CHAPTER ONE
INTRODUCTION

Background to the Study

Science is acknowledged as the bedrock of national development. This implies that any nation who desires to attain national development must make science education a priority (Ebuka, 2014). The Federal Government of Nigeria acknowledged the importance of science education in line with the global perspectives of science for all and made provisions for science and technology education.

In pursuit of goals of "Science for all" current reforms in science education lay emphasis on scientific literacy and the need to achieve equity and excellence in science classrooms (Okeke, 2011). In Nigeria, the situation is not different. The government through official policies and actions has demonstrated commitment to the inculcation of scientific literacy among all Nigerians and not only for those pursing scientific careers or science professions but also for those in non science related courses. One obvious example of government action in this regard is making science compulsory (i.e. a core subject) in our Primary and Junior Secondary Schools.

According to Omole (2012), the Federal Government of Nigeria did not lose sight of providing various modalities or strategies for implementing the policies at various levels of education with respect to science education. Specifically, at the secondary level, the government indicated that efforts will be

made to provide the following educational services: school library, basic health scheme, counseling, educational resource centers and provision of specialist teachers in schools. It also maintained that teaching shall be practical, exploratory and experimental in nature, with the medium of instruction being in English language and language of the immediate environment (Okpala, 2010). Also at the primary level, government promised that education shall be tuition free, universal and compulsory. As a consequence of this, the efforts of science teachers at various levels of education have been directed at ensuring that the goals of science teaching are being attained and not merely pursued.

These efforts have had relatively little impact on the performance and interest of students in science subjects. Several research reports (Ogbu, 2012, Thorton, 2008, Umar, 2007, Olorundare, 2006) indicated that students' achievement in science has been poor and unsatisfactory year after year. The students' poor achievement in science subjects were attributed to the teaching method (Achimugu, 2014 and Ugama, 2012). The major challenges of Basic Science education in Nigeria is that the Basic Science taught in schools fell below expectation. According to Ibe-Uro and Ukpai (2013), the science learning experiences in primary and secondary schools are not appropriate and consistent with the demands of the society at large. Okoro and Ukpai (2010) pointed out that there is glaring disconnect between what is learnt in school and what students practice at home or work place.

Graduates of science subjects are expected to acquire appropriate level of literacy, numeracy, manipulative, communicative and life skills and develop interest for further learning of science subjects in senior secondary classes and beyond (Bernard, 2013). At the primary school level, the pupils are expected to;

1. Explain events in nature;
2. Identify those beliefs that are superstitious;
3. Solve simple problems they encounter on a day to day basis;
4. Develop their physical skills e.g through the proper handling of objects and equipments;
5. Develop social skills e.g establishing friendship while working co-operatively in group;
6. Satisfy their natural curiosity through opportunities to carry out scientific investigations (FGN, 2004).

Unfortunately, what is obtained now is that science students lack adequate knowledge, skills, ability, experience and attitude towards science (Adigwe and Okonkwo, 2013). The situation is not different at the primary schools where pupils cannot:

1. Solve simple problems they encounter on a day to day basis.
2. Explain events in nature.
3. Develop their physical skills e.g through the proper handling of objects and equipments.
4. Develop social skills e.g establishing friendship while working co-operatively in groups.

These are indications of lack of scientific skills in them. For many pupils, there is generally difficulty in understanding and application of the concepts taught. As a result, many tend to exhibit a poor attitude towards the study of science, which has led to lack of personal and social awareness of the importance of science and inability to solve problems using the science process skills.

A number of factors have been identified to be responsible for the poor performance and lack of interest in science from the various studies conducted in Nigeria. These include the lack of motivation for most teachers, poor infrastructural facilities, inadequate textual materials, attitude of students to science learning, lack of teaching skills and competence by science teachers and lack of opportunities for professional development for science teachers (Adirika & Kanu, 2012).

In more specific terms, Achimugu (2013) attributed this to continuous use of ineffective strategies by teachers. According to Achimugu, lecture method which is the instructional mode mostly used by teachers is teacher – centred approach in which the teacher does most of the activities while the students are either passive listeners or are slightly involved. This approach involves lecture and story telling method of teaching and the instructional strategy is chalk – talk technique. Further, Lawal (2008) opined that this teaching mode does not promote active learning of science subjects because it appeals only to the sense of hearing. Thus, a situation where science teachers use teacher centred – lecture – chalk – talk instructional mode in teaching,

does not augur well for effective teaching and learning of science subjects.

Several research reports (Eze, 2002, Njoku, 2009, Umoh, 2012) reported that many science teachers prefer the traditional expository lecture method of teaching and shy away from innovative activity oriented teaching methods such as inquiry, discovery, concept mapping, investigative laboratory approach, process – based approach and cooperative learning. Furthermore, Eze (2002) reported that students' conceptual difficulty and subsequent poor achievement in certain areas of the SSC physical chemistry is its method of teaching which most of the students find uninteresting. Eze also reported that poor teaching methods have been predominantly in use for a long time in the teaching of chemistry. This method according to him are said to be didactic, stereotyped, dull and therefore not result oriented.

Egolum (2010) has also noted that the manner in which science subjects are taught in Nigerian schools compel the majority of science teachers to use the traditional lecture method approach. Egolum maintained that science teachers embrace the lecture method as it leads to easy coverage of the school syllabus which unfortunately is the main concern of supervisors. With this, large amount of materials can be covered in a large class, within a single period. Inomesia and Unero (2003) have shown that the traditional method of presentation has not yielded expected results. This instructional method according to Asiyai (2005) has been observed not to be effective in learning especially when difficult tasks are involved.

Njoku (2009) opined that some methods as demonstration, guided inquiry and discovery method could be result oriented. Danmole (2011) proposed the need for a search of better innovative instructional methods for the attainment of improved learning outcomes. With regard to the foregoing, researchers suggested innovative methods and teaching approaches which make science more meaningful to the primary school child. Awafala (2002) suggested combined strategy of concept mapping and problem solving (CM+PS) strategies, Awolola (2009) recommended brain-based learning strategy. Ogbu (2012) recommended Context – Based Teaching (CBT) strategies. Other teaching methods recommended for use by teachers are: guided discovery, inquiry, demonstration, discussion, field trips/excursion, projects, process –based, concept mapping, scaffolding, team teaching, role play and cooperative learning (NTI, 2009). These methods of teaching foster retention of concepts and skill development and therefore lead to creativity (Achimugu, 2014). Notable among these innovative approaches is the process-based teaching strategy (PBTS).

Process – based method is the method that capitalizes on getting the children work on that which they learn through practice or hands–on activities. It is a child centered approach to learning. As an activity based method, it requires active process on the part of the learner and enhances meaningful understanding of the scientific process. It is therefore a learning method that encourages the learner to learn how to observe objects or events more closely as they use their senses. Its core

premises include the requirement that learning should be based on doing some hands – on experiments and activities. The idea of process – based learning is rooted in the common notion that children are active learners rather than passive recipients of information. If children are provided the opportunity to explore by their own and provided an optimum learning environment, then the learning becomes joyful and long lasting. According to Harry (2007) the process - based method of teaching and learning science involves the use of science process skills in solving problems which children come across in their daily lives. Cogne (2004) defines process skill as an ability in carrying out mental operation and physical actions that can be developed through experience. This implies that science process skills include not only cognitive skills but also psychomotor skills. As an innovative approach to teaching science, this method according to Chair (2009) allows children to perform mental processes such as observing, classifying, measuring, forming hypothesis, analyzing, which lead to discovery and generalization.

In more specific terms, process–based method involves pupils handling objects, being actively involved in:

1. Observing and noting attributes of objects with their sense organs.
2. Classifying objects based on specified attributes, may be by colour, shape, size etc.
3. Using measuring devices which employ standardized units like ruler, tape, measuring cylinders etc to describe the

properties of an object such as height, width, length, area, volume, time, and mass.

4. Using written and spoken words, graphs, tables, diagrams, write-ups and other information presentations to express their observations and experimental results.
5. Drawing a conclusion about a specific event based on observations and data collected.
6. Anticipating consequences of a new or changed situation using past experiences and observations.
7. Manipulating objects or data, either collected by self or by others, in order to make meaningful information and then finding patterns in that information that lead to making inferences, prediction and hypothesis.
8. Defining terms within the context of one's own experiences, stating a definition in terms of "what you do" and "what you observe".
9. Proposing an explanation based on observations.
10. Investigating, manipulating materials and testing to determine a result.
11. Formulating mental and physical models like charts, pictures, diagrams etc to represent the 'real world'.

In this sense therefore process – based method means any learning that involves physical and mental action, stimulating for creative action or expression. Hence in this work; it will be used to keep the pupils active throughout the lesson periods to enhance learning and stimulate their interest.

Furthermore, evidence in the related literature shows that some factors have been shown to either singly or in combination with instructional method influence students achievement in science subjects. Presently in our schools, there exist gender differences in science achievement and this has attracted some controversies. Some researchers link the difference to the way science is being taught in our schools (Obianyo, 2000). Others such as Okeke (2007) and Okoli (2012) see such differences as arising from socio-cultural factors. Danmole and Adeoye (2004) in their work reported that gender is one of the factors interacting with achievement. Also Deny and Devore (2000) and Unigwe (2006) in their separate studies indicated that gender is a significant predicator of learning styles and adult learners. Duyilemi (2000) opined that there is some degree of discrimination against women at the level of career opportunities in favour of boys from primary through junior and senior secondary to tertiary levels.

According to Njoku and Okeke (2003), males are helped to dominate Science and Technology (S & T) activities both at school and professional levels, while females experience formidable obstacles and conflicts in their efforts to participate in S & T activities at both school and professional levels. At the school level, females experience a lot of discouraging conditions that deter them from enjoying and achieving well in S & T subjects. For instance, at primary school level, males are given science related projects like construction of car, aeroplane, fan, radio, television, handset etc. while females are given home

management related projects like sowing of apron, handkerchief, table clothes, armrest etc. This has led to male domination in science project exhibition at various levels of education. These school-based factors are perhaps responsible for the observed low interest, poor participation, low aspiration and under-achievement of females in S & T (Obianyo, 2000).

The S & T teachers are members of the gender divided society and hence they carry their gender ideologies into their formal S & T teaching activities. Due to the erroneous notion that S & T subjects are for males rather than for females, teachers of S & T subjects do not expect females to perform well in these subjects, and they do not encourage them to improve, especially in physical sciences (Njoku and Okeke, 2003). Not only do teachers of S & T interact more with the boys during classroom discussions, question–and– answer sessions, practical activities, excursion and field trips, they also allow the boys to dominate S & T activities by overtly expressing more confidence in them. They always give them leadership positions as well as more challenging tasks (Obianyo, 2000). These factors according to Njoku and Okeke (2003) have led to differences in academic achievement of males and females in science subjects.

Okeke (2007) suggests that teachers should introduce hand-on-activities during instructions for students, for girls seem to perform better on this. He further suggests that constructivist approach to learning must be encouraged.

Evidence from literature has consistently shown attitude as an important component of science education (Osborne, Simon

and Collins, 2003) imparting not only pupils' participation and interest but also their performance in science. Attitude means the individual prevailing tendency to respond favourably or unfavourably to an object (person or group of people, institutions, events) Salta and Tzougraki (2004). Attitude is also defined as the way a person views something or tends to behave towards it, often in an evaluative way. Attitude can be positive (values) or negative (prejudice). When attitude is positive, it is a value to a learner but when it is negative it is a bigotry to a learner and the subject learnt. However positive and negative attitude have strong immeasurable effect on the outcome of a learning process. Negative attitude has the tendency to build a kind of repulsion in a learner to instruction which affects knowledge acquisition and prowess in a particular area of study. Pupils' attitude towards science therefore means the knowledge, feeling and action taken towards science. According to Yara (2009), attitude towards science denotes interest or feeling towards studying science. It is students' disposition towards liking or disliking science.

Attitude towards science has gained a lot of attention in realm of science education especially from the perspective of teaching and learning. A child that has developed positive attitude towards science is expected to show:

1. the manifestation of favourable attitude towards science and scientists;
2. the acceptance of scientific enquiry as a way of thought;
3. the adoption of 'scientific attitudes';
4. the enjoyment of science learning experiences;

5. the development of interest in science and science – related activities; and
6. the development of an interest in pursuing a career in science or science related work (Osborne, Simon and Collins, 2003).

However it has been noticed that students find science to be a difficult subject Anwar and Bhutta (2014). The interest of the students in science declines as they move to the higher grades of education. Students particularly at the secondary level, perceive science irrelevant to life. They feel that advancement in science has generated social and environmental problems; science is difficult and is about things not people (Bennett, 2001). The case is not different in primary schools where pupils perceive science to be difficult, boring and inaccessible. For these reasons, many pupils do not want to continue studying science Anwar and Bhutta (2014).

A number of factors have been found to influence students' attitude towards science. Studies completed so far in this area have linked attitude towards science with gender, socio economic status, parental education, student ability, maturity, motivation, quality of instruction, psychological environment, peer group outside the class and time involved with video/ television media that contribute to an individual attitude towards science (Muhammad and Hafiz, 2012).

Meltem and Oguz (2010 had noted that the method of teaching is particularly influential on the attitude of students towards science and effective science teaching enhances

students' attitudes towards science. Uyuata (2002) is of the same view that attitude to science which a child exhibits and the subsequent achievement the child attains might be greatly influenced by the pedagogical techniques individual teachers use during instructional process.

Papanastasiou (2002) pointed out that previous- learning experiences of pupils are also influential on pupil's attitude towards science course and science in general. In this respect, there is need to organize science learning in such a way that it takes into consideration the pupils' previous knowledge.

Retention is an important component of science education and its thorough understanding is very necessary to enhance students' achievement and success and their participation in science related careers. Retention of knowledge is the act of keeping knowledge rather than losing it. It is the ability to store facts or knowledge and remember them easily. Retention is the idea or facts the child has in his or her memory after the child has been exposed to some learning experiences. The purpose of education is to be able to transfer knowledge to new situation. This knowledge must be retained within an individual memory till the time of recall. However many students fail to perform well in science subjects because of their inability to recall or remember what they have learnt. According to Archibong (2012), students' low achievement and interest in science subject results from memory loss or forgetting as a result of students' inability to encode the information they have learnt into their long term memory for future use. When this happens, the information

merely fades away just like as water passively leaks out of a bucket. Archibong pointed out that effective science teaching positively influences students' retention of information. Hence in this study, the use of hands-on, minds-on activities which is embedded in process- based method will make the lesson meaningful to the pupils and this will help them to form the image and picture of the concepts learnt, facilitate the encoding, storing and transfer of the information learnt into the long term memory and once the information is 'filed' in the long term memory, it can be retrieved.

An effective science teaching consists of processes enabling students to gain scientific inquiry skills, display critical thinking skills and internalize scientific concepts and principles (Hershberger, 2007). In the light of this, it is clear that for science and technology teaching to be effective, learning processes where students actively participate in the process should be adopted by the teachers. The role of the teacher is to create varied opportunities for students to engage in activities that will enable them make sense of the world around them, make new discoveries, solve interesting problems and develop skills that are sustainability driven (Adipere, 2010).

In this respect, teachers need to exploit scientific process-based learning method to enable the students understand the nature of science, develop positive attitude towards science and also retain what they have learnt for future use.

Statement of the Problem.

A lot of concern has been raised by science educators and psychologists with regards to poor and unimpressive achievement of students in science subjects which is attributed mainly to the teaching method. Evidence shows that teachers use ineffective methods and strategies in science teaching, which among other factors contribute to students' poor achievement in science subjects. Achimugu (20014) observed that the teaching method employed by teachers is mostly conventional lecture method which does not involve much of students – students or students – teacher interactions. Thus scientific processes and attitudes are not emphasized and acquired and the products of Basic Science are unable to apply the science they learn in school to solve their personal and societal problems. It thus becomes necessary to try out a method that is more democratic and learner friendly, which will ensure better learning outcomes.

Furthermore, there is no study known to the researcher that has investigated the effect of process – based method at the primary school level. Many research carried out on process - based method were focused on secondary school level and had not been extended to primary school level. It therefore become imperative to investigate the effect of process – based teaching method on the primary school pupils' academic achievement, retention and attitude towards science.

The problem of this work is to determine the effectiveness of using process–based method in teaching some Basic Science concepts on pupils' achievement, attitude towards science and on

retention of what is learnt. The question then is; will teaching Basic Science with the process - based approach enhance primary school pupils' achievement, attitude and retention.

Purpose of study

The main purpose of this study is to determine the effects of process–based teaching method on primary school pupils' Academic Achievement' Retention and Attitude toward science. Specifically to determine;

1. Effects of process-based teaching method on primary school pupils' achievement scores in Basic Science when compared with the control group taught with conventional method.
2. Effects of process-based teaching method on primary school pupils' attitude scores in Basic Science when compared with the control group taught with conventional method.
3. Effects of process-based teaching method on primary school pupils' retention scores in Basic Science when compared with the control group taught with conventional method.
4. The influence of gender on primary school pupils' achievement scores in Basic Science when taught with process-based method.
5. The influence of gender on primary school pupils' attitude scores in Basic Science when taught with process-based method.

6. The influence of gender on primary school pupils' retention scores in Basic Science when taught with process-based method.

Significance of the Study

The findings of this study will be of importance to teachers, schools, curriculum planners, and the government.

The findings will help teachers see the need to provide real objects even if improvised during classroom instructions to enhance learning and stimulate pupils' interest. It will also help teachers to identify the instructional mode that will be more facilitative of instruction and that will help them to select, organize and present their content concisely to minimize students' low achievement.

The findings will also enable schools to make available and positive utilization of resources which are very few in majority of rural schools and also make provision of essential resources and encourage teachers to develop relevant materials in order to enhance teaching.

The findings will help curriculum planners to identify an effective method that will be used in teaching Basic Science in the primary schools. This will help them in the selection of primary science contents, and activities suitable for the pupils. It will also help them to arrange professional development programmes for elementary teachers to adopt more interactive methods of teaching science, make it more relevant to pupils' lives and society so that they see its value and importance.

The findings may bring out discussion which will enable the government to organize and provide equipments, learning materials and infrastructure that will enhance the teaching and learning of basic science in primary schools.

Finally, the findings will generate many opportunities for further research.

Scope of the study

The researcher used process – based teaching approach and conventional method to teach primary six pupils these Basic Science concepts of: Magnetism, Lever, Force and Solar System shown to be difficult for pupils (Debra, 2011), and determine its effectiveness in enhancing academic achievement, retention of Basic Science concepts and attitude towards science.

The study was carried out in four local government areas in Nnewi and Ogidi Education Zones of Anambra state. The study was carried out in the first term of the academic session. Primary six pupils from eight public primary schools in Nnewi and Ogidi Education Zone were used for the study.

Research Questions

1. What are the differences in the pre-test and post-test mean academic achievement scores of primary school pupils taught basic science using process-based method and those taught with conventional method?
2. What are the differences in the pre-test and post-test mean attitude scores of primary school pupils taught basic science

using process – based method and those taught with conventional method?

3. What are the differences in the post-test and retention mean academic achievement scores of primary school pupils taught basic science using process-based method and those taught with conventional method?
4. What are the differences in the pre-test and post-test mean academic achievement scores of male and female primary school pupils taught basic science using process–based method?
5. What are the differences in the pre-test and post-test mean attitude scores of male and female primary school pupils taught basic science using process-based method?
6. What are the differences in the post-test and retention mean academic achievement scores of male and female primary school pupils taught basic science with process–based method?

Hypotheses

The following hypotheses were formulated and tested at 0.05 level of significance.

1. There is no significant difference in the mean achievement scores of primary school pupils taught basic science with process-based method and those taught with conventional method.

2. There is no significant difference in the mean attitude scores of primary school pupils exposed to process – based method and those who received conventional teaching in Basic.
3. There is no significant difference in the mean achievement retention scores of primary school pupils taught Basic science with process-based method and those taught with conventional method.
4. There is no significant difference in the mean academic achievement scores of male and female primary school pupils taught Basic science using process-based method.
5. There is no significant difference in the mean attitude scores of male and female primary school pupils taught Basic science with process-based method.
6. There is no significant difference in the mean achievement retention scores of male and female primary school pupils taught Basic science with process-based method.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

The related literature was reviewed under the following subheadings:

A. **Conceptual Framework.**

Science process skills.

Process – based method.

Attitude.

Gender.

B. **Theoretical Framework.**

Constructivist Theory.

Information processing theory.

C. **Theoretical Studies.**

The concept of teaching and learning.

Teaching and learning of science.

Modes of presentation of science.

The lecture/Expository method.

Retention as a factor in Science achievement.

D. **Review of Related Empirical Studies.**

Effect of process – based teaching method on pupils' achievement in science.

Effect of process – based teaching method on pupils' attitude towards science.

Gender difference in students' achievement and

attitude toward science.

Effect of process – Based Teaching method on retention of achievement gain.

E. **Summary of the literature Review.**

Conceptual Framework

Science process skills.

Process according to Hornby (2010) refers to a series of things that are done in order to achieve a particular result. Skill on the other hand is also defined by Hornby (2010) as the ability to do something well. STAN, (2007) define skill as the ability to carry out a task and bring about some desired results with maximum certainty and minimum outlay of time and energy. Eze (2010) sees it as the possession of certain expertise of competence needed to perform a particular job or series of jobs. Science process skill is defined by curriculum project, Science – A Process

Approach (SAPA) as a set of broadly transferable abilities, appropriate to many science disciplines and reflective of the behavior of scientists. The American Association for the Advancement of science (AAAS) defines science process skill as a set of intellectual skills that are associated with acquiring reliable information about nature (Nnadi, 2009).

Science process skills according to Njoku (2008) are processing strategies which a scientist brings to bear in solving problems. Ndukwe (2006) was of the opinion that science process

skills are the pre-requisite knowledge of concept that could be attained only if the students have certain underlying capabilities. By capabilities, Ndukwe (2006) meant the ability to perform functions under specific conditions. It could be the ability to solve some problems in the non metric geometry, ability to solve number series. These capabilities according to Urevbu (2000) are regarded as science process skills. Science process skills are important for the practice and understanding of science and these processes are hierarchical in nature, starting from the most simple task to the complex one, from concrete material to abstract (Urevbu, 2000).

The American Association for the Advancement of Science (AAAS, 1967) in Urevbu (2000) identified eleven science process skills which were later modified by Nigerian Education Research and Development Council (NERDC) to fifteen science process skills: These include: observation, classification, communication, counting number relations, measurement, experimenting, controlling and manipulating variables, formulating mental models, manipulating skills, formulating hypotheses, prediction, inferring, interpreting data, making operational definitions, and raising questions.

These science process skills were grouped by SAPA and Bager (2006) into two groups – basic (Simplier) and integrated (More complex) process skills. The basic (Simplier) process skills provide a foundation for learning integrated (more complex) skills. According to (AAAS) the basic skills are appropriate for children in the primary grades. The basic skills are used in

experiments of scientists and students as well as into everyday life of average person, to a degree. They allow everyone to conduct objective investigation and to reach conclusion based on the results. The integrated science process skills according to SAPA are more complex skills and are more appropriate for children at grades four and above.

Thus, science process skills lay the basis of scientific inquiry and scientific thinking. As they show the means and methods of science and skills possessed by scientists, science process skills have potential to affect student's attitudes and their perceptions of science.

