and keep in a safe place.

d. Into dish C pour some saline solution and keep in a safe place.

e. Dish D should be kept in a safe place-this will be the control.

Step 4: (5 minutes) The teacher will explain to the students that: In the activities where culture media were inoculated with micro-organisms and some solution of detol, penicillin, and saline solution was put on the inoculated area respectively and the control which was not treated with anything but also kept in a safe place. We discovered that there was great difference between the treated and control.

Step 5 (5 minutes) The teacher will explain further to the students that: the treated did not show any further growth while the untreated there was continuous growth of micro-organism. This is just to confirm that Detol, penicillin and salt inhibited the growth of the micro-organisms.

Step 6 (5 minutes) The teacher will further explain to the students that: Heating to a high temperature or freezing to low temperature, or applying large quantity of salt can be used to kill or to prevent and cure diseases, that are spread by air, by coughing or sneezing, or by contact with dishes, towels, bed clothings, or food. For example, antibiotic (penicillin, terramycine streptomycin etc are used to combat typhoid fever, dysentary, pneumonia, tuberculosis and syphilis.

Step 7 (5 minutes) The teacher will explain again that: Antiseptics and disinfectants are used to minimize the possibility of infection. Good personal hygiene and body cleanliness can lead to reduce the number of harmful mirco-organisms on the body and clothing. We should drink clean and treated water, wash our hands before eating, wash fruits and vegetables before eating them.

Step 8 (5 minutes) The teacher explains the prevention of diseases transmitted by vectors can be achieved.

1. killing the adult vectors. The vector transmits the disease-causing micro-organisms (pathogens). Use insecticides to spray the house. Is good for killing mosquitoes, flies, fleas etc.

   Rats can be controlled by poisoning. Traps and cats can be

used to kill rats.

Step 9 (5 minutes) The teacher further explains that: Preventing the vectors from biting us. Insects can be prevented by the use of nets e.g. mosquito nets, use of insect repellant cream on our skin. Killing the developmental stages of the vectors. This is good for preventing mosquito from breeding, for example use of fish in ponds, use of oil blocks the respiratory tubes of the larvae and pupae.

Step 10 (5 minutes) The teacher will explain further that: Using medicines to kill the micro-organisms in the human body before they develop harmful stage example malaria can be prevented by taking anti-malaria drugs as Daraprin, choloquine and Norolin regularly.

Step 11 (5 minutes) The teacher will ask the students the following questions:

1. Is there any difference between the treated and control?
2. What are the effect of applying Dettol, penicillin and salt solution.

Conclusion: (15 minutes) The teacher will give the student the notes. The student will do the below Home Work.

Home Work

Look for a stagnant water or a container with water around your house in which mosquitoes are breeding observe very closely. If there are larvae and pupae, then apply some kerosine to the surface of the water observe again after ten minutes. What do you see?.

APPENDIX -L

Time Table for Biology Lessons in both Experimental and Control Schools.

Period Days	1	2	3	4	5		6	7	8
Monday		* G.S.S Biology		** Alhudahuda Biology		BREAK			
Tuesday									** Alhudahuda Biology
Wednesday		* G.S.S Biology				TIME			
Thursday									
Friday			** Alhudahuda Biology		* G.S.S. Biology				
Friday									

Key* G.S.S. Government Secondary School, Tukur-Tukur, Zaria (Experimental)
** Alhudahuda Secondary School, Zaria-City, Zaria. (Control)

APPENDIX M

Alhudahuda Secondary School, Zaria-City. Categorization Scores and their achievement Levels (Control Group)

STUDENT	SCORE	ACHIEVEMENT LEVEL
041	52	AVERAGE
042	26	LOW
043	59	AVERAGE
044	62	HIGH
045	70	HIGH
046	37	LOW
047	44	AVERAGE
048	26	LOW
049	30	LOW
050	22	LOW
051	56	AVERAGE
052	44	AVERAGE
053	19	LOW
054	15	LOW
055	15	LOW
056	11	LOW
057	33	LOW
058	37	LOW
059	22	LOW
060	22	LOW
061	41	AVERAGE
062	33	LOW

063	30	LOW
064	30	LOW
065	56	AVERAGE
066	52	AVERAGE
067	33	LOW
068	33	LOW
069	33	LOW
070	33	LOW
071	37	LOW
072	22	LOW
073	22	LOW
074	44	AVERAGE
075	19	LOW
076	22	LOW
077	44	AVERAGE
078	52	AVERAGE
079	26	LOW
080	48	AVERAGE

TOTAL = 1412

Mean = 35.30

Std.Dev = 14.38

APPENDIX N

Government Secondary School, Tukur-Tukur, Zaria.

