EFFECTS OF CROSSWORD-PICTURE PUZZLE AND ENHANCED EXPLICIT TEACHING STRATEGIES ON STUDENTS' LEARNING OUTCOMES IN BASIC SCIENCE IN SOUTHWESTERN NIGERIA

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ABSTRACT

Public examination records have shown that students record low achievement in basic science. This has been attributed to over dependence on the conventional method of talk and chalk. Scholars have thus recommended the use of other instructional strategies that could help students learn collaboratively and acquire problem solving skills. Two of such strategies are Crossword-Picture Puzzle and Enhanced Explicit Teaching strategies. There is paucity of research on their effects on students' learning outcomes in basic science at the secondary school level in Southwestern Nigeria. This study, therefore, determined the effects of Crossword-Picture Puzzle (CPP) and Enhanced Explicit Teaching (EET) on students' learning outcomes in basic science in Southwestern Nigeria while the moderating effects of gender and mental ability were also examined.

The study adopted a pretest-posttest control group quasi-experimental design with 3x3x2 factorial matrix. Multi-stage sampling technique was used. Three hundred and eighty nine JSS 2 students from nine junior secondary schools were randomly selected in three states (Oyo, Ogun and Ondo). The schools were randomly assigned to experimental (CPP and EET) and control (CLM) groups, and the treatments were for 13 weeks. Seven instruments used were: Crossword-Picture Puzzle Teaching Strategy (r=0.76); Enhanced Explicit Teaching Strategy (r=0.72) and Conventional Lecture Method (r=0.74); Basic Science Students' Achievement Test (r=0.70); Basic Science Students' Attitude Scale (r=0.80); Australian Council for Educational Research Test (r=0.86) and Evaluation sheets for assessing research assistants. Seven hypotheses were tested at 0.05 level of significance. Data were analysed using ANCOVA and Scheffe post hoc test.

There was significant main effect of treatment on students' achievement score [$F_{(2,389)}$ =202.16; η^2=.52]. Crossword-picture puzzle enhanced achievement scores ($\bar{x}$ =16.92) than EET ($\bar{x}$ =14.82) and CLM ($\bar{x}$ =8.82). Treatment had significant main effect on students' attitude to basic science [$F_{(2,389)}$ =11.51; η^2=.06]. Crossword-picture puzzle enhanced attitude scores ($\bar{x}$ =58.43) than EET ($\bar{x}$ =54.14) and CLM ($\bar{x}$ =52.08). Gender had significant main effect on students' achievement [$F_{(1, 389)}$ =3.99; η^2=.01]. Male students had higher mean score of achievement in basic science ($\bar{x}$ =13.85) than the female students ($\bar{x}$ =13.19). Mental ability of students had significant main effect on their achievement [$F_{(2, 389)}$ =5.04; η^2=.03]. High mental ability students had the highest mean score ($\bar{x}$ =14.15) followed by moderate mental ability students ($\bar{x}$ =13.44) and the low mental ability students ($\bar{x}$ =12.96) respectively.

Crossword-picture puzzle and enhanced explicit teaching strategies improved students’ academic achievement in and attitudes to basic science. Basic science teachers and curriculum developers should adopt the two activity based strategies for the improvement of students’ learning outcomes in basic science.

Keywords: Crossword-picture puzzle strategy, Enhanced explicit teaching strategy, Learning outcomes in basic science

Word count: 423

CERTIFICATION

I certify that this work was carried out by **John Olakunle BABAYEMI** (135819) in the Department of Teacher Education, University of Ibadan, Ibadan, Nigeria.

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DEDICATION

This work is dedicated to my God, my wife Catherine Adebola Babayemi and my children Othniel Abiola Babayemi, Barnabas Okikiola Babayemi and Epaphras Toluwani Folarinde Babayemi.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Science and Technology remains the arrow head that determines the degree, direction and dimension of national development. Investing in Science and Technology is therefore, a pointer to clues for bringing a nation out of under-development (Dayananda, 2005). Government's policy statement and practices determine how effective Science and Technology would take off at both primary and secondary levels of education. Although various fields in science and technology derive their foundational principles from Integrated Science which changed to Basic Science in September 2008 (Oyediran, Agoro and Fabiyi, 2004; Oludipe, 2011), there are diverse problems in the teaching and learning of Basic Science ranging from lack of human and non-human resources to pedagogy.

There is a dearth of human resources to teach Basic Science in Nigeria because professionals are not many (Adesoji, 2002; Afuwape and Olatoye, 2004). A professional Basic Science teacher is professionally prepared in contents and methods of teaching Basic Science effectively, having acquired a professional qualification in Basic Science (e.g. NCE, or a university degree in Basic Science Education). Any other Basic Science teacher with qualifications outside the above is categorized as unprofessional. This is why Babarinde (2009) stated that "effective transfer of the subject matter depends on whether the teacher is a professional or a quack."

As stated in NERDC (2012, pp vi), the objectives of Basic Science and Technology curriculum expect the learners to:

i) Develop interest in science and technology.
ii) Acquire basic knowledge and skills in science and technology.
iii) Apply scientific and technological knowledge and skills to meet contemporary societal needs.
iv) Take advantage of the numerous career opportunities provided by science and technology.
v) Become prepared for further studies in science and technology.
vi) Avoid drug abuse and related vices; and
vii) Be safety and security conscious.

However, these objectives have not been maximally achieved probably because Basic Science is one of the major subjects offered by all students in junior secondary schools in Nigeria. The number of students offering Basic Science is more than the number of teachers employed to teach the subject in various schools, and the class size is large. This increases teachers' workload, resulting in teachers' ineffectiveness. In addition, Basic Science has the perennial problems of lack of class activities and instructional resources to teach the subject. Lemon (2011) emphasizes the importance of class activities. Class activities make the learning process successful. Teachers should allow students' creative ideas during instructional process by providing meaningful class activities. Basic Science at the Junior Secondary School (JSS) level is all about doing. An attempt to make science class all of teachers' activities but none of students' activities is making science passive to learners. Students will only be familiar with the scientific concepts but will not also be able to live in the real world of science.

The importance of studying Basic Science in schools is not only meant for obtaining certificate but also meant for producing future scientists in all spheres of life that will bring about national developments in all her ramifications. The future scientists begin their scientific experience from the studying of Basic science in Junior Secondary Schools (JSS) which should be activity-based, and they continue with this experience at higher educational levels including Senior Secondary Schools (SSS). Teachers should therefore apply the constructivism methodology that allows students to construct their own knowledge and learners should be given opportunity to join in doing tasks (Lemon, 2011).

The role of instructional resources has implication for students' effective learning of science. It brings the abstract scientific concepts into visual form making it clearer and more comprehensive (Adedayo, 2011). The use of relevant instructional resources as well as carefully guided activities engages students in meaningful learning. Supporting the potential benefit of instructional resources in Basic Science teaching and learning, Dogara and Ahmadu (2000) observes that success can only be achieved when resources are used in a well planned activity.

Another major problem is the use of inappropriate teaching methods. Nwagbo (2001); Ezeliora (2004); Akpan (2008); Ibraheem and Oladele (2010) identify poor teaching method as one of the reasons for poor academic achievement. Asiriuwa's (2011) study reveals that some of the teaching methods employed by teachers do not facilitate real learning of the science subjects. Students' educational gains, acquisition of scientific knowledge, attitudes and skills depend on the right type of instructional methodologies employed by the teacher. All students are not the same in every respect; they acquire learning at different time and rate. For this reason, any inappropriate method used by the teacher affects the objectives of the lesson, makes students' scientifically illiterate and places students' performance on a level worst than it could ever be. Therefore, teachers should adopt methods that will promote the holistic view of science at the basic education level for better understanding of contemporary world (NERDC, 2012).

To worsening the situation, teachers' subject content and concept area of interest is a problem of concern. Some Basic Science teachers would only teach contents/concepts they have mastery. The reason could be that they manage to acquire knowledge in those contents'/concepts' areas when they are undertaking their teacher training programmes. This has now become major professional challenge in the field of practice. Since the introduction of Basic Science, despite the various efforts of government in embarking on the training and retraining of teachers (NTI, 2008, 2009 and 2010), the problems of teaching Integrated Science still persist in the teaching and learning of Basic Science.

National Dailies revealed the incessant poor performance of students in Senior School Certificate Examinations (SSCE) which calls for the attention of researchers, educators, government, parents and other stakeholders in finding lasting solutions to this disheartening experience through research in Junior Secondary School education especially, Basic Science. Prior scientific knowledge and skills in Physics, Chemistry, and Biology received through Basic Science at junior school level are necessary for science effectiveness at senior secondary school level, and they also serve as basis for subsequent acquisition of knowledge in science at higher levels.

In 2000 and 2001 examinations, 100% pass rate was announced by National Examination Council (NECO). All candidates passed registered papers in the two years. In the June/July 2007 examinations, NECO announced that 987,395 candidates out of 1,015,561 that sat for the examinations passed (that is, 97.2% pass rate). But this declined to 27.74% in November/December 2008. In the June/July 2009 result, it further went down to 10.53% and for November/December 2009, it came to a pass rate of 1.80%. The steady decline in pass rates from 100% in 2001 to 1.80% (almost zero) in November/December 2009 (The Guardian, May, Thursday 13, 2010; Okpala, 2010) necessitates a functional research to trace and address this fundamental issue. This is why Okpala (2010) regrets the poor performance in the examination and advocates the need for stakeholders to intensify efforts in ensuring improvement in candidates' performance. Research efforts to improve Students' performance in Senior School Examinations (Ukoh, 2012; Ogundiwin, 2013), should incorporate Basic Science as the foundational subject upon which scientific knowledge and skills in Physics, Chemistry and Biology are based. The problem of poor academic achievement at Junior Secondary School level in Basic Science should be seriously addressed. Table 1 reveals the performance of candidates in Junior Secondary School Certificate Examination in Integrated Science.

Table 1: Analysis of JSSCE Basic Science Result, Nigeria

YEAR	NUMBER OF CANDIDATES REGISTERED	NUMBER WITH CREDIT (A-C)	%	NUMBER WITHOUT CREDIT (P-F)	%
2000	12719	7324	57.58	5395	42.42
2001	12984	7286	56.11	5698	43.90
2002	14725	7597	51.60	7128	48.40
2003	16916	9013	53.30	7903	46.72
2004	17613	9492	53.87	8125	46.13
2005	19362	12561	64.90	6801	35.13
2006	18913	9062	47.91	9851	52.10
2007	20614	11585	56.20	9029	43.80
2010	15803	6639	42.01	9164	57.99
2011	16429	7693	46.83	8736	53.17
2012	20187	10249	50.77	9938	49.23
2013	26765	12903	48.21	13862	51.79
TOTAL	213030	111404	629.29	101630	570.78

(Source: Federal Ministry of Education, Research Statistics and Planning Section, 2013) (The examination was not conducted in 2008 and 2009 because of the federal government's declaration to scrape Unity Schools)

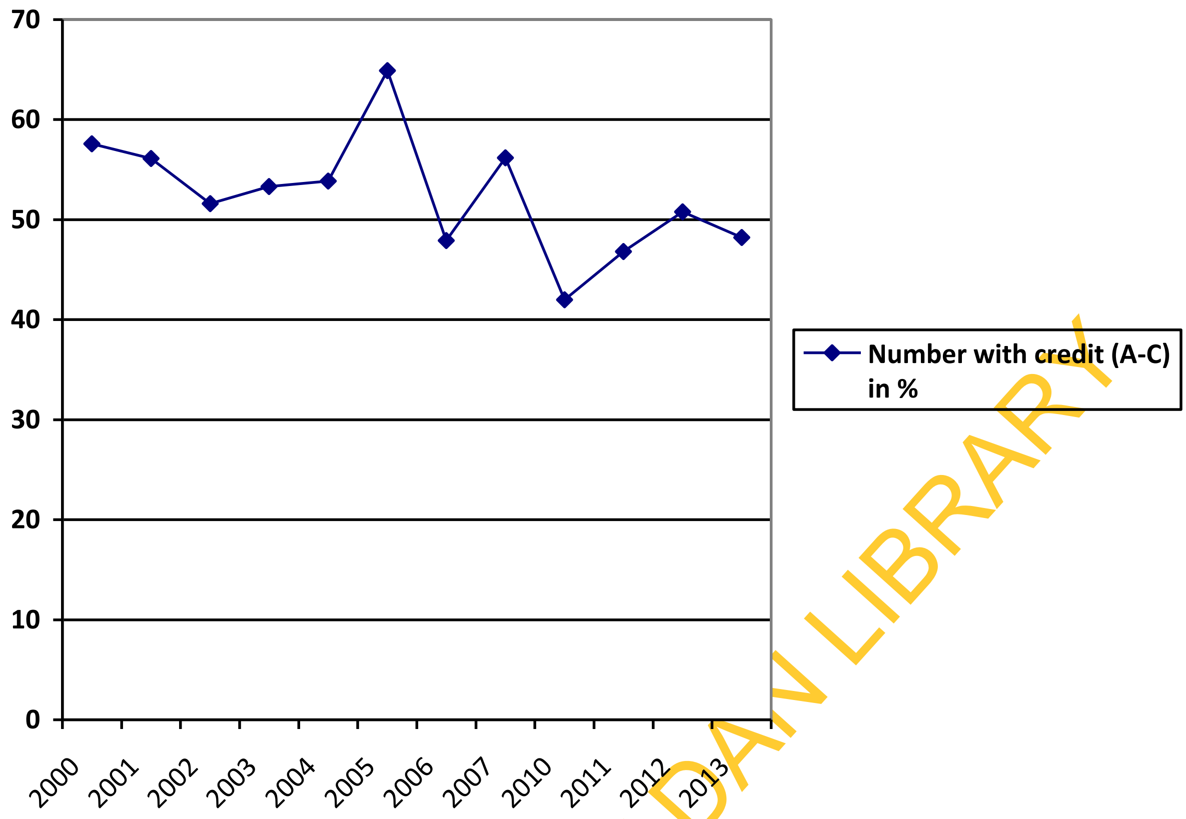

Figure 1: JSSCE Credit Passes Trend (2000-2013)

Profile of Integrated Science (Basic Science) results for twelve years is presented as Table 1 and Figure 1. Generally, the result was not consistent over the years. Looking at the analysis, performance in 2006, 2010, 2011 and 2013 (four years) was less than 50% with reference to credit passes (that is, A-C). The performance was slightly higher than 50% (just above 50%) in 2000, 2001, 2002, 2003, 2004, 2007 and 2012 (seven years). It was only in 2005 that the performance rose above 50% to 64.90%. But it was worrisome to see an appreciable decline in performance by 17% year immediately after 2005 (that is, 2006). Another worrisome trend is that in more recent years, there was still a noticeable decline from 50.77% in 2012 to 48.21% in 2013. The implication is that the economy of the nation and social development will probably be a mess since science and technology that enhances the socio-economic development is starting from unappreciable statuesque, considering it from the state of students' academic achievement in foundational science subject (that is, Basic Science) for more than a decade (twelve years) as revealed in Table 1.

Abimbola, Olorundare, Omosewo, Ahmed, Johnson and Yahaya (2011), on the importance of science and technology in national development, emphasize that teaching science in secondary schools is very important and lament that despite the numerous usefulness of science, its greatest problem is poor performance among students. Previous researchers further attribute reasons for poor achievement in science to:

i) Shortage of qualified teachers (Ajayi, 2005).

ii) Failure of teachers to put into use research findings and recommendations (Osuafor, 2008).

iii) Instructional methods used which have no bearing on the students' practical life (Adodo and Gbore, 2012).

iv) Inadequate materials in schools (Adedayo, 2011).

v) Teachers' inability to satisfy the students' aspirations or goals (Fasasi, 2014), and

vi) Lack of regard for the cultural belief of learners (Hiwatig, 2008)

Effort has been put in place by government, individuals, educational researchers and other stakeholders in improving students' achievement in science. In Nigeria and abroad, increasing overall student's achievement, especially lifting the performance of low achievers, is a central goal of education reform. In the United States, this goal is reflected in the mandate that all students in each state reach the proficient level of achievement by 2014 (Science and Engineering Indicators, 2012). In Nigeria, National Policy on Education (NPE, 2004) stipulates that "special provision and incentives shall be made for the study of the sciences at each level of the national education system..." One of the reasons government embarks on this perhaps is to encourage students' enrolment and achievement in the sciences. Both federal and state governments run scholarship scheme to encourage science and technology studies. However, this effort, especially in Nigeria, has not been yielding the desired results.

To possibly proffer solutions to poor science academic achievement, findings of various researchers reveal that the instructional strategy adopted also significantly influences students' academic achievement in science (Igwe, 2002; Raimi, 2002; Afuwape, 2002; Ajila, 2003; Oshodi, 2006) and should be reviewed. Single strategy is grossly inadequate; effective teachers now adopt varied instructional strategies that accomplish varied learner outcomes that are both behavioural and cognitive. Recent studies suggest diverse strategies for teaching and learning Basic Science: Inquiry-Based Instructional Strategy (Martins and Oyebanji, 2000); Simulation Game-Assisted Instructional Strategy (Afuwape, 2002); NISTEP Instructional Strategy (Shaibu and Usman, 2002); Hypothetico-Deductive Instructional Strategy (Ige and Arowolo, 2003); Multimedia Instructional Strategy (Oyediran, Agoro and Fabiyi , 2004); Experigamepics instructional strategy (Bolorunduro, 2005); Jigsaw II Instructional Strategy (Olaniyi, 2009); Multiple Intelligence Teaching Strategies (Duru and Okereke , 2010) and Ethnoscience Instructional method (Fasasi, 2014). Since students' performance is still declining, Agoro (2012) suggests the use of other methods that could promote effective Basic Science delivery. Such methods are Enhanced Explicit Teaching (Ajila, 2003) and Crossword-Picture Puzzle-based teaching (Bolorunduro, 2005) strategies.