According to Banjulaye, Okedeyi and Ogunmade (2009), the skills acquired in science and technology enables the citizens to engage in the production of goods and services, to meet human needs to increase human potential to solve practical problems and modify the world and to be self employed.

Process-based method.

Cogne (2004) defines process – based method as instructional method that capitalizes on getting students to work on that which they are learning through hands– on – activities. According to Urevbu (2000), the process approach in the teaching and learning of science involves the use of science process skills in solving problems which children come across in their daily lives.

In the words of Aina (2007), the process-based learning method lays emphasis on helping the children develop process

skills through practice or hands-on-activities. The pupils are encouraged to learn how to observe objects or events more closely as they use their senses. From their observations, they can classify the objects, and report their activities verbally or through writing.

This implies that process – based method is a method of teaching that involves practical investigation by the learner. The learner is required to make sense of experience and information through their own mental and physical activity. In this sense, process – based method enables the learner to have opportunities for:

- actively seeking evidence for themselves through their own senses;
- testing their ideas against evidence and previous experience;
- become aware of ideas other than their own;
- Seeking more effective ways of testing ideas.

These imply that there should be plenty of handling of materials and objects. There should also be plenty of discussion in the classroom, between pupils and teacher and among pupils. Process – based activities are rarely silent; like adults, children need the chance to talk through their ideas and may be more convinced by arguments advanced by their peers than by their teacher. The teacher's role in this learning is different from what has been regarded as normal in content–based science, where the emphasis was placed only on providing correct information, but it is nonetheless central. It will involve;

- ensuring that the children have real things to observe, handle and investigate and so have access to evidence on which to test their ideas;
- finding out about children's existing ideas and taking these seriously as the starting point for learning;
- making available access to a range of ideas from others – other pupils, books, media, visitors, visits, where possible;
- discussing with children ways of improving their testing of ideas and their use of evidence;
- ensuring that the children reflect upon and communicate their results in a variety of appropriate ways.

Urebv (2000) opined that meaningful teaching and learning of Basic science would depend on the use of active learning method such as the process approach. The process approach is an innovative strategy that creates opportunity for the development of process skills in science learning in the primary school and other levels of science learning. Modern Science teaching and learning emphasize active participation of the learners in the learning process through series of activities hence process-based strategy is an ideal method of achieving this objectives.

Attitude.

The term attitude encompasses a wide range of affective behaviors (e.g, prefer, accept, appreciate and commit). It is the tendency to think, feel or act positively or negatively towards objects in our environment. Ajzen (2001) defines attitude as a

psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour. Attitude has also been defined as effective disposition of a person or groups of persons to display an action towards an object based on the belief that such a person or groups of persons have about the object (Ogunkola, 2002). Papanistasiou (2002) also defines attitude as "emotional tendency, either positive of negative, of an individual towards objects, people, places, events and ideas". Hence Papanistasiou view the responses such as "I like Science", "I love Science" and "Science is boring" as the indications of attitude towards science.

Haddock and Malo (2010) identify three components of attitude;

1. The cognitive component, which is the thoughts and beliefs that people form about the attitude objects.
2. The Affective component, which is people's emotional reactions toward the attitude objects.
3. The behavioral component, which is how people act towards the attitude objects.

Bennett (2003) makes the distinction between attitude towards science and scientific attitude . according to him attitude towards science is linked with the views and images that the individual develops about science as a result of interaction with different situations, while the term scientific attitude is linked to the way of thinking or scientific method, which covers the skills and is related to the undertaking of practical work.

The learner's characteristic such as attitude plays a key role in the pupils' performance in a subject. Uyoata (2002) said that attitudes are determining factor of what students learn. When a student's attitude towards a school subject or instructional mode is positive, it is very likely that such a student would likely develop interest in the learning tasks associated with the subject. The learner who is interested in a subject would likely enjoy and feel satisfied in what he is expected to do. The satisfaction so derived would lead to success which in turn would engender higher positive attitude of perseverance, patience and open mindedness which are scientific attitudes required for successful science activities (Uyoata, 2002)

Gender.

According to Okeke (2007), gender is a broad analytical concept which draws out women's role and responsibilities in relation to those of men. Okeke (2001) defines gender as social and cultural construct, characteristics, behaviors and roles which society ascribes to females and males. In line with this definition, Okeke (2008) and Enaiyeju (2008) said that Gender refers to the socially/culturally constructed characteristics and role which are ascribed to males and females in any society. Nworgu (2005) was also of the view that gender is socially and culturally oriented and therefore it is dynamic.

Gender roles according to Okoli (2012) are roles which society assigns to a man or woman in accordance with the culture and tradition of the society. According to Okeke (2007),

males are assigned such attributes as bold, aggressive, dominating/ assertive, tactful, economical in use of words etc. Females are assigned the opposite attributes such as fearful, timid, gentles, illogical in reasoning, dull, passive, submissive, tactless and talkative.

Men and women therefore choose occupations or professions that are in accordance with societal expectations of their gender. Hence relatively few females venture into male dominated disciplines such as science, technology, engineering and other science based professions. The great majority of women and girls whose occupations such as nursing, hair dressing, cooking and selling of food, clerical jobs and other menial jobs in industries and other establishments are in accordance with what the society expected of their gender Okoli (2012).

Some factors have been found out to account for the differences in male and female students' achievement in science subjects. Such factors include sex-role stereotyping, masculine image of science and female socialization process (Ezeliora, 2004). Gender or sex stereotyping according Okeke (2007) is a collection of commonly held beliefs of opinions about what are appropriate characteristics, behaviours and activities for males (Masculine) and females (feminine) in any society. The sex-stereotyping involves male and female students showing interest in subjects relevant to the roles they are expected to fill in the society. Hence the feeling about women's role and marriage scare girls away from sciences and engineering which they regard as

masculine field. This feeling inhibits girls' aspiration and hinders achievement in sciences Egolum (2010).

Theoretical frame work

Constructivist Theory

The underlying philosophy of this study lies in the theories of cognitive science particularly that of constructivism.

Constructivism is basically a theory based on observation and scientific study about how people learn. It says that people construct their own understanding and knowledge of the world through experiencing things and reflecting on those experiences Tytler (2002). It is the learning theory which argues that learning occurs when learners are actively involved in the process of meaning and knowledge construction from previous experience rather than passive recipience of information (Aniodoh and Eze, 2014). According to Fosnot (1996), constructivism is the concept that leaner actively construct their own knowledge and meaning from their experience. It is a kind of learning strategy that lay emphasis on active role of learners in the process of constructing their own knowledge. Thus a constructivist based method in science instruction is the method which accepts the child's ownership of idea (Osborne, 1996). Central to the constructivist perspectives is that a learner constructs meaning from new information and event as a result of an interaction between that individual's alternative concepts and his or her current observation.

The two principles of constructivism according to Glassersfeld (1993) are that:

(i) Knowledge is not passively received but actively built up by the cognizing students.

(ii) The function of cognition is adaptive and serves the organization of experimental world, not the discovery of ontological reality.

The implication of constructivism according to Kato and Kamoi (2001) is that the child becomes very autonomous, refusing to be governed by reward and punishment.

According to Aina (2007) the constructivist learning theories that have had profound impact on curriculum development and the methodology of science teaching at both primary and secondary school levels are those of David .P. Ausubel (meaningful learning), Jerome S. Bruner (discovery learning), Robert Gagne (problem solving) and Jean Piaget (cognitive and developmental theory).

Of major importance to this work is that of Jean Piaget cognitive and developmental theory. The work of Jean Piaget in developmental psychology has become an important guide in the selection and arrangement of science materials for primary school children. According to Piaget (1994), at about the age of six or seven, a child enters the concrete operational stage and this stage lasts till age of eleven or twelve. During this period, the child's mental process is limited to thinking about things. The concepts of quantity, time, space, conservation and reversibility have developed. The child can also understand the relationships

of classes, ratios and numbers. Logical processes such as observing, describing, classifying and measuring real objects can take place. Characteristic of this period is also the fact that children like to be active and desire to play with other children. They generally frown at being isolated or confined. They enjoy running around, playing games and do not like to be idle or bored.

The implication of this according to Aina (2007) is that the primary years should be viewed as a period of exploration and observation. This is a time for children to examine relationship between man and his physical and biological environments, with the involvement of all the basic senses of sight, smell, hearing, touch and taste. The emphasis is on hands-on science activities whereby the teacher acts as the facilitator while the pupils is the actor or doer. Thus the pupils are actively involved in what is being taught, rather than being passive listeners. Due to their age, primary school pupils will learn science better if they are involved in concrete activities, and explanations are given using objects-diagrams, pictures and other instructional aids.

Therefore the process-based instructional mode, which is learner-centred and activity oriented is based on Piaget's theory of learning. And in this, meaningful learning takes place when the learner ties new knowledge to relevant concepts they already posses. The Piaget's cognitive theory has great potential for guiding the design and delivery of instruction (Kato & kamoi, 2001). It can also provide direction in selecting teaching/learning

techniques, sequencing activities and designing achievement measures.

Information Processing Theory

The information-processing theory approach to the study of Cognitive development evolved out of American experimental tradition in psychology. According to Wayne (1989), information processing theory of memory emphasizes how information flows through a series of separate memory stores. According to this analogy, our memory systems, much like computers, have temporary storage buffers and permanent storage areas.

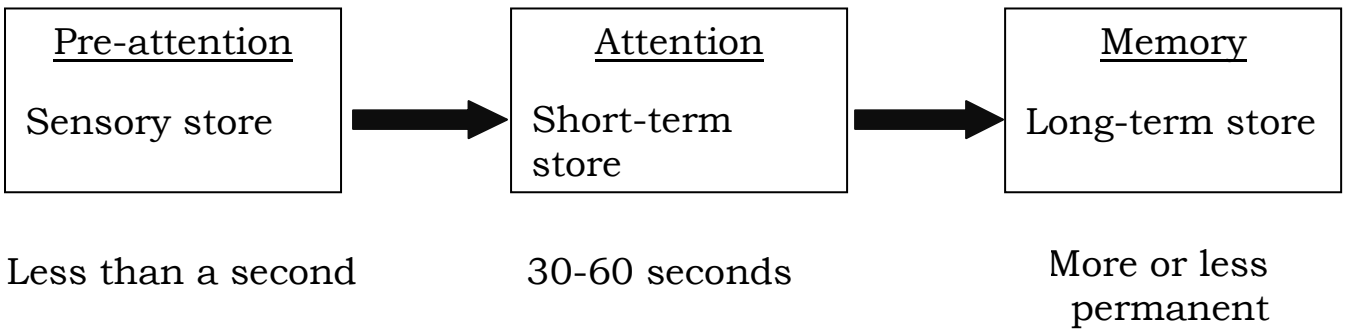
According to Huitt (2003), a primary focus of the information processing approach is on "Memory" (the storage and retrieval of information). The dominant view is labeled the "stage theory" and is based on the work of Atkinson and Shiffrin (1971). This model holds that information is processed and stored in three (3) stages.

1. **Sensory Memory:** The sensory memory consists of stimulus inputs that are held for a second or two while the processes of perceptual analysis are going on. It is a process and mechanism by which initial coding and brief storage of stimuli occur. The duration of the visual sensory register is one-quarter of a second.
2. **The short-term memory (STM):** This is the memory process that temporarily stores information for immediate or short-term use. Short term memory contains only a few bits of information about events that have just occurred. This information without rehearsal or any other maintenance remains

for a minute or so and then it is likely to be forgotten. According to Buss (1978), short-term store is in some way like a leaky bucket. Items come into short-term store as water drops into a bucket. It fills rapidly and then starts leaking. The memories merely fade away, just as water passively leaks out of a bucket. Also new memories interfere with old ones. Old items are pushed out of short-term memory the way water pumped into the bucket might push out water already there.

3. Long-term Memory (LTM): This is an unlimited capacity store that can hold information over lengthy periods of time and forgetting is believed to be quite slow. Information must somehow be encoded for storage in long-term memory.. Once the information has been 'filed' in long-term store, it should be permanently available. Later, it can be retrieved from long-term store during recall or recognition.

Figure I: The Alkinson and Shiffrin's model of memory storage.



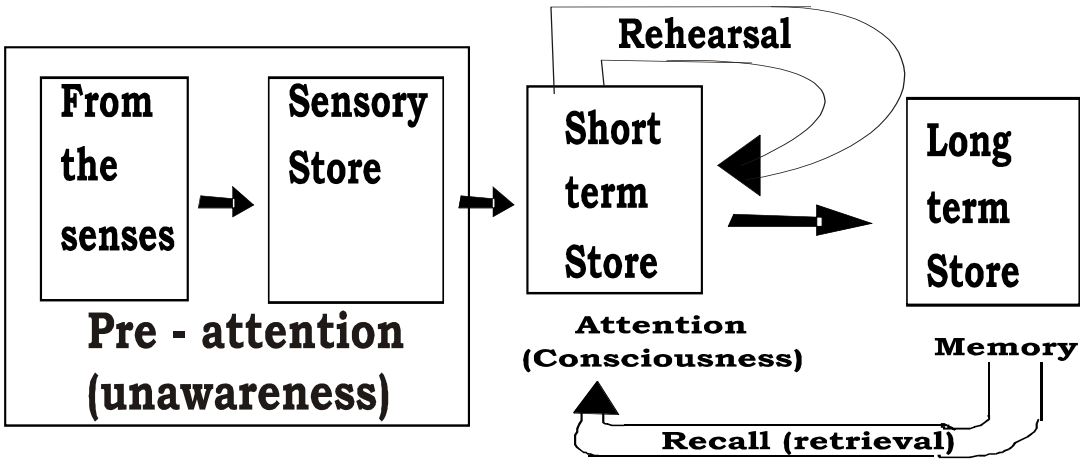
Transfering Information into Long-term Memory (LTM).

Atkinson and Shiffrin (1971) distinguished among several different mechanisms for transferring material into LTM, but their emphasis was on verbal rehearsal. They proposed that the probability of recalling an item from LTM increases each time the item is rehearsed. According to their model, information that is being maintained in STM through verbal rehearsal is gradually absorbed into LTM. One of the critical variables that determine whether an item will be transferred into LTM is its importance that is, how meaningful the object is to the learner. Rehearsal of an item is a second important determinant of LTM. Events that are repeated often are etched into LTM.

Much like the sensory register, information in short-term memory is either transferred into subsequent coding mechanism (long-term memory) or it is forgotten.

In summary, there are two separate processes involved in moving information in and out of long-term store-encoding and retrieval. The information in short-term store must be encoded so that it can be placed in long-term store. Later, the information encoded in long-term store is retrieved through recall or recognition. Hence in this work, there would be constant rehearsal of already leant materials, and also the use of hands-on activities will make the lesson meaningful to the pupils and this will help them to form the image and picture of the concepts learnt, facilitate the encoding, storing and transfer of the information learnt into the temporal and permanent storage buffer.

Figure II: The three stages of memory sequence



Theoretical Studies

The concept of Teaching and Learning.

According to Abanikanda (2003), teaching involves talking (on the part of the teacher) and clapping, nodding, echoing the teachers voice whenever the need arises (on the part of the students). But definitely these are just some aspect of it, and such actions alone may not result in the students gaining much. Good teaching is a deliberate, intentional and purposely activity and also a partnership activity involving the teachers and the students in the act of sharing the meaning of a word or concept.

The episode of teaching according to Abanikanda (2003) is tied with occurrence of learning. Since meaningful or effective learning is synonymous with positive change in behavior, good teaching can be said to be that which is capable of producing positive change in behavior on the part of the students. However, the responsibilities for learning lies with the students, all the

teacher can do is to make deliberate effort to teach in such a way that the students can be seen to have been sufficiently stimulated to learn, by making use of all the available resources at his/her disposal.

To ensure that the students shall learn, the teacher must make his teaching effective. In his study on how to bridge the gap between merely theorizing about teaching and the actual practice of teaching, Abanikanda (2003) suggested the following teaching methods that will hopefully result in effective learning; lecture method, tutoring method, textbook recitation project/problem solving, assignment method, stimulations, expository, pre-testing and post-testing method, field trips and excursions, enquiry-discovery method.

Teaching and Learning of Sciences.

The teaching of science has experienced various innovations in an attempt to achieve its objectives. According to Ndukwe (2006), a science teacher needs proper exposure and orientation to the basic psychological, sociological and possibly philosophical dimensions of science teaching to be able to understand the children's development and intellectual standing. The teacher must grasp the knowledge of the concepts taught and relate them to the child's interest, environment and basic needs. Each science teacher must realize the human angle in science and should be able to use his understanding to re-organize the school syllables and state the objectives in operational terms to achieve the desired result (Ndukwe, 2006).

If the teacher has stated the objectives of the lesson in operational terms and focuses his minds on them, he will be able to select the right methods and familiar examples that will give children the desired experiences. For a child to have interest in a school lesson, the lesson must be presented in an interesting manner to give the child some fun and meet his basic needs. Students' centered method helps a lot in the rate of students learning and retention of knowledge. Mendu (2000), in his study, emphasized that students' centered method provides maximum opportunities for students to make use of their various sense organs during learning process and this aids in maximum acquisition and retention of creativity and initiative on the part of the students. With this method the students see science as being real, interesting and meaningful.

Esiobu (2000), added that research in science education have clearly demonstrated that for meaningful learning to take place, the students must be actively involved in the learning process. Nwosu (2000), in the work resource utilization in science education classroom and its implication for the teacher, stated that a teacher has three basic functions namely: instruction, supervision and management and or utilization of learning facilities or resources.

Teaching requires a special approach or procedure. Such approach must encourage a retention and transfer of facts rather than memorization and regurgitation of facts. The purpose of education is to be able to transfer knowledge to new situation. However, one of the problems of teaching and learning of science

is the method of impacting knowledge to the learners. Ibraheem (2004) stated that despite all research works, seminars and conferences to improve the teaching and learning of sciences, there is still a poor scenario in science education in primary and secondary schools. According to Ibraheem, the major difficulty in learning science is the method by which the subjects were customarily taught. The pedagogical approaches in imparting knowledge to learners have become inadequate to their needs.

Methods of Presentation of Science

Through investigation and experience, various patterns of lesson presentation have been identified and these are called methods of teaching science. There are methods of teaching science, as there are different views on the nature of science. A review of literature shows that the following methods among many others exist, in imparting knowledge to the young ones. They are lecturing, tutoring, recitation, project method, enquiry approach, assignment, laboratory method, team teaching and micro teaching (Abanikanda, 2003). Lawal (2001), grouped teaching methods into two dorminant instructional approaches namely:

1. Teacher – centred approach.
2. Student – centred approach.

Teacher – Centred Approach: In this approach, the teacher does most of the activities while the students are either passive listeners or slightly involved. This approach involves conventional lecture and story telling methods of teaching and the

instructional strategy is chalk – talk technique (Lawal 2008). This teaching mode does not promote meaningful learning of science because it appeals only to the sense of hearing. Thus, a situation where science teachers use teacher centred – lecture - chalk – talk instructional mode in teaching, does not augur well for effective teaching and learning of sciences and therefore, not recommended. But some researchers (Asiyai, 2005, Egolum, 2010, and Adejoh, 2011) maintained that lecture method cannot be completely ruled out of use as a teaching method since it can produce good result when combined with other instructional strategies.

Student – Centred Approach: In this approach, students are giving opportunity to carry out search and discover facts about events, concepts and ideas. This approach is activity – based and practical oriented and it promotes independent thinking/self – reliance. NTI (2009) listed the methods of teaching as follows: Inquiry, guided discovery, process – based, project, field trip/excursion, concept mapping, discussion, demonstration, team teaching, cooperative learning, scaffolding, etc. The instructional techniques for the above methods of teaching are concretizing, grouping, pairing, individualization, questioning, answering learners question, illustration, dramatizing, guiding etc (Lawal 2008) as opposed to chalk and talk method.

The lecture/Expository Method.

According to Abanikanda (2003), lecturing as a method of teaching has a long history behind it, and it involves the teacher

talking more or less continuously to the class, while the students take down notes of the facts worth remembering.

This is a method of teaching in which the teacher present a verbal discourse on a particular subject or concept to the learner. According to Gbodi and Laleye (2006), in lecturer method, the teacher dominates the scene as the authority in the field while the learners are inactive. There is no room to challenge learners' ingenuity and development of cognitive skill through experiments. They only engage themselves mainly in listening and writing notes. There is no interaction between the teacher and the students. The fundamentals and details may not be understood by the students, also the teacher may assume some knowledge which the students may not possess and so the lecture method may not be meaningful to the students.

Egolum (2010) explained that the proponents of the lecture method hold the view that the teacher is the custodian of knowledge while the learner who is supposed to have nothing to contribute to the learning simply swallows all the facts presented by the teacher, stores them and regurgitates them on demand. As a result, retention of ideas, facts and principle learned in this way may not be effectively learned and also the students may not be able to apply those newly obtained materials to new related situations.

According to Ezeani (2004), at the secondary school level, the lecture method could be used when introducing a new topic or unit; when presenting important materials not easily

obtainable; when developing interest and appreciation; when summarizing important points after a unit of instruction; when attempting to cover a lot of materials in a short time. But it does not promote meaningful learning of science as it appeals to only the sense of learning and students can become restless and disruptive when it is used for a long time. It also encourages rote learning and regurgitation of information without necessarily adding understanding. This is because the teacher gives facts and opinions and gives over view of material and opinion about the subject matter being discussed. He poses problem and goes further to solve the problem for the students.

This method according to Abanikanda (2003) is commonly used in universities, and many higher institutions of learning, and it demands thorough preparation and a variety of styles in lecture and adequate use of the chalkboard to make it effective.

Oloruntegbe and Oduinyi (2003), emphasized that continued adherence to traditional methods of science delivery will continue to lower students' performance in science at all levels of cognitive skills and scientific attitude unless if combine with other instructional strategies.

Retention as a Factor in Science Achievement.

Retention of knowledge is the action of keeping knowledge rather than losing it or stopping it (Udogu, 2009). It is the ability to store facts or knowledge and remember it easily. The purpose of retaining knowledge is to prevent the loss of knowledge. There are many criteria that can determine if a particular knowledge

should be retained. In most cases, only one criteria needs to be met in order to make a plan to retain the knowledge.

The individual must determine if the knowledge could be useful or valuable in the future. If the knowledge could be significantly valuable, then the knowledge could be retained. Knowledge depreciation or decay tends to increase as the retention period increases, if the knowledge is not actively used. The true value of knowledge may lie in the ability to predict trends or future events based on previous knowledge. Storing knowledge exclusively within the individuals themselves is the best desirable location for storing knowledge. According to Argote (2000) the final stage of the knowledge retention in chemistry process is the sharing of the stored knowledge.

Farrant (1986) stated that increase in knowledge depends on ability to remember. He explained that if one could not grasp and keep hold of what was learnt, it would be like attempting to fill a jacket without a bottom. This is to say that if one cannot retain what one learns, then there is no need expecting one to perform in that activity in future. Farrant, further explained that knowledge is retained more at the tender age than at the old age. The fact that the mind can store knowledge and recall them when needed makes survival possible.

Review of Related Empirical Studies

Process-Based Teaching Strategy and Pupils' Achievement in Science.

