EFFECT OF IMPROVISED CHROMOSOME MODEL IN TEACHING GENETICS ON STUDENT ACADEMIC ACHIEVEMENT OF SENIOR SECONDARY SCHOOL STUDENT IN MINNA METROPOLIS

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NOVEMBER, 2019.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

Science is from a Latin word scientia, meaning ‘knowledge’; is a systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the universe. Today we talk of modern science as it phases out the former scientific methods.

The modern science is typically divided into three major branches that consist of the natural sciences (that is, biology, chemistry and physics) which study nature in the widest sense, the formal sciences (that is, logic, mathematics and theoretical computer science)which study abstract concepts and the social sciences (that is, economics, psychology and sociology), which study individuals and societies. It is evident, however on whether the formal sciences actually constitute a science as they do not rely on empirical evidence. Disciplines that use existing scientific knowledge for practical purposes, such as engineering and medicine are referred to as applied sciences. Science is based on research which is commonly conducted in academic and research institutions as well as in companies and government agencies. The practical impact of science policies that seek to influence the scientific enterprise by prioritizing the development of commercial products, health care, environmental protection and armament (weapons used to attain efficacy at hunting, law enforcement, self-defense and warfare). Imagine our world without science and technology.

No vaccines, no cure for diseases, no farm machineries, no herbicides, no computers, no cars and the host of numerous others, that has placed us on the eased side of life. Wouldn’t life be joyless and unbearably and extremely hard? However, with science on our side, it’s an

entirely different tale. This simply depicts the significance of science in our daily different experiences. Right from time man began to exist: eating, tilling the land, putting on clothes, lighting fire, science became inseparable part of life.

Biology and its application is another factor need be we consider in this study. Over the ages biology has been thought across the globe to kids of all schooling ages even to old age and those in demise. It is therefore widely known to be the natural science that studies life and living organisms, including their physical structure, molecular interaction, chemical processes, evolution, physiological mechanisms and development (Benjamin 2005). Biology may of course be complex, but there are certain unifying concepts that consolidate it into a single coherent field. Biology recognizes the cell as the basic unit of life, genes as the basic unit of heredity, and evolution as the engine that propels the creation and extinction of species. Sub disciplines of biology are defined by the research methods employed and the kind of system studied: theoretical biology uses mathematical methods of formulate quantitative models while experimental biology performs empirical experiments to test the validity of proposed hypothesis and theories and understand the mechanisms underlying life and how it appeared and evolved from nonliving matter about four million years past through a gradual increase in the complexity of the system.

Biology is embodied with much branches such as: anatomy, astrology, biochemistry, biological engineering, biogeography, bioinformatics, biolinguistics, biochemistry, biomechanics, biomedical research, biophysics, biotechnology, botany, cell biology, chronobiology, cognitive biology, conservation biology, cryobiology, developmental biology, ecology, evolutionary biology, genetics, immunology, marine biology, microbiology, molecular biology, nanobiology, neuroscience, paleontology, pathobiology or pathology, pharmacology,

psychobiology, quantum biology, systems biology, structural biology, theoretical biology and zoology. If we were to consider the advantage of application of the individual branches already mentioned, then it would be glare enough that biology is a broad course and graced with vast applications and importance to life in general. However, just considering the general application of biology, it ranges from knowing that biology is the science in charge of studying all living beings; the feeding, agriculture, health, industrial growth, humans, solving problems, of modern civilization, cultural beliefs, the understanding of the human body, justice and ecosystem.

Haven't said all that had been mentioned earlier, the study of biology is core. It is a mandatory subject in all Nigerian schools that needs to be passed at least with a credit or with even better grades, before being qualified as to study any of the related branches of biology in higher educational institutions.

Genetics is the study of genes, genetic variations and heredity in living organism. It is considered a field of biology, but intersects frequently with many other life sciences and it is linked with the study of information system. The father of genetics: Gregor Mendel a nineteenth century scientist, studied trait inheritance patterns. In the way trait are handed down from parent to offspring. He observed that organisms inherit trait by way of discrete 'unit of inheritance'. The term is still used today as a somewhat ambiguous definition of what is referred to as gene.

Klug (2006) defined genetics as the biology of variation. Heredity or inheritance focuses on the transmission of characteristics from one generation to another, hence similarities. While variation dwells on the causes of differences among individuals. Genetics therefore attempts to make plain the mechanisms of two constants that are found in the universe-similarities and differences. No

doubt, genetics is been recognized as the conceptual foundation for the understanding of biology itself (Deadman& Kelly, 2000).

Chromosomes is one of the very small structures like threads in the nuclei (central parts) of animal and plants cells or better said to be one of the minute threads in every nucleus in animals and plants cells, carrying genes. German biologist Walter Flemming in the early 1880s revealed that during cell division the nuclear material organize themselves into visible thread like structures which were named as chromosomes which stains deep with basic dyes. The term chromosome was coined by W. Waldeyer in 1888. Chrome is coloured and soma is body, hence they mean "colored bodies" and can be defined as higher order organized arrangement of DNA and proteins. It contains many genes or the hereditary units, regulatory elements and other nucleotide sequences. Chromosomes also contain DNA-bound proteins, which serve in packaging the DNA and control its functions. Benden and Bovery in 1887 made report that, the number of chromosomes in every species is constant. W.S. Sutton and T. Boveri in 1902 suggested that chromosomes are the physical structures which acted as heredity messengers.

Chromosomes are tightly coiled DNA around basic histone proteins, which help in the tight packing of DNA. During inter-phase, the DNA is not tightly coiled into chromosomes, but exists as chromatin.

Science being a field replete with ideas such that pose difficulty to visualize and most times counterintuitive for learners , has therefore made improvising or modeling an important tool to impactful training of learners to understanding its concept and circumstances. As we can say, the concept of chromosomes would be totally an abstract one, since chromosomes are not visible by the ordinary eyes. Here we put the use of improvisation to function, in order to aid

effective teaching (Harrison 2008). He suggests that younger learners will benefit more from concrete analogies that they can feel and see. He however, said even older ones may not possess the necessary visualization skills as to utilizing verbal and abstract analogies. This issue poses an interesting puzzling question: Should teachers improvise for chromosomes in order to with ease broaden and simplify these complex genetics concepts, or would they be wasting time and resources if they do? Wadsworth (2004) cited that analogical reasoning is not available to children until the stage of formal operations, when children are able to use analogical rules and articulate the form of the analogy.

As it is, in this part of the world, the concepts of chromosomes is usually introduced to learners at the age range of 14-18, or let's just say that in school biology curriculum, it was observed that genetic concepts play important role in scientific achievement that affects the live of mankind. A review of West African Examination Council (WAEC) chief examiner's reports in biology for May/June and November/December examinations in the past years yielded an insight into the state of the situations embattling the success of learning biology and the final ordinary level's results. Remarks such as: student's poor understanding of topics taught in biology, poor retention of certain terms and poor performance on questions related to genetics, were among the numerous reasons the chief examiner stated (WAEC 2009-2015). The year in and out poor plus fluctuating performance of students in biology was a recurrent menace in the same document. Failure in biology has resulted into massive lack of manpower during admission into related course of studies into higher educational institutions. The persistent poor achievement and retention of student in biology, specifically in basic genetic concepts at senior secondary school examination of May/June (2009-2015) reported by the WAEC chief examiner,

leaves one with doubt about the effectiveness of the teaching methods popularly used by the biology teacher.

1.2 Statement of the Problem

The poor achievement in student basic genetics concept a review of West African Examination Council (WAEC), chief Examiner report for biology in May/June (2009 – 2015) shows students poor achievement has posed a great concern to the study revealed that lack of instructional materials leads poor performance and that improvised materials improves learning Kenny &Gellrich, (2002).

Therefore the study intends to investigate the effect of improvising chromosome for teaching genetics in biology among senior secondary school (SS3) students in patigi. Since lack of instructional materials in teaching biology is found to be among the factors causing poor performance in WAEC biology examination in Nigeria.