Ajila's (2003) experimental study determines the effect of enhanced explicit teaching strategy on students' learning outcomes. The study was carried out on 'primary school' pupils (six primary schools) in 'primary science', using only 'one local government' in 'one selected state', and the moderating effects of gender and academic ability were not significant on pupils' achievement and attitude. This present study was carried out to determine effects of treatment on 'Junior Secondary School' students' learning outcomes in 'Basic Science' in 'Southwestern' Nigeria. Reports from Bolorunduro (2005) on the use of game and picture to teach Integrated Science show that: the study involved six secondary schools, two hundred and eight subjects (208) in Zaria, Kaduna State. This is of course, a state completely outside Southwestern states, that is, a northern state. This researcher determined the moderating effects of gender and students' background on the achievement, motivation and attitude of students, which was carried out in Integrated Science. This present study was carried out in Basic Science in Southwestern Nigeria using more schools, teachers and subjects. This present study also determined the moderating effects of students' gender and mental ability on Students' achievement in and attitude to Basic Science.

Furthermore, studies have reported the potential of game (the use of puzzles) in teaching and learning of science (Scott, 2006; Ogundiwin, 2013). This is game-based teaching, which is the teaching strategy of using games teach a subject. It means that the games that are used for this purpose have been designed with the idea of achieving learning outcomes. However, there seems to be a perception that gaming has a detrimental impact on students' academic achievement and attitudinal development. Many parents and some teachers that lack the knowledge of research contributions on the use of game in classroom ignorantly believe that children that engage in gaming soon lose their educational focus and attainments. They may be of the opinion that those children will not improve in their academic endeavours. To such teachers and parents, games in education are no longer a choice. This implies that educational games are still often seen as a non-serious activity and the potentials of games for learning stay undiscovered. Nonetheless, games and games-based learning have been a part of education for decades, only that teachers have not harnessed the potential roles of game in enhancing students' learning in Basic Science.

Michalewicz (2008), on the potential role of educational puzzles, identifies some essential features of educational puzzles. These are:

1. Generality: Educational puzzles should explain some universal problem-solving principles which if properly understood would form general strategies that would allow for solving

new problems in the future. The instructor plays an active role in introducing and applying the new strategies.

2. Simplicity: Educational puzzles should be easy to state and easy to remember. This makes the puzzle attractive to all categories of learners. Puzzles that are easy to remember increase the chance that the solution method will also be remembered.

3. Eureka factor: A puzzle should be interesting because the result is counter-intuitive. A Eureka moment is reached when the correct path to solving the puzzle is recognized. This creates an atmosphere of excitement for the learners. Hence, the puzzles should have elementary solutions that are not obvious.

4. Entertainment factor: Educational puzzles should be entertaining; otherwise, it is easy to lose interest in them. They can also be placed in an interesting setting.

This researcher further highlights the characteristics of puzzle based learning. These are:

i) Learning is driven by challenging, open-ended problems;

ii) Students work in small cooperative groups;

iii) Teacher takes the role of facilitator of learning.

Carly (2014) outlines the importance of educational games and points out that, students enjoy the challenge of participating in games and the process of playing some of educational activities. Puzzle games play an important part in developing and advancing motor skills. They help students coordinate the body with the brain, which have the advantage of improving hand-eye coordination and visual focus. Games also have the significant benefit of improving social skills through encouraging diplomatic and organized communication between students. Learning games inspire cooperation since students can interact in groups on common goal. Carly further points out that many educational games have the power to improve students' focus and lengthen their attention spans. Students who easily get frustrated and might quit other activities without seeing quick results might tend to stick with games for longer periods of time because of the possibility of advancement and rewards. This researcher also notes that many educational games seem to improve students' self-esteem and provide a positive feeling of accomplishment. Educational games offer rewards for tasks that students have independently completed or completed in group, and may inspire them to take productive risks in other areas of their lives as well. In addition, educational games encourage creativity. Exploring and expanding creativity through such games can also help with nurturing self-esteem and self-acceptance. They also inspire a greater connection between personality and activity.

Educational games have inherent potential to: arouse and sustain interest in learning, excite learners, generate new ideas in learners, teach difficult science concepts, develop critical thinking, remove fatigue, foster social interaction, recall information easily and generally help learners with low achievement potential. Studies have shown the relevance of using puzzles to teach and learn science. As many studies reveal the use of puzzles being effective (Anany and Mary, 2002; Scott, 2002, 2006; Serj, 2002; Idowu and Ige, 2007; Kendall, Parks and Sperer, 2008), few other studies show its limitation (Ross and Huang, 2001; Hill, 2003). As identified by Scott (2002), puzzles find their applications in science learning to introduce new ideas, test skills; pose problems that make learners ask challenging questions, help slow learners, serve as classroom resources and develop students' manipulative skills. Bowers (2006) identify different types of puzzles. These are: Wooden puzzles, Jigsaw puzzles, Crossword puzzles, Logic Puzzles (Word puzzles or Mechanical puzzles), Pattern puzzles (which can be colors, shapes, numbers, letters or any combination of them), Riddles and Brain Teasers, Mazes and Picture puzzles while Cardenas-Nelson and Connolly (2011) identified three types of picture puzzle: Spot-the-changes puzzles, Knot puzzles and Cut-Up puzzles. Out of these puzzle types, Crossword puzzle and Picture puzzle (Spot-the-changes puzzles) were used for the purpose of this study and this is called 'Crossword-Picture Puzzle Based Teaching Strategy'. Bolorunduro (2005) finds that crossword-picture puzzle is effective in teaching Integrated Science (Basic Science). Keshta's and Al-Faleet's (2013) study recommends the necessity of implementing puzzles in teaching-learning processes to ensure better outcomes in students' achievement and to shed light on techniques that emphasize organizing information for long-term learning (retention).

The choice of Crossword-picture puzzle in this study is in line with Ausubel theory which holds that knowledge exists in the cognitive structure of any child (subsuma) which if properly connected, will probably help in learning a new task. Children play with, for example, Ludo game and cards (that is, the subsuma in child's cognitive structure) which has square or rectangular grid with distinct colours and involves the use of numbers and materials (counters) that 'cross' each other when playing the game. Generally, children enjoy playing game. Picture attracts the attention of children to the extent that authors of their various textbooks realize this and count much on it to integrate pictures in their products to foster learning. At the elementary level of education (pre and lower level of primary school), children are taught mostly using pictures. In Science subjects, most concepts and structures are illustrated using pictures and diagrams to bring about students learning. Hence, the rationale for choosing crossword and picture puzzle in this study.

Another strategy that attracted the attention of the researcher in this study is Enhanced Explicit Teaching Strategy which combines peer tutoring with Explicit Teaching Strategy. Explicit teaching involves directing student attention towards a specific learning objective in highly structured environment (Picmanns, 2008). Explicit teaching means teaching where the instructor clearly outlines what the learning goals are for the student, and offers clear, unambiguous explanations of the skills and information structures they are presenting (Bill, 2012). Topics are taught in a logical order directed by the teacher through demonstration, explanation and practice. In explicit teaching, teacher sets the stage for learning by telling the students the purpose for learning, explain to students what to do, model the process of how to do it, and guide the students with hands-on-application/practice. Researchers found this strategy effective in science classroom (Edwards-Groves, 2002; Hall, 2002; Ajila, 2003; Picmanns, 2008; Anita and Charles, 2011; Bill, 2012).

Peer tutoring is an instructional strategy that employs peer interaction for the purpose of teaching and learning (Ginsburg-Block, 2010). It is an intervention in which students work in pairs to master academic skills or content (Scruggs, 2011). Peer tutoring is the instructional process between two or more students in a group where one of the students acts as a peer teacher for the other group-mate(s) (acting as students). Peer tutoring can be applied among students of the same age or students belonging to different age groups and also of the same or different ability levels. Different forms of peer tutoring exist (Lieberman and Houston-Wilson, 2009). These are: Unidirectional peer tutoring, Bidirectional or Reciprocal peer tutoring, Class wide peer tutoring, Same-age peer tutoring and Cross-age peer tutoring.

For the purpose of this study, unidirectional peer tutoring was chosen to enhance explicit teaching. This form of peer tutoring was chosen in line with the theory propounded by Vygotsky (1978), which views learning as a social activity. Vygotsky emphasizes that what a child is able to learn in collaboration today, such a child is able to do independently tomorrow. The theory points out that other people that have higher ability than the child play important roles in the development of the child. However, children have different abilities (Aremu and Sangodoyin, 2010) and in unidirectional peer tutoring, students with higher mental ability are selected using a standardized test (Australian Council for Educational Research Test) to coordinate learning tasks with students of moderate or low mental abilities in groups of 4-5 members. Empirical studies revealed the effectiveness of peer tutoring on academic gains of students (Ajila, 2003; Yuen-Lokea and Chowb, 2007; Menesses and Gresham, 2009; Ginsburg-Block, 2010; Okilwa, 2011). Experts have ascertained the fact that combining varieties of instructional strategies improves students' learning outcomes (Maal, 2004; Orlich , Harder, Callahan, Trevisan and Brown, 2010).

In Enhanced Explicit Teaching Strategy, the teacher briefly reviews the previous science tasks, presents the new science tasks, guides students' practice of these tasks using peer tutoring and provides feedback and necessary correction repeatedly. This strategy allows learners to acquire learning in a step-by-step manner through the teacher (a facilitator) and student (acting in the capacity of a teacher) because the learners are put into small groups. The more capable learners of the group help those with difficulties in mastering learning task. Ajila (2003) ascertains the effectiveness of Enhanced Explicit Teaching Strategy in improving students' academic gains and recommends it to be adopted by science teachers and curriculum planners. The method teacher adopts determines what will be the outcomes of instructional process. It is therefore imperative for teachers to closely study their students for individual differences in order to determine the appropriate method that will promote students' learning effectively (Adedayo, 2011). The teachers' methods of instruction are still taking the form of chalk and talk self-centred types (Bamidele, 2008). This type of method is traditional (conventional) in nature.

Conventional lecture method is a 'teacher-addicted' method of instruction. It is a method of instruction involving a unidirectional (one-way) flow of information just by the teacher. Students are not allowed to fully exercise their academic freedom and construct their own knowledge. Teachers often prefer this method to other instructional methods probably because they feel that it is a faster means of achieving curricular objectives. Conventional method is characterized with teacher setting the stage for learning and dominating the period of instruction, students are mainly passive and auditory learners, teaching-learning process is strictly all of teacher but little or none of students, learning is always classroom based (in-door) and large class size. Of greater concern in traditional setting, is the use of science laboratory for traditional lecture class.

In addition, conventional mode of instruction is usually characterized with review of previous lesson in form of questioning, oral presentation of lessons through chalk-talk style, writing and sometimes by demonstration, presentation of main points in form of 'preaching style', the main active stage of students' participation is when students copy notes and assignments (which may not be checked). Conventional Lecture method is a teaching method where teacher is the central focus of information transfer. It is the practice of having the teacher at the front of the classroom talking to students. This is seen as one-way communication, since the teacher is the only one fully involved in the instructional activities. Typically, the teacher will stand before a class and present information for the students to learn. Sometimes, they will write on a board or use an overhead projector to provide visuals for students.

Also, Students are expected to take notes during the instructional process. Usually, very little exchange occurs between the teacher and the students during the class (Kelly, 2014). Kelly, describing learners in conventional lecture method class, notes that students are experts in listening only to their teachers. Kelly further highlights the disadvantages of conventional lecture method pointing out that, students who are weak in note-taking skills will have trouble understanding what they should remember from lessons. Students can find lectures boring causing them to lose interest.

Students may not feel that they are able to ask questions as they arise during lessons. Teachers may not get a real feel for how much students understand because there is not that much opportunity for exchange of ideas during lessons.

However, this researcher suggests reasons for the use of conventional lecture method. Teachers use it probably because it is a straightforward way to impart knowledge to students quickly. Teachers also have a greater control over what is being taught in the classroom because they are the sole source of information. Students who are auditory learners find that lectures appeal to their learning style. Logistically, a lecture is often easier to create than other methods of instruction. Lecture is a method familiar to most teachers because it was typically the way they were taught.

Conventional lecture method has attracted the attention of researchers in previous studies. The earlier study of Bolorunduro (2005) indicates that though other methods are encouraged to be adopted in teaching science, the conventional method can still be combined with other methods to bring about learning. Sola and Ojo (2007) writing on the importance of conventional lecture method remarks that it is a valuable method for summarizing ideas, showing relationship between theory and practice, effective in re-emphasizing main points and in teaching a skill that can be observed. However, scholars in the field of educational and social research counter the use of traditional lecture method and advocate for child-centred method. Okoye's and Igboabuchi's (2011) study shows that in theory, Basic Science teachers are against the use of traditional method, but in practice it is very often used. Adesoji (2004) list reasons which make teachers use conventional method. These are:

i) Lack of infrastructural facilities.
ii) Lack of training programmes/workshops, and
iii) Lack of skill in handling difficult concepts (Olagunju, 2002).

Menesses and Gresham (2009); Duru and Okereke (2010) and Agoro (2012) contradict the use of conventional method (lecture) remarking that it is the most abused of all teaching methods and the least effective in many respects hence, there is the need for more proven methods of instruction.

Science, including Basic Science, is an exciting, fascinating and useful subject (Kresse, 2010). However, the subject can be presented in a very uninteresting and seemingly irrelevant manner. If students do not develop an enthusiasm for the subject, they may perceive the subject as difficult. But, to help each learner creates interest in the subject, develops the skills, knowledge and positive attitudes to choose from a full range of future pursuits (since Basic Science is connected to many paths of study and professions), there is the need to carry out research on attitude. Attitude plays a vital role in the life of an individual. Attitude is either a ‘promoter’ or ‘inhibitor’ of achievement. It becomes a promoter when it is positive and inhibitor when it is negative.

Studies hold different views on students’ attitude. Adediwura and Bada (2007) define attitude as a consistent tendency to react in a particular way-often positively or negatively-towards any matter. Adodo and Gbore (2012) note that students show negative attitude to the study of Basic science, and observe that not many students love studying the subject. In line with this observation, Adedayo (2008) also observes students’ lukewarm attitude towards science attributing this to the wrong perception that science is difficult. Such students only study it because it is a compulsory subject for every student at Junior Secondary School level. Bolorunduro (2005) finds that female students had better attitude to Integrated Science than male students. Afuwape’s (2002) and Akinsola’s (2007) results reveal a significant main effect of simulation-game on students’ attitude, whereas Akuche’s (2008) reports no significant effect of four instructional strategies on attitude. According to Aremu and Sangodoyin (2010), students have negative attitude to learning.

Establishing positive attitudes toward science is important to the educational community as a whole because attitude and interest are closely correlated with achievement (Sorge, 2007). The correlation between interest and achievement increases as students advance through elementary school (Denissen, Zarret and Eccles, 2007). This correlation suggests that as students get older, they tend to achieve in the subjects that they enjoy. This makes the elementary years crucial for provoking and feeding students’ interest in science and other subjects. Interest in science has the potential to be self-perpetuating. Denissen et al. (2007) proposes that “a high level of interest in a domain may lead to an increased level of effort and persistence, resulting in higher achievement levels that may in turn reinforce the already high level of interest” (p. 443). This proposition suggests that interest, effort and achievement operate in a continuous cycle. This study attempts to improve students’ attitudes in order to maximize their learning and achievement in science and having positive attitudes about subjects, including Basic Science, which is an impetus to exploring and gaining knowledge in these areas.

Research indicates that students’ attitudes impact both the quality of their work in school and their opinions of classes and jobs in science (Pell and Jarvis, 2001,). Also, there is a disconnect between students’ enjoyment of science and their desire to pursue science-related careers. Silver and Rushton (2008) find that although children hold positive attitudes towards doing science and about the benefits of science, these attitudes rarely translate into a desire to enter into scientific fields. In order to be effective, the strategies must improve students’ attitudes in a sustainable manner. The study of students’ attitudes toward science is also relevant because of the gaps that exist between male and female students in terms of interest, experience, achievement and career

interest in science (Hammrich, Richardson and Livingston, 2000). Many female students' interest and confidence in science decline during adolescence (Hammrich et al., 2000). Female students' perceptions of science as a masculine field can discourage interest in the subject and the pursuance of science careers (Hammrich et al., 2000). Researchers have found conflicting results in their study of attitudes and achievement (Nadirova and Burger, 2008; Sorge, 2007). For example, different studies have produced contradictory results about whether male or female students have more positive attitudes in science (Sorge, 2007, p. 33). Other studies indicate little or no relationship between attitudes toward science and gender (Nadirova and Burger, 2008).
Mattern and Schau (2002) describe the situation, "In developed countries, it has been determined that goals of science are never fully realized, that students do not like science lectures and that most have no preference for science". Though scientific concepts are functioning in daily life, these are difficult and complex in nature. In learning these concepts, students' attitude and interests could play a substantial role among pupils studying science (Normah and Salleh, 2006). Students can succeed in science subject if they have positive attitude towards science (Erdemir, 2009). In science education, the affective outcomes of instruction are as important as the cognitive outcomes. The affective domain is characterized by a variety of constructs, such as attitudes, preferences, and interests. But negative attitude toward a given subject leads to a lack of interest and avoidance of the subject (Nurulazam, Rohandi, and Jusoh, 2010).