The review of related literatures shows that there are some studies that deal with determining the student achievement in science using process-based teaching strategy. In respect to this study, Okoli (2006) investigated the effects of the investigative laboratory approach and expository method on acquisition of science process skills using 143 senior secondary school year one (SS1) Biology students of different levels of scientific literacy drawn from four randomly sampled schools in Onitsha urban area of Anambra State. Test of Science Process Skills Acquisition (TOSPSA) and Scientific Literacy Test (LST) were the instruments used for data collection. Mean and standard deviation were used to answer research questions while ANCOVA was used to test the hypotheses at 0.05 level of significance. Results revealed that students taught using the investigative laboratory approach performed significantly better than those taught using the expository method.

Awotua-Efebo and Uchenna (2008) investigated the effects of co-operative/collaborative interaction in Problem-Based Learning (PBL) context on students' achievement and interest in physics with 304 SS2 physics students in all the special science schools in Anambra State. The 2-way ANCOVA was used to analyse the data. Scheffe test was used to determine the level of difference between two means. The result from the analysis showed that there was significant effects on students overall

achievement and interest in physics at 0.05 level of significance. The result showed that the students who used co-operative/collaborative learning strategy preformed better than those who used traditional lecture-based learning strategy.

Okeke (2009) also studied the effect of activity centered teaching approach, using low cost learning kits in facilitating students achievement and interest in mathematics using 162 J.S.1 students in Onitsha Education Zone. Data were collected from the subjects using Mathematics Achievement Test (MAT) and Mathematics Interest Scale (MIS). ANCOVA was used to analyze data and test the significance of difference between two means at 0.05 level of significance. She found that the students taught mathematics using activity centered teaching approach with low cost learning kits, exhibited greater achievement in mathematics and a significant change in interest than those taught with conventional method.

In another study conducted by Egolum (2010) on the effect of concept mapping instructional strategy on achievement of chemistry students with different cognitive style, with 193 senior secondary one (SS1) chemistry students from the co-educational schools in 32 governments owned secondary schools in Onitsha Education Zone. The data collected were analyzed using mean and standard deviation to answer the research questions and analysis of covariance (ANCOVA) to test the hypothesis at 0.05 level of significance. The results of the analysis showed that field dependent and field independent cognitive style students taught chemistry using concept mapping achieved better than those

taught using conventional lecture method. The males of field independent and field independent achieved better than their field dependent and field independent females. The interaction effect of teaching method and gender was significant while the interaction effect of teaching method and cognitive style was not significant.

Bawa (2011) investigated the effects of Process – Based Teaching Method on the performance of J.S.S(II) Students in Basic Science. The population of the study was 1,835 students out of which 120 students were randomly selected and placed into experimental and control groups. The research instrument was 40 items Process – Based performance test of process skills. The results obtained revealed that there was a significant difference in the performance of the experimental and control groups as shown by their mean scores while there was no significant difference between the performance of male and female students.

Nzewi and Okoyefi (2013) also examine the effect of four-mode application (4MAT) instructional model on students' achievement and interest in basic science using 97 JSII students in two intact classes from two secondary schools in Nsukka Education Zone in Enugu State. The instruments for data collection were basic science achievement test (BSAT) and basic science interest inventory (BSII). Mean and standard deviation were used to answer research questions while analysis of covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. The result of the study showed that students

taught basic science with the 4MAT model had higher mean score than student taught with the conventional method. Student taught with 4MAT model had higher mean interest score than their counterparts in the control group and gender does not significantly affect students' interest and achievement in basic science. There was also no significant interaction effect of gender and teaching methods on students' achievement and interest scores.

From these studies one can deduce that there is an empirical gap in the area of immediate achievement gain (short term memory) and retention (long term memory). Most of the researchers focused their work on the immediate achievement gain and performance of students after treatment excluding measure of retention of the achievement gain which according to Farrant (1986), would be like attempting to fill a jacket without a bottom if one could not grasp and keep hold of what was learnt. Therefore the inclusion of retention measure in any research work on the modification of mode of science instruction to enhance students' achievement gain is very crucial. Hence this work will test immediate achievement at the end of instruction as well as retention some time after instruction.

Effects of Process-Based Teaching Strategy on Pupils' Attitude Towards Science

Uyoata (2002) investigated the effect of co-operative small group instructional mode on primary school pupils attitude towards science with 82 primary five pupils randomly selected

from 2 intact classrooms in 2 primary schools in Uyo Local Education Authority. A-15 items questionnaire tagged attitude towards Science and Technology Questionnaire (AS/TQ) was used to obtain information on attitude of pupils before and after treatment. The mean, standard deviation and t-test were used to analyze the data. However, CSGIM was found to be more potent in stimulating pupils' interest to develop more positive attitude towards science and technology than conventional instructional mode.

In another study, Ahiakwo (2002) investigated the attitude of students towards the social implications of science. The population is made up of the senior secondary school students in SS1 and SS2 in all the 18 public secondary schools in Ogba/Egbema/Ndoni L.G.A. of Rivers State. A sample of 500 students used for the study was made up of 300 boys and 200 girls randomly drawn from 10 different schools. The Test of Science-Related Attitude (TOSRA) developed by Fraser (1978) was adopted as the measuring instrument. The data was analyzed using simple frequency counts and percentages of occurrence and mean scores of the students. The result showed that students were neutral of their attitude to science which shows that they are neither positive nor negative in their attitude towards science. The result also revealed that when the boys and girls are compared, their attitudes to the social implications of science were similar and neutral.

In a study conducted by Ezeliora (2002) on relating chemistry teaching to local practice for sustainable science

education, with 340 SS1 students at Enugu, Enugu state. Two instruments; Chemistry Achievement Test (CAT) and Science Attitude Test (SAT) were used to collect data for the study. Mean scores and Z-test analysis were used to answer the researcher questions. The results of the study showed that there was statistically significant higher level of achievements and positive attitude towards chemistry by the experimental group.

Meltem and Oguz (2010) investigated the effects of scientific process skills-based science teaching on students' attitude towards science with primary 6th and 7th grades in Cumhuriyet primary school in Dalaman province of Mugla. The samples were 108 pupils randomly assigned to experimental and control groups. "The scientific process skills test" (10 items) and "scale of attitude towards science" (19 items) were used as data collection tools. T-test was used to test the hypotheses at 0.05 level of significance. The findings showed that experimental group students subjected to learning experiences enabling them to improve and display their science process skills enhanced their science skills more significantly than the students in the control group, but no difference occur in their attitude towards science.

Gender Differences in students' Achievement and Attitude towards Science.

Attempts were made by some researchers to find out gender differences in students achievement and attitude towards science.

Nwosu (2001) investigated the effect of gender, cognitive ability and teacher practices on the acquisition of nine science process skills by 440 senior secondary school year one students (246 girls and 194 boys) in Enugu and Nsukka Education Zones of Enugu state. Students in the experimental group were taught by teachers sensitized to the inquiry method of teaching science, while those in the control group were taught by the teachers not so sensitized. Two instruments 45 items test on science process skills (TOSPS) and cognitive ability test items were used for data collection. ANOVA were used for statistical analysis of data. Hypotheses were tested at 0.05 level of significance. It was found that boys generally performed better than girls. However, teacher practices and students' cognitive ability had strong effect than gender on levels of acquisition of the science process skills investigated. Also the differential performance due to gender was not significant for the experimental group.

Nwagbo (2002) determined the level of scientific literacy of secondary school science students in Nsukka, Enugu state. She also investigated the influence of gender in scientific literacy of the students. The sample consisted of 215 science students randomly drawn from eight out of twenty four schools in the area. The instrument used for data collection was scientific literacy test (SLT) developed by the researcher. Analysis of data was done using means, standard deviation and students' t-test. Results indicated low level of scientific literacy among the science students and significant gender difference existed between the two groups in favour of the males.

In a study conducted by Ibe and Nwosu (2006) on the effects of instructional materials manipulation on breaking gender barrier on achievement of male and female students in STME, 150 senior secondary one students were randomly picked from 3 co-educational secondary schools in Nsukka. Treatment consisted of teaching students science (Biology) using hands-on, mind-on activity (guided inquiry) and demonstration method using teachers sensitized to these methods of teaching. A twenty (20) item test on achievement comprising of two sections were used. Section A consisted of a practical questions and B consisted of ten multiple choice objective questions. Research questions were analyzed using mean and standard deviation while ANCOVA was used in testing hypothesis at 0.05 level of significance. It was observed that students (boys and girls) who were exposed to science process based learning yielded a more effective learning irrespective of gender than other students. There was no significant interaction effect of gender and teaching methods on students' performance in science.

Ukwungwu (2006) investigated the magnitude and direction of gender differences in performance in physics of Nigeria students. Twenty three research studies conducted all over Nigeria were collated for the research synthesis. The result showed that the magnitude of the gender differences in performance in physics was 0.58 in the direction of males. This figure corresponded with a correlation coefficient r=0.28 which means that 7.8% of the variance in students performance in physics was accounted for by gender. The r-value is also

equivalent to increasing the success rate of males from 36% to 64% on the Binominal Effect size display (BESD). In other words being a male enhances performance in physics by 28%.

Again Ndioho (2007) investigated the relative effectiveness of constructivist based instructional model on senior secondary students' achievement in Biology in Obio/Akpor local Government Area of River State. A sample of 240 SS11 Biology students from four secondary schools was randomly selected and used for the study. A Genetic achievement Test was used for the data collection. Analysis of data collected was done using mean, simple percentage, standard deviation and T-test results showed that constructivist – based instructional model was significantly more effective in teaching genetics and increasing biology students' achievement than the conventional lecture method. The result also did not reveal any significant difference between performance of male and female students.

In a study conducted by Anchor and Kurumeh (2010) on the effect of Dienes Multibase Blocks' Approach on students achievement in number bases with 200 junior secondary students from four single sex secondary schools in Makurdi Metropolis in Benue State were used. The instrument for data collection was Mathematics Achievement Test on Number Bases (MATONB). Mean was used to answer research questions while ANCOVA was used to test the hypotheses. The result showed that Dienes Blocks' Approach significantly enhanced students' achievement in number bases, whereas gender was not a significant factor in students' achievement in number bases.

However there was a significant interaction effect of gender and teaching method on students' achievement in number bases.

Also Nwagbo and Obiekwe (2010) investigated the effects of constructivist instructional approach on students' achievement in basic ecological concept in Biology. The sample was made up of 154 senior secondary year two (SS2) Biology students, randomly drawn from 4 out of 24 government owned senior secondary schools in Ogidi Education zone in Anambra State. The instrument was a 38 - item multiple choice biology achievement test on ecology concepts (BATEC). Mean and standard deviation were used to answer the two research questions while ANCOVA was used to test the null hypotheses at 0.05 level of significance. The result revealed that constructivist instructional approach was more effective in facilitating students' achievement in ecological concepts. There was no significant difference in achievement between male and female students taught ecological concepts using constructive instructional approach.

The studies on gender – related differences in achievement of both experimental and control groups do not seem to provide a clear picture of gender differences in achievement. Indeed, the review of literature conducted in this section indicated an inconclusive and inconsistent in the difference in achievement of male and female in the sciences. In view of the noted inconsistency, there is need to determine this issue of gender – related differences using an innovative teaching strategy – process-based strategy for teaching of primary science concepts.

Effect of Process –based Teaching Approach on Retention of Achievement gain.

Numerous studies have appeared in recent years which suggest various ways in which science instruction may be improved. In these studies, there had been considerable emphasis on the need for the modification of science instruction to enhance student gain in understanding of scientific facts and principles and the acquisition of science process skills. However, most of these studies conducted for modifying modes of instruction to achieve this objectives concentrated on the achievement gain on short term memory (Immediately after treatment is given) only very few has extended their work to determining the effect on long term memory (retention).

Ibeneme and Igboko (2006) investigated the effects of cognitive constructivism on the achievement and retention of students in Introductory Technology. Cognitive Constructivism was compared with conventional methods of teaching. The sample was made up of 50 students of Comprehensive Development Secondary School Owerri as the control group. Data were collected using Introductory Technology Achievement test (ITAT) which was administered immediately after treatment was given. A retention test followed three weeks after the achievement test. An analysis of covariance showed no significant difference among the dependent variables (achievement and retention) between the constructivist and the traditional groups. This implies that both methods (constructivist and conventional) are

equally effective and should be emphasized in teaching of Introductory Technology.

In another study, Archibong (2012) investigated the relative effectiveness of two teaching methods with respect to gender on students' retention of electrochemical concepts in chemistry in Uyo L.G.A of Akwa Ibom state. In carrying out the study, three intact classes were used; the control group in which subjects were taught using expository method, an experimental group 1 in which subjects were taught using problem solving method and experimental group 2 in which subject were taught using inquiry method. The sample consisted of 160 SSC students who constitute the subject of the study, were pre- tested with achievement test on Electrochemistry (ATOE) before treatment for 4 weeks, and later post- tested with same ATOE to determine the extent of retention of male and female students in the concept learnt. The reliability index of 0.78 was deemed adequate for measuring the intended outcomes. Data collected were analyzed using means and ANCOVA. Results revealed that though male and female students did not differ significantly in their level of retention of electrochemical concepts when taught using problem-solving, guided inquiry and expository methods, there were significant differences in the effectiveness of the three methods used. Also there were no significant interaction effect of gender and teaching methods on students' retention scores.

From the related studies, it has shown that numerous research studies that have attempted to suggest various ways in which science instruction may be improved have not considered

retention as an important factor in the selection of appropriate instructional mode for teaching science. Udegbe (2008) pointed out the importance of retention in the child's whole learning when she said that if pupils are not trained to achieve and retain what they were taught at the primary level, then other higher level will be affected and consequently the whole nation will be negatively affected. Therefore any research on the modification of science instruction to enhance students' achievement gain should be extended to the measure of retention of the achievement gain. Hence this research study will test immediate achievement at the end of instruction as well as retention some time after the instruction.

Summary of the Literature Review

From the literature reviewed such as that of Nwagbo (2001), efforts were made to highlight the poor achievement of students in science subjects, which is attributed to teaching method employed by the teacher. Available literature on methods of teaching sciences as reviewed suggested the need to employ innovative instructional modes such as process-based approach (Aina, 2007).

Studies such as Okeke (2009) and Awotua-Efebo and Uchendu (2008) which used process approach instructional strategy to address low achievement in students were also reviewed in relation to their effectiveness.

Some researchers reported that student taught with process-approach performed significantly better than those

taught with lecture method (Okoli, 2006; Okeke, 2009 and Bawa, 2011). Other researchers reported non-significant difference in their academic achievement (Nwagbo, 2002).

Studies such as that of Achor and Kurumeh (2010) on gender difference in students' achievement were reviewed. It is noted that the results of these studies were contradictory and inconclusive. Some researchers found significant difference between the two groups (Nwagbo, 2002 and Ukwungwu, 2006) while others reported non significant difference (Achor and Kurumah, 2010 and Ndioho, 2007).

There are some inconsistencies as regards the empirical studies on the relationship between teaching methods and attitude towards science. Some researchers such as Uyoata (2002) and Ezeliora (2002) reported that the experimental group had significantly higher level of achievement and positive attitude towards science. Others such as Meltem and Oguz (2010) and Ahiakwo (2002) found no difference in attitude of the two groups. The findings of Ibeneme and Igboko (2006) and Archibong (2012) leaves one in doubt of the effectiveness of the two methods on the retention as they found no significant difference when the two groups were compared on the retention test. There are inconsistencies as regard to the teaching method to be employed for enhancing achievement, attitude towards science as well as facilitating the retention of what is learnt.

Since the inception of new the elementary science programmes and vocational and technical education, emphasis had been on the use of activity-oriented methods such as

inquiry/problem solving, process approach and discovery method. Therefore in teaching science to pupils in our primary and secondary schools, leading students to investigate and explore their environment may not be out of place knowing fully well that students are generally excited whenever they are interacting with materials. This made it imperative not only to explore the effect of process-based teaching method in enhancing pupils' achievement and attitude towards science but also to determine the effect of the method on retention.

CHAPTER THREE
METHOD

This chapter was discussed under the following subheadings: Research design, Area of Study, Population of Study, Sample and Sampling Technique, Instrument for Data Collection, Validation of the Instrument, Reliability of the Instrument, Lesson Plans, Validation of the Lesson Plan, Experimental Procedure, Control of Extraneous Variables, Method of Data Collection, Scoring of the Items, Method of Data Analysis.

Research Design

The design of the study is quasi experimental design. Specifically, it used non-equivalent control group design. Non equivalent control group design was used because the pupils were not randomly sampled. Rather, intact classes were used which were randomly assigned to experimental and control groups. According to Nworgu (2015), this design allows maximum control of extraneous variables. It also offers less vigorous control compared to the true experimental design (Ali, 2006). The design is shown in table 1.

Design of the Experiment.

$O_1 \quad x \quad O_2$

$O_1 \quad \sim x \quad O_2$

Meaning of these symbols are:

~ **X** represents no treatment.

O_1 refers to first observation or pre-test.

O_2 refers to second observation or post-test.

---------- Doted lines separating two rows show two groups not equated by random assignment.

a row represents one group of persons and all the **X**s and **O**s in that row apply to all present in this group.

The **Xs** and **Os** on the same vertical line occur simultaneously.

Area of Study

The research was carried out in selected public primary schools in Nnewi and Ogidi Education Zones of Anambra State. Nnewi Education zone comprises four local government areas namely: Ekwusigo, Ihiala, Nnewi North and Nnewi South Local Government Areas, while Ogidi Education Zone is made up of three local government areas; namely: Idemili North, Idemili South, and Oyi Local Government Areas.

In Nnewi, there are many big industries and big markets and many young people are interested in working in these industries while many others are traders in the markets. As a result, these people came and live with their families in Nnewi and nearby towns. This has consequently led to high enrolment of pupils in primary and secondary schools in the two zones. This gives the researcher opportunity to get many children that were used for the research work in the two education zones.

Population of Study

The population of this study comprised all primary six pupils in the public primary schools in the seven local government areas of Nnewi and Ogidi Education Zones. There are total o f 14,550 primary six pupils in the two Education Zones. Out of this population, 7243 pupils are males while 7287 pupils are females (ASUBEB, 2014) (See Appendix A)

Sample and Sampling Technique.

The research sample comprised 256 primary six pupils from public primary schools in Nnewi and Ogidi Education Zones. Out of this sample, 131 were males while 125 were females (See Appendix F).To produce this sample, random sampling technique was used to select two local government areas from each of the two Education zones. From each of the four selected local government areas, two public primary schools were randomly selected. In each of these selected schools, one intact class was randomly selected from primary six streams thus having eight classes for the study.

Instrument for Data Collection

Two instruments were used for the study. They are;

1. Basic Science Achievement Test (BSAT).
2. Science and Technology Attitude Scale (STAS)

Basic Science Achievement Test was developed by the researcher based on the topics taught to the pupils in both groups. BSAT consists of thirty (30) multiple choice questions with options A-D

with only one correct answer (See Appendix B). Questions on BSAT were based on four Basic Science concepts from primary six curriculum which were taught to the pupils. These concepts are:

1. Lever
2. Force
3. Magnetism
4. Solar system

The BSAT was used for pre-test, post test and retention test. The pre-test was used to establish the prior knowledge of the pupils before the commencement of the treatment. The post-test was used to determine the influence of the process-based and conventional teaching methods after treatment on pupils' achievement, while the retention test was used to determine the influence of the process-based and conventional methods on the long term memory (retention) of the subjects.

Structured interview was conducted on the pupils using Science and Technology Attitude Scale (STAS) as a guide. The Science and Technology Attitude Scale (STAS) is a Likert type instrument developed by the researcher. The researcher used the following aspects of the affective domain in Science as her main dimensions of attitude to Science:

1. Social Implications of Science.
2. Normality of Scientists.
3. Attitudes towards scientific inquiry.
4. Adoption of Scientific attitudes.
5. Enjoyment of science lesson.

6. Leisure interest in science
7. Career interest in Science.

The STAS consists of ten (10) items (Appendix C). The STAS was used for pre-test and post-test. The pre-test was used to determine their attitude scores prior to the experimental treatment. Post-test was used to determine the influence of process-based and conventional methods on pupils' attitude to science.

Validation of the Instrument.

To ensure the content validity of the instrument for (BSAT), a table of specification was developed by the researcher to make sure that the items were representative of all areas identified in the curriculum. The objectives are written on the horizontal part of the table while the topics to be covered are written on the vertical part. The test blue print or table of specification that was used for the BSAT is shown in table 2.

Table 2: Table of Specification for Basic Science Achievement Test (BSAT)

S/N	CONTENT	KNOWLEGDE	COMPREH-ENSION	APPLICATION	HIGH ORDER QUESTIONS	TOTAL (100%)
1	lever	2	3	2	1	8(27%)
2	Magnetism	2	2	2	1	7(23%)
3	Force	2	2	2	1	7(23%)
4	Solar System	3	3	1	1	8(27%)
	TOTAL	**9(30%)**	**10(34%)**	**7(23%)**	**4(13%)**	**30(100%)**

The table of specification serves as a means of ensuring content validity of the test. For the face validity of the two instruments (BSAT and STAS), two experienced lecturers in the Department of Science Education, an experienced lecturer in Measurement and Evaluation department and an educational psychologist, all from Nnamdi Azikiwe University Awka and an experienced graduate Physics teacher from federal government college Awka were all given the initial drafts of BSAT and STAS along side with the Basic Science topics covered in the treatment and the test blue print to find out; if the questions were at the level appropriate for primary six pupils; if the language used for the questions were clear and unambiguous to the pupils; if the questions assessed the content as defined in the unit chosen. After the scrutiny, the thirty (30) out of 35 items of BSAT and ten (10) out of 15 items of STAS which survived the validation exercise were used by the researcher for the study.

Reliability of the Instruments.

The test items of the BSAT and STAS were assessed for reliability using 40 primary six pupils from 2 schools in Anaocha Local Government Area of Awka Education Zone. Those pupils were not part of the population of the main study but they were equivalent to the group for which the test was developed. The data collected from the pupils' responses to the items of the instruments were used to determine the reliability of the instruments.

For BSAT reliability, Kudder-Richard (K-R21) method was used. According to Anaekwe (2007), K-R21 is ideal for the instrument that is dichotomously scored. The reliability co-efficient obtained for BSAT was 0.80 (See Appendix E).

On the other hand, Cronbach Alpha's internal consistency measure was used for STAS, as it is applicable to items that are not dichotomously scored (Anaekwe, 2007). The reliability co-efficient of STAS was 0.89. This is shown in appendix D. According to Anaekwe (2007), a high internal consistency value of 0.80 (80%) and above signifies a large degree of intra-item coherence in interpretations and answers by the respondents. Hence the instruments are reliable.

Lesson Plans

The researcher prepared two lesson plans for the study. The lesson plan (appendix G) was based on the process-based instructional method while the second lesson plan (appendix H) was based on conventional method. Both lesson plans were drawn from Basic Science curriculum and textbooks.

The process-based lesson plan is identical to the conventional method lesson plan in terms of contents, instructional objectives and mode of evaluation. The only difference is in the instructional activities where process-based lesson plan deviated from the conventional method by employing hands on activities and questioning during the instructional process. The process-based lesson plan was used for the

treatment group while the conventional method lesson plan was used for the control group.

Validation of the Lesson Plan.

Two experts in Science Education validated the lesson plans. They were specifically requested to examine the extent to which the:

i. lesson plans covered the unit of study;
ii. objectives were clearly stated;
iii. objectives were appropriate to pupils' level;
iv. appropriateness of instructional strategies were specified;
v. appropriateness of instructional materials were specified;
vi. adequacy of pupils' activities; and
vii. evaluation questions measured the objectives of the lesson.