1.3 Aims and Objectives of the Study

i. To determine the effect of improvised chromosome model on teaching on student academic achievement on secondary school biology students.

ii. To determine the effect of improvised chromosome model on male and female students taught genetics with chromosome model.

1.4 Research Question

The following research questions were raised to guide this study:

i. Is there any difference between the academic achievements of students taught with improvised chromosome and those taught with the conventional method of teaching?

ii. Is there any difference in achievement of females and males taught genetics with improvised chromosome and those taught without chromosome model?

1.5 Research hypothesis

The following null hypotheses are raised to answer research questions.

$H0_1$: There is no any difference between the achievement of students taught with improvised chromosome and those taught with conventional method.

$H0_2$: There is no difference in the achievement of male and female students taught with improvised chromosome model.

1.6 Scope of Study

The study is limited to the research for effect of improvised chromosome for teaching genetics in Senior Secondary School, Minna Metropolis.

1.7 Significance of Study

The significance of this research work covers the benefits of the students, teachers, parents and the Nigerian government. Such as:

- The students; to be able to comprehend the concept of genetics and other biological terms, with ease, thereby, avoiding unnecessary delay of admission into related higher educational institutions as a result of failure of biology and other subjects.
- The teachers being able to handle genetics class without recording failure.

- The parents; being relieved of paying tuition fees repeatedly.
- The government; would be able to concentrate on other educational programs, instead of budgeting for rewriting of exams. The government would be certain about what and what not to supply to schools to help in stimulating knowledge.

1.8 Operational Definition of Terms

Improvisation: Is the process of making something by using whatever is available other than original required thing usually, because what is really needed is not available.

Chromosome Model: This is a constructed chromosome using steel and colours used in the study.

RNA: Ribonucleic Acid

DNA: Deoxyribonucleic Acid.

CHAPTER TWO

2.0 LITERATURE REVIEW

This chapter discussed concepts of the study under the following subheadings: conceptual framework, Theoretical Framework, Empirical Studies and Summary of literature Reviewed.

2.1 Conceptual Framework

Conceptual framework of this study project explains the concepts that make up the topic of interest in a way that makes it understandable. This study intends to reviewed the following concepts:

i. Biology
ii. Academics achievement in biology
iii. Genetics
iv. Gender performance
v. Improvisation and its important

2.1.1 The Concept of Biology and Important

Biology is the natural science that deals with life and living organisms, including their chemical process, molecular connections, physical mechanism, morphology, development and evolution.

The subject of biology piques intellectual curiosity, increase awareness of fragile ecosystem and stimulates critical thinking. The study of biology aims to increase understanding of living system and to allow you to consider the systems in relationship to self and other organisms in the in the natural environment. An advantage of biology subjects is the application

of the theory to the real world. The goals is to be able to test theories developed about living thing by utilizing the scientific method and then to apply the new information in a beneficial way.

Biology is an indispensible component of daily life. Whether it is been known or not. According to Oloddu (2010) Biology is of importance by understanding our bodies, that is, it helps us prevent, and even eliminate disease. Also understanding our immediate environment that is how plant and animal interact with human, animal planet teaches us how to help us to pinpoint what causes harm to ecological system harvesting of food etc

Therefore biology uses scientific process and skills to solve human problems so that student can achieve the content knowledge of science in an investigative way. Therefore, the effects of improvised chromosome model for technology genetic in biology is investigate.

2.1.2 Academic Achievement in Biology

In school biology curriculum, it was observed that genetically concept play important role in scientific achievement that affects the lives of mankind. Despite it important in the society, an Examiner reports in biology for the May/June and November/December examination in past years yield an insight into that state of the situation. Remarks such as “students poor understanding and retention of certain genetic terms non-familiarities with concept of genetic” for performance on questions related to genetics, were among the numerous reason the WAEC chief examiner stated (WAEC 2009 – 2015).

The year in and out poor plus fluctuating performance of students in biology was a recurrent menace in the same document. Failure in biology has resulted in massive lack of manpower during admission into related course of studies such as Medicine, Agriculture,

Industry and Education (Samikwo, 2013). This picture is even more depressing when viewed against the back drop that biology is the third most registered subject (after English Language and Mathematics) in the May/June WAEC Examination (2009 – 2015) recorded a very poor achievement at senior school certificate examination. The persistence poor achievement of student in biology, specifically in basic genetic concept at senior secondary school examination of May/June (2009 – 2015) reported by the WAEC chief examiner leaves one with doubt about the effectiveness of the teaching methods popularly used biology teachers. This therefore, intents to investigate the effect of improved chromosome for teaching genetics in biology.

2.1.3 Genetics

Genetics is the study of genes, genetic variation and heredity. In living organism (Griffiths *etal;* 2000). It is considering a field of biology, but intersects frequently with many other life sciences and it is linked with study of information system. The father of Genetics Gregor Mendel a nineteenth century scientist, studied trait inheritance pattern. In the way trait are handed down from parents to offspring. He observed that organism inherit by way of discrete unit definition of what is referred to as gene.

Klug (2006)defined genetics as the biology of variation. Heredity or inheritance focuses on the transmission of characteristics from one generation to another, hence similarity while variations dwell on the causes of difference among individuals. Genetics therefore attempts to make plain the mechanisms of two constant that are found in the universal similarities and difference. No doubt, genetics is biology itself (Deadman& Kelly, 2000).

2.1.4 Gender Performance

Gender refers to the socially constructed characteristics of women and men such as norms, roles and relationships of and between you groups of women and men (W.H.O 2018). For more understanding one would refer to gender as a variation in physical strength and the cerebral size that is ability to accumulate or tolerate academic stress by the male and female. Although studies have shown that an average girl does better in school those boys. Girls get higher grade and complete school with higher grades than boys (Jacob, 2002, Blume, 2009).

Gender differentiation is an old controversial issue in education different opinion and views abound on the issue of gender and it effects on student's achievement especially in science. The proposing and research: Obiekwe (2001), Yong (2009), Okoro (2011), Opera (2011) and Nasr &Asghar (2011), contend that there is a significant difference in in the achievement and retention between male and female student's in biology, whereas the opposing argument and research: Ibe (2004), Nwagbo and Chukelu (2011), Bello and Animbola (2012) and Oludipe (2012) one of the view that there is no significant difference in the achievement and retention of male and female student's in the biology that both male and female student's achieve equally in biology when exposed to the same treatment and given equal opportunities.

Although many studies have pointed to the fact that male student are academically superior to their female counterparts in mathematics and sciences: Usman (2000) Oluwafemi (2017) revealed no gender difference in both academic achievement of male and female student's in science. On a large level, excluding women from science in the classroom sets the stage for a huge decline in scientific literacy for the whole society. This makes the public less savvy consumers of scientific information, by pseudo-scientific claims (Microsoft Encarta Reference library 2005). The gender difference that exist in science achievement have been linked to the way science is being taught in the classroom (Harding and White Leg 1997, Aigboman, 2002).

The issue of gender difference is still a controversy, even though the literature cited above were on gender in relation to achievement performance in biology and science. The aspect of effect of improvised chromosome model for teaching genetics in biology was not investigated which may be another factor vesting in improvised chromosome model have effect on the academic achievement of male and female student's in senior secondary schools.

2.1.5 Improvisation and Importance

According to Hornby (2012), improvisation means to make or do something by using whatever is available, other than the originally required thing, usually because what is really needed is not available. Improvisation is a provision of alternative to all things. Although we often hear about improvisation of instruction material in education, it is also viewed as substituting or replacing. Improvisation can also be formulating or originating a totally new tool, instrument, material or devise for serving certain function. Also altering the size, shape and out look of a thing to serve a purpose that is other than its original usage and substituting something in place of another to serve a unique function. Improvisation conjure the nation of materials for effective teaching and learning, it is basically mostly around this idea of material that improvisation finds its footings, usage and essence.