According to Salta and Tzougraki (2004), attitude is a tendency to think, feel, and act positively or negatively toward objects in our environment. Attitude organizes thoughts, emotions and behaviours towards a psychological object. Some attitudes are based on people's own experiences, knowledge and skills, and some are gained from other sources (Erdemir, 2009). Other study reveals that attitudes are learned, not inherited (Craker, 2006). The attitudes toward science change with exposure to science, but that the direction of change may be related to the quality of that exposure, the learning environment, and teaching method (Craker, 2006). It can be said that a negative attitude towards a certain subject makes learning or future-learning difficult. As conceived by Nurulazam, Rohandi, and Jusoh, (2010), a positive attitude toward science results to a positive commitment to science that influences students' lifelong interest and learning in science.

Almost all researchers agreed that for science education, one of the critical problems is the negative attitude towards science (Kresse, 2010; Ogundiwin, 2013; Anne, 2013; Fasasi, 2014). So to overcome this problem, study of attitude towards science and science learning should be conducted. The importance and role of attitude towards science can be recognized from the researches' findings showing positive relationship of attitude towards science and achievement, and students with more positive attitude towards science has sustainable learning, and also want to continue with those subjects they enjoy (Pell and Jarvis, 2001).

These researchers provided revealing insight regarding attitude towards science and most of them have reported positive attitude of students towards science (Osborne, Simon and Collins, 2003). Acquiring positive attitudes especially towards science is possible with student-centered education (Dede, 2006). In this regard, detection of students' attitudes can have a contribution to making interests and curiosity lively and increasing the success of students. Studies have revealed that teaching methods influence students' attitudes towards science (Adesoji, 2008; Gok and Sılay, 2008; Erdemir, 2009). On the other hand, attitudes, whether positive or negative, affect learning in science (Nurulazam et al (2010). Since teaching methods in science education influences attitudes and also predict achievement (Siegel and Ranney, 2003; Erdemir, 2009), a positive attitude toward science can be developed through hands-on activities and other methods of instruction that excite students and encourage them to learn like Crossword-Picture Puzzle and Enhanced Explicit Teaching strategies. Since there are contradictory findings on attitude, the present study therefore, considers attitude as an important variable to be examined. There are still other factors that could probably influence students' achievement. One of such factors is gender.

Various definitions of gender exist from the field of research. Ochnogor (2006) defines gender as the societal roles that are usually assigned to males, but not the biological characters in person. Gender roles still permeate virtually every society especially Nigeria. This is noticed when boys are expected to follow their fathers to the farm, cultivate lands and other farm operations that seem difficult, while girls are expected to stay with their mothers at home to be engaged in all sorts of domestic activities such as washing, cooking, grinding, sweeping, carrying and playing with newly born baby in the family. Supporting this view, Oludipe (2012) points out that tasks that are considered as complex and difficult are especially reserved for boys, while girls are assigned the relatively easy and less demanding tasks. A reflection of this is observed in career choice for boys and girls. Boys tend to choose professions that have been traditionally regarded as men's (medicine, engineering, architecture) and others as women's such as nursing, catering, typing and arts (Oludipe, 2012). Females tend to avoid engineering and technical courses where applied mathematics, tools, machinery and electrical equipment are in daily use (Ochnogor, 2006). Literature reveals that:

i) Girls tend to lose interest in science during the secondary school period;

ii) Relatively fewer girls enroll in elective and advanced tertiary level Science and Mathematics courses to prepare for university

iii) Relatively fewer girls enter under-graduate studies in science disciplines, particularly in physical sciences, computer science and engineering;

iv) Disproportionately few of the young women who graduate in science disciplines continue to attain graduate degrees in physical sciences, computer and engineering (Ochnogor, 2006).

Okeke (2008) defines gender as the socially/culturally constructed characteristics and roles which are ascribed to males and females in any society. Males are considered to exhibit attributes as bold, aggressive, logical reasoning, intelligent, self-confident, dominating/assertive, tactful, economical use of words, while females are considered to have the opposite attributes as fearful, timid, gentle, illogical reasoning, dull, passive, submissive, tactless and talkative (Okeke , 2008) . Thus, parents may transfer their societal perception of gender in dealing with their children including choice of career/profession of their children.

Mixed reports abound from fields of research on gender as it affects students' learning outcomes. Some researchers report a decline in gender differences in science achievement (O'Connor, 2000; Martin, Mullis, Gonzales, Gregory, Smith, Chrostowski, 2004; Afuwape and Oludipe, 2008; Yuwen, 2008). Others find significant main effect of gender on subjects' learning outcomes in science. Aguele and Agwugah (2007); Becker (2006); Kolawole (2007); Olaniyi (2009); Ugwungwu (2002) and Ugwungwu (2006) find in their studies that male students achieved significantly better than female students in science subjects, while in the studies carried out by Raimi (2002) and Soltani and Nasrl(2010), girls performed better than boys in science subjects. Findings by Akpinar, Yildiz, Tatar, and Ergin (2009); Ajitoni (2004) and Bolorunduro (2005) reveal that there are significant differences between female and male students in terms of attitude in favour of female. Research reports from different dimension, Afuwape (2002), Raimi and Adeoye (2002), Ajila(2003), Oduwaiye(2009), Aremu and Sangodoyin (2010) and Dimitrov(2010) find no significant difference in students' achievement in science.. Since the reports from various studies on gender are inconsistent, gender as a variable attracted further investigation in this study.

Deary (1998) observes that on tests of general ability, men and women tend to come out at about the same scores. Tests of general mental ability measure various constructs including overall cognitive ability. There are:

A) Longer tests: Typically measure the following dimensions:

- General knowledge: The degree to which an individual has accumulated knowledge about diverse topics.
- Social Intelligence: Ability to evaluate social behaviour and likely outcomes, to apply standards for moral and ethical judgement in both verbal and visual forms.

- Arithmetic: Ability to reason numerically and to engage in problem-solving.
- Verbal concepts: Ability to categorise, conceptualise likenesses and differences, and to make subtle comparisons.
- Vocabulary: Extent of verbal concepts learned. This indicates communication skills, openness to information, ability to effectively use information.
- Coding : Adaptability and speed of learning
- Detail orientation: Ability to pick up on important details, using perceptual and analytical skills.
- Spatial rotation: Ability to visualise objects in different dimensions and perspectives.
- Spatial reasoning: Ability to see both the disparate parts of an object and how they fit.

B) Shorter tests

Shorter test incorporates a wide variety of problem types including conceptual comparisons, word and sentence meanings, deductive logic, sequential reasoning, detail matching, analysis of geometric figures, and story problems requiring mathematical solutions. Higher scoring individuals will perform better in a formal setting and are more likely to effectively learn. In contrast, lower scoring individuals will require more detailed and explicit instruction, hands on practice, more time and repetition, and close supervision.

Studies revealed the effect of mental ability on students' learning outcomes. Aremu and Tella (2009) report non-significant effect of mental ability on achievement. Mental ability as a construct has been found to have significant effect on learning outcomes (Raimi and Adeoye, 2002; Aremu and Sangodoyin (2010). There are differences in performance levels of students as a result of varying ability levels (Aremu and Sangodoyin, 2010). Students with higher mental ability tend to achieve highly in academic settings (Sophie, Benedikt, Chamorro-Premuzic and Tomas, 2011). Students with low mental ability tend to have low level of motivation towards learning and their attitude towards learning may be negative (Aremu and Sangodoyin, 2010). According to these researchers, methods and materials used for instruction play an active role in motivating students with low mental ability. This supports Ajiboye's and Ajitoni's (2008) study that learners with different academic ability respond differently depending on the types of methods and materials used.

It then implies that if students with low mental ability are exposed to right method of instruction and appropriate materials, their motivation to learn is likely to increase and this can invariably have a positive effect on their attitude and performance level as students with high mental ability also learn with ease. Learners have varying degree of mental abilities. By implication, learners being categorized as having high, moderate and low mental ability levels respond differently when subjected to certain learning conditions. In the study conducted by Calero, Garcia-Martin, Belen, and Robles (2011), findings reveal that children with high ability (IQ) have a greater potential for learning than children of normal intelligence. Since mental ability is an important construct that may determine the performance of students coupled with controversial research reports on this same variable, mental ability is germane to this study.

1.2. Statement of the Problem

Basic Science is a core subject in Junior Secondary School Curriculum which has the potential of laying the foundation for subjects like Physics, Chemistry and Biology at the later stage of education. As important as the subject is, reports from examination bodies have shown that students record low achievement and problem solving skills in the subject. This has been attributed to the use of Conventional Lecture Method which concentrates on talking about problems rather than solving problems. Scholars have thus recommended the use of instructional strategies that could help students learn collaboratively, engage in thought-provoking activities and acquire problem solving skills. Two of such strategies are Crossword-Picture Puzzle and Enhanced Explicit Teaching strategies. These two strategies have been proved in literature to be effective in teaching Basic Science and Technology at primary school level, Biology and Integrated Science mostly in Northern Nigeria. However, there is paucity of research on their effects on students' learning outcomes in Basic Science especially in Southwestern Nigeria. Therefore, this study determined the effects of Crossword-Picture Puzzle and Enhanced Explicit Teaching on students' achievement in and attitude to Basic Science in Southwestern Nigeria. It also determined the moderating effects of gender and mental ability on students' learning outcomes in Basic Science.

1.3. Hypotheses

The following hypotheses were tested at 0.05 alpha level.

HO1: There is no significant main effect of treatment on Students':

(a) Achievement in Basic Science

(b) Attitude to Basic Science

Ho2: There is no significant main effect of Gender on Students':

(a) Achievement in Basic Science

(b) Attitude to Basic Science

Ho3: There is no significant main effect of Mental Ability on Students':

(a) Achievement in Basic Science

(b) Attitude to Basic Science

Ho4: There is no significant interaction effect of treatment and Gender on Students':

(a) Achievement in Basic Science

(b) Attitude to Basic Science

Ho5: There is no significant interaction effect of treatment and Mental Ability on Students':

(a) Achievement in Basic Science

(b) Attitude to Basic Science

Ho6: There is no significant Interaction effect of Gender and Mental Ability on Students':

(a) Achievement in Basic Science

(b) Attitude to Basic Science

Ho7: There is no significant interaction effect of treatment, Gender and Mental Ability on Students':

(a) Achievement in Basic Science

(b) Attitude to Basic Science

1.4. Significance of the Study

The findings of this study would supply the practical empirical basis for assessing the effect of crossword-picture puzzle and enhanced explicit teaching strategies on students' achievement in and attitude to Basic Science at Junior Secondary School level in Nigeria. Consequent on this, the study would form empirical evidence for subsequent studies in Basic Science and other science related disciplines. The study would also supply the empirical basis for evaluating the effect of gender and mental ability on students' achievement in and attitude to Basic Science.

In addition, the study would expose teachers to innovations in their profession, take cognizance of changes in methodology for the effective performance of their duty and provide teachers with the intellectual and professional background adequate for their assignment. It would also create awareness in teachers, make them adopt and use strategies that promote creativity and inquiry in learners.

The study would also have implications for curriculum developers and education sector in the area of training and retraining of teachers for professional developments, constitute part of the empirical evidence for planning and implementing a more proven technique of learning Basic Science concepts in schools for possible improvement on students' achievement in and attitude to Basic Science, concentrating on the two cognitive and affective domains of learning.

The study would make the teaching and learning of Basic Science fascinating and exciting in schools. The combinations of game and peer interaction components in the strategies used in this study would produce an improved academic achievement in Basic Science and students' motivation to learn.

1.5 Scope of the Study

The study covered nine junior secondary schools in Southwestern Nigeria (Oyo, Ogun and Ondo), that is, three (3) secondary schools from each of the three states. An intact class was used in each school. The teachers of the selected classes (3 teachers per State) were involved in the study. The study involved three hundred and eighty nine (389) JSS 2 students. The study focused on the effects of Crossword-Picture puzzle-based Teaching and Enhanced Explicit Teaching Strategies on students' achievement in and attitude to Basic Science. The study was delimited to the effect of gender and mental ability on JSS 2 students' achievement in and attitude to Basic Science. Only public junior secondary schools in Oyo, Ogun and Ondo (Southwestern Nigeria) were involved in the study.

The content for the study is from six Basic Science topics. These topics are:

(i) Drug Abuse
(ii) Habitat
(iii) Respiration
(iv) changes in matter
(v) Information and Communication Technology
(vi) You and Energy (Heat Energy)

1.6. Operational Definition of terms

Achievement in Basic Science: This refers to the scores obtained from pretest and posttest administration of Basic Science Students' Achievement Test.

Attitude to Basic Science: Individual way of acting, behaving and feeling about Basic Science. It is also the scores obtained from administration of Basic Science Students' Attitude Scale.

Conventional Lecture Method (CLM): This is the normal method of teaching used by teachers in schools. This is modified by presenting general instructional steps in this study.

Crossword-Picture Puzzle Based Teaching Strategy (CPP): This is a teaching strategy that combines the use of crossword puzzle (Fill-In crossword) and picture puzzle (spot-the-changes) to bring about learning.

Enhanced Explicit Teaching (EET) Strategy: This refers to the combination of peer tutoring and explicit teaching. It is designed to facilitate meaningful learning among learners of diverse learning abilities. It involves the giving of clear instruction, demonstration, explanation, practice and corrective feedback for each new step in learning through the teacher and peer-teacher.

Gender: This is categorized at two levels-Male/Female

Learning Outcomes: These refer to the scores obtained from the achievement test and attitude to Basic Science.

Mental Ability: It is defined at three levels- high, moderate and low. It is also the scores obtained from the Mental Ability Test (Australian Council for Educational Research Test, ACER).

Peer-Teacher: It is the student acting in the capacity of a teacher

Peer Tutoring: This refers to the process whereby the more capable students help those with difficulties in mastering learning tasks.

Puzzle: It is a problem to make the user think and usually tests the ingenuity of the solver.

Teacher: This is the instructor in charge of the whole class.

CHAPTER TWO

LITERATURE REVIEW

The outline of the literature reviewed is organised under three main headings namely theoretical, conceptual and empirical.

2.1 Theoretical Framework

2.1.1 Zig Engelmann's Theory of Direct Instruction

2.1.2 Vygotsky theory on Peer Collaboration

2.1.3 Constructivist theory on Knowledge Construction

2.1.4 Scruggs, Mastropieri and Berkeley Peer Tutoring Model

2.2 Conceptual Framework

2.2.1 9-Year Basic Education Curriculum: Implication for Basic Science Teaching And Learning

2.2.2 Students' Achievement in Science

2.2.3 Students' Attitude to Science

2.2.4 Puzzle-Based Learning

2.2.4.1 Crossword Puzzle

2.2.4.2 Picture Puzzle

2.2.5 Explicit Teaching

2.2.5.1 Enhanced Explicit Teaching

2.2.6 Peer Tutoring

2.3 Empirical Studies on Variables of the Study

2.3.1 Instructional Strategies and Students' Achievement in Basic Science

2.3.2 Instructional Strategies and Students' Attitude to Basic Science

2.3.3 Crossword-Picture Puzzle-Based Teaching Strategy and Students' Achievement

2.3.4 Crossword-Picture Puzzle-Based Teaching Strategy and Students' Attitude

2.3.5 Enhanced Explicit Teaching Strategy and Students' Achievement

2.3.6 Enhanced Explicit Teaching Strategy and Students' Attitude

2.3.7 Conventional Lecture Method and Students' Achievement and Attitude

2.3.8 Gender and Students' Learning Outcomes

2.3.9 Mental Ability and Students' Learning Outcomes

2.4 Appraisal of the Literature Review

Theoretical Framework:

2.1.1 Zig Engelmann's Theory of Direct Instruction

This study is based on Zig Engelmann's theory of instruction (Engelmann, 2009). The theory holds teacher directing and following a definite structure with specific steps to guide pupils toward achieving clearly defined learning outcomes. The teacher maintains control over the instructional process and monitors students' learning throughout the process. The proponent of this theory discusses six stages involved in the instructional process:

Introduction/Review

The first step ensures that the teacher uses his expertise to gain pupils' attention. Sometimes this step is referred to as 'focusing event' and the purpose is to set the stage for learning to take place by informing the learners about the goals for the learning, its relevance or importance. This step can either take the form of introducing new information or building upon what has been previously learned or covered as a review.

Development

Once the goal is communicated to pupils, the teacher models the behaviour (knowledge or skill) that pupils are ultimately expected to demonstrate. This step includes clear explanations of any information with as many examples as needed to assure pupils' understanding (depending on pupils' learning needs) of what is to be learned. During this step, the teacher also "checks for understanding" by asking key questions relative to what is to be learned or by eliciting questions from pupils. At this stage, teachers can also use 'prompts' (visual aids, multimedia presentations, etc.) to encourage pupils to process information successfully.

Guided Practice

Once the teacher is confident that enough appropriate examples and explanation of the material to be learned has been modeled with sufficient positive pupil response to the instruction, activities or tasks can be assigned for pupils to practice the expected learning with close teacher monitoring. It is at this stage that teachers can offer assistance to pupils who have not yet mastered the material, and who may need more 'direct instruction' from the teacher.

Closure

Closure brings the whole lesson to a 'conclusion' and allows the teacher to recap what was covered in the lesson. It is meant to remind pupils the goal for instruction and prepare them to complete the independent practice activities that are then assigned by the teacher.

Independent Practice

Activities or tasks related to the defined learning outcomes are assigned in this step usually after pupils have demonstrated competency or proficiency in the third step. Independent practice is meant to eliminate any prompts from the teacher and is meant to determine the degree of mastery that pupils have achieved. Homework can be classified as an independent practice because it is meant to provide the opportunity for pupils to practice without the assistance or help from the classroom teacher.

Evaluation

Evaluation tools are used to assess pupils' progress either as it is occurring (e.g. classroom assignments) or as a culminating event (tests, projects, etc.) to any given lesson. Evaluation of pupils' learning provides the necessary feedback to both the teacher and the pupil and can be used to determine whether expected learning outcomes have been met or have to be revisited in future lessons.