The comments of these experts were used to modify the lesson plan.

Experimental Procedure

Prior to the actual teaching, the eight intact classes were assigned to experimental and control groups using simple random sampling by balloting method. There were 128 pupils in experimental group with 70 boys and 58 girls. The control group was made up of 128 pupils with 61 boys and 67 girls. The experimental group was exposed to various hands-on activities during the lesson periods while the control group were not exposed to hands-on activities rather they were taught using explanations and use of examples. To account for possible pre-

existing differences in overall ability between the experimental and control groups, the BSAT and STAS were pre-tested on the pupils in both experimental and control groups.

A one week training was organized by the researcher for the teachers so as to acquaint them with the methods and uses of the teaching materials. This involved detailed instructions on the conduct of learning activities for both groups. The experimental group was taught with process-based lesson plans for 8 periods (Appendix G) while the control group was taught using conventional lesson plans for 8 periods (Appendix H). The study lasted for six weeks using normal school period of 35 minutes per lesson period, giving 70 minutes per week. Both experimental and control groups were taught the following science concepts and sub topics.

Lever

- What lever is.
- Components of lever
- Classes of lever.
- Uses of lever.

Magnetism

- What magnetism is.
- Types of Magnet.
- Magnetic and non magnetic materials.
- Properties of a magnet.
- Ways of making magnet.
- Uses of magnet.

Force

- What force is.
- Types of force.
- Friction and its effects.
- Principles of friction.
- Advantages and disadvantages of friction.

Solar System

- What solar system is.
- The nine planets.
- The earth and movements of the earth.
- Eclipse of the Sun and moon.

The experimental groups were taught using process-based teaching method while the control groups were taught with conventional method.

At the end of the six weeks set out for the study, the items of same instruments were reshuffled and administered as post-tests to all the students by the research assistants to measure pupils achievements and attitude towards science.

Fifty-six days after post-tests were given, the same items of BSAT were reshuffled again and administered to the pupils to determine retention of information. According to Bahrick and Lorraine (1993) recall was highest for the 56 days interval as opposed to a 28 – days or 14 - days interval.

Control of Extraneous Variables.

The following measures were taken to control extraneous variables;

1. The experimental and control groups were located at different schools which were far from each other so that there were no group interactions.
2. Initial group differences: Randomization is one of the procedures of controlling initial group differences in experimental studies. This was not done in this study because it would disrupt normal school administration. Instead intact classes were used.
3. To control the initial differences of subjects in these intact classes, Analysis of Covariance (ANCOVA) was used in data analysis.
4. To avoid experimental bias and to maintain homogeneity of instruction, the teaching of experimental and control groups were done by the research assistants and the use of a common lesson plans which was provided by the researcher. With this, the researcher was not personally involved in administering any of the research materials.
5. In order to control for teacher quality variable, and ensure uniform standards, the researcher personally prepared all the teaching materials – processed-based lesson plans and conventional method lesson plans.

Method of Data Collection

The instruments were administered to the pupils by their class teachers who were used as research assistants. Before the commencement of treatment, the pupils were pre-tested with BSAT and STAS. After the treatment was given, the same items of

BSAT and STAS were reshuffled and administered as post-test to the pupils. Fifty-six days after the post-test was given, the items of BSAT were reshuffled again and administered as a retention test to the pupils. The time that was given for BSAT was 1 hour 20 minutes.

Scoring of the Items

For BSAT, the test score is the total number of items correctly answered out of 30 objective test items. Pupil's response was scored as one when they correctly get the answer and zero when they fail it. BSAT score was the total number of questions correctly answered. The maximum score was thirty (30).

For STAS, which consisted of 10 items rated along 3 – points Likert scale of Agreed (3), Undecided (2), and Disagree (1). The instrument consists of 8 positive and 2 negative statements. For all positive statements, the scoring is 3, 2 and 1 (3-1) along the scale while for negative statements, the scoring is reversed (1-3). The sum of all statements of each respondent shows his/ her total score on the scale. So, the maximum possible score on the attitude scale is 10 x 3 = 30, and the minimum score 10x1= 10. It means that higher score on the scale reflects more positive attitude towards science and vice versa.

For Retention, the mean difference in the post-test and retention scores of each pupil in each group was used to determine the pupils' retention of the Basic Science concepts. If the difference is small, it means that the individual has retained

most of what he has learnt. But if the difference is big, it means that the individual has forgotten most of what he has learnt.

Method of Data Analysis

The research questions were answered using mean scores of pupils while hypotheses were tested using Analysis of Covariance (ANCOVA). ANCOVA was used because it will remove the bias that might have resulted from intact groups whose initial difference had not been established.

CHAPTER FOUR
PRESENTATION AND ANALYSIS OF DATA

In this chapter, the data collected from the field for this study were analysed and the summaries were presented in tables to highlight the findings. The presentation was sequentially done starting with the answer to the research questions and then the testing of the null hypotheses.

Research Question 1

What are the differences in the pretest and posttest mean academic achievement scores of primary school pupils taught basic science using process based method and those taught with conventional method?

Table 3: Pretest and Posttest mean achievement Scores of pupils who were taught with process based method and those taught with conventional method

Group	N	Pretest Mean	Posttest Mean	Gained Mean	Remark
Process- Based	128	49.89	79.47	29.58	More Effective
Conventional	128	50.88	70.69	19.81	

Table 3 shows that with pretest mean score of 49.89 and posttest mean score of 79.47 with gained mean 29.58 for the pupils taught basic science with process based method as against pretest mean score of 50.88 and posttest mean score of 70.69 with gained mean of 19.81 for the pupils taught with conventional method. Therefore, process based method is more

effective in enhancing academic achievements of primary school pupils in Basic Science.

Research Question 2

What are the differences in the pretest and posttest mean attitude scores of primary school pupils taught basic science using process based method and those taught with conventional method?

Table 4: Pretest and Posttest mean attitude Scores of pupils who were taught with process based method and those taught with conventional method

Group	N	Pretest Mean	Posttest Mean	Gained Mean	Remark
Process- Based	128	18.13	25.80	7.67	More Effective
Conventional	128	18.09	22.94	4.85	

Table 4 indicates that with pretest mean attitude score of 18.13 and posttest mean score of 25.80 with gained mean 7.67 for the pupils taught basic science with process based method as against pretest mean score of 18.09 and posttest mean score of 22.94 with gained mean of 4.85 for the pupils taught with conventional method. Therefore, process based method is more effective in enhancing the attitude primary school pupils towards Basic Science.

Research Question 3

What are the differences in the posttest and retention mean academic achievement scores of primary school pupils taught

basic science using process based method and those taught with conventional method?

Table 5: Posttest and retention mean achievement Scores of pupils who were taught with process based method and those taught with conventional method

Group	N	Pretest Mean	Posttest Mean	Memory decay	Remark
Process- Based	128	79.47	77.63	1.84	More Effective
Conventional	128	70.69	63.24	7.45	

Table 5 reveals that with posttest mean score of 79.47 and retention mean score of 77.63 with lost mean 1.84 for the pupils taught basic science with process based method as against posttest mean score of 70.69 and retention mean score of 63.24 with lost mean of 7.45 for the pupils taught with conventional method. Therefore, process based method is more effective in retention of knowledge of primary school pupils in Basic Science.

Research Question 4

What are the differences in the pretest and posttest mean academic achievement scores of male and female primary school pupils taught basic science using process based method?

Table 6; Pretest and Posttest mean achievement Scores of male and female pupils who were taught with process based method.

Group	N	Pretest Mean	Posttest Mean	Gained Mean	Remark
Male	70	49.16	78.51	29.35	Marginal
Female	58	50.77	80.62	29.85	

In table 6 it was observed that with pretest mean score of 49.16 and posttest mean score of 78.51 with gained mean 29.35 for the male pupils taught basic science with process based method as against pretest mean score of 50.77 and posttest mean score of 82.62 with gained mean of 29.85 for the female pupils taught with process based method. Therefore, the male and female pupils taught with process based method do not differ in their academic achievements in primary school Basic Science

Research Question 5

What are the differences in the pretest and posttest mean attitude scores of male and female primary school pupils taught basic science using process based method?

Table 7: Pretest and Posttest mean attitude Scores of male and female pupils who were taught with process based method

Group	N	Pretest Mean	Posttest Mean	Gained Mean	Remark
Male	70	18.29	25.77	7.48	Marginal
Female	58	17.95	25.83	7.88	

Table 7 reveals that with pretest mean attitude score of 18.29 and posttest mean score of 25.77 with gained mean 7.48 for the male primary school pupils taught basic science with process based method as against pretest mean score of 17.95 and posttest mean score of 25.83 with gained mean of 7.88 for the female pupils taught with process based method. Therefore, the male and female pupils taught with process based method do not differ in their attitude towards Basic Science.

Research Question 6

What are the differences in the posttest and retention mean academic achievement scores of male and female primary school pupils taught basic science using process based method?

Table 8: Posttest and retention mean achievement Scores of male and female pupils who were taught with process based method

Group	N	Pretest Mean	Posttest Mean	Gained Mean	Remark
Male	70	78.51	76.79	1.72	Marginal
Female	58	80.62	78.66	1.96	

Table 8 shows that with posttest mean score of 78.51 and retention mean score of 76.79 with lost mean 1.72 for the male pupils taught basic science with process based method as against posttest mean score of 80.62 and retention mean score of 78.66 with lost mean of 1.96 for the female pupils taught with process base method. Therefore, the male and female pupils taught with process based method do not differ in their retention of knowledge of primary Basic Science.

Testing the null Hypotheses

Null Hypothesis 1

There is no significant difference in the mean achievement scores of primary school pupils taught Basic Science with process based method and those taught with conventional method.

Table 9: ANCOVA on the mean achievement scores of pupils taught Basic science with Process based method and those taught with conventional method

Source of variation	SS	df	MS	Cal.F	Crit.F	Remark
Corrected Model	12616.129	2	6308.064			
Intercept	9959.681	1	9959.681			
Achievement 1	7681.066	1	7681.066			
Treatment Model	5714.725	1	5714.725	138.59	3.84	S
Error	10432.309	253	41.234			
Total	1466050.000	256				
Corrected Total	23048.437	255				

In Table 9, it was observed that at 0.05 level of significance, 1df numerator and 255df denominator, the calculated F 138.59 is greater than the critical F 3.84. Therefore, the first null hypothesis is rejected. Then process based method is significant in enhancing academic achievements of primary schools pupils in Basic science when compared with conventional method.

Null Hypothesis 2

There is no significant difference in the mean attitude scores of primary school pupils exposed to process based method and those who received conventional teaching in Basic science.

Table 10: ANCOVA on the mean attitude scores of pupils taught with Process based method and those taught with conventional method

Source of variation	SS	df	MS	Cal.F		Crit.F
Remark						
Corrected Model	598.233	2	299.116			
Intercept	1527.883	1	1527.883			
Attitude 1	74.967	1	74.967			
Treatment Model	519.056	1	519.056	227.49	3.84	S
Error	577.252	253	2.282			
Total	153178.000	256				
Corrected Total	1175.484	255				

Table 10 shows that at 0.05 level of significance, 1df numerator and 255df denominator, the calculated F 227.49 is greater than the critical F 3.84. Therefore, the second null hypothesis is rejected. Then, the process based method is significant in enhancing the attitudes of primary schools pupils towards Basic science.

Null Hypothesis 3

There is no significant difference in the mean achievement retention scores of primary school pupils taught Basic science with Process based method and those taught with conventional method.

Table 11: ANCOVA on the mean achievement retention scores of primary school pupils taught basic science with process based method and those taught with conventional method

Source of variation	SS	df	MS	Cal.F	Crit.F	Remark
Corrected Model	28316.394	2	14158.197			
Intercept	12.357	1	12.357			
Achievement 2	15062.628	1	15062.628			
Treatment Model	2049.176	1	2049.176	235.81	3.84	S
Error	2198.606	253	8.690			
Total	1300644.000	256				
Corrected Total	30515.000	255				

Table 11 shows that at 0.05 level of significance, 1df numerator and 255df denominator, the calculated F 235.81 is greater than the critical F 3.84. Therefore the third null hypothesis is rejected. Then, the achievement retention scores in Basic science of primary school pupils taught with Process based method differ significantly when compared with those taught with the conventional method.

Null Hypothesis 4

There is no significant difference in the mean academic achievement scores of male and female primary school pupils taught Basic science using process based method.

Table 12: ANCOVA on the mean achievement scores of male and female primary school pupils taught Basic Science with process based method.

Source of variation	SS	df	MS	Cal.F	Crit.F	Remark
Corrected Model	4022.750	2	2011.375			
Intercept	9014.145	1	9014.145			
Achievement 1	3882.016	1	3882.016			
Gender	37.687	1	37.687	0.665	3.84	N S
Error	7083.125	125	56.665			
Total	819462.000	128				
Corrected Total	11105.875	127				

Table 12 reveals that at 0.05 level of significance, 1df numerator and 127df denominator, the calculated F 0.67 is less than the critical F 3.84. So the fourth null hypothesis is accepted. Therefore, the academic achievements scores of male and female primary school pupils taught basic science with process based method do not differ significantly.

Null Hypothesis 5

There is no significant difference in the mean attitude scores of male and female primary school pupils taught basic science with process based

Table 13: ANCOVA on the mean attitude scores of male and female primary school pupils taught Basic Science with process based method

Source of variation	SS	df	MS	Cal.F	Crit.F	Remark
Corrected Model	10.547	2	5.274			
Intercept	1273.060	1	1273.060			
Attitude 1	10.447	1	10.447			
Gender	.289	1	.289	0.13	3.84	NS
Error	272.172	125	2.177			
Total	85464.000	128				
Corrected Total	282.719	127				

Table 13 indicates that at 0.05 level of significance, 1df numerator and 127df denominator, the calculated F 0.13 is less than the critical F 3.84. The fifth null hypothesis is accepted. Therefore, the attitude of male and female primary school pupils taught basic science with process based method do not differ significantly.

Null Hypothesis 6

There is no significant difference in the mean achievement retention scores of male and female primary school pupils taught Basic Science with process based method.

Table 14: ANCOVA on the mean achievement retention scores of male and female primary school pupils taught basic science with process based method

Source of variation	SS	df	MS	Cal.F	Crit.F	Remark
Corrected Model	11089.973	2	5544.986			
Intercept	6.154	1	6.154			
Achievement 2	10979.120	1	10979.120			
Gender	1.778	1	1.778	0.41	3.84	NS
Error	539.769	125	4.318			
Total	783067.000	128				
Corrected Total	11629.742	127				

Table 14 indicates that at 0.05 level of significance, 1df numerator and 127df denominator, the calculated F 0.41 is less than the critical F 3.84. The sixth null hypothesis is accepted. Therefore, the academic achievement retention scores of male and female primary school pupils taught basic science with process based method do not differ significantly.

Summary of the Findings

From the analysis the following findings were made:

1. Process based method is more effective in enhancing academic achievements of primary school pupils in Basic Science than conventional method.
2. Process based method is more effective in enhancing the attitude primary school pupils towards Basic Science than conventional method.
3. Process based method is more effective in retention of knowledge of primary school pupils in Basic Science than the conventional method.

4. The male and female pupils taught with process based method do not differ in their academic achievements in primary school Basic Science.
5. The male and female pupils taught with process based method do not differ in their attitude towards Basic Science.
6. The male and female pupils taught with process based method do not differ in their retention of knowledge of primary Basic Science.
7. Process based method is significantly more effective in enhancing academic achievements of primary schools pupils in Basic science when compared with conventional method.
8. The process based method is significantly more effective in enhancing the attitudes of primary schools pupils towards Basic science than conventional method.
9. The achievement retention scores in Basic science of primary school pupils taught with Process based method differ significantly when compared with those taught with the conventional method.
10. The academic achievements scores of male and female primary school pupils taught basic science with process based method do not differ significantly.
11. The attitude scores of male and female primary school pupils taught basic science with process based method do not differ significantly,
12. The academic achievement retention scores of male and female primary school pupils taught basic science with process based method do not differ significantly.

CHAPTER FIVE

DISCUSSION OF RESULTS, CONCLUSION AND RECOMMENDATIONS.

This chapter deals with the discussion of the results, conclusion and recommendations based on the research findings.

The research findings based on the data presented are interpreted and discussed under the following headings:

1. Effect of process-based method and conventional method on primary school pupils' achievement scores in Basic Science.
2. Effect of process-based method and conventional method on primary school pupils' attitude scores in Basic Science.
3. Effect of process-based method and conventional method on primary school pupils' retention scores in Basic Science.
4. Effect of gender on primary school pupil's achievement scores in Basic Science taught with process-based teaching method.
5. Effect of gender on primary school pupils' attitude scores in Basic science taught with process-based teaching method.
6. Effects of gender on primary school pupils' retention scores in Basic Science taught with process –based teaching method.

Also conclusion, implications of the study, recommendation and suggestions for further research were made.

Discussion of Results.

The effect of process-based method and conventional method on primary school pupil's achievement scores in Basic Science.

Result from table 3 showed that the gained mean achievement scores of pupils in the process-based group were higher than that of the gained mean achievement scores of pupil's in the conventional method group. This was further confirmed by the ANCOVA result in table 9 which revealed that teaching method was a significant factor on pupil's achievement in Basic Science. Thus it was confirmed that pupils taught with process-based method performed better than those taught with conventional method. This implies that process-based instructional method was more effective in enhancing and facilitating pupil's achievement in Basic Science concepts than the conventional method.

The finding of the study seems to support the finding of previous researchers- Bawa (2011), Egolum (2010), Okeke (2009), Awotua- Efebo and Ucheudu (2008) and Okoli (2006) which confirmed that appropriate teaching method leads to students' improved achievement in science subjects. This improved and significant achievement must have been as a result of the variety of activities which characterized process-based approach, where every learner must fully be involved in all fun-like, practical and interesting activities. These hands-and minds-on activities must have empowered and enabled all learners with different

characteristics and abilities to benefit from the variety of the learning experiences provided by this approach.

Effect of process-based method and conventional method on primary school pupils' attitude scores in Basic Science.

The result in table 4 indicated that the overall gained mean attitude scores of primary school pupils taught with process-based method is greater than the scores of those pupils taught with conventional method. This is further confirmed by the ANCOVA result in table 10 which showed significant difference in the mean attitude scores of pupils taught with process-based method and those taught with conventional method. This implies that process-based method has positive influences on pupil's attitude towards science. This finding disagrees with the finding of Meltem and Oguz (2010) and Ahiakwo (2002) who found no significant difference in pupils' attitude towards science. However, it agrees with the findings of Uyoata (2002) and Ezeliora (2002) who reported that the experimental group had significantly higher level of achievement and positive attitude towards science.

The significant higher level of achievement and positive attitude towards science exhibited by the process-based group might have been caused by characteristics hands-on and minds-on activities imbedded in process-based approach which is very likely to stimulate pupils' interest and makes them enjoy and feel satisfied with the learning experiences. The satisfaction so

derived lead to success which in turn engender higher positive attitude towards science.

Effect of process-based method and conventional method on primary school pupils' retention scores in Basic Science.

Results in table 5 showed that the lost means retention scores of primary school pupils taught with process-based method is less than those taught with conventional method. The high lost mean scores obtained by the conventional method group showed that they had forgotten more than those of the process-based group which had less lost mean scores. This was further confirmed by the ANCOVA result in table 11 which revealed that method was a significant factor in pupils' retention of Basic Science concepts. Thus it was confirmed that pupils taught with process-based method retained more than those taught with conventional method. This implies that process – based method is more effective in enhancing and facilitating pupils' retention of Basic Science concepts than conventional method. The finding agrees with that of Archibong (2012) who also found significant difference in the effectiveness of the three methods used in favour of innovative teaching methods. However, the finding disagrees with that of Ibeneme and Igboke (2006), who reported no significant difference between the constructivist and conventional groups.

The significant high level of retention by the process-based group must have resulted from the activity – instructional process provided by the process-based method which makes for a

better retention of the concepts by the process-based group than the conventional method group.

Effect of gender on primary school pupil's achievement scores in Basic Science taught with process-based teaching method.

The effect of gender on primary school pupil's achievement in Basic Science was obtained by comparing the gained mean achievement scores of male and female pupils' taught with process-based method. Table 6 showed that the gained mean achievement scores of performance of male and female pupils in both groups were almost the same. This was further confirmed by the ANCOVA result in table 12 where calculated F 0.67 is less than the critical F 3.84 and so not significant at 0.05 alpha levels. This is an indication that gender is not a significant factor on pupil's achievement in Basic Science. The result is in compliance with the finding in recent studies of Achor and kurumeh (2010), Nwagbo and Obiekwe (2010), Ndioho (2007), Ibe and Nwosu (2006) and Nwosu (2001) who also found no significant difference in the achievement of male and female students while it disagrees with the findings of Ukwungwu (2006) and Nwagboo (2002) who found a significant gender difference in achievement in favor of male. However, any difference found in the performance of male and female might be due to sampling error or measurement error but not due to gender.

Effect of gender on primary school pupils' attitude scores in Basic science taught with process-based teaching method.

Result in table 7 revealed that the main effect of gender on the attitude scores of primary school pupils, taught with process-based teaching methods is not statistically significant. This was further confirmed in the ANCOVA result in table 13. This result is in line with Achor and Kurumeh (2010), Nwagbo and Obiekwe (2010), Ndioho (2007) and Ibe and Nwosu (2006) who found no significant difference between male and female attitude scores when taught with activity-based method and lecture method. The findings also disagree with those of Ukwungwu (2006), and Nwagbo (2002) who found significant gender difference between the two groups in favour of males.

Result in table 7 however showed that the gained mean attitude score of males and females were almost the same. There was no significant difference in both male and female attitude scores. The difference in their mean attitude scores might be due to sampling or measurement error.

Effects of gender on primary school pupils' retention scores in Basic Science taught with process–based teaching method.

The mean retention scores of males and females pupils showed no significant difference in their performance. Result in table 8 showed that the performance of male and female pupils in the gained mean retention scores using process-based methods were almost the same. This was further confirmed in the ANCOVA result in table 14 which showed no significant

difference between the performance of male and female in their retention scores.

This result is in line with the findings of Archibong (2012) who found out that male and female students did not differ significantly in their level of retention of electrochemical concepts when taught using problem-solving, guided inquiry and expository methods.

However, any difference found in the performance of male and female in the two groups might be due to sampling or measurement error but not due to gender

Conclusion

The results of the study showed that exposure of the learner irrespective of sex to hands–on, mind-on activity (process-based approach) that involved learner's participation yielded a more viable result on achievement, attitude and retention. A non significant gender influence on achievement, attitude and retention was indicated. It is hereby concluded that process-based method remains a very good option method for teaching Basic Science concepts and should therefore be effectively put to use by all science teachers in our schools.

Implications of the Findings.

The finding of this study has implications for the science teachers, curriculum planners, government and the general public (society). This study aligned its finding on the method that will be more effective in enhancing pupils' achievement, engender

development of positive attitude towards science and facilitate the retention of Basic Science concepts. The implication of this study to science education, borders on the use of instructional strategy that will be more effective in addressing the diverse needs of pupils.