The fact still remain that it is virtually impossible to purchase or male all facilities, supplies and equipment require for equality and sound education available, especially in this part of our content. This makes it so imperative for teachers to reason how best to make use of their manipulative skills to improvised in order to achieve their lesson subject at least to a reasonable extent that would be satisfying. Instructional media ensure that the learner hears, see, feel, recognized and appreciate as they learn, making use of the five sense modalities at the same time

(Lidia & Sara 2010). When the real equipment and instructional media aren't available improvisation takes their place and function as if it is the real things to use. This is to enhance to enhance teaching and learning and learning process as well as make the make the expensive nature of scientific equipment, the difficulties experienced in producing them, as well as excruciating and persistent problems of inadequate funds irrelevant in achieving the instructional objective.

It is a fact that non provision of real media and equipment have all combined to worsen teaching of science and technology education in schools (Kenny and Gellrich 2002). But with well packaged and relevant improvisation arbitrary and complete abstract of the subject matter in the face of learner, os significantly reduced to lend credence to the importance and essence of improvisation where and when the real instructional material are not readily available. Improvisation can be described as substitute to make a substitute for an item, out of material can be easily sources for, or available at the time. Improvisation and fabrication can be explained as composing a careful selection and of media, as alternative means of complementing the existing to otherwise instructional media and equipment in schools (Osho 2011). Through improvisation, learners' attention are captured and retained and retained for better part of what they had been taught. Since serve as educational media, student's interest in science and technology education is stimulated, interesting and meaningful. Learning is more permanent and there is development of skills in psychomotor domain. The need for improvisation becomes essential where population outweighs what is available because of insufficient funding in education (Azzara 2002) Due to grass inadequacy of media and equipment's meant to enhance the effectiveness of science and technology.

Understanding the role of improvisation requires an imagination of the type of teaching and learning that is likely to place. Situation whereby improvisation is necessary and not explored, learner solely rely on imagination, in order to synthesize the information and or knowledge being presented or taught to them. Haven't said almost all, this study aims at improvising chromosome model for teaching genetics in biology in senior secondary school.

Benefits of Improvised Teaching Materials

The following are some of the benefit of improvised teaching materials:

i. Improvised tools help teacher with ease as the students easily understand teaching with instructional material.
ii. Communication is more effective in classes where improvised tools are explored.
iii. Confidence of the teacher is helped by improvised tools
iv. Decision making by both teachers and learning is made faster
v. Improvise tools because teacher and students to work as term.
vi. Social interaction is achieved

2.2 Theoretical Framework

2.2.1 Concept of Learning

Learning is a process that leads to change which occurs as a result of experience and increase the potential for improvise performance and future learning. (Ambrose *et al*, 2010, P.3). The change in the learner may happen at the level of knowledge, attitude or behaviour. As a result of learning, learners come to see concepts ideas and/or the world differently. Learning is the act of acquiring new skills or modifying existing knowledge, behaviour, value or preference

and may involve synthesis of different types of information. Learning is a phenomenon that leads to change behaviour. Okpala (2015), Opined that the main problem of the teachers is how to convey effective knowledge skills and capacities to students. The remarked further that is important for teacher to be knowledge with the knowledge and skills on how to make learning effective. Effective teaching and learning improvises student's comprehension in all aspect of education. Due to complex nature of biology syllables, it can be boring to the student but their used model, charts and diagram in teaching and learning biology is more interesting and more and this can positively reduce the stress and also impact positively on student's achievement. It is also a known fact that student's academic comprehension in biology is depend upon the efficiency of the methodology of teaching and the effectiveness of the use of instructional media such as diagrams, models and other teaching aids which helps students to understand what they are been taught better

2.2.2 Theory of Learning

Gestalt Theory

The term "Gestalt" comes from a German word that roughly means pattern or form. The main tenet of Gestalt theory is that the whole is greater than the sum of its parts, learning is more than just invoking mechanical response from learners. As with other learning theories, Gestalt theory has laws of organization by which it must function. The organizational laws already exist in the makeup of the human mind and how perception is structured. Gestalt 1theroist proposed that the experience and perception of learners have a significant impart in the way that they learn. One aspect of Gestalt is phenomenology, which is the study of how people organized learning by looking at their lived experiences and consciousness. Learning happens best when the instruction

is related to their real life experience. The human brain has the ability to make a map of the stimuli caused by these life experiences. This process of mapping is called: Isomorphism".

When a brain sees only part of a picture, the brain automatically attempts to create a complete picture. This is the first organizational law, called the "factor of closure" and it does not only apply to thoughts, feeling and sounds. Based upon Gestalt theory, the human brain map element of learning that is presented close to each other as a whole instead of separate parts. This organizational law is called the "Factor of proximity and is usually seen in learning areas such as reading, and music where letters and words or musical notes make no sense when standing alone but become a whole story or song when mapped together by the human brain. The next organizational law of Gestalt theory is the "Factor of similarity", which state that learning is facilitated when group that are alike are linked together and contrasted with groups that present differing ideas. These forms of Gestalt learning enable learners to development and improve critical thinking skills.

When observing things around us, it is normal for the eyes to ignore space or holes and to see, instead of whole subjects. This organizational law is called the "Figure ground effect". As new thoughts and ideas are learned the brain tends to make connection or trace; those are respective of the links that occurs between conceptions and ideas as well as image. This organizational law is called the "trace theory".

Gestalt theory placed its main emphases on cognitive processes of a higher order causing the learner to use higher problem solving skills. They must looked at the concept presented to them and search for the underlying similarities that link than together into a cohesive whole. In this way learners are able to determine specific relationship almost the ideas and precipitance of

presenting information or image that contain gap and element that don't exactly fit into picture. This type of learning requires the learner to used critical thinking and problem solving skills. Pattern than pitting out answers by rote memory the learning must examine and deliberate in order to find the answer they are seeking. When educators are presenting information to the students using the Gestalt theory of learning, they must ensure that their instructional strategies make use of the organizational law presented earlier in this article. The Gestalt theories of learning come into the forefront of learning theories as a response to the behaviorist theory. Other theories have evolved out of the original Gestalt learning theory with different forms of the Gestalt theory taking shape. The field of Gestalt theories has come to be acknowledged as a cognitive interaction family of theories.

Gestalt Theory purports that an individua**l** is a whole person and the instructional strategies used to teach them will help to discovered if there is anything that is mentally blocking them from learning certain new information. Teaching strategies are used to present problems as a whole and to attempt to remove any mental block from the learner so that new information can be stored.

Designing Instructional strategies that into consideration the learner's past and current experiences and perceptions are the key to teaching new information. In Gestalt learning theory, when the learner comes across information or concepts that are not organized, the mind organized it in an attempt to enable learner to recognize and apply the concept being taught (David L, Gestalt theory (VON Ehrefels)" in learning theories February 11. 2015). Beside on this theory this study intends to investigate effect of improvised chromosome for teaching genetics.

2.3 Empirical Studies

This study seeks to investigate the effect of improvised chromosome model for teaching genetics in Senior Secondary Schoolbiology students. There are several studies in respect of this. For example, Grady *et al* (2008) investigated the effect of a model using genetics as a topic. Learners from early childhood to late adolescence were taught about genes and DNA, using analogical model during their regular biology classes. Changing conceptual understandings of the concepts of genes and DNA as a result of the teaching, that incorporate the model investigated. The research design was a multiple case study enacted in four 'classes (year 2, 5, 9 and 12). In all these classes, the teacher used the same wool model to engage learners in the learning about genes and DNA. The results suggested that the role of the wool model was largely determined by the learner's prior knowledge. The model was malleable and had multiple roles in the teaching and learning process that reflected the learners developing conceptual understanding about genes and DNA.

Ambusson*et al*. (2006) sited that no, only do science teachers, laboratory manuals and science textbooks utilize models and analogies to captivate -the conceptual attention of learners, but science-based television programmes and computer software abound in graphical representations scientific phenomena. However, little is known, about how models and analogies are used by learners of different ages. We know little about the way young children in the early years of primary school are able to use models to understand scientific conceptsCompared with students in the final years of high school or about how model-building capacity develops between these ages.