The theory is relevant to the study in that in explicit teaching, teacher sets the stage for learning by telling the students the purpose for learning, explaining to students what to do, modelling the process of how to do it, and guiding the students with hands-on-application/practice. The six stages are found relevant to the study:

1. Introduction/Review: Topics or information to be learned is presented to the pupils or review of information sets the stage for learning.

2. Development: The teacher provides clear explanations, descriptions, examples, or models of what is to be learned, while checking for pupils' understanding through questioning.

3. Guided Practice

Opportunities are provided to the pupils to practice what is expected to be learned while the teacher monitors the activities or tasks assigned.

4. Closure

Teachers concludes the lesson by wrapping up what has been covered.

5. Independent Practice

Assignments are given to reinforce learning without teacher assistance.

6. Evaluation

Assessment of pupil progress was conducted to determine levels of mastery.

2.1.2 Vygotsky Theory on Peer Collaboration

Vygotsky theory (Vygotsky, 1978) also provides a framework for this study. The theory holds that a child's cognitive development is a product of his social interaction. This development occurs twice: first, on the social level, that is, between people (interpsychological) and later, on the individual level, that is, inside the child (intrapsychological). All the higher functions originate as actual relationships between individuals. Next, he points at the idea that the potential for cognitive development is limited to a certain time span, which he names the "zone of proximal development" (ZPD). This refers to the difference between what a learner can do without help which is their level of actual development, and what he/she can do with help which is their level of potential development. In addition, full development during ZPD depends upon full social interaction. The range of skill that can be developed with adult guidance or peer collaboration exceeds what can be attained alone.

Other people play important roles in helping children to learn. These other people Vygotsky refers to as ‘More Knowledgeable Other’ (MKO) with a distinctive ability. According to him, much important learning by the child occurs through social interaction with a tutor. The tutor may model behaviours and/or provide verbal instructions for the child. He referred to this as co-operative or collaborative dialogue. The child seeks to understand the actions or instructions provided by the tutor (often the parent, teacher or peer) then internalize the information, using it to guide or regulate their own performance. Vygotsky suggested that intelligence could better be measured by what a child can do with skilled help.

For children to learn meaningfully among their peers, they are not left alone to pick up activities of their choice. Allowing them to pick up any activity can be injurious or destructive. They need somebody to guide, instruct (an instructor) and facilitate (a facilitator) meaningful activity. This instructor or facilitator is what Vygotsky referred to as ‘More Knowledgeable Other’ (MKO). MKO refers to someone with a better understanding or a higher ability level than the learner, with respect to a particular task, process, or concept. With the help of the instructor (teacher) or child’s peer (teacher), learners can carry out tasks that they are incapable of completing on their own.

Vygotsky also identifies a zone called ‘Zone of Proximal Development’ (ZPD). Here, in this present study, students were given certain activities to carry out during tutoring session in order to operate within their level of actual development. The study allowed the teacher to present a brief review of the learning task, put students in peer groups with a more capable learner helping others in the group. As the child followed the example of other (teacher, child’s peer), he/she gradually develops the ability to do certain tasks without help or assistance. The study among other things provides the learners with experiences which are in their zone of proximal development, thereby encouraging and advancing their individual learning. The study involves activities that encompass not only what children are capable of doing on their own, but also what they could learn with the help of others. Anything can not just be taught to any child, only instructions and activities that fall within the zone promote development.

From Vygotsky, the following steps make the theory applicable to the study:

Step 1: Developing instruction in small steps

Step 2: Assisted performance/Feedback

Step 3: Provision of adequate tools for group (peer) learning

Step 4: Internalization

Step 5: Actualization

Step 6: Independent Practice

2.1.3 Constructivist Theory on Knowledge Construction

Another theory that formed the framework for this study is the constructivist theory. The theory emphasizes that knowledge is constructed through the process of adapting to the events and ideas a child experiences, and that the construction of knowledge is significantly influenced by the child's environment, symbols and materials available. These symbols and materials become the tools to think with, and they affect how the child perceives, interprets and functions in his/her environment. This theory sees puzzle activity as the child's engagement in his own development. Materials (pictures, puzzle, and laboratory apparatus) constructed or made available by the instructor promote the thinking process and make learners active. As learners are effectively engaged, they are able to discover hidden knowledge and skills, making them scientifically literate. The instructor or child's peer and the learners engage in active learning environment (Bruner, 1973). The practical activities, that is, picture puzzles, crossword puzzles and class activities/experiments provide learners with meaningful experience through the manipulation of materials in such a manner that leads to discoveries. The theory is also relevant in that it provides learners with a lot of opportunities to explore for themselves under the guidance and instruction of teacher or child peer.

Six steps could be used to connect this theory with the work:

Step 1: Introduction/Construction (constructing systems of meaning)

Step 2: Developing instruction (in small steps)

Step 3: Grouping (for peer learning)

Step 4: Reflective Activity (using motor and logic skills; hands-on-mind-on)

Step 5: Guided practice (Engagement in guided activities using learning materials for knowledge construction) through active process/independent thinking

Step 6: Checking for understanding/Feedback

2.1.4 Scruggs et al (2010) Peer Tutoring Model

Scruggs, Mastropieri and Berkeley (2010) designed a peer tutoring model which combines explicit teaching with peer tutoring. This model has six components:

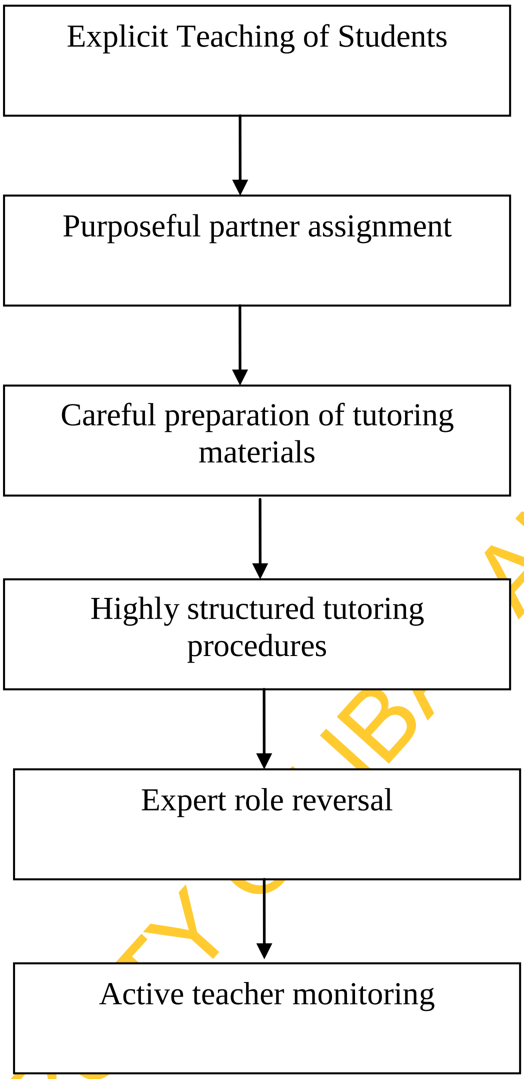

Figure 2: Model for Development and Application of Enhanced Explicit Teaching

Source: Scruggs, Mastropieri and Berkeley (2010)

Explicit Teaching of Students

Explicit teaching of students in how to be tutoring experts can include:

- Modeling examples and non-examples of appropriate tutoring interactions.
- Posting tutoring guidelines as reminders for students
- Giving feedback on how well students are meeting expectations for tutoring
- Re-teaching procedures as necessary.

Partner Assignment

Partner assignment can be based on:

- Student academic skill
- Tutoring activity content
- Interpersonal relationships between students

Preparing Tutoring Materials

Preparing tutoring materials carefully is necessary to:

- Ensure success in the tutoring experience and may include differentiation of materials.

Highly Structured Tutoring Procedures

- Materials typically include highly structured tutoring procedures that indicate how tutors can determine if a response is correct and to respond to both correct and incorrect responses.
- Finally, teachers actively monitor peer tutoring and may give feedback to students both on content and procedures.

2.2 Conceptual Framework

2.2.1 9-Year Basic Education Curriculum: Implication for Basic Science Teaching And Learning

The 9-Year Basic Education Curriculum is divided into basic levels: Lower Basic Level- Primaries 1-3, Middle Basic Level- Primaries 4-6 and Upper Basic Level- JSS 1-3. The 9-Year Basic Education Curriculum was a product of a meeting of experts held between January and March 2006 an array of workshops organized by Nigerian Educational Research and Development Council, NERDC (NERDC, 2007). This curriculum was expected to ensure continuity and flow of themes, topics and experiences from primary school to junior secondary school levels. The above new curriculum structure was approved by the National Council on Education (NCE) based on the following reasons: (i) The decision of the Federal Government to introduce the 9-Year Basic Education Programme (ii) The need to attain the Millennium Development Goals (MDGs) by 2015 (iii) The need to implement the National Economic and Empowerment. Development Strategies (NEEDS) summarised as: Value reorientation, Poverty eradication, Job creation, Wealth generation and using education to empower the people. It then became necessary that the former curricula for both primary and junior secondary schools be reviewed, re-structured and re-aligned to fit into a 9-Year Basic Education Programme. The new curriculum reflects depth, appropriateness, and inter-relatedness of the curricula contents. Not only these, but emerging issues which covered value reorientation, family life, HIV/AIDS education, entrepreneurial skills were also infused into the curriculum.

The 9-Year Basic Education Programme gave rise to Basic Science (formerly referred to as Integrated Science). In selecting the contents of this Basic Science curriculum, globalization, Information/communication technology and entrepreneurship education, identified as fundamental issues shaping the development of nations worldwide and influencing the world of knowledge, were considered for the approval of four curriculum innovations (Adeniyi, 2007). These are: Environmental Education, Drug Abuse Education, Population and Family Life Education, Sexually Transmitted Infection (STI, HIV/AIDS). The overall objectives of this curriculum centre on the learners. These objectives are: (i) development of interest in science and technology (ii) acquisition of basic knowledge and skills (iii) application of scientific and technological knowledge and skills to meet societal needs (iv) taking advantage of the numerous career opportunities offered by science and technology and (v) becoming prepared for further studies in science and technology.

Basic Science is a subject integrating science subjects into a single course in which the concepts of science are presented through a unified approach (Adesoji, 2002). Hence, through Basic Science, various scientific concepts from different science disciplines are viewed as just 'one body of knowledge' which enhances holistic understanding of the world of science by the learners and not science in isolations. Adesoji (2002) stated that "science is integrated when the course is presented in such a way that learners: (i) gain the concepts of the fundamental unity of science (ii) gain the commonality of approach to problems of a scientific nature and (iii) are helped to gain an understanding of the role and function of science in everyday life and the world in which they live."

To achieve a holistic presentation of science and technology contents to learners, four themes were used to cover cognitive (knowledge), psychomotor (skills) and affective (attitudinal) domains of learning. For primary Basic Science and Technology, the themes are: You and Environment, Living and Non-Living Things, You and Technology, You and Energy. At the Upper Basic Level (JSS 1-3), theme '3' You and Technology was changed to "Science and Development" (NERDC, 2007), to allow Basic Technology to run as an independent subject. Hence, Basic Science themes at this level are: You and Environment, Living and Non-Living Things, Science and Development, You and Energy. The spiral nature of these themes makes sure that contents become gradually difficult as learners progress from primary level (1-3, 4-6) to junior secondary level (1-3) (NTI, 2010). To facilitate students' understanding of science content, Martins and Oyebanji (2000) recommended three types of interactions which are: (i) students-students (ii) students-materials and (iii) students-teachers.

Therefore, there should be collaborative efforts among students, materials and teachers in order to enhance science teaching and learning. The science teaching and learning should generate in the learners, specific skills as identified by Shaibu and Usman (2002): (i) active involvement in the learning process (ii) ability to learn with some degree of independent (iii) recall of information for use within relevant contexts (iv) developing cognitive schemes for solving problems (v) using and classifying information (vi) interpreting data (vii) communicating results/findings effectively.

To build scientific skills in learners, there will be the need to have: Professional (specialists) teachers of Basic Science, adequate materials for science lessons and practical, effective teaching strategies, teachers' training and development, and adequate understanding of scientific concepts.

2.2.2 Students' Achievement in Science

David McClelland's Achievement Theory (McClelland, 2002-2010) emphasizes that individual with a high need for achievement seeks to excel and thus tend to avoid both low-risk and high-risk situations. Achievers avoid low-risk situations because the easily attained success is not a genuine achievement. In high-risk projects, achievers see the outcome as a chance rather than one's own effort. Achievers need regular feedback in order to monitor the progress of their achievements. They prefer either to work alone or with other high achievers. Considering this from classroom situation, learners achieve differently. There are higher achievers, middle achievers and low achievers. High achievers should be given challenging projects with reachable goals.

The proponent of this theory identifies the need for achievement as the individual's desire for significant accomplishment, mastering of skills, control, or high standards associated with a range of actions. These include: intense, prolonged and repeated efforts to accomplish something difficult, to work with singleness of purpose towards a high and distant goal and to have the determination to win. This need is influenced by internal drive for action (intrinsic motivation), and the pressure exerted by the expectations of others (extrinsic motivation). The need for achievement motivates an individual to succeed in competition, and to excel in activities important to him or her. There are individuals with low need for achievement and may choose very easy tasks, in order to minimise risk of failure, or highly difficult tasks, such that a failure would not be embarrassing. Those with high need of achievement tend to choose moderately difficult tasks, feeling that they are challenging, but within reach.

McClelland identifies sources of high need achievers. These are:

i) Parents who encouraged independence in childhood (background training)
ii) Praise and rewards for success (reinforcement)
iii) Association of achievement with positive feelings (favourable attitude)

iv) Association of achievement with one's own competence and effort, not luck (independence)
v) A desire to be effective or challenged (courage)
vi) Intrapersonal Strength
vii) Desirability
viii) Feasibility
ix) Goal Setting Abilities

Reports from examination bodies reveal low achievements of students in science (Okpala, 2010; Federal Ministry of Education, Research Statistics and Planning Section, 2013). Since students' achievement is still declining, researchers continue in their research efforts to find solution to this disheartening experience.

Martins and Oyebanji (2000) investigated effects of inquiry and lecture methods on the cognitive achievement of Integrated Science students. One hundred and sixty seven (167) JSS II students were involved in the study. The finding revealed that students who were taught using inquiry performed significantly better than those taught using lecture method.

Shaibu and Usman (2002) carried out a study on effects of NISTEP mode of teaching on students' academic achievement in Integrated Science among junior secondary school students. The sample comprised one hundred (100) JSS III students. The result of the study showed that students exposed to NISTEP instructional strategy performed significantly better than those exposed to the conventional lecture method.

Ige and Arowolo (2003) worked on effects of hypothetico-deductive strategy on JSS III students' achievement in Integrated Science. The study was conducted among seventy three (73) JSS3 Integrated Science students. The finding revealed that the hypothtico-deductive approach group performed better than the lecture method group.

In a study conducted by Oyediran, Agoro and Fabiyi (2004) on a multi-media approach to the teaching of some difficult topics in Integrated Science, sixty (60) Junior Secondary III students participated in the study. The result showed that multi-media group performed better than the control group (lecture method group).

Duru and Okereke (2010) investigated effect of multiple intelligence teaching strategies on students' achievement in Integrated Science. The sample consisted of two thousand, seven hundred and eighteen (2718) JSS 2 students and twenty seven (27) Integrated Science teachers. The result showed that multiple intelligence teaching strategies enhanced students' achievements in Integrated Science.

A study carried out by Ajila (2003) revealed the effectiveness of Explicit Teaching strategy in helping learners to achieve maximally in Integrated Science lessons. Further researches on what enhance the overall students' learning outcomes in science is still the concern of this present study in terms of instructional strategies (crossword-picture puzzle and enhanced explicit teaching (explicit teaching + peer tutoring) strategies.

2.2.3 Students' Attitude to Science

There is widespread interest of educational researchers on students' attitude in improving the level of performance in science in schools. Probably, researches into students' attitude can serve as a catalyst for reform in science education. Attitude is defined as the individual (learner) way of thinking, behaving and feeling about a thing. Quality attitude is of utmost importance (Marlow, 2002). There are two sides to this view- teachers' attitude and learners' attitude. The attitude of a teacher has a potential influence on the attitude of the learners. The positive attitude of the teachers and learners are very important. Teacher is at the centre of learners' attitude formation (Yoloye, 2001). Teacher can pave way for learners to develop either positive or negative attitude towards his subject being taught. Teacher can develop negative attitude in the learners in the following ways:

- putting on cruel outlook,
- making himself a "teaching soldier",
- using punishment always as the only means of correcting students' wrong/bad behaviour,
- not always excited and enthusiastic,
- fond of using mannerism,
- using slang and derogatory words,
- always being pessimistic about learners' achievement,
- measuring academic victimization on students due to sexual (immoral) feelings and
- teachers' inability or reluctance to accept corrections from learners and
- using inappropriate methodology

Kresse (2010) is of the view that when students have positive attitudes about science, they will be more open to exploring and gaining knowledge in these areas. This researcher further posited that using effective strategies for improving students' attitudes in science is important because science is an exciting, fascinating and useful subject. Establishing positive attitudes toward science is therefore important to the educational community as a whole. Attitude is closely correlated with achievement (Sorge, 2007). Attitude can affect achievement (Ajitoni, 2004). Report from literature reveals students' negative attitude to science (Aremu and Sangodoyin, 2010), which affects students' learning in the negative way and this could be attributed to the way science is taught (Kresse, 2010) or may be because of the misconception that science is a difficult subject. However, positive attitude is necessary for the acquisition of scientific knowledge and skills.