The study showed that pupils taught with process based method performed significantly higher in achievement, attitude and retention than those taught with conventional method. This provides useful feedback on the relative efficacy of process-based method. This implies that the active involvement of the pupils in process-based class gave rise to efficient learning. Pupils' participation in teaching–learning process leads to a more scientific and acceptable understanding of concepts, enhance the levels of acquisition of science tasks, engender positive attitude towards science and facilitate retention of science concepts. It means that process-based instructional method in science teaching makes the learner an active information processing organism.

Gender is not a significant factor in Basic Science achievement, attitude and retention. The difference in the performance of male and female in both methods might be due to sampling or measurement error. Process –based teaching method is therefore not gender sensitive.

Recommendations

In view of the appreciable effect of process-based method on pupils' achievement, attitude and retention of science concepts, it is recommended that:

1. Science teachers should endeavor to apply this teaching approach in their teaching as well as ensuring that both sexes are given equal opportunity to do science.
2. Teachers should give boys and girls equal opportunity to handle materials in the science classroom.
3. Teachers should acquaint themselves with the skills and principles of process-based approach with a view to enhance pupils' achievement, attitude and retention of science concepts. To this end, the Science Teachers Association of Nigeria (STAN) and the government can organize seminars and conference to help teachers in this direction.

Suggestions for Further Research

There are some areas this study has generated for further research. Hence further research should be under taken to:

1. Examine the effect of process-based teaching method and cognitive style on pupil's achievement in Basic science.
2. Ascertain how interest level of pupils will interact with process-based method to affect pupil's achievement in Basic science.
3. Investigate the effect of process – based method and lecture method on the acquisition of science process skills by the students.

4. Carry out the study in other Local Government Areas and states to see if the same result will be obtained.
5. Ascertain the effect of process-based method on achievement, attitude and retention in other topics on Basic Science.

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APPENDIX A

Population of primary six (6) pupils in public primary schools in Nnewi and Ogidi Education Zones according to local government area.

Education Zone	Local Government Area	No of primary Six stream	Number of pupils Male	Female	Total
Nnewi	Nnewi North	79	1,046	1,100	2,146
Education	Nnewi South	66	926	884	1,810
Zone	Ekwusigo	44	537	515	1,052
	Ihiala	122	1,483	1,345	2,828
Ogidi	Idemili North	160	1,795	2,043	3,838
Education	Idemili South	62	734	668	1,402
Zone	Oyi	63	722	732	1,454
TOTAL		**596**	**7,243**	**7,287**	**14,550**

Source: Anambra State universal Basic Education Board Awka. September, 2014.

APPENDIX B

BASIC SCIENCE ACHIEVEMENT TEST.

Name of Pupil:_____

Age:_____

Sex Male ( ) Female ( )

Name of School: _____

Underline the correct answer to each question.

1. There are _____ classes of lever.
   A. four B. five C. two D. three
2. One of the advantages of friction to mankind is _____
   A. Grinding things B. cooking things C. washing things D. cleaning things.
3. The rotation of the earth causes day and _____
   A. light B. morning C. night D. evening
4. One of these is not among the uses of a lever in everyday life
   A. carry things B. grind things C. damage things D. opening things
5. The common instrument used by the Astronomers to study the heavenly bodies is the _____
   A. microscope B. electroscope C. telescope D. stereoscope
6. One of these is not a type of magnet. _____
   A. ring magnet B. rectangular Bar magnet C. electrical magnet D. cylindrical magnet
7. Frictional force is more on _____surface and less on smooth surface.
   A. rough B. flat D. straight D. smooth
8. We have _____ when the light of the sun or moon is covered by another body
   A. Revolution B. Eclipse C. Rotation D. Orbit
9. Magnets show the properties of attraction and _____
   A. reduction B. revolution C. rejection D. repulsion
10. One of the ways of making a magnet is by ____
    A. stroking B. demagnetizing C. attraction D. repelling
11. A point at lever machine where force is applied is called ____
    A. load B. effort C. fulcrum D. pivot
12. One of the disadvantages of friction is _____
    A. grinding things C. damage machine parts C. help in movement D. sharpens knives

13. The force that exists between two moving surfaces in contact with each other is called _____ force.
    A. magnetic B. gravitational C. frictional D. mechanical
14. A lever machine found in school is _____
    A. force B. seesaw C. computer D. pulley
15. One of these is a non magnetic material.
    A. nail B. bottle top C. wood D. razor blade
16. Scissors is example of simple machine under _____ class lever.
    A. 2^{nd} B. 1^{st} C. 3^{rd} D. 4^{th}
17. One of these is not the use of magnet in everyday life.
    A. separate mixture B. produce sound C. cut things D. collect lost pins
18. The force that pulls objects down to the earth is called _____ force.
    A. gravitational B. frictional C. electrical D. magnetic
19. It takes the earth _____ to make complete revolution round the sun.
    A. 265 days B. 365 days C. 625 days D. 565 days
20. _____ is made up of a bar or rod, lying or resting on a support.
    A. Incline plane B. pulley C. lever D. wedge
21. One of these is not a type of force.
    A. frictional force B. conventional force C. electrical force
    D. gravitational force
22. One of the following is a magnetic material
    A. plastic B. nail C. paper D. wood
23. Revolution is the movement of the earth round the _____
    A. star B. axis C. moon D. sun
24. The three components of lever are load, fulcrum and _____
    A. effort B. pivot C. rod D. screw
25. The scientists who study about the sky or the heavenly bodies are called __
    A. Dentists B. Oculists C. Astronomers D. Othologists.
26. To reduce friction we apply _____
    A. water B. grease C. sand D. gum
27. Like poles of magnets repel while unlike poles _____
    A. disperse B. converge C. attract D merge
28. The sun and the _____ make up the solar system.
    A. universe B. moons C. stars D. nine planets
29. It takes the earth _____ hours to make a complete rotation.
    A. 12 hours B. 6 hours C. 24 hours D. 10 hours.
30. An example of simple machine under second order lever is _____
    A. wheel barrow B. forceps C. scissors D. opener

APPENDIX C

SCIENCE AND TECHNOLOGY ATTITUDE TEST

Name of Pupil: _____

Age: _____

Name of School: _____

Sex: Male [ ] Female [ ]

S/N	ITEMS	AGREE	NOT SURE	DISAGREE
1	I like science lessons.			
2	I feel happy when it is time for science lessons.			
3	I want more of science lessons in future.			
4	Science lessons are very enjoyable and fun.			
5	I do not have much interest in science.			
6	Studying science gives me great pleasure.			
7	I would like to belong to a science club.			
8	Science can help man live more comfortable.			
9	Science taught in my school is interesting.			
10	Science lessons are too difficult for me to understand.			

APPENDIX D

Computation of the reliability of Science and Technology Attitude Scale (STAS) using Cronbach Alpha Internal Consistency Measure.

Cronbach Alpha Formular = Alpha $\alpha = \left[\frac{K}{K-1}\right]\left[1 - \frac{\varepsilon vi}{\varepsilon vt}\right]$

Where

K = Number of item

εvi = Item variance obtained by adding the variances of all the items.

- εvt = Variance of the total scores on the instrument.

Computation of item variance

Item	Direction	Agree	Not sure	Disagree	Item variance
1	P	32	3	5	0.48
2	P	27	7	6	0.56
3	P	26	8	6	0.56
4	P	30	6	4	0.44
5	N	9	12	19	0.65
6	P	27	9	4	0.46
7	P	23	11	6	0.56
8	P	24	12	4	0.46
9	P	25	7	8	0.66
10	N	14	3	23	0.90
					∑ = 5.73

$\boldsymbol{vi}$ = 5.73

Computation of the standard deviation (SD) and variance of Total test scores (vt) using the composite scores from the rating scale.

X	F	FX	$X - \overline{X}$	$(X - \overline{X})^2$	$F(X - \overline{X})^2$
70	1	70	−16.2	262.44	262.44
74	1	74	−12.2	148.84	148.84
77	1	160	−9.2	84.64	84.64
80	2	77	−6.2	38.44	76.88
83	9	747	−3.2	10.24	92.16
87	14	1218	0.8	0.64	8.96
90	8	720	3.8	14.44	115.52
93	2	186	6.8	46.24	92.48
97	2	194	10.8	116.64	233.28
∑	40	3446			1115.2

$$\text{Mean} = \frac{3446}{40} = 86.15 \sim 86.2$$

$$\text{SD} = \sqrt{\frac{1115.2}{39}} = \sqrt{28.6} = 5.3$$

$$vt = \text{SD}^2 = 5.3^2 = 28.09$$

Using Cronbach Alpha Formular = Alpha $\alpha = \left[\frac{K}{K-1}\right]\left[1 - \frac{\varepsilon vi}{\varepsilon vt}\right]$

$= \frac{10}{9}\left[1 - \frac{5.73}{28.09}\right]$

$= \frac{10}{9}\left[1 - 0.20\right]$

$= \frac{10}{9}\left[0.8\right]$

$1.11 \times 0.8 = 0.888 = 0.89$

APPENDIX E

Computation of the Reliability of Basic Science achievement test (BSAT) using Kudder Richardson 21 method.

X	F	FX	$X - \overline{X}$	$(X - \overline{X})^2$	$F(X - \overline{X})^2$
36	3	108	−25.9	670.81	2012.43
40	4	160	−21.9	479.61	1918.44
43	2	86	−18.9	357.21	714.42
47	1	47	−14.9	222.01	222.01
50	3	150	−11.9	141.61	424.83
54	3	162	−7.9	62.41	187.23
58	3	174	−3.9	15.21	45.63
60	2	120	−1.9	3.61	7.22
64	2	128	2.1	4.41	8.82
68	3	204	6.1	37.21	111.63
70	2	140	8.1	65.61	131.22
76	4	304	14.1	198.8	795.24
84	3	252	22.1	488.41	1465.23
86	3	258	24.1	580.81	1742.43
92	2	184	30.1	906.01	1812.02
∑	40	2477			11598.8

$$\text{Mean} = \frac{2477}{40} = 61.9$$

$$\text{SD} = \sqrt{\frac{11598.8}{39}} = \sqrt{297.4} = 17.2$$

Kudder Richardson 21 Formular = K – R21, $r = \frac{n}{n-1}\left[1 - \frac{x(n-x)}{n(SD^2)}\right]$

where

r = Reliability coefficient.

n = Number of items in the test.

ε = Summation.

Sd^2 = Variance of the test scores.

X = Mean of test scores.

Number of items = 30

Number of pupils = 40

$$\frac{30}{29}\left[1 - \frac{61.9(30 - 61.9)}{30(17.2^2)}\right]$$

$$\frac{30}{29}\left[1 - \frac{61.9(-31.9)}{30(295.84)}\right]$$

$$\frac{30}{29}\left[1 - \frac{1974.61}{8875.2}\right]$$

$$\frac{30}{29}\left[1 - 0.222\right]$$

$$\frac{30}{29}\left[0.778\right]$$

$= 1.034 \times 0.778 = 0.80$

APPENDIX F

LIST AND POPULATION OF SAMPLED SCHOOLS.

NAME OF SCHOOL	BOYS	GIRLS	TOTAL
EXPERIMENTAL GROUP			
Nwafor uruagu central school Nnewi	19	16	35
Oganiru primary school Ojoto	21	14	35
Odida primary school Abatete	13	15	28
Unity model primary school Ichi	17	13	30
CONTROL GROUP			
Obi memorial primary school Nnobi	13	19	32
Central School Ideani	17	15	32
Nnewichi central school Nnewi	15	18	33
Ibolo Central School Oraifite	16	15	31
TOTAL	**131**	**125**	**256**

APPENDIX G

LESSON PLAN ON BASIC SCIENCE FOR 1st PERIOD FOR THE EXPERIMENTAL GROUP

Class: Primary 6
Duration: 35 minutes
Average age of pupils: 11years.
Topic: What a lever is, and components of lever
Instructional Objectives: By the end of the lesson, the pupils should do the following:

COGNITIVE DOMAIN.

1. Say what a lever is.

2. Identify and name some simple levers.
3. Identify components in any given lever.

PSYCHOMOTOR DOMAIN

1. Collect and use common levers such as bottle opener, wheelbarrow, scissors, pliers and crow bar.
2. Play with simple lever such as seesaw.
3. Draw and label components of lever.

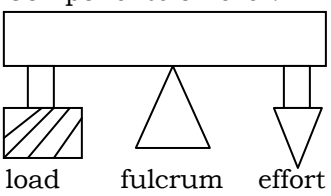
AFFECTIVE DOMAIN

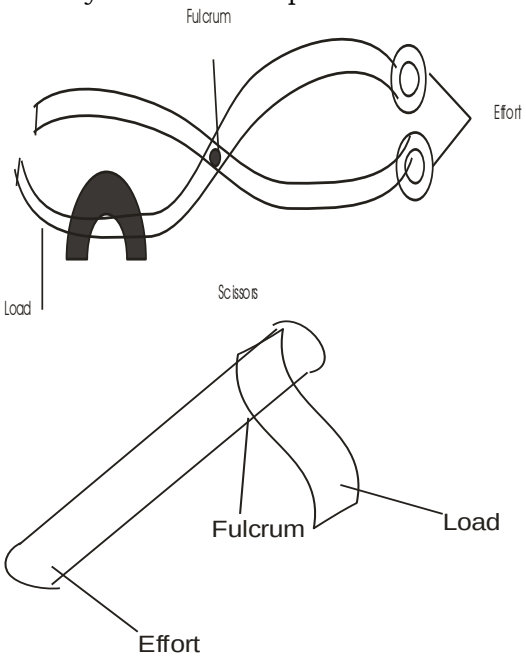
1. Feel excited when using common levers.

Instructional Materials: scissors, bottle opener, wheel barrow, seesaw, pliers, fishing rod, crowbar, vulcanizer's tyre remover, claw hammer, spanner, charts showing types of simple lever.
Instructional Technique: Discussion, questioning, illustration, use of examples
Entry Behaviour: Pupils have learnt what machine is and types of machine. They can give examples of simple machine.

Instructional Procedure

Content Development	Teacher's Activities	Pupils' Activities	Instructional technique
Set induction	The teacher ask the pupils the following questions: 1. What is machine? 2. Mention two types of machine. 3. Give examples of simple machines. 4. Mention examples of complex machine	Listen and answer teacher's questions	Questioning.
Step I What a lever is.	Discuss with the pupils what a lever is, using simple levers like scissors, opener, pliers etc as follows: A lever is an efficient and simple machine for lifting loads or for producing a great force to do various jobs. **Question** 1. What is a lever?	Take part in the discussion and define lever.	Discussion, use of examples and questioning.

Step II Identification of simple lever.	**Activity 1:** let the pupils do the following; 1. Display simple lever brought to the class such as bottle opener, hammer, scissors etc and let them observe, identify and name them. 2. Write out what each of them is used to do. **Question.** 1. Give examples of simple levers.	Identify and name the simple levers, write out what each is used to do.	Use of examples and questioning.
Step III Components of lever.	**Activity 2: let the pupils do the following:** 1. Use the common lever to do some work. 2. Draw each of the common lever and label their components parts. 3. play with see-saw. Discuss with the pupils the three components of lever using simple lever such as scissors, wheel barrow, opener etc. and charts and drawings of lever. A lever is made up of three main components 1. The Load: which is the weight that we are trying to lift or move. 2. The fulcrum or pivot: which is a point or support around which the lever turns. 3. The effort: which is the force we apply on the lever. Components of lever.  **Questions** 1. How many components of lever do we have? 2. Mention and explain the three components of lever. 3. Use diagram to illustrate the three components of lever.	Perform the activities and take part in the discussion, and answer teacher's questions.	Discussion, illustration and questioning.

Step IV Identification of the three components of lever using simple lever Questioning	Ask them to take each simple lever and identify the three components as follows:  **Question.** 1. Take each simple lever and show the points of load, fulcrum and effort	Identify the three components in each simple lever.	
Evaluation	1. What is a lever? 2. Give examples of simple lever. 3. How many components has a lever? 4. What are the three components of a lever? 5. Draw a lever and label the three components.	The pupils answer teacher's questions.	Questioning.
Summary	Ask the pupils to practice what they have learnt at home and to collect and bring more simple levers to the class.	Listen to teacher's instructions.	Instructional closure.

LESSON PLAN ON BASIC SCIENCE FOR 2ND PERIOD FOR THE EXPERIMENTAL GROUP

Class: Primary 6
Duration: 35 minutes
Average age of pupils: 11years.
Topic: classes of lever and uses of lever.
Instructional objectives: by the end of the lesson, the pupils should do the following:
COGNITIVE DOMAIN

1. Mention the three classes of lever.
2. List common uses of lever.

PSYCHOMOTOR DOMAIN

1. Group a collection of simple levers into three classes.
2. Make use of common lever to work.

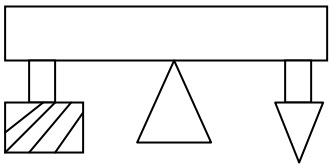
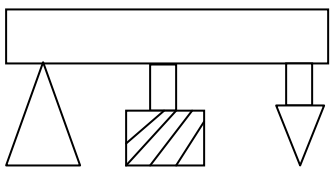
AFFECTIVE DOMAIN

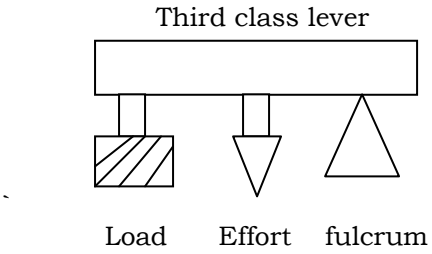
1. Feel excited when using common lever to work.

Instructional Materials: scissors, bottle opener, wheel barrow, pliers, axe, matchet, shaving stick, seesaw, claw hammer, tin cutter and charts showing three classes of lever.
Instructional Technique: Discussion, use of examples, questioning and illustration.
Entry Behaviour: Pupils have learnt what a lever is and components of lever.

Instructional Procedure.

Content Development	Teacher's activities	Pupil's activities	Instructional technique
Set induction	Ask the pupils the following questions: 1. What is lever? 2. Give examples of simple lever 3. How many components has a lever? 4. What are the three components of a lever?	Listen and answer teacher's questions.	Questioning.
Step I Discussion of the three classes of lever.	**Activity 1: let the pupils do the following:** 1. Display the simple machine brought to the class. 2. Sort and group them using the position of the three components. 3. give reasons for putting each simple machine to a group. Discuss the three classes of lever with the pupils using simple levers and charts showing the classes of lever as follows: There are <u>three</u> classes of lever: They are; 1. First class lever or first order lever 2. Second class lever or second order lever. 3. Third class lever or third order lever. **Questions** 1. How many classes of lever do we have? 2. Mention the three classes of lever.	Take part in the discussion and answer teacher's questions.	Discussion and questioning.

Step II First class lever	Group the pupils into smaller groups. Call out all number 1 pupils from each group, discuss the characteristics of first class lever with them and let them go back and teach their groups. Discuss the characteristics of first class lever with the pupils using simple levers such as scissors, claw hammer, pliers, tin cutter and seesaw and drawings showing the position of the three components of lever. Lever of first class has its fulcrum between the effort and the load. First class lever  Load fulcrum effort **Activity 2:** Let each group display the simple levers they brought to the class and ask them to sort out those simple levers that belong to first class lever using the position of their components. Let each groups answer the following questions: **Questions.** 1. What are the characteristics of first class lever? 2. Give examples of simple lever that belong to first class lever.	Go back to their groups and teach them the characteristics of first class lever, sort out those lever machines that belong to first class lever and answer teacher's questions.	Discussion, illustration, use of examples and questioning.
Step III Second class lever	Pick number twos from each group and discuss with them the characteristics of second class lever with them and let them go back and teach their groups. Second class lever has load between the fulcrum and effort. Second class lever  Fulcrum load effort Show them the position of the components using: wheelbarrow, bottle opener, truck, nutcracker and drawing showing the position of the three	Discuss the characteristics of second class lever within their groups, sort out simple levers under second class lever and answer teacher's questions.	Discussion, illustration, use of examples and questioning.

	components of lever. **Activity 3:** Let them sort out those simple lever that belong to second class lever and also discuss within their groups and answer the following **Questions** 1. What is the characteristic of second class lever? 2. Give examples of simple lever that belong to second class lever		
Step IV Third class lever	Call out number threes from each group and discuss the characteristics of third class lever with the pupils using simple lever such as fishing rod, fore arm, table knife, forcep etc and drawing showing the position of the components of lever after which they go back and teach their groups. Third class lever has effort between the load and fulcrum.  **Activity 4:** Ask each group to sort out those simple levers that belong to this class and answer the following questions: **Questions** 1. What is the characteristics of third class lever? 2. Mention simple lever that belong to third class lever.	Discuss the characteristics of third class lever within their groups, sort out the simple levers that belong to third class lever and answer teacher's questions.	Discussion, illustration, use of examples and questioning.
Step V Common uses of lever.	Ask each group to list at list ten simple machines and state their uses. Wheel barrow – To carry load. Knife – To cut bread. Broom – To sweep floor. Bottle opener – To open beer bottle. Hammer – To drive nail into wood. Spoon – To eat. Nutcracker – To crack nuts. Axe – To split wood. Scissors – To cut cloth. A hand to lift load. **Questions** 1. Ask them to say more uses of lever in everyday life. 2. Make use of the variety of simple	List simple machines and state their uses, submit their group work and take part in the discussion.	Discussion and questioning.

	lever.		
Evaluation	1. How many classes of lever do we have? 2. Mention the three classes of lever. 3. Mention the characteristics and examples of simple levers under the following: a. First class lever b. Second class lever c. Third class lever 4. List at least five common uses of lever.	Answer teacher's questions.	Questioning.
Summary	Ask the pupils to practice what they have learnt at home, and use cardboard sheet and make a chart of 3 classes of lever.	Pupils carry out teacher's instructions.	Instructional closure

LESSON PLAN ON BASIC SCIENCE FOR 3RD PERIOD FOR THE EXPERIMENTAL GROUP

Class: Primary 6
Duration: 35 minutes
Average Age of Pupils: 11 years
Topic: The meaning of magnetism, magnet, types of magnets and magnetic and non magnetic materials.
Instructional Objectives: By the end of the lesson, the pupils should do the following:
COGNITIVE DOMAIN

1. Define the following:
a. Magnetism b. magnet.
2. List and identify magnetic and non magnetic materials.
3. Mention five types of magnets.

PSYCHOMOTOR DOMAIN

1. Collect and sort materials into magnetic and non magnetic materials using magnet.
2. Collect and classify magnets into five groups.
3. Draw and label types of magnets.

AFFECTIVE DOMAIN

1. Feel excited when playing with magnets.
2. Develop interest in playing with magnets.

Instructional Materials: Different types of magnets, iron nails, office pins, iron fillings, paper clips, steel pins, drawing pins, needles, coins, rubber band, pebbles, wood, pieces of plastic materials and charts of types of magnet.
Instructional technique: Discussion, questioning and use of examples
Entry Behaviour: Pupils have been playing with magnets and other materials in their various homes.

Instructional Procedures

Content development	Teacher's activities	Pupil's activities	
Set induction	Ask the pupils the following questions 1. What are those materials you use to play at home?	Listen and answer teacher's questions	Questioning.