Categorization scores and their achievement levels. (Experimental Group).

Student	Score	Achievement Level
001	48	Average
002	07	Low
003	37	Low
004	44	Average
005	26	Low
006	15	Low
007	30	Low
008	44	Average
009	37	Low
010	33	Low
011	26	Low
012	37	Low
013	33	Low
014	30	Low
015	22	Low
016	14	Low
017	60	High
018	39	Low
019	44	Average
020	48	Average
021	39	Low

022	19	Low
023	30	Low
024	44	Average
025	59	Average
026	56	Average
027	63	High
028	52	Average
029	48	Average
030	11	Low
031	30	Low
032	22	Low
033	11	Low
034	56	Average
035	41	Average
036	26	Low
037	33	Low
038	30	Low
039	44	Average
040	30	Low

Total:- 1418.

Mean = 35.45

STD.DEV = 14.25

APPENDIX O

Alhudahuda Secondary School, Zaria City Pre-test scores (Control Group)

STUDENT	PRE-TEST SCORE
041	13
042	15
043	23
044	20
045	24
046	06
047	22
048	08
049	08
050	02
051	09
052	24
053	22
054	07
055	05
056	05
057	16
058	06
059	02
060	06
061	06
062	07

063	04
064	13
065	07
066	08
067	05
068	04
069	09
070	15
071	25
072	02
073	05
074	14
075	06
076	03
077	21
078	09
79	11
080	10

Total= 427.00

Mean = 10.68

Std.Dev= 7.04

APPENDIX P

Government Secondary School, Tukur-Tukur Zaria Pre-Test scores Experimental Group).

STUDENT	PRE-TEST SCORE
001	25
002	08
003	20
004	00
005	06
006	10
007	10
008	06
009	16
010	14
011	14
012	12
013	04
014	08
015	07
016	04
017	22
018	18
019	10
020	22
021	14
022	02

023	04
024	06
025	10
026	12
027	26
028	10
029	23
030	00
031	02
032	08
033	02
034	08
035	15
036	02
037	02
038	24
039	26
040	04

Total = 436.00

Mean = 10.90

Std.Dev = 7.81

APPENDIX Q

Alhudahuda Secondary School, Zaria-City Post-test scores and their Achievement Levels for Control (Lecture) Method.

STUDENT	POST-TEST SCORE	ACHIEVEMENT LEVEL
041	32	LOW
042	36	LOW
043	24	LOW
044	36	LOW
045	46	AVERAGE
046	08	LOW
047	50	AVERAGE
048	56	AVERAGE
049	12	LOW
050	12	LOW
051	10	LOW
052	52	AVERAGE
053	52	AVERAGE
054	08	LOW
055	08	LOW
056	08	LOW
057	18	LOW
058	08	LOW
059	08	LOW
060	10	LOW
061	16	LOW
062	12	LOW

063	08	LOW
064	24	LOW
065	18	LOW
066	08	LOW
067	14	LOW
068	08	LOW
069	10	LOW
070	24	LOW
071	60	HIGH
072	06	LOW
073	12	LOW
074	14	LOW
075	18	LOW
076	12	LOW
077	50	AVERAGE
078	46	AVERAGE
079	19	LOW
080	16	LOW

APPENDIX R

Government Secondary School Tukur-Tukur Zaria, Post-test scores and their Achievement Levels for Individualized (LAP) Method.

STUDENT	POST-TEST SCORE	ACHIEVEMENT LEVEL
001	62	HIGH
002	24	LOW
003	60	HIGH
004	20	LOW
005	30	LOW
006	22	LOW
007	36	LOW
008	20	LOW
009	30	LOW
010	36	LOW
011	32	LOW
012	42	AVERAGE
013	26	LOW
014	20	LOW
015	45	AVERAGE
016	50	AVERAGE
017	64	HIGH
018	30	LOW
019	36	LOW
020	54	AVERAGE
021	43	AVERAGE
022	36	LOW

023	04
024	06
025	10
026	12
027	26
028	10
029	23
030	00
031	02
032	08
033	02
034	08
035	15
036	02
037	02
038	24
039	26
040	04

Total = 436.00

Mean = 10.90

Std.Dev = 7.81