Wadsworth (2004) after a study of Piaget's examination of children understands of analogies concluded that analogical reasoning is not available to children until the stage of

formal operations when children are able to use analogical rules and articulate the form of the analogy.

Harrison (2008), the use of analogical models to explain science in schools is not a straight issue on one hand. It is plausible that pupils who do not have formal operational thought patterns are incapable of using models and analogies because the process ot drawing comparisons between two scientific phenomena is an abstract process in itself. On the other hand, it also is plausible that models particularly those of concrete, hands on nature, and may have much to offer pupils who cannot comprehend abstract scientific concepts. Concrete models may be useful tools to help pup.ls of a very young age visualize non-observable, explanatory phenomena such as disease causing bacteria, the day/night cycle and genes and DNA.

Paul (2018) the study reviewed students' dread for Genetics in Biology in Nigerian schools. Personal observation of the researcher and evidence from literature showed the conventional g strategies have low positive effect on students' comprehension of the concept of Genetics. Also, the review depicts that poor performance on questions bothering on Genetics has been severally attributed to Biology teachers' use of conventional lecture method which fails in communicating Genetics concepts effectively. This formed the basis of review. It wasconcluded that the Information and .Communication Technology (ICT) packages could be implored by teachers to assist in conveying genetic concepts and distilling students" dread of it and make teaching and learning more realistic and effective even productive, as it would be of great help to the society at large. It was recommended that Biology teachers should be trained and regularly retrained by the government on the utilization of ICT packages for instructional delivery in Biology.

Venville*et al* (2005) 10-15 years old children were targeted with an interview protocol. The first part of the interview aimed to determine whether the interview could differentiate between genetically inherited traits and socially and culturally acquired traits. Part 2 of the interview aimed to determine the interviewees' understandings of how and' why offspring resemble their parents. That is to probe for knowledge of related mechanisms such as genes and DNA, the aims of the third part of the interview was to determine the interviewees' conception of the means of genetic inheritance. If the pupil had either mentioned or heard of genes or DNA, they were asked questions such as 'where do you think genes are in the body? what do you think genes look like? And how do genes work? This third section of the interview was expanded post-intervention to help determine the role of the wool model in developing the pupils' conceptions of genes and DNA.

Yu-Chien Chu (2008), studied to seek and explore the challenges of learning genetics and to identify possible ways forward. The research ensued at junior high school level in Taiwan. Genetics is often deemed of as a subject or a topic in biology that is difficult to learn and understand, especially for novices. A review of literature on learning difficulties in genetics is provided to explore the nature of the difficulties, with likely explanations for the challenges or difficulties encountered. Glaringly, many would accept that genetics is an important subject to learn in these days and age where its applications are unavoidable and even the cause of many arguments. However, due to the nature of the subject matter and the way learning processes occur and, possibly, the way it is being taught, the understanding of genetics ideas of the majority of students is thought to be very shallow and full of confusions and alternative views.

Chifwa (2015) made a study that investigated the teaching of genetics in selected secondaryschools of Kit we District in order to determine very causes of poor performance in

genetics questions in the biology tests and examinations held at the end of senior secondaiy education. This study was guided by the following questions: Who teach genetics in secondary schools in Kitwe District? How is genetics taught in secondary schools in Kitwe District? What challenges do teachers and learners face when teaching and learning genetics respectively? How could the teaching of genetics be improved? The research design used was cross section survey. The target population was all teachers and students of biology in Kitwe District. Data was collected from 18 teachers of biology and three heads natural science department who were purposively sampled. Data was also collected from 180 randomly sampled grade12 pupils. Three participating secondary schools were purposively sampled. The research mainly used the qualitative research methodology. Qualitative data was collected by using lesson observations, open ended interview guides and questionnaires. The data collected was analyzed using qualitative content analysis approach.

Mberekpe (2013) in his study investigated effects of learner's improvised instructional materials on students' achievement in Biology. This study became very necessary because of the unavailability of instructional materials for teaching biology in the secondary schools. The study employed a quasi-experimental design, specifically the pretest - posttest nonequivalent group design. One hundred and forty SSI students from potiskum Education Zone from 2 schools randomly drawn from public primary schools in Potiskum education zone of Yobe State formed sample of the study. Three experts validated the instrument Biology Achievement Test (BAT). Five hypotheses were tested as soon as five research questions were answered. The data were analyzed using mean, standard deviation and ANCOVA. The results revealed that students taught using improvised instructional materials performed betterthan students taught using conventional material; male students did not perform better than their female counterparts in

Biology; rural students performed better than urban students in biology; The results do not suggest ordinal interaction effect between mode of method and gender on students' achievement in biology. This was because at all the levels of gender, the mean scores were higher for student's improvised instructional material; the result suggests ordinal interaction effects between modes of method and location on students' achievement in Biology; this was because at all the levels of location, the mean score were higher for student's improvised instructional material compared to environment materials with lower mean scores; there was no significant difference in the mean achievement scores of male and students in biology; there was significant difference in the mean achievement scores ofurban and rural students in biology; The interaction effect of method and gender on students mean achievement scores in Biology was, not statistically significant. The interaction effect of method and location on students' mean achievement scores in Biology was, not statistically significant. Based On the findings and implications, it was recommended that teaching of Biology in secondary school should be conducted in a manner that students will effectively understand and learn the concept taught. It was suggested that further research could be carried out on this topic using true experimental research design.

Knippel et al (2005) While learning and teaching difficulties in genetics have been abundantly explored and described, there has been less focus on the development and field-testing of strategies to address them. To inform the design of such a strategy a review study, focus group interviews with teachers, a case study of a conventional series of genetics lessons, student interviews, and content analysis of school genetics teaching were earned out. Specific difficulties reported in the literature were comparable to those perceived by Dutch teachers and found in the case study and the student interviews. The problems associated with the abstract and

complex nature of genetics were studied in more detail. The separation of inheritance, reproduction and meiosis in the curriculum accounts for the abstract nature of genetics, while the different levels of biological organization contribute to its complex nature.

Finally, four design criteria are declined for learning and teaching strategy | address these problems: linking the levels of organism, cell and molecule; explicitly connecting meiosis and inheritance, distinguishing the somatic and germ cell line in the context of the life cycle; and an active exploration of the relations between the levels of organization by the students.

Bahattin et al (2016) Advances in genetics and related technology have significant influence on our life. Recently, one of the most popular scientific and technological advances are related with genetics such as human genome project, genetically modified organism, cloning of organism, gene therapy and genetic background of various illness etc.. With the discoursing of this, society demands clear cut information to evaluate these genetics related issues having ethic and social characteristics. Becoming of evaluations' skills for genetics related controversial issues required sufficient understanding of basic genetic concepts. At this point science education and science teachers take priority for the supplying of scientific literacy which is required for making informed decision about of genetic related controversial issues imposed by daily life. However, some researches indicated that teachers are one of the reasons of students' misconceptions. In this study pre-service science teachers' difficulties of genetics concepts and relationship understanding level and learning approach was investigated with 196 pre-service science teachers, who were studying at Kastamonu University Faculty of Education. Data collection tools were multiple choice Genetics Concepts Test and Learning Approach Questionnaire, four-point like type instrument. Data obtained from. Genetics Concepts Test was described by means; variance and most frequently false responses were determined to uncover

misunderstanding of genetic concepts. Correlation analyses were conducted to examine relationship between pre-service teachers' understanding of genetics ppcppts and learning-orientations. One of the reasons for difficulty of genetics concepts isunfamiliarity of students with the definitions of the genetics related terms because terms look and sound very similar, e.g. transcription, translation, chromosome and chromatid (Baharct al, 1999). But this explanation seem not suitable for science teacher candidates because in science teacher training program there are two semester general biology and one semester genetics courses, so teacher candidates should be familiar with such concepts In this case should be learning orientation of teacher candidates more adequate explanation for low . Understanding level of genetics concepts. In this study a positive but weak correlation between understanding level of genetics concepts and level of tendency of meaningful learning approach. It is expected results since abstract characteristic of concepts of genetics is commonly expressed reason for the learning difficulty Saka*et al* (2006); Yenilmez 2011; Dikmenli et al. 2011. The abstractness of genetic concepts makes meaningful learning approach indispensable by preventing from getting misunderstanding. In contrast to this many students' learning approach display rote learning tendency and students don't construct the relationship between concepts Cavallo& Schafer (1994)).