	2. In which household appliances do we find magnet? 3. What are those materials a magnet can attract? 4. What are those materials a magnet cannot attract?		
Step I Definition of the concepts: Magnetism and magnet.	Define the concept magnetism and magnet with pupils as follows: Magnetism is the science of magnetic existence and properties. The word magnetism is derived from magnesia, place where magnetic iron ore (lodestone) was first discovered. Magnet is any object that can attract other materials such as iron ore or any of its alloys; cobalt, nickel, or any other magnetic materials to itself. **Questions** 1. What is magnetism? 2. What is magnet?	Define magnetism and magnet.	Discussion and questioning.
Step II Types of magnet	**Activity 1:** Group the pupils and let each group carry out the following activities: 1. Observe and note down the shapes of the magnets they brought to the class. 2. Classify them according to their shapes. 3. note down how many classes they get and submit for discussion. Discuss with the pupil types of magnet using magnets and charts of different types. We have five types of magnet named according to their shapes. 1. Rectangular bar magnet. 2. Ball magnet. 3. Ring magnet. 4. Cylindrical magnet. 5. Horse shoe magnet. **Questions** 1. Mention five types of magnet 2. How many classes of magnet do we have? 3. Mention the two classes of magnet and say their properties 4. Classify magnets collected into temporal and permanent magnets.	Go to their groups, record the shapes of magnet they observe and discuss types of magnet with the teacher.	Discussion, use of examples and questioning.
Step III Magnetic and non magnetic materials	**Activity 3:** Let the pupils go back to their groups and display different types of materials brought to the class and use magnet and sort them into magnetic and non magnetic materials and bring their list for discussion. Discuss magnetic and non magnetic	Go to their groups and use magnet to sort the collection of materials into magnetic and non magnetic	Discussion, use of examples and questioning.

Discussion, use of examples and questioning	materials with the pupils using various objects and charts. Magnetic materials: are those objects which are attracted by a magnet such as iron, cobalt, steel, nickel Non-magnetic materials: are those objects which are not attracted by a magnet such as wood, glass, plastic materials, brass, copper, gold, silver, pencil, eraser etc. The force in the magnet that makes it to attract things to itself is called magnetic force **Questions** 1. What is magnetic material? 2. What is non magnetic material? 3. Give examples of a. Magnetic materials. b. Non magnetic materials.	materials. Submit their list for discussion.	
Evaluation	1. What is magnetism? 2. What is a magnet? 3. What is magnetic material? 4. What is non magnetic material? 5. Give examples of a. Magnetic materials. b. Non magnetic materials. 6. What are the two classes of magnet? 7. Draw and label five types of magnet.	Answer teacher's questions.	Questioning.
Instructional closure	Ask the pupils to practice what they have learnt at homes and bring more magnets to the class.	Carry out teacher's instructions.	Instructional closure.

LESSON PLAN ON BASIC SCIENCE FOR 4TH PERIOD FOR THE EXPERIMENTAL GROUP

Class: Primary 6
Duration: 35 minutes
Average Age of Pupils: 11 years
Topic: Properties of a magnet, ways of making magnet and uses of magnet.
Instructional Objectives: By the end of the lesson, the pupils should do the following:
COGNITIVE DOMAIN

1. Mention at least two properties of a magnet
2. Say at least two ways of making a magnet.
3. Mention at least two uses of magnet in everyday life.

PSYCHOMOTOR DOMAIN

1. Draw a magnet and label the poles.
2. Use magnet to attract and repel things.
3. Deep magnet into iron fillings to identify the areas where a magnet is strongest.

AFFECTIVE DOMAIN

1. Feel excited when using magnet to attract and repel objects.
2. Develop interest in playing with magnet.

Instructional Materials: Different types of magnet, iron fillings and charts of magnetic appliances.
Instructional Techniques: Discussion, demonstration and questioning.
Entry Behaviour: Pupils have learnt

1. What magnetism and magnet is.
2. Magnetic and non magnetic materials.

Instructional Procedure

Content development	Teacher's activities	Pupils activities	Instructional techniques
Set induction	Ask the pupils the following questions 1. What is magnetism? 2. What is magnet? 3. What is a. magnetic material b. Non magnetic materials	Listen and answer teacher's questions.	Questioning.
Step I Properties of magnet	**Activity 1:** Group the pupils and ask each group to use the magnet given to them and do the following and record their findings: 1. Touch each object given to them with a magnet. 2. Bring two ends of magnet together. 3. Put magnet in iron fillings. Record and bring their finding for discussion. Discuss the findings of pupils as follows: 1. Magnets possess magnetic force which makes them attract objects such as iron and steel. 2. Magnets always come to rest, when suspended freely, with the poles pointing in the North and South direction. 3. Like or similar poles of magnets repel	Go to their group and test for properties of a magnet using magnets and report their findings.	Demonstration and questioning.

	while unlike or dissimilar poles attract. 4. Magnet has magnetic field around its poles. Magnetic field is a region around a magnet in which magnetic effects are experienced. **Question.** Ask them to test for these properties and report their findings.		
Step II Ways of making magnet. .	**Activity 2: let them perform the following activities;** Give each group unmagnetized steel bar, razor blade, bottle top etc and ask them to use magnet and stroke on them several times and then use them to attract other objects and record their findings. Discuss ways of making simple magnet with the pupils using charts; 1. **By stroking with a magnet** i.e. a steel bar is stroked from one end to the other, several times with one pole of a magnet in the same direction. 2. **By passing electric current:** An unmagnetized steel bar is placed inside a coil of wire of several turns called solenoid. Thus wire is connected to a battery. Current is switched on and then off. 3. **By hammering**: An unmagnetized steel bar is heated red hot and hammered. It is then placed in North-South direction and allowed to cool. **Questions** 1. Mention three ways of making a magnet. 2. How do we demonstrate: a. Stroking b. hammering	Go to their groups and stroke magnets on non magnetic materials and find out the result. Discuss ways of making magnet with the teacher.	demonstration, discussion, and questioning.
Step III Uses of magnet	**Activity 3:** Let them go to their groups and carry out the following demonstrations and record their findings. 1. Dip a magnet into a mixture of iron fillings and sand and record their observations. 2. Draw a magnet on a scattered office pins on the floor. Let each group read out their findings for discussions as follows: Electromagnets are used in the work of 1. Electric bell and telephone ear piece. 2. Large cranes to move heavy loads. 3. Separating magnetic substances from non magnetic substances. 4. Collect lost pins in the office. 5. Magnets are used in the construction of electric motors, generators, bicycle dynamo, load speaker, radio and T.V sets etc. **Questions** Ask them to demonstrate how they can use	Join in the discussion and carry out the demonstration of the uses of magnet.	Discussion and demonstration.

	magnet to: 1. Collect lost pins. 2. Separate iron fillings from sand.		
Evaluation	1. List at least three properties of a magnet. 2. Describe with a making temporal magnet. 3. Mention at least three uses of a magnet. 4. Draw a magnet and label the poles.	Answer teacher's questions.	Questioning.
Summary	Ask pupils to practice what they have learnt at home and collect different types of magnets to be kept in science corner.	Carry out teacher's instructions.	Instructional closure.

LESSON PLAN ON BASIC SCIENCE FOR 5TH PERIOD FOR THE EXPERIMENTAL GROUP

Class: Primary 6
Duration: 35 minutes
Average age of the pupils: 11 years
Topic: What force is, types of force and friction and its effect
Instructional objectives: By the end of the lesson, the pupils should do the following:
COGNITIVE DOMAIN

1. Define force.
2. Mention at least three types of force.
3. Define friction and give some instances of friction in everyday life.

PSYCHOMOTOR DOMAIN

1. Push and pull things to demonstrate the meaning of friction.
2. Rub two surfaces and narrate their experience e.g
   a. rough against rough. b. smooth against smooth. c. rough against smooth.

AFFECTIVE DOMAIN

1. Feel excited when demonstrating frictional effect or evidences of friction.

Instructional Materials: sand paper, glass, dry toasted bread, a large pebble, stone, cutlass, cement slab.
Instructional Technique: Discussion, demonstration and questioning.
Entry Behaviour: Pupils have learnt

1. Magnet and magnetic force.
2. They can rub their palms together to produce heat.

INSTRUCTIONAL PROCEDURE

Content Development	Teacher Activities	Pupils activities	
Set Induction	Ask the pupils the following questions: 1. What is a magnet? 2. What is it in a magnet that makes it to attract things. 3. When you rub heard your two palms together, what do you feel?	Listen and answer teacher's questions.	

Step I Definition of force.	**Activity 1:** Ask the pupils to do the following: 1. Push the door, table, desk etc. 2. Pull the chair, table, bucket, etc. Discuss with the pupils the meaning of force by allowing them to push and pull things around them. Force is anything that can change position of things either by pushing or pulling them. **Questions** 1. What is force? 2. Demonstrate to show effects of force	Push and pull things around them to demonstrate force and answer teacher's questions.	Demonstration, discussion, and questioning.
Step II Types of force	**Activity 2:** Let the pupils carry out the following activities to demonstrate types of force. 1. Rub their two palms together – **frictional force** 2. Use magnet to attract objects – **magnetic force.** 3. Throw objects up and observe it fall down – **gravitational force.** 4.Strike a knife on a stone and observe light spark – **mechanical force** Discuss types of force with the pupils as follows: There are **five** types of force: 1. Frictional force. 2. Magnetic force. 3. Electrical force. 4. Gravitational force. 5. Mechanical force. 1. Frictional force is the force that exists between two surfaces. 2. Magnetic force is the force with which a magnet attract objects made of iron. 3. Gravitational force is the force which pulls any object down to the ground. 4. Electrical force is the force of electricity. 5. Mechanical force is the force that exists when an object strike against another object. **Question** Mention and explain each type of forces.	Demonstrate to show the meaning of force and types of force. Join in the discussion and answer teacher's questions.	Demonstration, Discussion and questioning.
Step III Definition of friction and some instances of friction in everyday life.	Ask the pupils the following questions: what do you observe when you rub: 1. Your two palm together? 2. Two rough surfaces together? 3. Two smooth surfaces together? **Activity 3:** let them demonstrate the meaning of friction and some instances of friction in everyday life by rubbing each of the following together: sandpaper, dry toast bread, a large pebble, stone, cutlass and cement slab, two palms, match their feet on the floor, **Activity 4;** let them demonstrate instances	Demonstrate to show the meaning of friction, take part in the discussion and answer teacher's questions.	Demonstration, discussion and questioning.

	of friction in ever day life by doing the following; 1. Rubbing their palms together. 2. Walking in the class by matching their shoe soles on the floor. 3. Riding their bicycles and pressing the brake etc. 4. Use stone to grind things. Friction is the force which opposes or prevents motion between two surfaces in contact with each other. Some instances of friction in everyday life are; 1 Heat produced by rubbing two surfaces together. 2 Wearing of shoe heels/soles and tyres of motor. 3 Heat produce by moving parts of machines. 4 Light produced by hitting two hard objects e.g. stones or iron together. **Questions** 1. What is produced when you rub your palms together? 2. What do you observe when you rub together; a. Two rough surfaces. b. Two smooth surfaces.		
Step IV Effects/ Evidence of friction	**Activity 5:** Group the pupils into small groups and ask each group to carry out the following activities and report their findings for discussion. 1. Rub two slice of dry toasted bread together. 2. Rub two glasses together.. 3. Hit sharp edge of a cutlass against a stone or cemented floor. Demonstrate the effects or evidence of friction with the pupils using sand paper, stone, large pebbles, cutlass, cement slab etc Evidence of friction; 1. A spark is produced when a sharp edge of cutlass struck against a stone or on cement floor. 2. Heat in produced when two surfaces are rubbed together. 3. It is difficult to walk on a very smooth floor than a rough floor. This is because the rough floor produces more friction than the smooth floor. 4. Riding bicycle on sand is more difficult than riding on a tarred road. etc 5. Friction wears away surfaces. **Questions** What do you observe when you rub the following;	Go to their groups and carry out the activities, record their observations and report their findings for discussion. Answer teacher's questions.	Demonstration, discussion and questioning.

	a. Two slices of dry toast bread. b. A large pebble on a cemented surface. c. Hit sharp edge of a cutlass against a stone or cement floor.		
Evaluation	1. What is force? 2. Mention five types of force. 3. What is friction? 4. Mention at least three instances of friction in everyday life.	Answer teacher's questions.	Questioning.
Summary	Ask the pupils to practice what they have learnt at home, and read up useful and harmful effect of friction.	Carry out teacher's instructions.	Instructional closure.

LESSON PLAN ON BASIC SCIENCE FOR 6th PERIOD FOR THE EXPERIMENTAL GROUP

Class: Primary 6
Duration: 35 minutes
Average age of pupils: 11 years
Topic: Principles of friction, advantages and disadvantages of friction and ways of reducing friction
Instructional objectives: By the end of the lesson, the pupils should do the following:

COGNITIVE DOMAIN

1. Mention the two principles of friction.
2. Say at least three useful effect of friction
3. Mention at least two harmful effect of friction.
4. List ways of reducing friction

PSYCHOMOTOR DOMAIN

1. Demonstrate the two principles of friction using smooth and rough surfaces.
2. Produce and reduce frictional effects through simple activities.

AFFECTIVE DOMAIN

1. Develop interest in reducing friction by adding lubricants.
2. Feel excited when demonstrating principles of friction.

Instructional **Materials:** Sand paper, plane glass, dry toast bread, large pebble, grease, ball-bearing, rollers or wheels, stone, cutlass, cement slab.
Instructional Technique: Discussion, demonstration, use of examples and questioning.
Entry Behaviour: Pupils have learnt force, types of force and friction and its effects.

Instructional Procedure

Content Development	Teacher's activities	Pupils activities	Instructional techniques
Set inductions	1. What is force? 2. Mention five types of force. 3. What is friction? 4. Mention three instances of friction in everyday life	Listen and answer teacher's questions.	Questioning.
Step I Principles of friction	**Activity 1:** Group the pupils into small groups of five pupils in each group and ask each group to perform the following activities and report their findings: Rub the following surface together: 1.Smooth against smooth – plane glasses. 2. Rough against rough – sand paper 3. Rough against smooth – dry toasted bread and plane glasses. Discuss principles of friction with the pupils using sand paper, plane glass, ball-bearing, rollers or wheel. Two principles of friction are 1. The smoother the surface, the lesser the frictional force. 2. The rougher the surface, the greater the frictional force. **Questions** Ask them to rub the following surfaces together and report their observations. 1. Smooth against smooth 2. Rough against rough. 3. Rough against smooth.	Perform the activities within their groups and report their findings for discussion.	Demonstration, discussion and Questioning.
Step II Advantages or useful effect of friction	**Activity 2:** let them perform the following activities; 1. Grind tomatoes with stone. 2. Sharpen knives with stone. 3. Nail pieces of wood together. 4. Walk around the class. Discuss the useful effect of friction with the pupils as follows: 1. **Walking:** Friction between the soles of our feet and ground enables us to walk without slipping or falling. 2. **Brake:** Friction between the rim and the rubber brake pads makes wheel to slow down and stop. 3. **Movement of cars and bicycle**: friction between tyres and rough road surfaces makes the cars or bicycles to move on the surfaces without skidding. 4. **Nailing pieces of wood together.** Nails hold pieces of wood tightly	Perform the activities and discuss useful effect of friction within their groups and bring out their points for discussion.	Demonstration, discussion and questioning.

	together because of the friction between the nail and wood 5. **Climbing:** friction between our feet/tree trunks and hands makes climbing of a tree possible. 6. **Holding of fan belts over wheel or pulleys**: friction holds fan belts used over wheels or pulleys in machines **7. Grinding of things and sharpening of knives:** Friction helps to grind things with stone and to sharpen knives. **Question.** 1. Mention the useful effects of friction in everyday life.		
Step III Disadvantages or harmful effects of friction.	**Activities 3: let them perform the following activities;** **1.** Rub two sand paper together. 2. Rub dry toasted bread together. 3. Push a tin of milk on a rough surface. 4. Walk on a wet floor. 5. Walk on a sandy ground. Ask each group to discuss and list areas in our lives where friction is harmful or causes damage to things and submit their points for discussion. Discuss harmful effects of friction with the pupils using sand papers, dry toasted bread etc as follows: 1. Friction wastes a lot of energy in form of heat in machines. 2. It causes tears and wears of parts of machines. 3. Friction wears away surfaces of bicycle, motorcycle and vehicle tyre 4. Friction produces an electric spark which gives shocking effect on the body. 5. Friction makes pushing of things difficult. 6. Friction reduces the efficiency of machines. 7. Friction makes the heels of our shoes to wear out. **Question** Mention harmful effects of friction in everyday life.	Perform the activities and discuss harmful effects of friction in everyday lives within their groups and submit their points for discussion.	Demonstration, discussion, and questioning.
Step IV Ways of reducing friction	**Activities 4:** let them put oil or grease on the fulcrum of the following; scissors, wheelbarrow, bicycle wheel, use them to do some work and report their findings. Discuss ways of reducing friction with the pupils using different types of	Perform the activities and discuss the use of different types of lubricants, rollers and ball-	Demonstration, discussion, use of examples and questioning.

	lubricant, rollers, ball-bearings etc. 1. Friction can be reduced by greasing or oiling surfaces that rub together against each other. 2. Also rollers and ball-bearings are used to reduce friction **Question** How do we reduce friction?	bearing to reduce friction.	
Evaluation	1. Mention two principles of friction. 2. List at least three a. Useful effect of friction b. Harmful effect of friction 3. Mention two ways we can reduce friction	Listen and answer teacher's questions.	Questioning.
Summary	Ask them to practice what they have learnt at home and collect rollers and ball bearing to be kept in the science corner.	Carry out teacher's instructions.	Instructional Closure.

LESSON PLAN ON BASIC SCIENCE FOR 7th PERIOD FOR THE EXPERIMENTAL GROUP

CLASS: PRIMARY 6

DURATION: 35 MINUTES

AVERAGE AGE: 11YRS

TOPICS: What solar system is and the nine planets.

INSTRUCTIONAL OBJECTIVES: By the end of the lesson, the pupils should do the following.

COGNITIVE DOMAIN

1. Say what make up the solar system.
2. Mention the nine planets in their order from the sun.
3. Identify the importance of the sun as the source of energy (heat and light) for other planets.

PSYCHOMOTOR DOMAIN

1. Draw the solar system.

AFFECTIVE DOMAIN

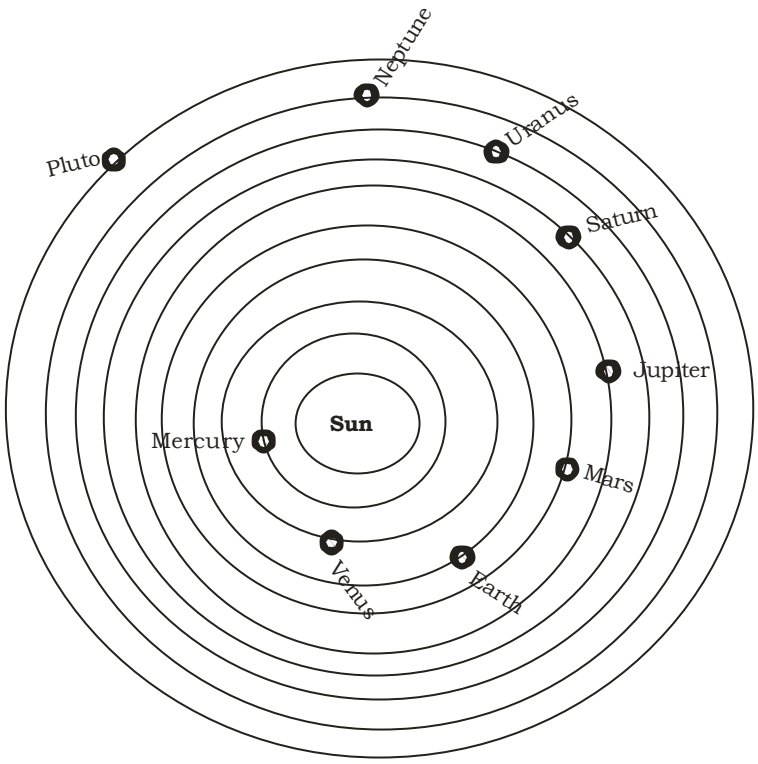
1. Develop interest in studying the solar system.

INSTRUCTIONAL MATERIAL: Charts and drawings of the solar system, Telescopes, Binoculars, Torch light and small balls.

INSTRUCTIONAL TECHNIQUE: Discussion, demonstration and questioning.

ENTRY BEHAVIOUR: Pupils are familiar with those natural objects seen on the sky such as the sun, the moon and the stars.

INSTRUCTIONAL PROCEDURE

Content development	Teacher Activities	Pupils' Activities	Instructional techniques.
Set induction.	Ask the pupils the following questions: 1. What are those natural objects you can see on the sky? 2. What is the main source of heat? 3. Light travels in _____ line.	Listen and answer teacher's questions.	Questioning.
Step I The solar system	**Activity 1:** group the pupils. Let a child in each group hold a touch light and stand on the center of a circle. While nine pupils roll nine small balls round the child at the center holding the touch light. Discuss the meaning of solar system using charts and drawing of the solar system with the pupils as follows: The **sun** together with all the **nine planets** that move round it, make up the **solar system.** The solar system consists of the sun, nine planets, thirty-two moons which move round some of the planets and other heavenly bodies.  Solar system **Questions** 1. What is in the centre of the solar system? 2. What are the things that make up the solar system? 3. From the arrangement of the planets round the sun, which planet is	Demonstrate to show the sun and the nine planets, take part in the discussion and answer teacher's questions.	Demonstration, discussion and questioning.

	a. Nearest to the sun. b. Farthest from the sun.		
Step II The names of the nine planets in their order from the sun.	**Activity 2:** Group the pupils into smaller groups, and ask each group to study the arrangement of the planets round the sun in the diagram of the solar system and then do the following: 1 List the names of the planets in their order from the sun. 2 Form a mnemonics or chunks that will help them to remember the names of the planets in their order from the sun. Discuss the names and arrangement of the planets round the sun with the pupils using the charts and diagrams of the solar system. The names of the planets, in order of their nearest to the sun are: **Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto.** You can name them by the letters (MVE MJS UNP). These planets rotate and revolve round the sun in their orbits. The sun is in the centre of the solar system. It is large than any of the planets. It is import ant sources of heat to the earth and other planets. Sun energy can be changed to heat energy in burning of paper using converging lens. The sun rises in the east and sets in the west. The scientist that studies about the heavenly bodies as called Astronomers. The instrument they use to study them is called Telescope. **Questions** 1. What is the third planet nearest to the sun? 2. What do we call the path through which each planet revolves round the sun? 3. What is the most important source of energy to the planets?	Go to their groups, study the arrangement of the planets round the sun and list their names in their order from the sun and submit for discussion and answer teacher's questions.	Discussion and questioning.
Step III General characteristics of planets and differences between the planets.	Let the pupils demonstrate and discuss general characteristics of planets using torch light and drawing of the solar system. The general characteristics of the planets are that each of the planets 1. Revolves round the sun. 2. Receives heat and light from the sun. 3. Revolves in the same direction. Differences between the planets are: 1. The distances of the planets from the sun are not the same. 2. The speed of rotation and revolution of the planets differs. 3. Planets differ in sizes; Jupiter is the largest planet, while mercury is the smallest. 4. The quality of heat and light felt in the planets are not the same because of their differences in distance from the sun. 5. The time taken for one complete rotation or revolution differs from planet to planet.	Take part in the discussion and demonstrates rotation and revolution of the earth Answer teacher's questions.	Discussion, Demonstration and questioning.