Achieving objectives of science education completely and fully have never been possible in any country and so is the situation in Nigeria. Describing the situation, Mattern and Schau (2002) stated that “In developed countries, it has been determined that goals of science are never fully realized, that students do not like science lectures and that most have no preference for science”. Although some scientific concepts are perceived difficult (Njoku, 2005), however, to learn these concepts, attitude and interests could play a substantial role among students studying science (Normah and Salleh, 2006). Success in science subject could be attained if students have favourable attitude towards science (Erdemir, 2009). In science education, “The affective outcomes of instruction are as important as the cognitive outcomes. The affective domain is characterized by a variety of constructs, such as attitudes, preferences, and interests. But negative attitude toward a given subject leads to a lack of interest and avoidance of the subject” (Nurulazam, Rohandi and Jusoh, 2010). It means, a positive attitude toward science will lead to a positive commitment to science that will affect students’ lifelong interest and learning in science (Mushtaq, Zubair, Zafar and Muhammad, 2010)

According to Salta and Tzougraki (2004), “Attitude is a tendency to think, feel, and act positively or negatively toward objects in our environment”. Attitude organizes thoughts, emotions and behaviours towards a psychological object (Mushtaq, Zubair, Zafar and Muhammad, 2010). Some attitudes are based on people’s own experiences, knowledge and skills, and some are gained from other sources (Erdemir, 2009). It can be concluded in the words of Craker (2006) that attitudes are learned, not inherited.

The attitudes toward science change with exposure to science, but that the direction of change may be related to the quality of that exposure, the learning environment, and teaching method (Craker, 2006). It can be said that a negative attitude towards science makes science learning difficult.

As conceived by Nurulazam, Rohandi, and Jusoh (2010), “A positive attitude toward science leads to a positive commitment to science that influences students’ lifelong interest and learning in science”. But once the attitudes are formed they are long lasting and difficult to change (Ajzen and Fishbein, 1980). Almost all researchers agreed that for science education, one of the critical problems is the negative attitude towards science (Ramsden, 1998). So to overcome this problem, study of attitude towards science and science learning should be conducted. The importance and role of attitude towards science can be recognized from the findings showing positive relationship of attitude towards science and achievement, and students with more positive attitude towards science has sustainable learning, and also want to continue with those subjects they enjoy (Pell and Jarvis, 2001). Researchers provided revealing insight regarding attitude towards science and most of them have reported positive attitude of students towards science (Osborne, Simon and Collins, 2003). Acquiring attitudes especially towards science is possible with student-centered education (Dede, 2006). In this regard, detection of students' attitudes can have a contribution to make interests and curiosity lively and increase the success of students. Studies have revealed that teaching methods have influence on students' attitudes towards science (Adesoji, 2008; Gok and Sılay, 2008; Erdemir, 2009). On the other hand, attitudes, whether positive or negative, affect learning in science (Mushtaq et al, 2010). Teaching methods in science education influence attitudes and also predict achievement (Siegel and Ranney, 2003; Erdemir, 2009). However, a positive attitude toward science can be developed through methods of instruction that excite students and encourage them to learn like problem solving teaching strategies.

2.2.4 Puzzle-Based Learning

Game-based teaching is the teaching strategy of using games such as puzzles while teaching a subject. It means that the games that are used for this purpose have been designed with the idea of achieving learning outcomes. Some potential benefits of using Game-Based Learning are outlined:

i) Get students attention. Students easily engage in game activities due to their willingness to play.

ii) Students get a positive experience about learning. The use of games encourages students to keep learning and to erase the idea that learning is boring.

iii) Rememorize concepts or facts. Activities such as solving a crossword are activities more engaging than a regular test. They encourage students to work in teams to achieve the goal where their knowledge is the clue to succeed.

iv) Reinforce and consolidate knowledge in a friendly environment. The most effective way to turn content in something meaningful is to find out where and when to use it. With games, students can reinforce and consolidate their knowledge through practicing and getting reward for their achievements.

v) Understand the consequences of students' choices. Using games enables students to understand the consequences of their choices. In other words, students learn through experiences, through trial and error. Games offer a safety environment to test and learn through mistakes so the information becomes meaningful when students understand its use.

Game and picture appeal so much to children that they like to be engaged with them. These concepts (game-crossword puzzle and picture puzzle) in conjunction with science process skills (observing, recording, inferring, etc), that is, inquiry method, have been found effective in the teaching and learning of Basic Science. Concerted effort to make social science lessons and social science related activities and concepts interesting and participatory has always being the major focus of educational research (Ajiboye and Ajitoni, 2008). Interest prepares learners' mind for science learning. But unfortunately, interest of students in science tasks is disappearing and almost graduating into extinction. This reason may be the way science is taught. One of the possible ways to make science teaching and learning effective is the use of game (crossword puzzle and picture puzzle).

Children have some background experiences that can easily be incorporated into classroom situation. These children have been using toys to play game which have scientific implications.

Table 2: Varieties of Toys Used by Nigerian Children to Play Game

S/N	Item	Related concept
1.	Catapult (*ofa)	Gravity, projectile and translational motion
2.	Mammalian Trap	Elastics and strings
3.	One string toy "guitar"	Sound-vibration curves and shapes
4.	Spinning snail shell (*okoto)	Motion, circular motion
5.	Kite (paper)	Air and motion
6.	Toy Telephone	Air and sound
7.	Spinning bottle top (*kanna-kanna)	Energy (motion changed to sound). Motion to and from straight line. Motion converted to 35otator motion as in the working car engine.
8.	Paper drum and stick	Sound
9.	Music box (*Agidigbo)	Sound
10.	Air gun	Air motion and translational motion
11.	Pawpaw stick toy gun (*Ibon)	Elastic, springs, gravity, motion accuracy and precision
12.	Bow and Arrow (*ofa)	Gravity, motion, shape, curves, muscular energy and parabola
13.	Pawpaw stalk gun	Variation of sound with air column being altered. Also, mechanical to sound energy
14.	*Ayo	Counting and reasoning
15.	Ballon filled with air	Force (Air force pushing up, balloon works like rocket)

(Source: Afuwape, 2002)

Table 2 reveals that learners already have background knowledge of the concept of game. They can have a misconception that if any of these toys for playing game is brought to the school environment, there is tendency for their teachers to punish them. Therefore, using game as instructional strategy will correct such a misconception and harness game as a means of learning science effectively.

Educational games have inherent potential to:

- arouse and sustain interest in learning;
- Excite learners;
- Generate new ideas in learners;
- Teach difficult science concepts;
- Remove fatigue;
- Foster social interaction;
- Recall information easily and
- Generally help learners with low achievement potential.

The qualities of mind that are vital for innovation and creativity and for economic and social progress are disappearing in relation to the learning of science (European Commission (2010) 4903 0f 19 July 2010). These qualities are inventiveness, imagination, intuition, wonderment and curiosity. These qualities are innate in young children but now become stifled. Puzzle is a problem to make the students think and usually tests the ingenuity of the learners who are solving it.

The use of puzzle in science learning is important in making science an interesting enterprise and making the learners to develop favourable inclinations to scientific problems that involve the use of applied mathematics and symbols. Puzzles develop in learners, problem solving skills, reasoning skills, cognitive skills, hand eye coordination, motor skills and better child's self-esteem (Carol, 2009). The use of puzzle in the classroom is not to make science scary, but to create students' keen interest in science. Puzzle increases students' confidence, comprehension, retention and remembrance of learnt concepts. According to Lynda (2010), Puzzles teach: shape, colour, letter and word recognition skills; sensory perception; fine motor skills such as grasping and manipulating objects; hand-eye coordination; spatial reasoning: problem solving/Reasoning skills; principles of deduction; part to whole/whole to part understanding; sorting and classifying; organization skills; self confidence; the value of patience and determination; social skills/cooperative play. Puzzles make the brain sharp and active; produce a great sense of thrill and excitement to students; they have great entertainment value and make students forget their failures in real life; they enhance creative and thinking abilities in students; develop an active and sharp mind in growing children, and develop their thinking power (Rukmani, 2010).

2.2.4.1 Crossword Puzzle

Crosswords take the form of a square or rectangular grid of black and white squares; the aim is to fill the white squares with letters, forming words (or word phrases) reading across and down, by solving clues which yield the words. The black squares (commonly called "blanks") have no letters, and are used to separate words. Squares in which answers begin are numbered, left to right, top to bottom. The clues are then referred to by these numbers. A white cell that is part of two entries (both across and down) is called *checked*, *keyed* or *crossed*. A white cell that is part of only one entry is called *unchecked*, *unkeyed* or *uncrossed*. Crossword puzzle is of different types which are:

Cipher crosswords: A cipher crossword replaces the clues for each entry with clues for each white cell of the grid - an integer from 1 to 26 inclusive is printed in the corner of each. The objective, as any other crossword, is to determine the proper letter for each cell; in a cipher crossword, the 26 numbers serve as a cipher for those letters: cells that share matching numbers are filled with matching letters, and no two numbers stand for the same letter.

Diagramless crosswords: In a diagramless crossword, often called a diagramless for short or, in the United Kingdom, a skeleton crossword or carte blanche, the grid offers overall dimensions, but the locations of most of the clue numbers and shaded squares are unspecified. A solver must deduce not only the answers to individual clues, but how to fit together partially built-up clumps of answers into larger clumps with properly-set shaded squares. A variation is the Blankout puzzle. The clues are not individually numbered, but given in terms of the rows and columns of the grid, which has rectangular symmetry. The list of clues gives hints about the locations of some of the shaded squares even before one starts solving them.

Fill-in crosswords: A fill-in crossword (also known as crusadex or cruzadex) features a grid and the full list of words to be entered in that grid, but does not give explicit clues for where each word goes. The challenge is figuring out how to integrate the list of words together within the grid so that all intersections of words are valid. Fill-in crosswords may often have longer word length than regular crosswords to make the crossword easier to solve. Fitting together several long words is easier than fitting together several short words because there are fewer possibilities for how the long words intersect together.

Crossnumbers: A crossnumber (also known as a cross-figure) is the numerical analogy of a crossword, in which the solutions to the clues are numbers instead of words. Clues are usually arithmetical expressions, but can also be general knowledge clues to which the answer is a number or year. There are also numerical fill-in crosswords.

Acrostic puzzles: An acrostic is a type of word puzzle that typically consists of two parts. The first is a set of lettered clues, each of which has numbered blanks representing the letters of the answer. The second part is a long series of numbered blanks and spaces, representing a quotation or other text, into which the answers for the clues fit. In most forms of the puzzle, the first letters of each correct clue answer, read in order from clue A on down the list, will spell out the author of the quote and the title of the work it is taken from. This can be used as an additional solving aid.

Arroword: The arroword is a variant of a crossword that does not have as many black squares as a true crossword, but has arrows inside the grid, with clues preceding the arrows.

2.2.4.2 Picture Puzzle

Picture appeals so much to children that it could be applied in science classes to effect learning in children. Cardenas-Nelson and Connolly (2011) identified three types of picture puzzle:

Spot-the-changes puzzles: These puzzles consist of two, seemingly identical pictures. However, one of the pictures contains several changes that learners have to find.

Knot puzzles: Instead of just two pictures and several changes, Knot puzzles have several pictures, one of which has just one difference from the others.

Cut-Up puzzles: In these puzzles, learners are given two grids. One grid contains a picture cut into two pieces and scrambled within the grid. The other grid contains just one of the picture pieces, which is correctly placed within the grid as a hint to get learners started. The rest of the grid is empty. Learners have to place the remaining pieces within the grid and complete the picture. Out of these three types, the one that is applied in the training manual in this study is 'Spot-the-changes' puzzle where learners are given two identical pictures. One of the pictures labelled and the other picture not labelled. Learners are allowed to study the labelled picture for some time and later allowed to complete the other one that is not labeled.

Picture puzzles improve the coordination between the eyes and the hands and provide the children with a better understanding of colours and shapes. Self esteem in a child will also increase by solving different picture puzzles. Picture puzzles are beneficial in keeping the mind active using specific manipulating skills. Picture puzzles stimulate learners' attention and promote learning through visual channel. This helps the child to understand so called difficult topics with ease. Solid solving strategies that can help the learner solve picture puzzles every time are:

Put together a solving routine:

It is important to map out the order of the steps to take in attacking the puzzle. For example, in tackling a spot-the-changes puzzle, try going from left to right, starting at the top and working your way to the bottom. Or try working it by sections in an orderly fashion. It is worthy to note that whatever solving routine that works for a solver may not work for other solvers. A solver should just ensure that he finds a routine he can stick to.

Check for the obvious:

Although it may sound rather apparent, glancing through the puzzle to look for obvious things that you may be missing can be a useful strategy when beginning to solve a puzzle or when you get stuck. Sometimes, focusing on details makes overlooking the obvious easy.

Use a pattern:

Regardless of the type of puzzle to solve, using a pattern, a systematic approach to scouring each nook and cranny of the puzzle keeps one focused and helps ensure that one does not go over the same spots repeatedly. Using some type of pattern should be part of one's solving routine.

Keep track of your work: Keeping track of what has been done and where you are in the puzzle helps you find your place if you have to take a break. It also helps you avoid reviewing details you have already checked out.

Dig out the details: When you are looking at details, be as specific as possible. Do not think of grass as just grass; think of it as long, wispy, green-yellow, ornamental grass or yellowed, bare grass that needs some mowing.

Take a break if you are stuck on a puzzle: Especially if you have been solving for a while, you may just need a break. If so, take one, but do not quit!

Free your mind: Clear the clutter from your head before you solve a picture puzzle. Get your to-do lists in order, put whatever is bothering you aside, and then focus on that puzzle.

Maintain focus: Limit the intrusions you will encounter by picking a good spot and time to solve your puzzles. Prepare for any interruptions that may distract you and try not to stop working on the puzzle until you can note where you have paused.

2.2.5 Explicit Teaching

Explicit teaching is the teaching that is focused on producing specific learning outcomes, through conscious effort of the teacher, by breaking learning tasks into bits of instruction for students' learning. Explicit teaching is a teacher-centered instructional approach that is most effective for teaching basic or isolated skills (Kroesbergen and Van Luit, 2003). It can be a scripted program that is very systematic with a step-by-step format requiring student mastery at each step. It is generally fast-paced instruction and often used with a small group of students. Students respond to instruction and receive immediate feedback. It also includes continuous modeling by teachers, followed by more limited teacher involvement, and then fading teacher involvement as students begin to master the material (Maccini and Gagnon, 2000).

In explicit teaching, topics and contents are broken into small parts and taught individually. It involves explanation, demonstration and practise. Children are provided with guidance and structured frameworks. Topics are taught in a logical order and directed by the teacher. Another important characteristic of explicit teaching involves modeling skills and behaviours and modeling thinking. This involves the teacher thinking out loud when working through problems and demonstrating processes for students. The attention of students is important and listening and observations are key to success.

Explicit teaching is useful for introducing topics and specific skills. It provides guided instruction in the basic understanding of required skills, which students can then build on through practice, collaboration, repetition, hands on activities and developmental play (Boyles, 2012). Explicit instruction begins with setting the stage for learning, followed by a clear explanation of what to do (telling), followed by modeling of the process (showing), followed by multiple opportunities for practice (guiding), until independence is attained. Explicit instruction moves systematically from extensive teacher input and little student responsibility initially- to total student responsibility and minimal teacher involvement at the conclusion of the learning cycle (Boyles, 2012).

A study carried out by Ajila (2003) revealed the effectiveness of Explicit Teaching strategy in helping learners to achieve maximally in Basic Science lessons. Explicit Teaching strategy involves breaking the instructional task into bits and each bit of the learning tasks is presented to the learners in a step-by-step manner in order to accommodate every category of learners with varying academic abilities and gender characteristics. It also involves specific instruction to follow, demonstrating, detail explanation, practice and necessary feedback (Ajila, 2003). From Ajila's study, the following procedure for using Explicit Teaching Strategy can be highlighted. The new science task is presented using examples, model, highlighting main points, asking frequent questions and necessary elaborate instructions.

The teacher ensures correct practice of the learning tasks by the learners by providing varieties of activities that will solicit students' response. The teacher involves an individual student to give required response to a given learning task and invariably involves the entire class. The teacher finally responds to students' inconsistencies by making the questions more simplified, giving hints and clues, going on the steps, process feedback given and praising improved answers.

Teacher directs and strictly monitors students' responses. Engelmann (2009) itemizes stages involved during explicit teaching instructional process as: Introduction/Review (of the new learning task), development (which involves demonstration, explanation, description, examples, etc.), guided Practice, closure, independent practice and evaluation.

2.2.5.1 Enhanced Explicit Teaching

The application of appropriate teaching strategy that has the support of educational research can be wisely employed in science teaching and learning. One of such strategies is 'Enhanced Explicit Teaching' strategy. This strategy allows learners to acquire learning in a step-by-step manner through the teacher (a facilitator), peer and peer tutor. The learners are put into small groups. The more capable learners of the group help those with difficulties in mastering learning task. Enhanced Explicit Teaching Strategy combines peer tutoring with Explicit Teaching Strategy and has been found to record great success on students' achievement (Ajila, 2003; Okilwa, 2011; Scruggs, 2011). The teacher briefly reviews the previous science tasks, presents the new science tasks, guides students' practice of these tasks and provides feedback and necessary correction repeatedly. Throughout these activities as guided and directed by the teacher, the learners work in pairs where one member of the paired group will act as the peer-teacher. The peer-teachers are acquainted with the purpose and the science activities to engage in during the instructional process. According to Ajila (2003), some criteria are identified necessary in selecting peer-teachers (students). These criteria are:

- Competence in science activities. This is determined from learners previous results;
- Willingness to tutor,
- Regularity in the classroom, and
- Ability to demonstrate positive social interaction with peers in the classroom. Tutor (learner appointed by the teacher) has double learning advantage: he/she learns from the teacher prior to the real time scheduled for science lesson and also during the science lesson.