Rundgren&Hoglund (2012) said that Creativity and improvisation have been an important ' teaching Basic Technology (Azzara, 2002). It indicates that improvisation happens when an individual has internalized a Basic Technology concept and is able to understand and to express Basic Technology ideas spontaneously. He added that there are important factors to consider in defining improvisation, such as the process of expressing Basic Technology thoughts and emotions, creating Basic Technology within certain structures previously leamt, and producing Basic Technology discourse. In researching the application of improvisation within

the context of Basic Technology, Azzara stated that improvisation allows self-expression, and to develop higher order thinking skills, and possess a more comprehensive and intimate relationship with Basic .Technology. It is important to develop improvisation in the community, develop an atmosphere where improvisation, interaction and spontaneity are nourished, understand improvisation as a way of life and not just as activity, believe that improvisation may be developed and that all teachers possess the potential to improvise, observe that improvisation can affect other Basic Technology skills, and incorporate a model to develop improvisation skills that will help teachers as well as students. In an attempt to find an answer on how teachers can improvise, Kenny &Gellrich (2002) suggested two strategies:transcendence and deliberate practice. Transcendence, as stated by Kenny &Gclinch (2002) is a state of consciousness that reaches beyond the knowledge accumulated within you, whereas the primary objective of deliberate practice is to stimulate the development of improvisation skills through the bases of acquired knowledge. It is important that group activities complement individual practice. Although individual practice is beneficial to the development of technical and theoretical principles, improvisation emphasizes more collective participation.

Creative improvisations majorly and generally occur in a collective participatory atmosphere as opposed to an individualized teaching and learning context. The ability of teachers to rca and create Basic Technology materials or media through unpredictable dynamics at variables is one of the most distinct aspects of improvisation (Lidia & Sara, 2010).

2.4 Summary of Literature Review

Biology knowledge is an essential element for national and human development. Over the years the use of in effective instructional materials in teaching biology has contributed to the

reduction in the number of students that could have opted for biological science and also in increasing of the potential of student in student of biology. Despite the importance of biology to the society, a review of West African Examination Council (WAEC) Chief Examiner report in biology for May/June and November/December in past years remarked such as student poor understanding and retention of certain genetics terms, non-familiarities with concept of genetics", poor performance questions related to genetics were among the numerous reason the WAEC Chief Examine Stated. (WAEC) 2009 – 2015).

Gender differentiation is an old controversial issue in education. Different opinions and views abound on the issue gender and its effects on students achievement especially in science. The proposing and research Obiekwe (2008), Yong (2009), Okoro (2011). Opera (2011), and Nasr &Asghar (2011), contend that there is a significant difference in the achievement and retention between male and female student's in biology, whereas the opposing argument and researchers: Ibe(004), Nwagbo and Chukelu (2011), Bello and Abimbola (2012) and Oludipe(2012) are of the view that there is no significant difference in the achievement and retention of male and female students in biology that both male and female student's achieve equally in biology when expose to the same treatment and give equal opportunities.

Rundgren&Hoglund (2012) said that creativity and improvisation have been an important role in teaching basic technology (Azzara, 2002). Chifloa (2015) made a study that investigate the teaching of genetics in Selected Secondary of Kitwe District in order determine very cause of poor performance in genetics question tests and examination held at the end of senor Secondary Education. Mberekpe (2013) in his study investigate effect of learner's improvised instructional materials on student's achievement in biology. This study becomes very necessary because of the unavailability of instructional materials for teaching biology in the Secondary Schools.

In view of these short comings, research's in biology education have continue to search for an effective method or instructional materials that could facilitate teaching and learning of genetics and biology as a subject to enhance student's achievement in biology. This present research intends to investigate the effect improvised chromosome for teaching genetics on student's achievement in biology.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Introduction

This chapter presents the method to be used in the cause of the study. It contains the research design, the area of the study, population, sample and sampling technique, research instrument, validity and reliability of the instrument, method of data collection and method of data analysis.

3.2 Research Design

This research design adopted for this study was quasi-experimental design precisely pre-test, post-test, non-equivalent group design. This is a design in which subjects are not randomized instead, they are used as they are (intact class). The subjects will be pretested, after the treatment, they null also be posttested as to assess the effect of the treatment.

3.3 Research Population

The population of this study consist of all the senior secondary school class three (3) Biology students with a population of 3,387 students (Niger State Ministry of education Senior Secondary School in Minna Metropolis 2018/2019). The target population are the biology students in all Government Secondary Schools of 2018/2019 session in Minna Metropolis of Niger State. The choice of SSIII is because the topics to be assessed falls under SSIII syllabus or scheme of work.

3.4 Sample and Sampling Technique

The sample size in this research was 107 students who were selected from two intact classes from two randomly selected schools. The two intact classes were randomly assigned into

experimental and control groups respectively. The experimental group has 48 (27males, 21females) students, while the control group has 59 (23males, 36females) students. The experimental was taught using the chromosome model, while the control was taught using chalk and board alone. The two schools selected as sample are AhmaduBahago Secondary School and Bosso Secondary School.

3.5 Research Instrument

The instrument used for the data collection was a Biology Achievement Test (BAT) which comprise 20 multiple choice questions were developed by the researcher in accordance with SSS III biology curriculum. The topic selected was genetics concept. Each item of the research instrument consist of multiple choice objective questions with four (4) different option (A – D) for the student to choose. 45 minutes was allowed for the students to complete the questions. The purpose of the instrument is to test the students' previous knowledge and academic achievement of the concept taught. This will be marked and scored in percentages.

The questions were drawn based on an approved table of specification on the six (6) levels of cognitive domain.

Table 3.1 specification for Biology Achievement Test (BAT)

Domain Level	Knowledge	Comprehension	Application	Total
1. Chromosome	4	1	1	6
2. Protein	2	1	1	4
3. DNA	3	1	1	5
4. Nitrogen bases	3	1	1	5

3.6 Treatment of Instrument

In the presentation of the lesson, a model that serves as an instructional material for chromosome was used. This model was made of iron which is printed or coloured with different colour indicating to sugar phosphate backbone, Cytosine, Guanine, Thymine and Adenine. The strand (nucleotide chain) is colour blue in between the strand there are tables connecting the nitrogen bases which pairs. Green (Adenine) pairs with red (Thymine) while black (Guanine) pair with blue (Cytosine).

3.7 Validity of the Research Instrument

The research instrument (Biology Achievement Test) was validated by the project Supervisor and two other Lecturers in Science Education Department FUT Minna. All observations and corrections were considered in the final draft of the instrument. The three validations considered the instrument valid. The treatment of the instrument was also validated alongside the test instrument and was adjudged valid.

3.8 Reliability of Instrument

In order to ascertain the reliability of the BAT, pilot study was carried out with the use of an intact classroom from a school outside the sample but within population. The main purpose of the pilot study according to Kerling, Fred and Howard (2000) is to confirm the suitability, adequacy and effectiveness of the instrument in meaning what was expected. Test retest reliability was used to administer BAT to total number of 60 students and the data obtained from response of the students were used to establish the reliability of the instrument. The reliability was determined using Kuder Richardson formula (KR-20). A reliability index of 0.76 was obtained for the instrument which means it was reliable.