	Questions 1. What are the general characteristics of the planet? 2. Which planet is a. Largest b. Smallest? 3. How many days does it take the earth to revolve round the sun?		
EVALUATION	1. What make up the solar system 2. How many planets move round the sun? 3. Mention the name of the planets in their order from the sun. 4. What provides heat and light to the planets? 5. What are the general characteristics of the planets? 6. Which is the a. Largest planet. b. Smallest planet. 7. How many days does it take the earth to make one complete revolution round the sun? 8. What do we call a. The scientists that study about the heavenly body? b. The instrument the scientists use to study the heavenly bodies?	Answer teacher's questions.	Questioning.
Summary	1. Wash out the sky at night and make list of the things you see. 2. Wash the position of the sun in the morning and in the evening and comment on that.	Carry out teacher's instructions.	Instructional closure.

LESSON PLAN ON BASIC SCIENCE FOR PERIOD 8 FOR THE EXPERIMENTAL GROUP

CLASS: Primary 6

DURATION: 35 minutes

AVERAGE AGE OF PUPILS: 11 years

TOPIC: The earth and movement of the earth, and Eclipse of the sun and moon.

INSTRUCTIONAL OBJECTIVES: By the end of the lesson, the pupils should do the following:

COGNITIVE DOMAIN

1. Mention the two types of movement made by the earth.
2. Relate the movement of the earth, moon and sun to such phenomena as day and night, season of the year and eclipses.
3. Say when the following eclipses occur
   a. Eclipse of the sun or solar eclipse.
   b. Eclipse of the moon or lunar eclipse.

PSYCHOMOTOR DOMAIN

1. Demonstrate the earth's rotation using the Globe.
2. Make models and draw diagrams to illustrate the earth's movement.

3. Illustrate with diagram the relative position of the earth, moon and sun during eclipse.

AFFEFTIVE DOMAIN

1. Feel excited when demonstrating the earth's movement using torch light and Globe.

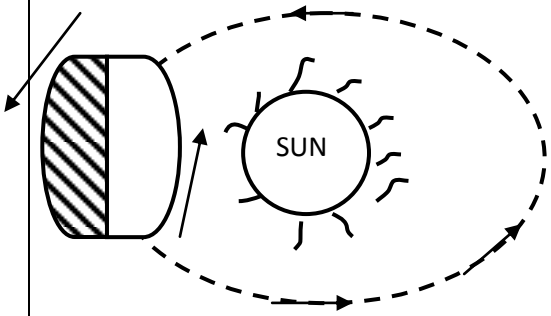
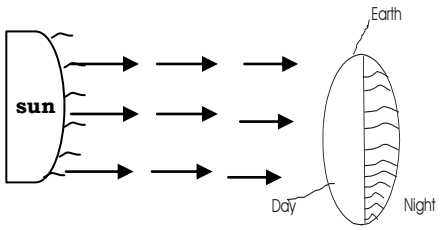
INSTRUCTIONAL MATERIALS: torch light, Globe, candle, big and small ball, charts and drawing to illustrate the earth's movement.

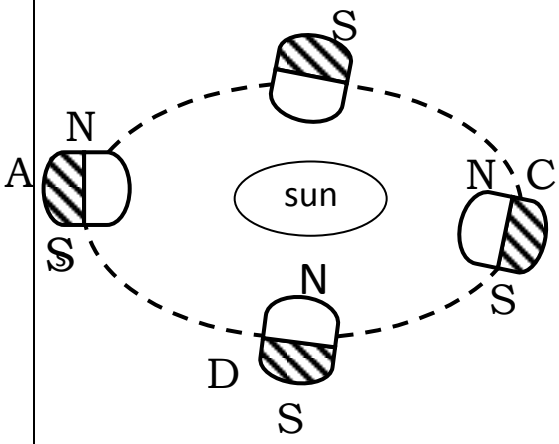
INSTRUCTIONAL TECHNIQUE: demonstration, discussion, illustration and questioning.

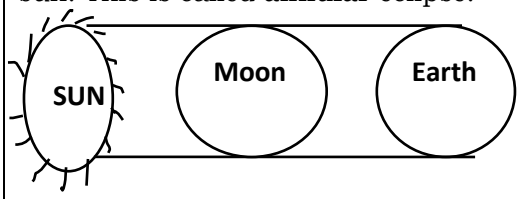
ENTRY BEHAVIOUR: Pupils have learnt the solar system and the nine planets.

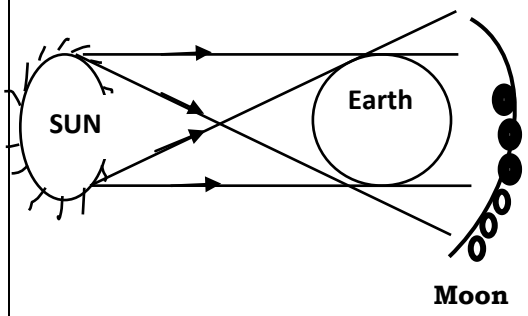
INSTRUCTIONAL PROCEDURE

Content development	Teacher Activities	Pupils Activities	Instructional techniques.
Set Induction	1. What is solar system? 2. How many planets move round the sun? 3. Mention the name of the planets in their order from the sun. 4. What are the general characteristics of the planets? 5. What do we call the scientists that study the heavenly bodies?	Listen and answer teacher's questions.	Questioning.
Step I The earth.	Show the pupils the globe and let them observe it and make comment in the shape and other things they can observe on the globe. Discuss the earth using the globe, with the pupils as follows: The earth is the planet on which we live. It is the third planet nearest the sun. The earth is represented on a map called Globe (let them observe the globe) **Questions** 1. What do we call the place on which we live? 2. What do we call the map on which the earth is represented.	Comment on their observations. Take part in the discussion and answer teacher's questions.	Observation, Discussion and questioning.
Step II The earth's movements	Perform the following activities with the pupils to demonstrate the movement of the earth. **Activity 1**: 1. Place an object in the middle of a big circle drawn on the table. Then, put your globe on the circle. Spine the globe and observe it for a short time. As the globe is still spinning, move it round the circle. The movement of the globe round the object is called **revolution** while the spinning of the globe as it moves is called **rotation.** **Activity 2:**	Demonstrate with the teacher the two movement of the earth using the globe, big ball and torch. Take part in the discussion of the earth's movements and answer teacher's questions.	Demonstration, discussion and questioning.

	2. Put the globe on the table, use touch light to represent the sun. Then point the touch light towards the globe which represents the earth. Mark the position R and S on the globe. With R facing you directly, rotate the globe. Let the pupils say their observations on the areas of R and S on the globe as it rotates. Discuss with the pupils the earth movements using globe and torch as follows: The earth makes **two** movements**.** **1. Rotation** **2. Revolution**  **The earth's movement round the sun.** 1. **Rotation:** This is the turning round and round of the earth about its axis, once every 24 hours. Rotation of the earth causes day and night let them use torch light and globe to demonstrate rotation of the earth. Rotation of the earth results to Day and night.  **Rotation of the earth** **2. Revolution of the earth.** This is the movement of the earth round the sun on its orbit. In Nigeria we have dry and wet season. This is because different part of the earth		

	comes under the influence of the sun rays at different times. It takes the earth one year to go round the sun. An ordinary year consist of 365 days while reap year contains 366 days. The earth revolves from east to west direction.  **Revolution of the earth.** **Questions** 1. Mention the two movements made by the earth. 2. Demonstrate rotation and revolution of the earth using ball and torch light. 3. What does each of these movements of the earth causes: a. rotation b. revolution. 4. How many days does it take to make one complete: a. Rotation. b. Revolution.		
Step III Eclipse of the sun and moon.	**Activity 3:** Perform the following activities with the pupils to demonstrate eclipse of the sun and moon with big ball to represent the earth, small ball to represent the moon and torch light to represent the sun. **Eclipse of the sun**: The small ball is placed between the torch light and the big ball. Let them observe that the small ball cast shadow on the big ball. **Eclipse of the moon:** The big ball is placed between the torch light and small ball. Let them observe the big ball cast shadow on the small ball. Discuss eclipse of sun and moon using charts and drawings to illustrate each eclipse with the pupils	Demonstrate eclipse of the sun and moon using big and small balls and torch light. Take part in the discussion.	Demonstration, discussion and questioning.

.	as follows: The earth and the moon do not give out light. The light from the sun shines on earth and moon which does not allow light to pass through them. The sun is therefore said to be luminous body while the earth and moon is non-luminous objects. Because of the movement of the earth and the moon, it is possible for one to shield (eclipse) the other from getting light from the sun. **Formation of shadow**: when opaque object is placed across in the direction of light rays, a shadow of the opaque object does not allow light to pass through it.(demonstrate formation of shadow using candle light screen, opaque object and torch light). **Eclipse of the sun or solar eclipse:** this occur when the moon comes between the sun and the earth. Because the earth is bigger than the moon, regions of total shadow and partial shadow may fall on the earth. These gives us **total** and **partial** eclipse of the sun respectively. At times the moon is so far away from the earth that no region of total shadow falls on the earth. The moon is then observed against the circular sun. This is called **annular** eclipse.  Eclipse of the sun 2. **Eclipse of the moon or Lunar eclipse:** This occur when the earth is in between the sun and the moon so that the moon is in the shadow of the earth. If the moon moves into the region of partial shadow, we have partial eclipse of the moon but if it moves into the region of total the total shadow, we have total eclipse of the moon. Let the pupils use torch light, big and small ball to demonstrate eclipse of the sun and moon.		

	 Eclipse of the moon. Let the pupils use torch light, big and small ball to demonstrate eclipse of the sun and moon.		
EVALUTION	1. What do we call the map on which the earth is represented? 2. Mention the two movements made by the earth. 3. What does the following earth's movement causes: a. rotation b. revolution 4. How many days does it take the earth to make one complete: a. rotation b. revolution 5. Give examples of opaque objects. 6. When do we have a. Eclipse of the sun? b. Eclipse of the moon?	Listen and answer teacher's question.	Questioning.
Summary.	Demonstrate what you have learnt at home. Use cardboard sheet to make a drawing of eclipse of the sun and moon.	Pupils carry out teacher's instructions.	Instructional closure

APPENDIX H

LESSON PLAN ON BASIC SCIENCE FOR 1st PERIOD FOR THE CONTROL GROUP.

Class: Primary 6
Duration: 35 minutes
Average age of pupils: 11years.
Topic: What a lever is, and components of lever
Instructional Objectives: By the end of the lesson, the pupils should do the following.

COGNITIVE DOMAIN

1. Say what a lever is.
2. Identify and name some simple levers.
3. Identify components in any given lever

PSYCHOMOTOR DOMAIN

1. Draw and label components of lever.
2. Copy note on the topic.

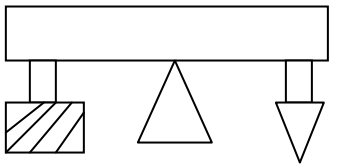
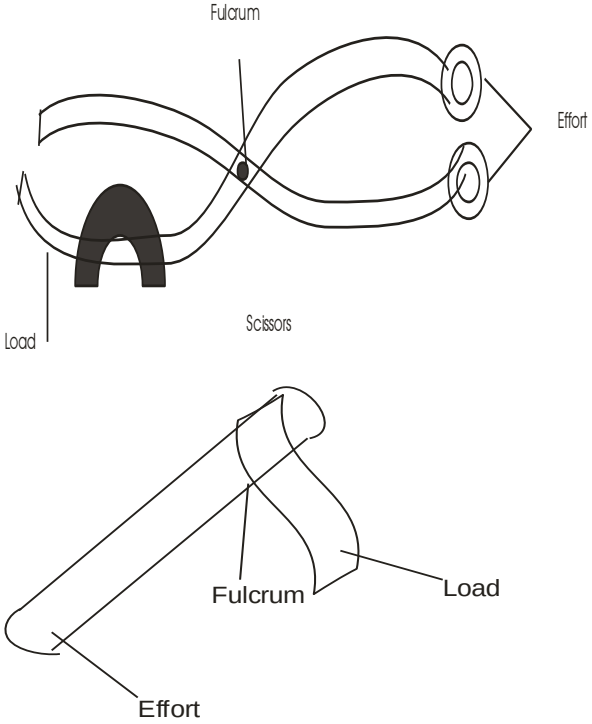
AFFECTIVE DOMAIN

1. Appreciate the need to use simple lever to do work.

Instructional Materials: scissors, bottle opener, wheel barrow, seesaw, pliers, fishing rod, crowbar, vulcanizer's tyre remover, claw hammer, spanner, charts showing types of simple lever.
Instructional Technique: Explanation, and use of examples.
Entry Behaviour: Pupils have learnt what machine is and types of machine. They can give examples of simple machine.

INSTRUCTIONAL PROCEDURE

Content Development	Teacher's Activities	Pupils' Activities	Instructional techniques.
Set induction	The teacher ask the pupils the following questions: 1. What is machine? 2. Mention two types of machine 3. Give examples of simple machines 4. Mention examples of complex Machine.	Listen and answer teacher's questions	Questioning.
Step I What a lever is.	Explain to the pupils what lever is using simple levers like scissors, opener, pliers etc. A lever is an efficient and simple machine for lifting loads or for producing a great force to do various jobs.	Listen to teacher's explanation of what a lever is.	Explanation and use of examples.
Step II Identification	Display simple lever brought to the class such as bottle opener, hammer, scissors etc and let them observe, identify and name	Identify and name some simple levers.	Use of examples.

of simple lever.	them.		
Step III Components of lever.	Explain to the pupils the three components of lever using simple lever such as scissors, wheel barrow, opener etc. and charts and drawings of lever. A lever is made up of **three** main components **1.The Load**: which is the weight that we are trying to lift or move. **2.The fulcrum or pivot:** which is a point or support around which the lever turns. **3.The effort:** which is the force we apply on the lever. Components of lever.  	Listen to the teacher's explanation.	Explanation and use of examples.
Step IV Identification of the three components of lever using simple lever	Identify the three components of a lever for the pupils using simple levers.  	Watch and see the three components in each simple lever.	Use of examples.
Evaluation	1. What is a lever? 2. Give examples of simple lever 3. How many components has a lever? 4. What are the three components of	The pupils answer teacher's questions.	Questioning.

	a lever 5. Draw a lever and label the three components.		
	Ask the pupils to practice what they have learnt at home and to collect and bring more simple levers to the class.	Listen to teacher's instructions.	Instructional closure.

LESSON PLAN ON BASIC SCIENCE FOR 2ND PERIOD FOR THE CONTROL GROUP

Class: Primary 6
Duration: 35 minutes
Average age of pupils: 11years.
Topic: classes of lever and uses of lever.
Instructional objectives: by the end of the lesson, the pupils should do the following:

COGNITIVE DOMAIN

1. Mention the three classes of lever.
2. List common uses of lever.

PSYCHOMOTOR DOMAIN

1 Copy note on the topic.

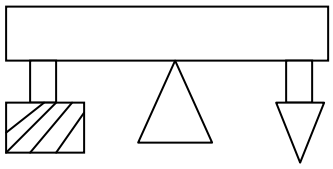
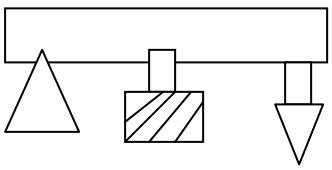
AFFECTIVE DOMAIN

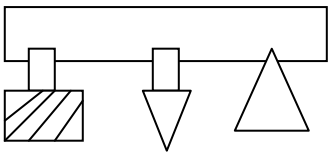
2. Develop interest in using common lever to work.

Instructional Materials: scissors, bottle opener, wheel barrow, pliers, axe, matchet, shaving stick, seesaw, claw hammer, tin cutter and charts showing three classes of lever.
Instructional Technique: Explanation, use of examples, and illustration.
Entry Behaviour: Pupils have learnt what a lever is and components of lever.

INSTRUCTIONAL PROCEDURE.

Content Development	Teacher's activities	Pupil's activities	Instructional technique.
Set induction	Ask the pupils the following questions: 1. What is lever? 2. Give examples of simple lever 3. How many components has a lever? 4. What are the three components of a lever?	Listen and answer teacher's questions.	Questioning.
Step I Explanation of the three classes of lever.	Explain the three classes of lever to the pupils using simple levers and charts showing the classes of lever as follows: There are <u>three</u> classes of lever: They are; 1. First class lever or first order lever 2. Second class lever or second order Lever. 3. Third class lever or third order lever.	Listen to teacher's explanation.	Explanation.

Step II First class lever .	Explain the characteristics of first class lever to the pupils using simple levers such as scissors, claw hammer, pliers, tin cutter and seesaw and drawings showing the position of the three components of lever. Lever of first class has its fulcrum between the effort and the load. First class lever  Load fulcrum effort Display the simple levers brought to the class and sort out those simple levers that belong to first class lever e.g. scissors, seesaw, claw hammer, pliers etc.	Listen to the teacher's explanation and examples.	Explanation, illustration and use of examples
Step III Second Class Lever.	Explain the characteristics of second class lever to the pupils using simple levers such as wheel barrow, bottle opener, nutcracker etc and drawing showing the position of the three components of lever. Second class lever has load between the fulcrum and effort. Second class lever  Fulcrum load effort Display the simple levers brought to the class and sort out those simple lever that belong to second class lever. E.g. wheelbarrow, bottle opener, truck, nutcracker etc.1	Listen to the teacher's explanation.	Explanation and use of examples.
Step Iv Third Class Lever. Explanation and use of example.	Explain the characteristics of third class lever to the pupils using simple lever such as fishing rod, fore arm, table knife, forcep etc and drawing showing the position of the components of lever. Third class lever has effort between the load and fulcrum.	Listen to the teacher's explanation and mention the simple levers that belong to third class lever.	

	Third class lever  Load Effort fulcrum Ask them to mention those simple levers that belong to this class. E.g. human arm, forcep, sugar tong, fishing rod etc.		
Step VI Common uses of lever.	Explain to them the common uses of lever using simple levers as follows: Wheel barrow – To carry load. Knife – To cut bread. Broom – To sweep floor. Bottle opener – To open beer bottle. Hammer – To drive nail into wood. Spoon – To eat. Nutcracker – To crack nuts. Axe – To split wood. Scissors – To cut cloth. A hand to lift load. Ask them to say more uses of lever in everyday life.	Listen to teacher's explanations and answer teacher questions.	Explanation and use of examples.
Evaluation	1. How many classes of lever do we have? 2. Mention the three classes of lever. 3. Mention the characteristics and examples of simple levers under the following: a. First class lever b. Second class lever c. Third class lever 4. List at least five common uses of lever.	The pupils answer teacher's questions.	Questioning.
Summary.	Ask the pupils to to copy note on the topic and use cardboard sheet and make a chart of 3 classes of lever.	Pupils carry out teacher's instructions.	Instructional closure

LESSON PLAN ON BASIC SCIENCE FOR 3RD PERIOD FOR THE CONTROL GROUP

Class: Primary 6
Duration: 35 minutes
Average Age of Pupils: 11 years
Topic: The meaning of magnetism, magnet, types of magnets and magnetic and non magnetic materials.
Instructional Objectives: By the end of the lesson, the pupils should do the following:

COGNITIVE DOMAIN

1. Define the following:
2. Magnetism b. magnet.
4. List and identify magnetic and non magnetic materials.
5. Mention types of magnets.

PSYCHOMOTOR DOMAIN

1. Draw and label types of magnets.
2. Copy note on the topic.

AFFECTIVE DOMAIN

1. Develop interest in playing with magnets.

Instructional Materials: Different types of magnets, iron nails, office pins, iron fillings, paper clips, steel pins, drawing pins, needles, coins, rubber band, pebbles, wood, pieces of plastic materials and charts of types of magnet.
Instructional technique: Explanation and use of examples and questioning.
Entry Behaviour: Pupils have been playing with magnets and other materials in their various homes.

INSTRUCTIONAL PROCEDURES

Content development	Teacher's activities	Pupil's activities	Instructional techniques.
Set induction	Ask the pupils the following questions 1. What are those materials you use to play at home? 2. In which household appliances do we find magnet? 3. What are those materials a magnet can attract? 4. What are those materials a magnet cannot attract?	Listen and answer teacher's questions	Questioning.
Step II Magnetism and magnet.	Discuss the concept magnetism and magnet with pupils using different types of magnet. **Magnetism** is the science of magnetic existence and properties. The word magnetism is derived from magnesia, place where magnetic iron ore (lodestone) was first discovered. **Magnet** is any object that can attract other materials such as iron ore or any of its alloys; cobalt, nickel, or	Listen to teacher's explanations.	Explanation and use of examples.

	any other magnetic materials to itself.		
Step II Types of magnet	Explain to the pupils types of magnet using magnets and charts of different types. We have **five** types of magnet named according to their shapes. 1. Rectangular bar magnet. 2. Ball magnet. 3. Ring magnet. 4. Cylindrical magnet. 5. Horse shoe magnet. Magnets are also classified into temporal and permanent magnet. Temporal magnets lose their magnetic property easily. This type of magnet is made from soft iron which is easy to magnetize and demagnetize while permanent magnets do not lose their magnetic property easily. They are made of steel which is not easy to magnetize and demagnetize.	Listen to teacher's explanations.	Explanation and use of examples.
Step III Magnetic and non magnetic materials	Explain magnetic and non magnetic materials to the pupils using various objects and charts. **Magnetic materials:** are those objects which are attracted by a magnet such as iron, cobalt, steel, nickel **Non-magnetic materials:** are those objects which are not attracted by a magnet such as wood, glass, plastic materials, brass, copper, gold, silver, pencil, eraser etc. The force in the magnet that makes it to attract things to itself is called **magnetic force**. Ask them to give more examples of magnetic and non magnetic materials.	Listen to the teacher's explanations and answer teacher's questions.	Explanation, use of examples and questioning.
Evaluation	1. What is magnetism? 2. What is a magnet? 3. What is magnetic material? 4. What is non magnetic material? 5. Give examples of a. Magnetic materials. b. Non magnetic materials. 6. What are the two classes of magnet? 7. Draw and label five types of magnet.	Answer teacher's questions.	Questioning.
Summary.	Ask the pupils to copy note on the topic and bring more magnets to the class.	Pupils carry out teacher's instructions.	Instructional closure

LESSON PLAN ON BASIC SCIENCE FOR 4TH PERIOD FOR THE CONTROL GROUP.

Class: Primary 6
TIME: 35 minutes
Average Age of Pupils: 11 years
Topic: Properties of a magnet, ways of making magnet and uses of magnet.
Instructional Objectives: By the end of the lesson, the pupils should do the following:

COGNITIVE DOMAIN

1. Mention at least two properties of a magnet
2. Say at least two ways of making a magnet.
3. Mention at least two uses of magnet in everyday life.