Hall (2009) presents instructional delivery components necessary for all explicit instructional processes. These are:

Frequent student responses

When students actively participate in their learning, they achieve greater success. The teacher must elicit student responses several times per minute, for example ask students to say, write, or do something. Highly interactive instructional procedures keep students actively engaged, provide students with adequate practice, and help them achieve greater success.

Appropriate instructional pacing

Pacing is the rate of instructional presentations and response solicitations. The pace of instruction is influenced by many variables such as task complexity or difficulty, relative newness of the task, and individual student differences. When tasks are presented at a brisk pace, three benefits to instruction are accomplished: (a) students are provided with more information, (b) students are engaged in the instructional activity, and (c) behavior problems are minimized (students stay on-task when instruction is appropriately paced).

Provide adequate processing time

Think time (adequate processing time) is the amount of time between the moment a task is presented and when the learner is asked to respond. Time to pause and think should vary based on the difficulty of the task relative to the student(s). If a task is relatively new, the amount of time allocated to think and formulate a response should be greater than that of a task that is familiar and in the learners' repertoire.

Monitor responses

This is an essential teacher skill to ensure that all learners are mastering the skills the teacher is presenting. Watching and listening to student responses provides the teacher with key instructional information. Adjustments may be made during instruction. Teachers should be constantly scanning the classroom as students respond in any mode.

Provide feedback for correct and incorrect responses

Students should receive immediate feedback to both correct and incorrect responses. Corrective feedback needs to be instructional and not accommodating. Feedback to reinforce correct responses should be specific. Feedback should not interfere with the timing of the next question/response interaction of the teacher and student. Feedback that does not meet these criteria can interrupt the instructional episode and disrupt the learner's ability to recall.

2.2.6 Peer Tutoring

Peer tutoring can involve partners who are the same age or different ages (cross-age). Cross-age peer tutoring involves older students serving as tutors for younger, lower-functioning students. In same-age tutoring, in which students of the same age tutor each other, more skilled students may be paired with less skilled students. In this case, students with stronger skills may provide the first responses, providing a model for the less skilled partner. In other cases, the teacher may decide to pair students of similar ability and have those alternate tutoring roles, which are sometimes referred to as reciprocal peer tutoring. Class-wide Peer Tutoring (CWPT) occurs when the teacher creates highly structured tutoring materials for use during the tutoring session (Scruggs, 2011).

Lieberman and Houston-Wilson (2009) identified five types of peer tutoring strategies which are:

Unidirectional peer tutoring: Here, the trained peer tutor teaches the entire time, and the students with a disability remain the tutee in the pair. The tutor and tutee always know their roles and that the peer tutor carries the responsibility throughout the entire program.

Bidirectional or Reciprocal peer tutoring: A student with a disability and a student without a disability form a dyad, or pair. Each student takes turns at being the tutor while the other serves as tutee.

Class wide peer tutoring: This strategy involves breaking the entire class into dyads or small groups. Each student participates in reciprocal peer tutoring by providing his or her partner(s) with prompts, error correction and feedback. All students are given task cards to keep them focused on the objectives of the lesson. The tutor uses task cards to keep track of skills mastered by the tutee. This strategy involves all students in the class in the tutoring activity.

Same-age peer tutoring: Students who are of similar age or grade tutor each other. This form of tutoring can be done in both the unidirectional and bidirectional models. It is less effective if the children are young or have a severe disability.

Cross-age peer tutoring: An older student is chosen to tutor a younger student. It works best when the peer tutor is interested in working with students with disabilities. The main benefit of this strategy is that the tutor gains valuable teaching experience while the tutee receives effective individualized instruction and feedback. Other types of peer tutoring exists which are:

(a) Incidental peer tutoring which often takes place either at school or while students are playing after school or when they are socializing. Incidental peer tutoring manifests whenever children are cooperating, playing or studying and one guides the others.

(b) Structured peer tutoring refers to peer tutoring implemented in specific cases and for specific subjects, following a well-structured plan prepared by the teacher. Structured peer tutoring is spontaneously used by experienced teachers who are able to plan well in advance and are familiar on how to combine peer-teachers and students appropriately in order to have good results. For the purpose of this study, unidirectional peer tutoring strategy is employed.

2.3 Empirical Studies

2.3.1 Instructional Strategies and Students' Achievement in Basic Science

Martins and Oyebanji (2000) investigated effects of inquiry and lecture methods on the cognitive achievement of Integrated Science students. One hundred and sixty seven (167) JSS II students were involved in the study. The finding revealed that students who were taught using inquiry performed significantly better than those taught using lecture method.

Shaibu and Usman (2002) carried out a study on effects of NISTEP mode of teaching on students' academic achievement in Integrated Science among junior secondary school students. The sample comprised one hundred (100) JSS III students. The result of the study showed that students exposed to NISTEP instructional strategy performed significantly better than those exposed to the conventional lecture method.

Ige and Arowolo (2003) worked on effects of hypothetico-deductive strategy on JSS III students' achievement in Integrated Science. The study was carried out among seventy three (73) JSS3 Integrated Science students. The finding revealed that the hypothtico-deductive approach group performed better than the lecture method group. In a study conducted by Oyediran, Agoro and Fabiyi (2004) on a multi-media approach to the teaching of some difficult topics in Integrated Science, sixty (60) Junior Secondary III students participated in the study. The result showed that multi-media group performed better than the control group (lecture method group).

Duru and Okereke (2010) investigated effect of multiple intelligence teaching strategies on students' achievement in Integrated Science. The sample consisted of two thousand, seven hundred and eighteen (2718) JSS 2 students and twenty seven (27) Integrated Science teachers. The result showed that multiple intelligence teaching strategies enhanced students' achievements in Integrated Science. In another study, Ajila (2003) revealed the effectiveness of Explicit Teaching strategy in helping learners to achieve maximally in Integrated Science lessons. Explicit Teaching strategy involves breaking the instructional task into bits and each bit of the learning tasks is presented to the learners in a step-by-step manner in order to accommodate every category of learners with varying academic abilities and gender characteristics. It also involves specific instruction to follow, demonstrating, detail explanation, practice and necessary feedback (Ajila, 2003). From Ajila's study, the following procedure for using Explicit Teaching Strategy can be highlighted.

- The new science task is presented using examples, model, highlighting main points, asking frequent questions and necessary elaborate instructions.
- The teacher ensures correct practice of the learning tasks by the learners by providing varieties of activities that will solicit students' response.

- The teacher involves an individual student to give required response to a given learning task and invariably involves the entire class.
- The teacher finally responds to students' inconsistencies by making the questions more simplified, giving hints and clues, going on the steps, processing feedback given and praising improved answers. The teacher directs and strictly monitors students' responses.

The Jigsaw II cooperation learning strategy was developed by Slavin (1995). In this strategy, as learners teach the assigned concepts to other members of the group, the peer-teacher (student in the group) becomes an expert on the topic/concept. Groups subdivide a topic into subtopics and members work on the sub-topics. They then go back to their original groups and explain their assigned subtopics to colleagues. A member of the group does not have holistic knowledge of the topic but just a part. This limitation necessitates other members of the group to listen carefully to learn from other topics apart from their own. It involves the incentive structure. The team scores are computed by summing individuals' scores and recognizing team accomplishment. Various researchers reported Jigsaw II cooperation learning strategy to have significant main effect on students' achievement. Researchers in this category include: Holliday (1995), Merebah (2001), Perkin and Saris (2001), and Olaniyi (2009). The Jigsaw II cooperative learning strategy would therefore provides learners with the opportunity to: exchange ideas, acquire learning in the simplified language of their group level, remember the concept learned because of the group circumstances that surround the learning, promote team-spirit, improve intergroup relations, improve communication skills, develop self-confidence and internal courage to face learning challenges.

Sharan and Sharan (1992) developed group investigation learning strategy in Israel. The group consists of two to six members. The teacher presents the learning unit to the class. Each group takes on the learning unit presented by the teacher. Each group member investigates all the topics in the learning unit. Findings of the members of each group are then submitted to the group. The group members work together on the submissions from peers. In the long run, each group now presents her findings to the class. This learning strategy has attracted the attention of many researchers. Their findings revealed significant main effect of the model on students' achievement. The model has been found to support the effective teaching and learning of Basic Science. Among the researchers that found this strategy effective are: Kosters (2000), Webb (2000), Perkin and Saris (2001), Wicklund (2002), Ross (2003), Olaniyi(2009).

Bolorunduro (2005) investigated the impact of the instructional strategies of the Nigerian Integrated science teacher education project on students' learning outcomes at junior secondary level. Two hundred and eight junior secondary school two students were involved in the study. The result revealed that there was significant difference in the achievement of the respondents exposed to treatment and the control group.

Afuwape (2002) worked on simulation Game –Assisted instruction, student cognitive style and numerical ability as determinants of learning outcomes in Integrated Science. The result showed no significant main effect of treatment on achievement. Akuche (2008) carried out a study on effects of four instructional strategies on students learning outcomes in practical physics. The sample size consisted of five hundred and twenty six (526) senior secondary school II physics students drawn from eight co-educational schools. The result revealed significant main effect on students' achievement in practical skills.

Awoderu and Oludipe (2012) investigate effectiveness of cooperative learning strategies on Nigerian Junior Secondary students' academic achievement in Basic Science. The sample consisted of one hundred and twenty (120) students in Southwestern Nigeria. The result showed that the two cooperative learning strategies: Learning together and Jigsaw II groups were found to be more effective in enhancing students' academic achievement and retention in Basic Science more than the conventional lecture strategy. In another study on factors that could influence students' achievement in science, Kong, Tai and Fan (2014) conducted a longitudinal study to examine the relationships between parental involvement and students' science achievement over time. Four dimensions of parental involvement were used: parent-child communication, school participation, educational aspiration for children, and home supervision. Data used in the study consisted of three waves of student information and parent surveys from Early Childhood Longitudinal Study, Kindergarten Class of 1998-1999 (ECLS-K). The results revealed that levels of parental involvement in terms of parent-child communication, parents' school participation, and educational aspiration for children were consistently and positively associated with students' science achievement over time. However, home supervision had a negative relationship with students' science achievement.

Furthermore, Ayodele, Adedayo and Ayeni (2012) investigated the predictive power of selected variables on academic achievement in Integrated Science among College of Education students in Ikere Ekiti, Ekiti state, Nigeria. The selected variables that were examined are school type, birth order, Physics, Chemistry, Biology, Mathematics, socio-economic status and Cummulative Grade Point Average (CGPA). A sample of two hundred and eighty (280) students in 2006/2007 academic sessions was drawn from all the subject combinations in the Department of Sciences. The results showed that there were moderate and positive relationships among the selected variables and achievements of students in Integrated Science at National Certificate in

Education level. Result further showed that , among the selected variables, school type was the most potent predictor of students' achievement in Integrated Science.

2.3.2 Instructional Strategies and Students' Attitude to Basic Science

One of the goals of science education is to encourage students to have favourable attitudes towards science. Effort needs to be concentrated on fostering desirable attitudes toward science and the teaching of science (Lucas and Dooley, 2006). Attitude toward science is closely related to achievement in science (George, 2000), while attitude toward science predicts achievement in science (Kan and Akbas, 2006). Students with higher achievement in science tend to show more interest in learning science, which may turn into career interest in science related fields (Bhattacharyya and Mead, 2011). Furthermore, positive attitude/favourable attitude is connected with significant/higher achievement in science. Therefore, the attitude of the teachers, to a large extent, affects achievement and attitude of students in science (Adetunji, 2000; Abram, 2004).

Rogers (1983) outlined attitudes which characterize a true facilitator of learning:

- Realness – The facilitator should not present a 'façade' but genuineness of his/her feelings and must engage in direct personal encounters with the students.
- Prizing the learner – This characteristics is all about accepting and trusting individual learner – his fear, hesitation, apathy and goals.
- Empathic understanding: The instructor can understand the students' reactions from the inside.

A study carried out by Akinsola (2007) showed that the use of simulation-games environment led to positive attitude towards mathematics. The study concluded that the use of stimulating teaching method (that is, game) by the teachers has a concrete role to play in sustaining and motivating students' interest in learning. Akinsola (2002) and Betiku (2002) reported boys to have positive attitude than girls towards Mathematics oriented science subject. The studies of Olagunju (1998) and Ajitoni (2004) revealed that the attitude of girls are more positively disposed towards environmental issues than boys. Ahiakwo (2002) compared the attitude of boys and girls to the social implications of science. He reported the attitude of boys and girls differentially insignificant.

Studies carried out by Uyoata (2002), Ajitoni (2004) and Ezike (2006) indicated that attitude can have a reciprocal effect on achievement. This implies that as attitude can affect achievement, so also achievement can affect attitude.

Soltani and Nasrl (2010) investigated attitude towards Biology and its effects on students' achievement. One hundred and eighty five (185) grade twelve (12) students were involved in the study. The study revealed that there was no significant difference between girls and boys on attitude towards Biology.

Akpinar, Yildiz, Tatar, and Ergin (2009) carried out a study on students' attitudes towards science and technology: an investigation of gender, grade level, and academic achievement. The participants of the study were six hundred and fifty eight (658) primary school pupils. The finding of the study revealed that there were significant differences between female and male students in terms of interest in science in favour of female. However, there were no significant gender differences in terms of other factors, 'enjoyment of science', 'anxiety', and enjoyment of science experiments' respectively. There were also significant positive correlations between Attitude Scale for Science and Technology (ASST) and academic achievement.

Various researchers report different views regarding students' attitude. Olatoye (2001) found that students' attitude towards science has significant direct effect on students' achievement in the subject. Adesokan (2002) asserted that in spite of the recognition given to Chemistry among the science subjects, it is evident that students still show negative attitude towards the subject thereby leading to low achievement and enrolments. Siegel and Ranny (2003) established modest positive correlations between science attitude and science achievement. Adesoji (2008) established the fact that appropriate method of instruction promotes the development of positive attitude towards the learning of science.

2.3.3 Crossword-Picture Puzzle-Based Teaching Strategy and Students' Achievement

The emphasis of educational researchers is on child-centred, active learning. This is the more reason teaching-learning processes should be devoid of teachers dominating the class with ordinary mouth presentation of learning tasks. Multi-various teaching and learning approaches that attract students' attention, interest and most sense organs found their effectiveness in enhancing students' learning outcomes and also in the areas of science teaching and learning (Maal, 2004; Orlich et al, 2010). One of these approaches that support students' inclusive education and learning outcomes is the use of educational puzzles (Scott, 2002).

Advocating for in-class activities and non-traditional teaching aids that can be effectively harnessed, researchers recommended the use of such activities and teaching aids such as puzzle games to be adopted in the teaching and learning of science (Leong, 2005; Saunders and Christopher, 2003). Hence, this research work tries to investigate effect of Crossword-Picture puzzle-based Teaching Strategy on students' learning outcomes. Falkner, Sooriamurthi and Michalewicz (2009) carried out a study on puzzle-based learning among 380 students. The result revealed that learning with puzzles increases students' learning outcomes. They concluded that puzzles are educational, engaging and thought provoking.

Merrick (2010) carried out an empirical evaluation of puzzle-based learning as an interest approach for teaching introductory computer science using students from two offerings of the course-with and without the puzzle-based learning concepts. The puzzle-based learning concepts improved students' learning experience. This is noticed in their interest and participation and the development of critical thinking skills.

The work of Massey, Brown and Johnson (2005) on the use of crossword puzzles for homework assignments showed that the puzzles were beneficial in terms of examination performance and students' perception of learning and learning process. Furthermore, Hoffjan (2005) discussed the use of puzzle games (calvados) in three different cost accounting courses. The researcher recorded an overwhelming positive feedback. This is noticed in the areas of students understanding of the complex issues of relevant costs for decision making and transfer pricing. Still on this, Behrooz (2008) used puzzle-based learning programme at the University of California, Santa Barbara with the results increasing students' motivation and the method was found as an effective strategy to retain students during educational programmes.

Wanko (2009) concluded that when students learn with puzzles, the result are the development of problem-solving strategies in the learners and consequently, laying foundation for good science and mathematical practices.

2.3.4 Crossword-Picture Puzzle-Based Teaching Strategy and Students' Attitude

Attitude, whether positive or negative, affect learning in science (Mushtaq, Zubair, Zafar and Muhammad, 2010). These researchers further pointed out that detection of students' attitude can contribute to making interests and curiosity lively and increasing the success of students. A positive attitude toward science can be developed through hands-on-activities and other methods of instruction that excites students and encourage them to learn such as crossword-picture puzzle teaching strategy. As conceived by Nurulazam, Rohandi and Jusoh (2010), a positive attitude toward science leads to a positive commitment to science that influences students' lifelong interest and learning in science. Students that have very strong disposition towards science are likely to succeed due to inner drive that will propel them to learn science. The result will reflect in their commitment to learn even the seemingly difficult concepts. Almost all researchers agreed that for science education, one of the critical problems is the negative attitude towards science (Anne, 2013; Kresse, 2010). Effort needs to be concentrated on fostering desirable attitudes toward science and the teaching of science (Lucas and Dooley, 2006). In concentrating efforts on fostering desirable attitudes toward science, Akuche (2008) carried out a study on effects of four instructional strategies on students learning outcomes in practical physics. The sample consisted of 526 senior secondary school II physics students drawn from eight co-educational schools. The result of the finding recorded no significant main effect of treatment on attitude.