3.9 Method of Data Collection

In the first place, letter of introduction was collected from the HOD Science Education Department to be presented to the sampled schools. The research administered the instrument as a pre-test to both groups before teaching commence. The data generated was analyzed and recorded. Teaching began and lasted for two weeks, each group was taught for a week using double periods. After the teaching the post-test was administered, scored and recorded for data analysis.

3.10 Method of Data Analysis

The data collected was analyzed using mean and standard deviation to answer the research questions, while t-test was used to test the hypotheses at 0.05 level of significance using statistical package for the Social Sciences SPSS (version 23).

CHAPTER FOUR

DATA ANALYSIS AND RESULT DISCUSSION

4.0 Introduction

This chapter contains the analysis result of the data generated by the researcher. It provides detailed tables containing results that answer the hypotheses of the study. It rounded with the discussion of the results.

4.1 Presentation of Results

Table 4.1 Pretest t-test result of the experimental and control groups

Group	N	d.f	Mean	SD	t-cal	P-value
Experimental	48	105	8.31	3.61	0.75	0.45

Control	59		8.75	2.85	

The result in the Table shows the t-test analysis of mean achievement score of the experimental and control group in the pretest. It shows that t(105) = 0.75 is greater than 0.05. This reveals that there is no significant difference between the achievement score of the two groups in the pretest which means they are of the same level of entry behavior.

Research Question 1: Is there any difference between the academic achievement of students taught with improvised chromosome and those taught with conventional method.

Table 4.2 Mean and Standard Deviation of posttest of experimental and control group

Group	**N**	**d.f**	**Mean**	**SD**
Experimental	48		12.44	2.86
	105			
Control	59		10.22	2.45

The result in Table 4.2 showed that there is difference between the academic achievement of student taught genetics with chromosome model with the mean (12.44) and standard deviation (2.86) and the academic achievement of students taught with conventional method of teaching with mean (10.22) and standard deviation (2.45) with marginal mean difference of 2.22.

Research Question 2: Is there any difference in achievement of female and male with improvised chromosome?

Table 4.3 Mean and Standard Deviation of Male and Female with Chromosome Model

Group	N	d.f	Mean	SD	
Male	27			12.63	3.16
		46			
Female	21			12.19	2.49

The result in Table 4.3 shows that there is no difference between the academic achievement of male students with mean (12.63) and standard deviation (3.16) and the academic achievement of female with mean (12.19) and standard deviation (2.49) with marginal mean difference of 0.44.

Research Hypothesis ($H0_1$): There is no significant difference between academic achievement of students taught with improvised chromosome model and those taught with conventional teaching method.

Table 4.4 Posttest t-test analysis of difference in mean of experimental and control groups

Group	N	d.f	Mean	SD	t-cal	P-value
Experimental	48		12.44	2.86		
	105			4.32	0.0001	
Control	59		10.22	2.45		

Table 4.4 shows the mean, standard deviation of both the experimental and control groups. The t-value 4.32 is greater than 0.05 level of significance. Hence, the null hypothesis is rejected; as it is clear that there is significant difference between the mean score of students taught genetics with improvised chromosome model and those taught with conventional method.

Research Hypothesis $H0_2$: There is no significant difference between academic achievement of male and female students taught with improvised chromosome model.

Table 4.5Posttest t-test analysis of the difference in the mean scores of males and females taught genetics with improvised chromosome model.

Group	N	d.f	Mean	SD	t-cal	P-value
Male	27		12.63	3.16		
	46			0.52	0.60	
Female	21			12.19	2.49	

Table 4.5 reveals the t-test result of the difference in posttest mean score of male and female in the experimental group. From the table male students have a mean score (12.63) and standard deviation (3.16) while the female students have mean score (12.19), standard deviation (2.49) and t(46) = 0.52, P-value 0.60 is greater than 0.05. Therefore, the null hypothesis is accepted. This implies that there is no significant difference in the mean scores of male and female students taught genetics with improvised chromosome model.

4.2 Discussion of Results

The discussion of the result based on research hypotheses are discussed below.

The result of the pretest: The students in both experimental and control groups were equal before the actual treatment were carried out. The in table 4.2 indicates there was significant difference in the Biology achievement of the students taught with chromosome model and those taught with conventional method. Those taught with chromosome model performed better than those taught with conventional method. This study shows that instruction and appropriate improvised chromosome model influence the performance of students in genetics at senior secondary school. The result from the study is in agreement with the earlier finding of Mberekpe (2013) in his study investigated effects of learners improvised material on students' achievement in Biology. The result revealed that students taught using improvised instructional material performed better than student taught with conventional method.Also, Abdulfatai .M. (2016) Impact of visual aid on achievement and retention among secondary school biology students in Minna. Shows that students taught with visual aid (instructional material) perform better than those taught with conventional method.

The result in table 4.3 above shows that there is no significant difference between male and female students in their academic achievement. The result from the study is supported with the earlier findings ofBege .H.N (2017) in his studies Effect of constructivist based instructional approach on student's achievement and retention in basic genetic concepts in Biology. Abdullahi .S.M (2015) in his Effect of mnemonic device on the academic achievement of students of Biology in secondary schools.Ibe (2004), Nwagbo and Chukelu (2011), Bello and Abimbola (2012) and Oludipe (2012) who stated that there is no significant difference in the achievement and retention of male and female students in biology that both male and female students achieve equally in biology when exposed to the same treatment and given equal opportunity.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATION

This chapter present the summary of the procedures used in the study, the implication of the study, contribution of the study to knowledge, conclusion of the findings were also advance towards the improvement of instructional strategies in biology, generally in science and with suggestion for further studies.

5.1 Summary

This study is carried out in order to determine the effect of chromosome model on student's achievement in biology in Minna Metropolis of Niger State. The research administers Biology Achievement Test (BAT) techniques which were used to as a pre-test and post-test treatment in order to use it as a data collection was conducted of thestudy. Before administering the treatment, a pre-test was conducted and the result was completed. A statistical mean, standard deviation and t-test were used to analyze the result obtained from the test scores. A post-test were also administrated to the student after the whole treatment the statistical mean, standard deviation and t-test were used as well for the analysis of the result obtained from the scored.

However, it is clearly seen that student taught biology using chromosome model as instructional strategiesperformed significantly better than the conventional method of teaching. In respect to issue of gender basis, the result also revealed that there is no any significant difference between male and female students performances in biology.

Therefore further investigation about this study due to the obviousneed to access the effect of chromosome model on student's achievement in biology.

5.2 Implication of the Study

The finding of the studyhas implication as instructional strategies for teaching of genetics in biology on Senor Secondary Schools in Nigeria. The study shows chromosome model as instructional strategies in teaching biologyfacilitate learning and also motivate students to desire a strong passion to genetics in biology. However, there is need to encourage our science teacher in respect of utilization of chromosome model instructional strategies in teaching genetics as a topic and biology as a subject and also allow students to be actively involved during the lesson.

5.3 Contribution of the Study to Knowledge

This study serves as a medium of the both learners and instructors on how important the chromosome model in biology were useful and contributed in teaching and learning of genetic in biology. This study contributed a lot to the body of knowledge in the following ways;

i. Utilization as improvise chromosome model as instructional strategiesmakes teaching and learning of genetics in biology easy and a major contribution to knowledge.
ii. This study helps students and researcher to achieve additional knowledge in the area of genetic, biology and science.
iii. Chromosome model helps to improvise qualities and standard of education in students' academic performance in senior secondary schoolas well as their performances in senior secondary schools certificate examination (WAEC) & (NECO).

5.4 Conclusion

The following conclusions were drawn from the findings as research study. They are as follows:

i. Proper utilization of chromosome model helps learners to develop interest, good attitude and behavior towards learning

ii. The effective and efficient use of chromosome model allows learners to actively participate in discovering process from an autonomous view point.

iii. The use of chromosome model should be encourage as instructional strategies of teaching genetics in biology.

iv. Chromosome model significantly enhance the performance among learners. Therefore, the same treatment and qualities should be given to both male and female students.

v. Students are easily recall what they have learned by the used of chromosome model.

vi. Students taught using chromosome model performances academically better than those taught with conventional method in teaching and learning of genetics in biology.