PSYCHOMOTOR DOMAIN

1. Draw a magnet and label the poles.
2. Copy note on the topic.

AFFECTIVE DOMAIN

1. Develop interest in playing with magnet.

Instructional Materials: Different types of magnet, iron fillings and charts of magnetic appliances.
Instructional Techniques: Explanation, demonstration, use of examples and questioning.
Entry Behaviour: Pupils have learnt the following:

1. What magnetism and magnet is.
2. Magnetic and non magnetic materials.

INSTRUCTIONAL PROCEDURE

Content development	Teacher's activities	Pupils activities	Instructional techniques
Set induction	Ask the pupils the following questions 1. What is magnetism? 2. What is magnet? 3. What is a. magnetic material b. Non magnetic material?	Listen and answer teacher's questions.	Questioning.
Step I Properties of magnet	Use magnet and magnetic materials to explain properties of magnet to the pupils as follows: 1. Magnets possess magnetic force which makes them attract objects such as iron and steel. 2. Magnets always come to rest, when suspended freely, with the poles pointing in the North and South direction. 3. Like or similar poles of magnets repel while unlike or dissimilar poles attract. 4. Magnet has magnetic field around its poles. Magnetic field is a region around a	Listen to the teacher's explanation and demonstration of the properties of a magnet.	Demonstration and use of examples.

	magnet in which magnetic effects are experienced.		
Step II Ways of making magnet.	Explain ways of making simple magnet to the pupils using charts; 1. **By stroking with a magnet** i.e. a steel bar is stroked from one end to the other, several times with one pole of a magnet in the same direction. 2. **By passing electric current**: An unmagnetized steel bar is placed inside a coil of wire of several turns called solenoid. Thus wire is connected to a battery. Current is switched on and then off. 3. **By hammering:** An unmagnetized steel bar is heated red hot and hammered. It is then placed in North-South direction and allowed to cool.	Listen to the teacher's explanations of ways of making magnet.	Explanation.
Step III Uses of magnet	Explain uses of magnet to the pupils using magnets, magnetic and non magnetic materials, charts of magnetic appliances. Electromagnets are used in the work of 1. Electric bell and telephone ear piece. 2. Large cranes to move heavy loads. 3. Separating magnetic substances from non magnetic substances. 4. Collect lost pins in the office. 5. Magnets are used in the construction of electric motors, generators, bicycle dynamo, loud speaker, radio and T.V sets etc. 6. Separate iron fillings from sand.	Listen to teacher's explanation of the uses of magnet.	Explanation and use of examples.
Evaluation	1. List at least three properties of magnet. 2. Describe with a making temporal magnet. 3. Give at least three uses of a magnet. 4. Draw a magnet and label the poles.	Answer teacher's questions.	Questioning.
	Ask pupils to copy note on the topic and practice what they have learnt at home and collect different types of magnets to be kept in science corner.	Pupils carry out teacher's instructions.	Instructional closure

LESSON PLAN ON BASIC SCIENCE FOR 5TH PERIOD FOR THE CONTROL GROUP.

Class: Primary 6
Duration: 35 minutes
Average age of the pupils: 11 years
Topic: What force is, types of force and friction and its effect
Instructional objectives: By the end of the lesson, the pupils should do the following:
COGNITIVE DOMAIN

1. Define force.
2. Mention at least three types of force.
3. Define friction and give some instances of friction in everyday life.

PSYCHOMOTOR DOMAIN
1. Copy note on the topic.

AFFECTIVE DOMAIN

2. Develop interest in learning frictional effect or evidences of friction.

Instructional Materials: sand paper, glass, dry toasted bread, a large pebble, stone, cutlass, cement slab.
Instructional Technique: Explanation, demonstration and use of examples.
Entry Behaviour: Pupils have learnt

1. Magnet and magnetic force.
2. They can rub their palms together to produce heat.

INSTRUCTIONAL PROCEDURE

Content Development	Teacher Activities	Pupils activities	Instructional technique.
Set Induction	Ask the pupils the following questions: 1. What is a magnet? 2. What is it in a magnet that makes it to attract things. 3. When you rub heard your two palms together, what do you feel?	Listen and answer teacher's questions.	Questioning.
Step I Definition of force.	Explain to the pupils the meaning of force to the pupils by pushing and pulling things in the class. Force is anything that can change position of things either by pushing or pulling them. Demonstrate to show effects of force on objects.	Listen to teacher's explanation and demonstration of effects of force on objects.	Explanation and demonstration.
Step II Types of force	Explain types of force to the pupils as follows: There are <u>five</u> types of force: 1. Frictional force. 2. Magnetic force. 3. Electrical force. 4. Gravitational force. 5. Mechanical force. 1. Frictional force is the force that exists	Listen to the teacher's explanation and answer teacher's questions.	Explanation and questioning.

	between two surfaces. 2. Magnetic force is the force with which a magnet attract objects made of iron. 3. Gravitational force is the force which pulls any object down to the ground. 4. Electrical force is the force of electricity. 5. Mechanical force is the force that exists when an object strike against another object. Ask them to mention and explain each type of forces.		
Step III Definition of friction and some instances of friction in everyday life.	Explain and demonstrate the meaning of friction and some instances of friction in everyday life to the pupils using sand paper, dry toast bread, a large pebble, stone, cutlass and cement slab. Friction is the force which opposes or prevents motion between two surfaces in contact with each other. Some instances of friction in everyday life are; 1. Heat produced by rubbing two surfaces together. 2. Wearing of shoe heels/soles and tyres of motor. 3. Heat produce by moving parts of machines. 4. Light produced by hitting two hard objects e.g. stones or iron together.	Listen to the teacher's explanation and demonstration of the meaning of friction.	Explanation, demonstration and use of examples.
Step IV Effects/ Evidence of friction	Explain and demonstrate the effects or evidence of friction for the pupils using sand paper, stone, large pebbles, cutlass, cement slab etc Evidence of friction 1. A spark is produced when a sharp edge of cutlass struck against a stone or on cement floor. 2. Heat in produced when two surfaces are rubbed together. 3. It is difficult to walk on a very smooth floor than a rough floor. This is because the rough floor produces more friction than the smooth floor. 4. Riding bicycle on sand is more difficult than riding on a tarred road. etc 5. Friction wears away surfaces. Questions What do you observe when you rub the following; d. Two slices of dry toast bread. e. A large pebble on a cemented surface.	Listen to the teacher's explanation and demonstration of the evidence of friction and answer teacher's questions.	Demonstration and questioning.

	f. Hit sharp edge of a cutlass against a stone or cement floor.		
Evaluation	1. What is force? 2. Mention five types of force. 3. What is friction? 4. Mention at least three instances of friction in everyday life.	Answer teacher's questions.	Questioning.
Summary.	Ask the pupils to copy note on the topic and practice what they have learnt at home, and read up useful and harmful effect of friction.	Pupils carry out teacher's instructions.	Instructional closure.

LESSON PLAN ON BASIC SCIENCE FOR 6th PERIOD FOR THE CONTROL GROUP

Class: Primary 6
Duration: 35 minutes
Average age of pupils: 11 years
Topic: Principles of friction and ways of reducing friction
Instructional objectives: By the end of the lesson, the pupils should do the following:

COGNITIVE DOMAIN

1. Mention the two principles of friction.
2. Say at least three useful effect of friction
3. Mention at least two harmful effect of friction.
4. List ways of reducing friction

PSYCHOMOTOR DOMAIN

1. Copy note on the topic learnt.

AFFECTIVE DOMAIN

3. Develop interest in reducing friction by adding lubricants.

Instructional Materials: Sand paper, plane glass, dry toast bread, large pebble, grease, ball-bearing, rollers or wheels, stone, cutlass, cement slab.
Instructional Technique: Explanation, demonstration and use of examples.
Entry Behaviour: Pupils have learnt force, types of force and friction and its effects.

INSTRUCTIONAL PROCEDURE

Content Development	Teacher's activities	Pupils activities	Instructional techniques
Set inductions	1. What is force? 2. Mention five types of force. 3. What is friction? 4. Mention three instances of friction in everyday life	Listen and answer teacher's questions.	Questioning.
Step I Principles of	Explain principles of friction to the pupils using sand paper, plane glass, ball-bearing, rollers or wheel.	Listen to the teacher's explanation and	Explanation and Demonstration.

friction	Two principles of friction are 1. The smoother the surface, the lesser the frictional force. 2. The rougher the surface, the greater the frictional force. Demonstrate the two principles of friction for the pupils by rubbing the following surfaces together 1. Smooth against smooth 2. Rough against rough. 3. Rough against smooth.	take down notes.	
Step II Advantages or useful effect of friction	Explain the useful effect of friction to the pupils as follows using the following examples: 1. Walking: Friction between the soles of our feet and ground enables us to walk without slipping or falling. 2. Brake: Friction between the rim and the rubber brake pads makes wheel to slow down and stop. 3. Movement of cars and bicycle: friction between tyres and rough road surfaces makes the cars or bicycles to move on the surfaces without skidding. 4. Nailing pieces of wood together. Nails hold pieces of wood tightly together because of the friction between the nail and wood 5. Climbing: friction between our feet/tree trunks and hands makes climbing of a tree possible. 6. Holding of fan belts over wheel or pulleys: friction holds fan belts used over wheels or pulleys in machines 7. Grinding of things and sharpening of knives: Friction helps to grind things with stone and to sharpen knives.	Listen to the teacher's explanation of the useful effects of friction and take down notes.	Explanation and use of examples

Step III. Disadvantages or harmful effects of friction.	Explain the harmful effects of friction with the pupils using sand papers, dry toasted bread etc. 1. Friction wastes a lot of energy in form of heat in machines. 2. It causes tears and wears of parts of machines. 3. Friction wears away surfaces of , motorcycle and vehicle tyre 4. Friction produces an electric spark which gives shocking effect on the body. 5. Friction makes pushing of things difficult. 6. Friction reduces the efficiency of machines. 7. Friction makes the heels of our shoes to wear out.	Listen to the teacher's explanation and take down notes.	Explanation and use of examples.
Step IV Ways of reducing friction	Explain ways of reducing friction to the pupils using different types of lubricant, rollers, ball-bearings etc. 1. Friction can be reduced by greasing or oiling surfaces that rub together against each other. 2. Also rollers and ball-bearings are used to reduce friction.	Listen to teacher's explanations and take down notes.	Explanation and use of examples.
Evaluation	1. Mention two principles of friction. 2. List at least three a. Useful effect of friction b. Harmful effect of friction 3. Mention two ways we can reduce Friction	Listen and answer teacher's questions.	Questioning.
Instructional Closure	Ask them to copy notes on the topic and practice what they have learnt at home and collect rollers and ball – bearing to be kept in the science corner.	Pupils carry out teacher's instructions.	

LESSON PLAN ON BASIC SCIENCE FOR 7th PERIOD FOR THE CONTROL GROUP

CLASS: PRIMARY 6

DURATION: 35 MINUTES

AVERAGE AGE: 11YRS

TOPICS: What solar system is and the nine planets.

INSTRUCTIONAL OBJECTIVES: By the end of the lesson, the pupils should do the following.

COGNITIVE DOMAIN

1. Say what make up the solar system.
2. Mention the nine planets in their order from the sun.
3. Identify the importance of the sun as the source of energy (heat and light) for other planets.

PSYCHOMOTOR DOMAIN

1. Draw the solar system.

AFFECTIVE DOMAIN

1. Develop interest in studying the solar system.

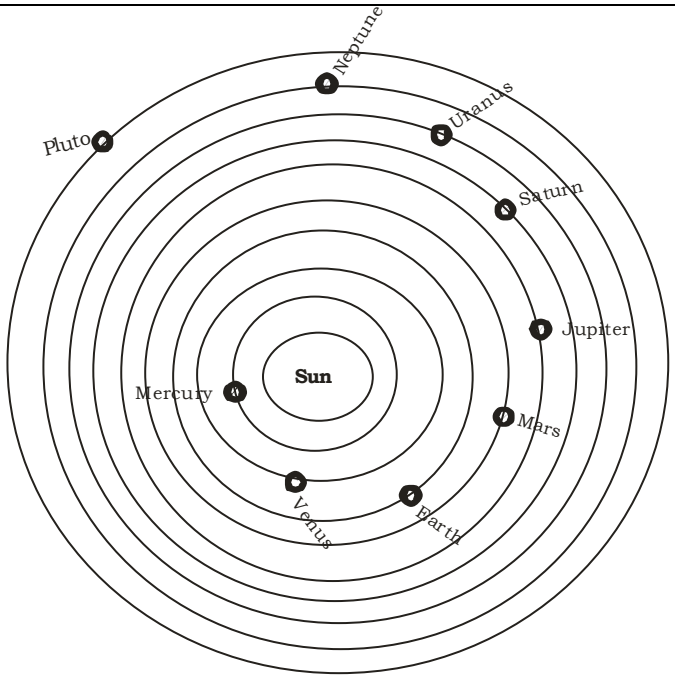
INSTRUCTIONAL MATERIAL: Charts and drawings of the solar system, Telescopes, Binoculars, Torch light.

INSTRUCTIONAL TECHNIQUE: Explanation, demonstration and use of examples and questioning.

ENTRY BEHAVIOUR: Pupils are familiar with those natural objects seen on the sky such as the sun, the moon and the stars.

INSTRUCTIONAL PROCEDURE

Content development	Teacher Activities	Pupils' Activities	Instructional techniques
Set induction.	Ask the pupils the following questions: 1. What are those natural objects you can see on the sky? 2. What is the main source of heat? 3. Light travels in _____ line.	Listen and answer teacher's questions.	Questioning.
Step II The solar system	Explain the meaning of solar system using charts and drawing of the solar system to the pupils as follows: The suns, together with all the nine planets that move round it, make up the solar system. The solar system consists of the sun, nine planets, thirty-two moons which move round some of the planets and other heavenly bodies.	Listen to teacher's explanations and draw the solar system and write down notes.	Explanation and illustrations.

	 Solar system.		
Step II The names of the nine planets in their order from the sun. .	Explain the names and arrangement of the planets round the sun to the pupils using the charts and diagrams of the solar system. The names of the planets, in order of their nearest to the sun are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto. You can name them by the letters (MVE MJS UNP). These planets rotate and revolve round the sun in their orbits. The sun is in the centre of the solar system. It is large than any of the planets. It is import ant sources of heat to the earth and other planets. Sun energy can be changed to heat energy in burning of paper using converging lens. The sun rises in the east and sets in the west. The scientist that studies about the heavenly bodies as called Astronomers. The instrument they use to study them is called Telescope. Questions 1. What is the third planet nearest to the sun? 2. What do we call the path through which each planet revolves round the sun? 3. What is the most important source of energy to the planets?	Listen to teacher's explanations and answer teacher's questions.	Explanation and questioning
Step III General characteristic s of planets and	Explain the general characteristics of planets to the pupils using torch light and drawing of the solar system as follows: The general characteristics of the planets are that each of the planets	Listen to the teacher's explanations and demonstration of rotation and revolution of the	Explanation and Demonstration.

differences between the planets.	1. Revolves round the sun. 2. Receives heat and light from the sun. 3. Revolves in the same direction. Differences between the planets are: 1. The distances of the planets from the sun are not the same. 2. The speed of rotation and revolution of the planets differs. 3. Planets differ in sizes; Jupiter is the largest planet, while mercury is the smallest. 4. The quality of heat and light felt in the planets are not the same because of their differences in distance from the sun. 5. The time taken for one complete rotation or revolution differs from planet to planet.	earth and write down notes.	
EVALUATION	1. What make up the solar system 2. How many planets move round the sun? 3. Mention the name of the planets in their order from the sun. 4. What provides heat and light to the planets? 5. What are the general characteristics of the planets? 6. Which is the a. Largest planet. b. Smallest planet. 7. How many days does it take the earth to make one complete revolution round the sun? 8. What do we call a. The scientists that study about the heavenly body? b. The instrument the scientists use to study the heavenly bodies?	Answer teacher's questions.	Questioning
Summary	1. Wash out the sky at night and make list of the things you see. 2. Wash the position of the sun in the morning and in the evening and comment on that.	Pupils carry out teacher's instructions.	Instructional closure

LESSON PLAN ON BASIC SCIENCE FOR PERIOD 8 FOR THE CONTROL GROUP
CLASS: Primary 6
DURATION: 35 minutes
AVERAGE AGE OF PUPILS: 11 years
TOPIC: The earth and movement of the earth, and Eclipse of the sun and moon.
INSTRUCTIONAL OBJECTIVES: By the end of the lesson, the pupils should do the following:
COGNITIVE DOMAIN

1. Mention the two types of movement made by the earth.
2. Relate the movement of the earth, moon and sun to such phenomena as day and night, season of the year and eclipses.
3. Say when the following eclipses occur
   a. Eclipse of the sun or solar eclipse.
   b. Eclipse of the moon or lunar eclipse.

PSYCHOMOTOR DOMAIN

1. Make models and draw diagrams to illustrate the earth's movement.
2. Illustrate with diagram the relative position of the earth, moon and sun during eclipse.
3. Copy note on the topic learnt.

AFFEFTIVE DOMAIN

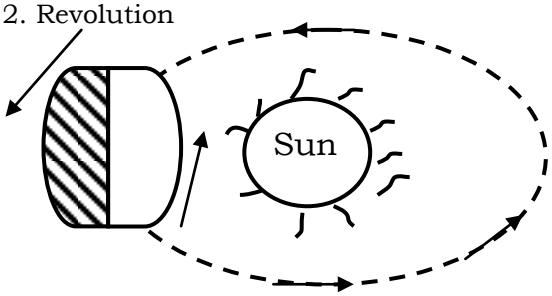
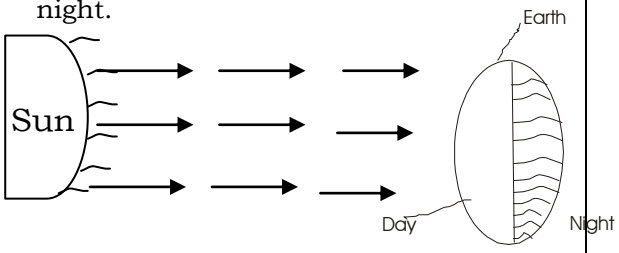
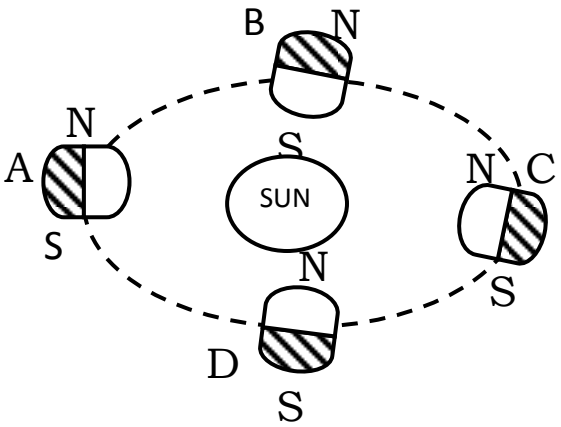
1. Feel excited when watching the teacher demonstrate the earth's movement using torch light and Globe.

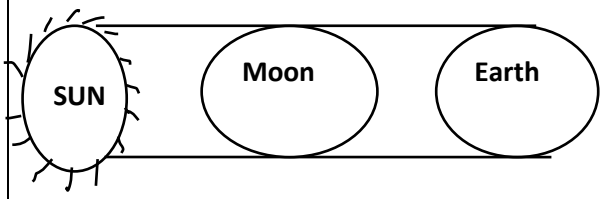
INSTRUCTIONAL MATERIALS: torch light, Globe, candle, big and small ball, charts and drawing to illustrate the earth's movement.
INSTRUCTIONAL TECHNIQUE: Explanation, illustration, demonstration and use of examples.

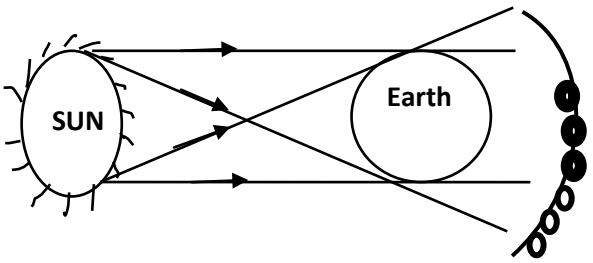
ENTRY BEHAVIOUR: Pupils have learnt the solar system and the nine planet

INSTRUCTIONAL PROCEDURE

Content development	Teacher Activities	Pupils Activities	
Set Induction	1. What is solar system? 2. How many planets move round the sun? 3. Mention the name of the planets in their order from the sun. 4. What are the general characteristics of the planets? 5. What do we call the scientists that study the heavenly bodies?	Listen and answer teacher's questions.	Questioning
Step I The earth.	Explain the earth using the globe, to the pupils as follows: The earth is the planet on which we live. It is the third planet nearest the sun. The earth is represented on a map called Globe (let them observe the globe)	Listen to teacher's explanations and write down notes.	Explanation.
Step II The earth's movements	Explain to the pupils the earth movements using globe and torch. The earth makes <u>two</u> movements.	Listen to the teacher's explanations and	Explanation, illustration, demonstration.

	1. Rotation 2. Revolution  The earth's movement round the sun. 1. Rotation: This is the turning round and round of the earth about its axis, once every 24 hours. Rotation of the earth causes day and night let them use torch light and globe to demonstrate rotation of the earth. Rotation of the earth results to Day and night.  **Rotation of the earth** 2. **Revolution of the earth.** This is the movement of the earth round the sun on its orbit. In Nigeria we have dry and wet season. This is because different parts of the earth comes under the influence of the sun rays at different times. It takes the earth one year to go round the sun. An ordinary year consist of 365 days while reap year contains 366 days. The earth revolves from east to west direction.  **Revolution of the earth.**	demonstration of the earth's movements.	

Step III Eclipse of the sun and moon.	Explain to the pupils eclipse of sun and moon using charts and drawings to illustrate each eclipse with the pupils as follows: The earth and the moon do not give out light. The light from the sun shines on earth and moon which does not allow light to pass through them. The sun is therefore said to be luminous body while the earth and moon is non-luminous objects. Because of the movement of the earth and the moon, it is possible for one to shield (eclipse) the other from getting light from the sun. **Formation of shadow**: when opaque object is placed across in the direction of light rays, a shadow of the opaque object does not allow light to pass through it.(demonstrate formation of shadow using candle light screen, opaque object and torch light). **1. Eclipse of the sun or solar eclipse:** this occur when the moon comes between the sun and the earth. Because the earth is bigger than the moon, regions of total shadow and partial shadow may fall on the earth. These gives us **total** and **partial** eclipse of the sun respectively. At times the moon is so far away from the earth that no region of total shadow falls on the earth. The moon is then observed against the circular sun. This is called **annular** eclipse.  Eclipse of the sun **2. Eclipse of the moon or Lunar eclipse:** This occur when the earth is in between the sun and the moon so that the moon is in the shadow of the earth. If the moon moves into the region of partial shadow, we have partial eclipse of the moon but if it moves into the region of total the total shadow, we have total eclipse of the moon. Let the pupils use torch light, big and small ball to demonstrate eclipse of the sun and moon.	Listen to the teacher's explanations and demonstration of formation of shadow on eclipse of sun and moon using torch light, small ball and big ball.	Explanation, demonstration and illustration.

	 **Eclipse of the moon**		
EVALUTION	1 What do we call the map on which the earth is represented. 2 Mention the two movements made by earth. 3 What does the following earth's movement causes: a. rotation b. revolution 4 How many days does it take the earth to make one complete: a. rotation b. revolution 5 Give examples of opaque objects. 6 When do we have a.Eclipse of the sun? b.Eclipse of the moon?	Listen and answer teacher's question.	Questioning.
Summary	Demonstrate what you have learnt at home. Use cardboard sheet to make a drawing of eclipse of the sun and moon.	Pupils carry out teacher's instructions.	Instructional closure