Adedoja, Abidoye and Afolabi (2013) carried a study on effects of two puzzle-based instructional strategies on primary school pupils' learning outcomes in social studies, the result revealed that puzzle-based strategies improved students' attitude. Ahiakwo (2002) compared the attitudes of boys and girls to the social implications of science. He reported the attitudes of boys and girls differentially insignificant.

2.3.5 Enhanced Explicit Teaching Strategy and Students' Achievement

Explicit teaching involves directing students' attention toward a specific learning objective in highly structured environment (Picmanns, 2008). Topics are taught in a logical order, directed by the teacher, through demonstration, explanation and practice. In explicit teaching, a teacher sets the stage for learning by telling the students the purpose for learning, explain to students what to do, model the process of how to do it, and guide the students with hands-on-application/practice. Explicit teaching begins with very teacher-centred with little student involvement, and ends with a goal of complete student independency with very little teacher involvement.

Explicit teaching as pointed out by Edwards-Groves (2002) is critically about clarity in: knowing the learner, responding to the learner, implementing focused lessons, reflecting and reviewing. This strategy has attracted the attention of researchers and it is found to be effective in classroom application (Adams, 1996; Hall, 2002; Ajila, 2003). Therefore, combining other effective strategy with it improves its effectiveness. Enhanced Explicit is such strategy that combines explicit teaching with peer tutoring.

Peer tutoring is an instructional strategy that employs peer interaction for the purpose of teaching and learning (Ginsburg-Block, 2010). It is an intervention in which students work in pairs to master academic skills or content (Scruggs, 2011). Empirical studies revealed the effectiveness of peer tutoring on academic gains of students. The work of Okilwa (2011) on the effects of peer tutoring on academic performance of students with disabilities in grades 6 through 12: a synthesis of the literature, revealed that peer tutoring has a positive effect on students' learning outcomes regardless of disability type.

The finding of Yuen-Lokea and Chowb (2007) on learning partnership –the experience of peer tutoring among nursing students: a qualitative study, showed that students had both positive and negative experiences from peer tutoring, but that positive experiences predominated. Positive aspects were: enhancement of learning skills/intellectual gains and personal growth. Negative experiences stemmed mainly from frustrations in dealing with mismatched learning styles between tutors and tutees and the required time commitment.

Menesses and Gresham (2009) carried out a study on relative efficacy of reciprocal and nonreciprocal peer tutoring. Participants were fifty nine (59) elementary pupils from second-, third-, and fourth-grade classrooms. The result showed that both strategies produced substantially larger academic gains.

Ojo-Ajibare (2002) investigated the effect of peer-tutoring instruction on students, achievement in Technical Drawing involving one hundred and twenty (120) Senior Secondary School II students. The study showed that the students that were exposed to peer-tutoring performed significantly better in Technical Drawing than students who were exposed to the conventional method. The study suggested that peer-tutoring instructional strategy should be used since it enhanced academic motivation and achievement.

Baker, Gersten and Lee (2002) found a range of effect sizes from small to large, and that peer-tutoring was most effective for computation. Kunsch, Jitendra, and Stood (2007) found that peer tutoring interventions showed moderate effect sizes in elementary school, but low effect sizes in secondary school, and that it was more effective for at-risk students compared to students with learning disabilities (LD). Conversely, Kroesbergen and van Luit (2003) found no evidence for the effectiveness of peer-tutoring.

2.3.6 Enhanced Explicit Teaching Strategy and Students' Attitude

Scruggs, Masropieri and Berkeley (2010) described Peer Assisted Learning Strategies (PALS) as one peer tutoring activity that has been researched for kindergarten grades through 12. This tutoring program is designed to help students improve in reading and other academic skill areas. The steps to the program for reading are:

- predicting,
- partner reading,
- Retelling and
- summarizing.

In this program, the stronger reader is the expert tutor. Students begin by making a prediction about the passage they are about to read. They then take turns reading the same passage with the stronger reader going first. Then the stronger reader prompts the weaker reader to retell the passage and then summarize the information with the following steps:

- "Name the who or what the passage is about,"
- "Tell the most important thing about the who or what," and
- "Say the main idea in 10 words or less."

Another example is peer tutoring with differentiated instructional materials targeted toward classrooms with students of different learning needs. Differentiation of materials can include:

- differential practice time,
- embedded strategic information, and
- increasing levels of difficulty.

Differential practice time allows for students to have as much time needed to master a concept before proceeding to the next skill set. Embedded strategic information can include specific strategies for improving memory or comprehension of important concepts, such as mnemonic strategies or comprehension questioning. Increasing levels of difficulty might include varying levels of support that can be provided to students as need arises. For example, students can begin with identification formats (in which they are asked to identify the correct response from an array) and advance to production formats (in which they produce the correct response independently) or to answering tutor questions under prompted or non-prompted conditions.

Agboola and Oloyede (2013) investigated effects of concept mapping and peer tutoring instructional strategies on learning outcomes of students in chemistry. The population for the study consisted of senior secondary school chemistry students. A total of 57 senior secondary school II (SSS II) chemistry students in two intact classes constituted the study sample size. The results revealed that the use of concept mapping and peer-tutoring instructional strategies did not significantly influence the attitude of students to the learning of chemistry.

Golding, Facey-Shaw and Tennant (2006) examined effects of peer tutoring, attitude and personality on academic performance of first year Introductory Programming Students. The study reported that peer tutoring had a positive effect on students' attitude. In another development, Ayse (2014) carried out a study on the effects of peer teaching on university students' achievements in cognitive, affective, psychomotor domains and game performances in volleyball courses. The study involved seventy second and third grade students at Abant Izzet Baysal University, the school of Physical Education and Sports. The sample consisted of seventy participants. The study concluded that using different instructional models in volleyball classes improved students' achievement in cognitive and psychomotor domains and game performances, but not affective domain (attitude).

Scruggs, Masropieri and Berkeley (2010) reported academic gains of enhanced explicit teaching strategy including its effect on students' attitude in their study on peer tutoring strategies. These researchers listed the gains in peer tutoring programs, with treatment effects in the medium to high range for both tutors and tutees. Effects have also been observed for students acting as tutors in the role of expert. Social benefits of peer tutoring, improved self-esteem and self-efficacy, improved attitude toward school, and improved interpersonal functioning are commonly reported. Research support for these more general outcomes has been inconsistent, although Scruggs, Masropieri and Berkeley reported that students commonly improve in their attitude toward the content being tutored and in their attitude toward their tutoring partner, teachers who have implemented peer tutoring typically respond favourably to the practice. Peer tutoring is beneficial in the following ways:

i) Creates a safer and less embarrassing and intimidating setting and climate for students to ask questions, express misunderstandings, etc.
ii) Allows students more opportunities for assistance.
iii) Increases academic and behavioural support.
iv) Provides frequent and constant redirection and refocusing.
v) Provides quicker feedback and attention.
vi) Gives students one on one help and attention.
vii) Helps students to get to know other students and make friends and trusted relationships.
viii) Increases student trust and rapport.
ix) Increases classroom teaching efficiency, and
x) Helps to free up the teacher to instruct and help other students.

Peer tutoring is necessary especially:

i) When a student is inattentive and unfocused.
ii) When a student needs frequent one on one help.
iii) When a student needs directions repeated a lot, and concepts reviewed multiple times and ways.
iv) When a student is apprehensive to ask questions or for help.
v) When a student gets overwhelmed and frustrated.
vi) When a student needs extra help starting assignments, and

vii) When a student asks frequent questions and needs frequent clarification

Appropriate use of effective instructional strategy will lead to the development of good attitude towards science on the part of the learners. This finds the support of Ajila (2003) who found that enhance-explicit teaching strategy was the most effective for attitude.

2.3.7 Conventional Lecture Method and Students' Achievement and Attitude

Traditional teacher-centered methods are focused on rote learning and memorization of facts. Students need acquisition and understanding of scientific knowledge and teachers are the instruments by which this knowledge is communicated and these standards of behaviour are enforced. In a conventional lecture setting, students would need to sit quietly in their places and listen to one student after another recite his or her lesson, until each has been called upon. The teacher's primary activity is assigning and listening to these recitations; students study and memorize the assignments at home. A test or oral examination might be given at the end of the instructional process. In addition to its over-emphasis on verbal answers, reliance on rote memorization (memorization with no effort at understanding the meaning), and disconnected, unrelated assignments, it is also an extremely inefficient use of students' and teachers' time.

This conventional approach also insisted that all students be taught the same materials at the same point; students that do not learn quickly enough fail, rather than being allowed to succeed at their natural speeds. Traditional education is associated with much stronger elements of coercion than seems acceptable now in most cultures. It has sometimes included: the use of corporal punishment to maintaining classroom discipline or punish errors; inculcating the dominant religion and language; separating students according to gender, race, and social class, as well as teaching different subjects to girls and boys. In terms of curriculum, there was and still is a high level of attention paid to time-honoured academic knowledge. Students are less attentive, more likely to skip class, and less engaged (Christopher, 2013). More of the disadvantages of conventional lecture method can still be highlighted. Conventional lecture method:

i) Places students in a passive rather than an active role, which hinders learning.

ii) Encourages one-way communication; therefore, the teacher must make a conscious effort to become aware of student problems and student understanding of content without verbal feedback.

iii) Requires a considerable amount of unguided student time outside of the classroom to enable understanding and long-term retention of content.

iv) Does not allow for different learning abilities or speeds.

v) Time and location controlled by the teacher.

vi) Is often perceived as “boring” by learners

2.3.8 Gender and Students' Learning Outcomes

Gender issue in Science Education has attracted the attention of many researchers. It is a broad analytical concept that calls for research review from time to time. Based on gender studies, Jiangun and Staver (1997) investigated gender differences in Chinese students' science achievement. A sample of over twelve thousand ninth graders in five rural and urban Chinese provinces was used. The analysis of the study found significant gender differences in science achievement with males receiving higher scores.

Afuwape (2002) studied simulation game assisted instruction, student cognitive style and numerical ability as determinants of learning outcomes in Integrated Science, and three hundred and five junior secondary III students were involved. The result revealed no significant main effect of gender on students' achievement in Integrated Science. Also, the work of Raimi and Adeoye (2002) on gender differences among college students as determinants of performance in Integrated Science involving fifty one (51) Integrated Science students drawn from two colleges of Education in Oyo State revealed no significant main effect of gender on students' cognitive achievement. However, Ukwungwu (2002) worked on gender difference study of performance in Integrated Science; by summarizing studies conducted in Nigeria. Thirty four studies were examined to assess the magnitude and direction of gender differences in performance in integrated science. The result showed that gender difference in performance in integrated science was small and in favour of males.

In his study, Ajila (2003) investigated comparative effects of explicit and enhanced-explicit teaching on learning outcomes in primary science. Three from twelve randomly selected classes in six public primary schools were involved in the study. The study found no significant main effect of gender on science achievement.

Becker (2006) investigated gender and science achievement (a reanalysis of studies from two meta-analysis). Thirty studies of the magnitude of gender differences in science achievement previously examined in two separate reviews were synthesized. Analysis revealed that males showed significant advantages in studies of biology, general science and physics, but significant differences were not found for studies of mixed science content, geology and earth sciences, or in a single study of chemistry.

In a related study, Ukwungwu (2006) did Meta analysis of gender differences in students' performance in physics. Twenty-three studies conducted all over Nigeria were collated. The result revealed that being a male enhances performance in physics.

Okoruwa (2007) investigated effects of conceptual change and enhanced explicit teaching strategies on learning outcomes in primary science among one hundred and ninety primary six pupils were used. The result revealed no significant moderating effect of gender on achievement, but it was significant on attitude.

To determine the influence of gender and cognitive style on students' achievement in physics essay test, Okwo and Otubah (2007) involved eighty seven senior secondary II students, comprising thirty seven boys and fifty girls as participants in the study. The result revealed that gender influences the achievement of students in physics essay test.

Leeson, Ciarrochi and Heaven (2008) worked on cognitive ability, personality, and academic performance in adolescents. The participants were all students in the Wollongong Youth Study and five high schools in a Catholic Diocese of New South Wales (NSW), Australia. The findings revealed significant gender differences with girls out-performing boys.

Olaniyi (2009) examined the effects of Jigsaw II and group – investigation cooperation learning models on pre-service teachers' learning outcomes in selected environmental concepts in Integrated Science. The study involved four hundred and fifty, 200-level Integrated Science pre-service teachers. Students participated in the study (225 male and 225 female). The study revealed a significant effect of gender on pre-service teachers' achievement with male respondents performing better than their female counterparts.

Oludipe (2012) worked on the influence of gender on Junior Secondary students' academic achievement in Basic Science using cooperative learning teaching strategy. Total number of one hundred and twenty (120) students participated in the study. The findings revealed that there was no significant difference in academic achievement of male and female students at the pretest, posttest, and delayed posttest levels respectively.

2.3.9 Mental Ability and Students' Learning Outcomes

In recent times, research attention has been on the role that ability plays in relation to achievement. From literature, students with high mental ability tended to perform higher and students with low mental ability tended to perform lower.

Raimi and Adeoye (2002) investigated gender differences among college students as determinants of performance in Integrated Science. The sample consisted of fifty one (51) Integrated Science students drawn from two colleges of Education. The result of the study showed that mental ability has a relationship with students' performance.

Aremu and Tella (2009) conducted a study on the relationship between gender, age, mental ability, anxiety, mathematics self-efficacy and achievement in mathematics. One thousand and ninety nine senior secondary school students (1,099) were involved in the study. The results revealed non-significant contribution of general mental ability to achievement in Mathematics.

Patan (2010) investigated the effects of four methods of teaching on achievement in basic mathematics. The result showed a relationship between methods of teaching and mental ability, which resulted in high performance level among students.

While investigating the relationship between the mental ability of the high school students and their academic performance, Layno and Ong (2010) found a moderate relationship between the mental ability of respondents and their overall grade point average (GPA).

Deary (1998) on mental ability established the following findings:

- Differences in mental abilities have a hierarchical structure, from narrow specific abilities to general ability.
- Environmental and genetic contributions to these differences are sizeable, the genetic contribution possibly increases with age.
- Differences may change or remain stable during the adult lifespan, stability being especially high for verbal abilities.
- Differences in mental ability have some modest predictive validity for real life outcomes.
- Cognitive and biological bases of differences in mental ability are being explored but are not yet understood.

2.4 Appraisal of the Literature Review

Review of literature indicated that the trend of improvement in students' academic achievement in Basic Science is low (Federal Ministry of Education, Research Statistics and Planning Section, 2011), and one of the factors responsible for low academic achievement is the instructional strategies teachers use during the instructional processes (Oshodi, 2006).

Also, studies revealed that Enhanced Explicit Teaching Strategy is effective in enhancing students' achievement and attitude (Ajila, 2003; Picmanns, 2008; Yuen-Lokea and Chowb, 2007; Menesses and Gresham, 2009; Ginsburg-Block, 2010; Okilwa, 2011). Enhanced Explicit Teaching strategy is directing student attention towards a specific learning objective in highly structured environment, when students are put in small groups for the purpose of teaching and learning among children peers. The effectiveness of Enhanced Explicit Teaching strategy in helping learners to master academic skills or content allows learners to acquire knowledge in a step-by-step manner through the teacher (a facilitator) and peer-teacher (student acting in the capacity of a teacher), good for helping learners with different academic abilities, helps in the development of favourable attitude, and foster social interaction. Therefore, researchers recommended the use of this strategy to enhance achievement in and attitude to Basic Science.

In addition, domiciled in various studies was the potential of Crossword-Picture Puzzle strategy on students' achievement and attitude (Bolorunduro, 2005; Scott, 2006; Idowu and Ige, 2007; Kendall, Parks and Sperer, 2008). These researchers pointed out puzzles' applications in science learning to introduce new ideas, test skills; pose problems that make learners ask challenging questions, help slow learners, used as classroom resources and develop students' manipulative skills. They advocated the use of Crossword-Picture Puzzle strategy to improve students' learning outcomes in Basic Science.

Many researchers show the limitation of conventional lecture method in effecting learning (Menesses and Gresham, 2009; Duru and Okereke 2010;; Agoro, 2012) and submitted that the use of conventional lecture method should be discouraged during science teaching and learning. Reporting from different dimension, Bolorunduro (2005) indicated that though other methods are encouraged to be adopted in teaching science, the conventional method can still be combined with other methods to bring about learning. Since researchers are not conclusive, the need for this study is germane.

Replete on students' attitude were contradicting reports. Some studies reveal significant difference in the attitude of the respondents (Ajitoni, 2004; Bolorunduro, 2005). Afuwape's (2002), Akinsola's (2007) results revealed a significant effect of treatment on students' attitude, whereas, Akuche's (2008) finding recorded no significant effect of treatment on attitude. Since there are contradictory findings on this variable, this study therefore considers attitude as an important variable to be investigated.

Many research reports on basic sciences (Physics, Chemistry, and Biology) and Basic Science (formerly known -as Integrated Science) showed that gender and mental ability have generated lots of inconclusive and conflicting arguments. This study, therefore, carried out further studies on these variables and determined their effects on students' achievement and attitude to Basic Science. In addition, there seems to exist a dearth of empirical studies especially in Basic Science on Crossword-Picture Puzzle-based teaching strategy and Enhanced Explicit Teaching Strategy (Explicit teaching + Peer tutoring) which now informed carrying out more studies on these variables. Literature consulted showed that studies on the effectiveness of these strategies concentrated on Northern part of Nigeria with different learning environments, and where students' attitude to learning may have some kind of peculiarities. This research has a distinctive feature from those studies reviewed in that it was carried out in Southwestern Nigeria, with larger numbers of teachers trained, more schools and students were used in a larger community (Southwestern Nigeria), and it was richly activity-based. The use of game and child peer interaction was carefully incorporated, which enhanced students' motivation and fostered meaningful learning.