5.5 Recommendation

On the basis of finding of the study, the researcher makes the following recommendation. In order to make teaching and learning in biology more effective.

i. All biology teachers should be taught the important using instructional strategies starting from National Certificate in Education (NCE) level and above in order to promote standard and quality of Education.

ii. Government should support factories for the production of instructional materials that will be used as instructional strategies so that they can be available and cheap.

iii. School authorities should try as much as possible to have instructional strategies that are relevant to the content of the course provided for teaching and learning of biology.

iv. Mandatory workshop and seminal should be organized on how to improvised and used instructional materials for biology teacher to update their knowledge.

v. Conductive environment should be provide to make teaching and learning easier and effective.

5.6 Suggestion for Further Studies

The researcher have discovered the impact of chromosome model as instructional strategies in teaching and learning genetics in biology at senior secondary school. This research therefore will throw light on the need to conduct more research on the effect of chromosome model on senior secondary school academic achievement in biology.

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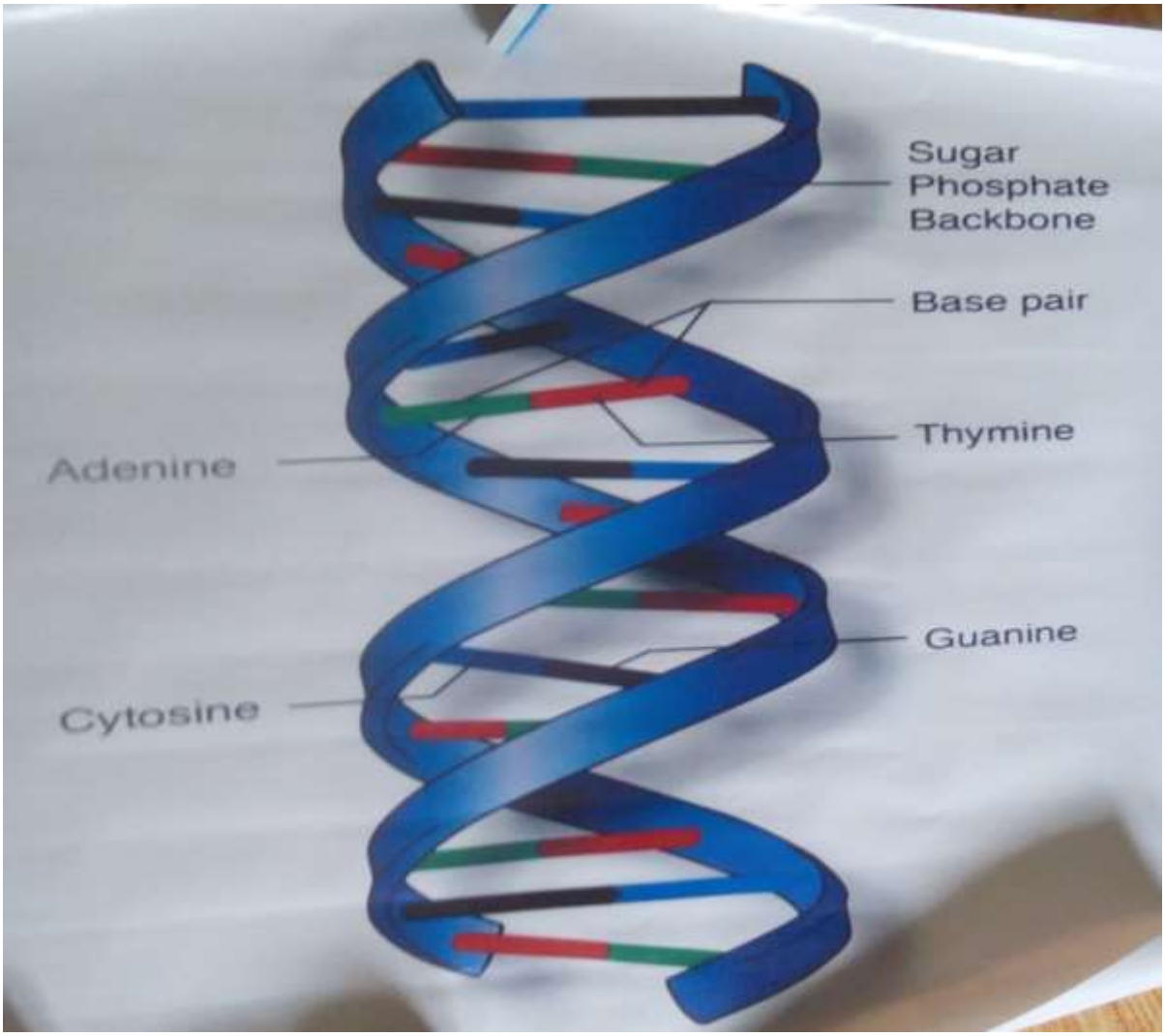
APPENDICES

APPENDIX I



Structure of Chromosome (DNA)

APPENDIX II

LESSON PLAN FOR EXPERIMENTAL GROUP

Date:

Subject: Biology

Topic: Genetics

Sub – topic: Chromosome: The basis of heredity

Class: SS3

Duration of Lesson: 45 minutes

Instructional Material: Improvised Chromosome Model

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

(i) Define chromosome and explain the appearances of chromosome
(ii) Know the number of chromosomes in human being and some other organisms
(iii) Structure of Deoxyribonucleic Acid (DNA)

Previous knowledge: Students have been taught introduction to genetics.

Introduction: The teacher introduces the lesson by briefly going over some key point in their previous lesson such as:

Genetics: Is defined as the scientific study of heredity and variation in living things.

Heredity: Is defined as transmission and expression of characters or trait in organism from parents to their offspring.

Presentation: The teacher presents the lesson as follows:

Step I: Teacher explain chromosome and its appearance as thus: Chromosomes are rod or thread – like bodies found in the nucleus of a cell.

Function: Chromosome houses or contains the genes which are responsible for the transmission of characters from parents to offsprings.

Appearance: Chromosomes can be seen with a microscope only during cell division (mitosis or meiosis). They appear at the beginning of cell division, as long, slender thread. As cell division progresses, they shorten (condense) and thicken. After some time, each chromosome is observed to be made up of two threads called Chromatidheld together at the centromere.

Step II: Teacher explain number of chromosomes in human being and some other organisms. All organisms of the same species have the same number of chromosomes in each body cell known as diploid number is double number of chromosome in a gamete known as the haploid number.

The diploid number is represented 2n while the haploid number is represented by n. some example of chromosome number in body cells are:

(i) Dog 52 (26 pairs) (ii) Cat 38 (19 pairs) (iii) Domestic fowl 18 (9 pairs)

(iv) Fruit fly (drosophilia) 8 (4 pairs) (v) Housefly 12 (6 pairs)

(vi) Man 46 (23 pairs)

In human beings, there are naturally 46 chromosome which occur as 23 pairs

(23 × 2 = 46). Each chromosome of a pair occupies the same position as and it's similar in shape and size in the other. Each pair is therefore, called Homologous chromosome and only separate during meiosis.

The 46 chromosomes are represented as 2n i.e 2 × n = 2 × 23 = 46. Since 46 chromosomes is twice n, it is called the diploid number of chromosome while n(23) is called the haploid number.

Step III: Teacher explain the structure of Deoxyribonucleic Acid (DNA) as:

The DNA is found in chromosomes located in the nucleus of cells. It stores the organism's hereditary trait and directs the day to day metabolic activities of each cell in the organism.

The chromosome is made up of deoxyribonucleic acid (DNA) and protein. The DNA molecule consists of two helical chains coiled around each other to form a double helix. The DNA is made up of repeating unit called nucleotides.

Each nucleotide is made of: (i) deoxyribose, a sugar molecule (ii) phosphate (iii) an organic nitrogen compound which may be adenine, guanine, thymine or cytosine.

The repeating unit or chains are organized in form of a double helix and are held together by hydrogen bonds. The sides of the helix are formed by sugar and phosphate. The step in the ladder are formed by organic nitrogen compound in a definite way. The two chains are held together by hydrogen bonds between the nitrogenous bases.

Guanine always pairs with cytosine and adenine with thymine. The two chains are also referred to as complementary strands of DNA since it is the exact opposite of the other. Guanine is the opposite of cytosine and adenine opposite of thymine.

Evaluation: The teacher evaluates the lesson by asking questions based on the lesson taught such as:

(1) What is a Chromosome?
(2) How many chromosomes are in the body cells of:
    (a) Cat (b) Housefly (c) Man (d) Dog
(3) What is the full meaning of DNA?

Conclusion: The teacher concludes the lesson by briefly going over the lesson again for more understanding.

APPENDIX III

LESSON PLAN FOR CONTROL GROUP

Date:

Subject: Biology

Topic: Genetics

Sub – topic: Chromosome: The basis of heredity

Class: SS3

Duration of Lesson: 45 minutes

Instructional Material: Chalk and board

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

(iv) Define chromosome and explain the appearances of chromosome
(v) Know the number of chromosomes in human being and some other organisms
(vi) Structure of Deoxyribonucleic Acid (DNA)

Previous knowledge: Students have been taught introduction to genetics.

Introduction: The teacher introduces the lesson by briefly going over some key point in their previous lesson such as:

Genetics: Is defined as the scientific study of heredity and variation in living things.

Heredity: Is defined as transmission and expression of characters or trait in organism from parents to their offspring.

Presentation: The teacher presents the lesson as follows:

Step I: Teacher explain chromosome and its appearance as thus: Chromosomes are rod or thread – like bodies found in the nucleus of a cell.

Function**:** Chromosome houses or contains the genes which are responsible for the transmission of characters from parents to offsprings.

Appearance: Chromosomes can be seen with a microscope only during cell Division (mitosis or meiosis). They appear at the beginning of cell division, as long, slender thread. As cell division progresses, they shorten (condense) and thicken. After some time, each chromosome is observed to be made up of two threads called Chromatidheld together at the centromere.

Step II: Teacher explain number of chromosomes in human being and some other organisms. All organisms of the same species have the same number of chromosomes in each body cell known as diploid number is double number of chromosome in a gamete known as the haploid number.

The diploid number is represented 2n while the haploid number is represented by n. some example of chromosome number in body cells are:

(i) Dog 52 (26 pairs) (ii) Cat 38 (19 pairs) (iii) Domestic fowl 18 (9 pairs)

(iv) Fruit fly (drosophilia) 8 (4 pairs) (v) Housefly 12 (6 pairs)

(vi) Man 46 (23 pairs)

In human beings, there are naturally 46 chromosome which occur as 23 pairs

(23 × 2 = 46). Each chromosome of a pair occupies the same position as and it's similar in shape and size in the other. Each pair is therefore, called Homologous chromosome and only separate during meiosis.

The 46 chromosomes are represented as 2n i.e 2 × n = 2 × 23 = 46. Since 46 chromosomes is twice n, it is called the diploid number of chromosome while n(23) is called the haploid number.

Step III: Teacher explain the structure of Deoxyribonucleic Acid (DNA) as:

The DNA is found in chromosomes located in the nucleus of cells. It stores the organism's hereditary trait and directs the day to day metabolic activities of each cell in the organism.

The chromosome is made up of deoxyribonucleic acid (DNA) and protein. The DNA molecule consists of two helical chains coiled around each other to form a double helix. The DNA is made up of repeating unit called nucleotides.

Each nucleotide is made of: (i) deoxyribose, a sugar molecule (ii) phosphate (iii) an organic nitrogen compound which may be adenine, guanine, thymine or cytosine.

The repeating unit or chains are organized in form of a double helix and are held together by hydrogen bonds. The sides of the helix are formed by sugar and phosphate. The step in the ladder are formed by organic nitrogen compound in a definite way. The two chains are held together by hydrogen bonds between the nitrogenous bases.

Guanine always pairs with cytosine and adenine with thymine. The two chains are also referred to as complementary strands of DNA since it is the exact opposite of the other. Guanine is the opposite of cytosine and adenine opposite of thymine.

Evaluation: The teacher evaluates the lesson by asking questions based on the lesson taught such as:

(4) What is a Chromosome?
(5) How many chromosomes are in the body cells of:
    (b) Cat (b) Housefly (c) Man (d) Dog
(6) What is the full meaning of DNA?

Conclusion: The teacher concludes the lesson by briefly going over the lesson again for more understanding.

APPENDIX IV

Biology Achievement Test (BAT)

Duration: 45minutes

Group:

Class:

Sex: Male ( ) **Female ( )**

Instruction: Answer all questions, all questions carry equal marks.

1. Chromosomes are rod or thread-like bidies found in the nuclues of -----?

(a) cell (b) mind (c) bacterium (d) all of the above

2. The..... contain the genes which is responsible for the transmission of characters from parents to offspring

(a) Chromatids (b) chromosome (c) chromate (d) chlorophyll

3. The two chains are referred to as complementary ..... of DNA since one is the exact opposite of the other

(a) Thread (b) strands (c) bonds (d) rods

4. The DNA molecules consist of two helical chains coiled around each other to form a .....helix

(a) triple (b) double (c) complementary (d) multiple

5. The number of chromosomes in body cell known as the ..... is double the number of chromosome in a gamete known as the.....

(a) diploid and haploid (b) haploid and diploid (c) helix and helical (d) helical and helix

6. While man have 23 pairs of chromosomes, Dog have..... pairs, Cat ..... pairs and Housefly ..... pairs

(a) 26, 19 and 6 (b) 6, 12 and 19 (c) 19, 26 and 6 (d) 6, 19 and 26

7. Deoxyribonucleic acid is made of repeating unit called .....

(a) chromosome (b) nucleotide (c) nucleus (d) cell

8. The two chains are held together by .....bond

(a) nitrogen (b) hydrogen (c) DNA (d) phosphate

9. Each pair of chromosome is called .....

(a) homonym (b) double (c) homologous (d) multiple

10. A nucleotide is made up of deoxyribose sugar molecule ... …….and an organic nitrogen

(a) phosphate (b) sulphate (c) hydrogen (d) nitrogen

11. Guanine will always pair with.....

(a) Adenine (b) Thymine (c) Cytosine (d) Guanine

12. ..... is found in chromosome located in the nucleus of cells. It stores the organism's hereditary trait and direct the day to day activities of each cell of the organism

(a) blood (b) DNA (c) nucleotide (d) gene

13. Chromosome can be seen with microscope only during cell.....

(a) division (b) development (c) growth (d) distribution

14. Each chromosome is observed to be made up of two objects called..... held together at the .....

(a) chromatids, centromere (b) centromere, chromatids (c) daughter, cell (d) cell, daughter

15. An organic ..... compound may be adenine, cytosine, thymine or guanine

(a) hydrogen (b) nitrogen (c) sulphur (d) phosphate

16. A chromosome is made of deoxyribose acid (DNA) and .....

(a) cell (b) protein (c) molecules (d) nucleus

17. ..... are responsible for the transmission of characters from parents to offspring

(a) blood (b) gene (c) sex (d) mating

18. Chromosome appear at the beginning of cell division as long ..... thread

(a) slender (b) thick (c) round (d) flat

19. Adenine is located opposite to.....

(a) thymine (b) cytosine (c) adenine (guanine)

20. The total number of chromosomes found in a cell is represented as.....

(a) 23n (b) 46n (c) 50n (d) 60n

ANSWERS

1. A 2. B 3. B 4. B 5. A 6. A 7. B 8. B 9. C 10. A 11. C 12. B 13. A 14. A 15. B 16. B 17. B 18.A 19. A 20.A