CHAPTER THREE

METHODOLOGY

This chapter presents an overview of the Research Methodology employed in carrying out this study. The chapter describes the research design, sampling, procedure for data collection as well as treatment procedure and data analysis and results.

3.1 Research Design

The study adopted a pretest-posttest control group quasi-experimental design with 3x3x2 factorial matrix. The subjects were exposed to pretest before treatments and posttest after the treatment. This research design can be illustrated as represented below:

Experimental group $E_1 = O_1\ X_1\ O_2$

Experimental group $E_2 = O_3\ X_2\ O_4$

Control group, $C = O_5\ X_3\ O_6$

Where

$O_{1,}$ O_3 and O_5 were pretests,

$O_{2,}$ O_4 and O_6 were posttests

E_1=Experimental Group 1 (Crossword-Picture Puzzle-Based Teaching Strategy)

E_2=Experimental Group 2 (Enhanced Explicit Teaching Strategy)

C = Control group (Conventional),

X_1, X_2 and X_3 were the treatments

3.2 Variables of the study

1. Independent Variable: This was the Instructional strategy at three levels:

   a. Crossword-Picture Puzzle Teaching Strategy

   b. Enhanced Explicit Teaching Strategy

   c. Conventional Lecture Method

2. Moderator Variables: There were two moderator variables:

   a. Gender at two levels- Male/Female

   b. Mental Ability at three levels- High, Moderate and Low

3. Dependent Variables:

   a. Achievement in Basic Science

   b. Attitude to Basic Science

The study made use of 3 x 3 x 2 factorial matrix which is represented in the table below:

Table 3.1: Summary of Variables in the Study

TREATMENT	MENTAL ABILITY	GENDER	
		Male	Female
CROSSWORD-PICTURE PUZZLE TEACHING STRATEGY	High		
	Moderate		
	Low		
ENHANCED EXPLICIT TEACHING STRATEGY	High		
	Moderate		
	Low		
CONTROL GROUP	High		
	Moderate		
	Low		

3.3. Selection of Participants

The participants were chosen from three randomly selected States in Southwestern Nigeria (Oyo, Ogun and Ondo). Three educational zones were randomly selected from all educational zones in each of the three selected states. Three (3) secondary schools were randomly selected from all secondary schools in each of the three selected educational zones. One class was randomly selected from all JSS II classes in each school. An intact class was used in each school. The study involved nine schools (9) in the three selected States. The teachers of the selected classes (3 teachers per State) were used for the study. Multi-stage sampling technique was used. Three hundred and eighty nine (389) JSS 2 students from nine junior secondary schools were randomly selected in three states (Oyo, Ogun and Ondo).

3.3.1 Criteria Used for the Selection of Concepts for the study

Ncharam's (2011) study on the relationship between students' learning difficulties and achievement in Junior Secondary School Three (JSS 3) Integrated Science (Basic Science) content finds that poor achievement in Integrated Science concepts is consistent with the perceived difficulty by the students in energy concepts. Abimbola, Olorundare, Omosewo, Ahmed, Johnson and Yahaya (2011) identify difficulty in ecological concepts. Njoku (2005), Ncharam (2011) and Abimbola et al (2011) identify areas of difficulty in secondary school science curriculum as one of the reasons for low achievement in the subject. Abimbola et al (2011) point out that the performance rate is poor because of difficult topics in the subject, which are often ignored by students and even teachers. These researchers recommend that there should be a re-evaluation of the difficult concepts. There are reasons for such difficulty:

i) There is inadequacy of resources for teaching these concepts;

ii) Teachers generally use unsatisfactory resources and even when available, they use it wrongly.

iii) There is also the general unsatisfactory field and practical work in schools (Abimbola et al, 2011).

The concepts selected for the study required resources, field and practical work which were provided for in the study. The content covered six topics: Drug Abuse, Habitat, Changes in Matter, Respiratory System, Information and Communication Technology and Heat Energy. All the concepts taught in the study and on which the test was based are in the former Integrated Science curriculum, with the exception of one concept which is an addendum in the new Basic Science curriculum (that is, Information and Communication Technology), following the thematic approach to content organization of Basic Science curriculum (NERDC, 2007):

- You and the Environment (Drug Abuse)
- Living things and Non-living things (Habitat, Respiration, changes in matter)
- Science and Development (Information and Communication Technology)
- You and Energy (Heat Energy)

These topics were chosen to ensure that some new issues (topics) in Basic Science curriculum (NERDC, 2007) and other topics perceived difficult (Njoku, 2005; Ncharam, 2011; Abimbola et al, 2011) were examined in the study to make the teaching and learning of Basic Science interesting and effective.

3.4. Research Instruments

Seven instruments were used and validated by the researcher to collect data for the study. The instruments are:

i. Basic Science Students' Achievement Test, BSSAT

ii. Basic Science Students' Attitude Scale, BSSAS

iii Australian Council for Educational Research Test (ACERT)

iv. Teachers' Instructional Guide for Crossword-Picture Puzzle-Based Teaching Strategy (TIGCPPTS)

v. Teachers' Instructional Guide for Enhanced Explicit Teaching Strategy (TIGEETS)

vi. Teachers' Instructional Guide for Conventional Lecture Method (TIGCLM)

vii. Evaluation Sheets for Assessing Teachers' Performance during Training (ESATPT)

3.4.1 Basic Science Students' Achievement Test, BSSAT

The test was designed by the researcher. The test content covered six topics: Drug Abuse, Habitat, Changes in Matter, Respiratory System, Information and Communication Technology and Heat Energy. The test was divided into two sections: A and B. Section A covered the personal data of the participants which are gender and name of school; Section B contained twenty (20) multiple choice items with five options (A-E) from which participants selected the correct alternative. Each correct response attracted one mark while an incorrect response was awarded zero. The initial draft of forty multiple choice items was given to some lecturers in Science Unit of the Department of Teacher Education, Faculty of Education, University of Ibadan, Ibadan; and some doctoral students in the field of Basic Science and two lecturers in the School of Science, Emmanuel Alayande College of Education, Oyo, who are experts in the field of Science Education. This was done to ascertain the face and content validity of the instrument. Thirty two (32) items survived scrutiny. It was later trial-tested in a secondary school that was not selected for the main study. It was the 20 items with discrimination indices between 0.4-0.6 that were used. The data collected were analysed using Kuder-Richardson formula 20 (Kr_{20}). The reliability coefficient of 0.70 was obtained. The table of specification for BSSAT is presented as follows:

Table 3.2: Table of Specification for Basic Science Students' Achievement Test (BSSAT)

S/N	Content Area	Knowledge(recall)	Understanding	Thinking	Total number of items
1	Drug Abuse	(1) 2	(0) -	(1) 1	2
2	Habitat	(1) 3	(1) 4	(1) 5	3
3	Changes in matter	(1) 7	(1) 8	(2) 6,9	4
4	Respiratory System	(1) 12	(1) 10	(2) 11,13	4
5	Information and Communication Technology	(1) 15	(0) -	(1) 14	2
6	Heat Energy	(2) 16,17	(1) 19	(2) 20,18	5
	Total Number of Items	7	4	9	20

3.4.2 Basic Science Students' Attitude Scale, BSSAS

This scale was designed by the researcher. It contained two sections: A and B. Section A covered personal data of the participants which include Age, class, gender and school, while Section B was on the attitude of students towards Basic Science. The scale sets out to collect information on students' opinion for each statement on class assignment, scientific activities, science classes, and Basic science teacher. Respondents indicated their opinion on a 4- point Likert scale. The scales were strongly Disagree (SD), Disagree (D), Agree (A) and strongly Agree (SA). The weights were SD(1), D (2), A (3), SA (4) for favourable statements, while for unfavourable statements, the weights were assigned as follows: SD(4), D(3), A(2), SA(1). There were 25 items in this instrument. The initial thirty five (35) items were given to higher degree students and experts who are in the field of science Education for face and content validity and relevance to the purpose of research. The researcher came up with 25 items with a reliability index of 0.80 using Crombach alpha.

Table 3.3: Table of specification on Basic Science Students' Attitude Scale(BSSAS)

S/N	Concepts/Topics	(+) Positive	(-) Negative	Total
1	Basic Science Teacher	(2) 9,10	(3) 6,7,8	**5**
2	Basic Science Assignments	(2) 14,15	(3) 11,12,13	**5**
3	Scientific Activities	(2) 18,19	(3) 16,17,20	**5**
4	Basic Science Subject	(4) 21,25,23,24	(1) 22	**5**
	Total	**10**	**10**	**20**

3.4.3 Australian Council for Educational Research Test (ACERT)

This is a standardized test and was adapted from Ehikhamenor (2012). It was a test employed to classify the students into mental ability level (that is: high, moderate and low). It contains questions of different kinds: fill-in, essay type and multiple choice objective questions. The test measures mental ability of the testees. The original test consists of forty- two items (42).

The effectiveness of this test has been ascertained by Adekunle (2005). The test was observed to have capacity in discriminating between high, moderate and low ability participants. The test was revalidated for its suitability by reviewing and critiquing in order to modify and detect technical errors. Thirty six (36) items survived scrutiny. The test items were pre-tested on two separate occasions within two weeks interval on participants different from participants of the study. The reliability was determined and the reliability index of 0.86 was obtained using Alternate/ Parallel forms of reliability. The total correct scores for a student were noted. These were used to classify students into high, moderate and low ability groups. The participants who scored 60% and above in the ACER test were assigned to high mental ability group, those participants who scored within the range 40% to 59% were assigned to moderate ability group, while those who obtained scores less than 40% were placed in low ability group.

3.4.4 Teachers' Instructional Guide for Crossword-Picture Puzzle-Based Teaching Strategy, TIGCPPTS

This instrument was adapted with modification from Bolorunduro (2005). It contained the lessons for the eight weeks of treatment. The general features of this guide were: subject, class, Instructional strategy, topic, sub-topic, duration, initial capability of the learner (previous knowledge), instructional objectives, reference book, Introduction, presentation and evaluation. The specific features of this guide were: small group experiment, individual experiment, the use of laboratory apparatus, the use of game with picture puzzles and crossword puzzles. To ascertain the face and content validity of the instrument, two lecturers from Science Unit in the Department of Teacher Education, Faculty of Education, University of Ibadan, Ibadan, were given copies of the instrument for close examination. Their suggestions and ratings were incorporated to produce the final copy of the instrument and the inter-rater reliability was estimated using Scott's π, and inter-rater reliability index of 0.76 was obtained.

3.4.5 Teachers' Instructional Guide for Enhanced Explicit Teaching Strategy (TIGEETS)

This was adapted from Ajila (2003) with modification. It contained lessons for eight weeks of the treatment. The general information on the guide was: subject, class, topic, sub-topic, duration, instructional objectives, initial capability of the learners (previous knowledge), instructional aids and reference book. The specific features of the guide were teachers activities which are: daily reviews, assessment of pupils previous works, brief introduction, teacher presenting learning tasks in a condensed and precise form, pairing of teachers with students (4 students to a teacher).Teachers were chosen based on their scores from previous class tests. Other features are: tutoring session by teachers with students, teachers guiding students, checking for understanding and providing feedback and class conclusion and decision making. It also contained students' activities. The instrument was given to Basic Science expert and peer reviewers to read and comment on the instrument. Their comments and recommendations helped to improve the face and content validity of the instrument. The inter-rater reliability was estimated using Scott's π statistic with inter-rater reliability index of 0.72 obtained. This ascertained the suitability of the instrument.

3.4.6 Teachers' Instructional Guide for Conventional Lecture Method, TIGCLM

This instrument was a conventional lecture method. The features were: subject, class duration, topic, sub-topic, instructional objectives, entry behaviour, instructional materials, introduction, and presentation (which is dominated by the teacher), evaluation (with the use of questions and answers), summary (usually done verbally), conclusion (students asked to copy the chalkboard summary), and assignment. The instrument was given to two experienced junior secondary school teachers in the field of Basic Science to ensure its face and content validity. The instrument was validated subject to their necessary corrections. The inter-rater reliability was estimated using Scott's π statistic and the inter-rater reliability index of 0.74 was obtained.

3.4.7 Evaluation Sheets for Assessing Teachers' Performance during Training, ESATPT

This was meant to assess the research assistants' performance during the course of the training. The instrument contained personal data of the research assistants which are: school, gender and criteria for evaluation. The instrument was placed on four point likert scale as follows:

Very High- 5

High – 4

Moderate – 3

Low – 2

Very Low - 1

This instrument was given to the experts and peers that are in the field of Science Education. Their comments, criticism and scholarly contributions and suggestions were used to modify the items. This ascertained the appropriateness and relevance of the method to the target population.

3.5 Procedure for Data Collection

Work Schedule

The following time schedule was adopted:

- The first one (1) week was used for visitations to Ministries of Education and schools.
- The next two (2) weeks for training of research assistants.
- Next one (1) week for pretest.
- Next eight (8) weeks for treatment using the trained research assistants.
- Next one (1) week for posttest.

This makes a total of thirteen (13) weeks.

3.5.1 Training of Research Assistants

Training was done step by step using the teaching guides on:

- Crossword-Picture Puzzle-Based teaching strategy
- Enhanced Explicit Teaching strategy
- Conventional Lecture Method

3.5.2 Administration of Pretest

All the students in the class involved in all the nine (9) schools were involved in the experiment and were given a pretest on all the evaluative instruments. The pretest was for a period of one (1) week. For the students, Basic Science Students' Attitude Scale, BSSAS was given first, followed by ACERT Test and lastly, Basic Science Students' Achievement Test, BSSAT.

3.5.3 Treatment Procedure

The treatment was carried out on the experimental and control groups. The schools were randomly assigned to experimental (CPP and EET) and control (CLM) groups. During this period, students were taught six selected concepts in Basic Science (Drug Abuse, Habitat, Changes in matter, Respiratory System, Information and Communication Technology and Heat Energy) by the research assistants using:

- Crossword-Picture Puzzle-based teaching
- Enhanced Explicit Teaching
- Conventional Lecture Method

This stage lasted eight weeks.

3.5.3.1 Experimental Group I (Crossword-Picture Puzzle-Based Teaching Strategy)

For experimental group 1, the steps in the treatment were as follows:

PHASE 1: Inquiry, Question and Answer

Step 1: Questions were asked from students to help students understand a given idea, concept, principle, etc.

Step 2: Divide students into small groups of 4-5 members.

Step 3: Students follow written instructions.

Step 4: Students manipulate apparatus.

Step 5: students classify quantities

Step 6: students take measurements of quantities.

Step 7: Students record observations.

Step 8: Students infer from results.

Step 9: Students report individually.

PHASE 2: Games-Crossword and Picture Puzzles

Step 1: Students follow verbal instruction on games.

Step 2: Students manipulate games.

Step 3: Students record score in games.

Step 4: Winner of games recognized.

Rules for playing the game-Picture puzzle (Group work)

Ask a member of group to pick a number.

The picture (from students' content note) that corresponds to this number would be given to the group to solve the puzzle.

Give five (5) minutes to the group to complete the puzzle by fixing the labels on the picture.

Rules for playing the game-Crossword puzzle (Individual work)

Give individual student crossword puzzle on the given topic.

Ask individual student to form specific number of words (e.g. at least 10 words) in a specific time (e.g. 5 minutes) using the crossword puzzle.

3.5.3.2 Experimental Group II (Enhanced Explicit Teaching Strategy)

The following steps were involved in experimental group 2:

Step 1: Learning tasks are presented in a condensed and precise form through:

-Daily Review: The objectives of the lesson and duration of lesson explained.

-Assessment of Students' Previous Work: Students will be asked some questions.

-Brief Introduction.

-Lesson Demonstration.

-Provision of Guided Practice.

-Checking for Understanding and Providing Feedback.

Step 2: Pairing of Peer Teachers with Students

- Peer teachers are selected among the Students based on ability and social interaction in the class.

- Peer teachers are paired with Students.

Step 3: Tutoring Session by Peer teachers with Students.

-Each peer goes into tutoring session.

- Peer teachers explain the objectives of the lesson and the lesson tasks to students.

- Peer teachers ask students probing questions and offer assistance where necessary.

- Peer teachers record vital points observed.

Step 4: Peer teachers guide students.

- Students carry out certain activities as directed by the teacher.

- Peer teachers ask questions from students and give assistance.

Step 5: Checking for Understanding and Providing Feedback.

- Peer teacher sums up the total activities performed by the students and relay them to the students.

- Peer teacher corrects errors and asks students to repeat the learning task in which an error has occurred.

- Peer teacher prompts student to participate actively in the task by encouragement and praises for correct response, waiting for students to attempt a problem independently before offering assistance.

-The activities of the peers are monitored

Step 6: Class Conclusion and Decision Making.

-Each peer teacher presents summary.

-Each class member asks question.

-Important points are written on the chalkboard.

-Peer differences are reconciled.

-Well behaved peers are rewarded by clapping for them and offering them verbal praises.

3.5.3.3 Control Group (Conventional Lecture Method)

The steps involved are:

Step 1-Teacher introduces the lesson by asking students questions on the previous lesson.

Step 2-Teacher states the new topic.

Step 3-Teacher discusses the content of the new lesson.

Step 4-Teacher asks oral questions from the learners to ascertain change in the initial capability of the learners.

Step 5-Teacher gives a brief oral review of the lesson taught.

Step 6-Teacher asks learners to write the content notes.

Step 7-Teacher gives homework to the learners.

3.5.4 Administration of Posttest

At the end of the treatments, one (1) week was used for the administration of the evaluative instruments.

3.6 Method of Data Analysis

Data collected were analysed using Analysis of Covariance (ANCOVA) of the posttest achievement and attitude scores of students by treatment, gender and mental ability with the respective pretest scores used as covariates. The pretest scores were used as covariates in order to cater for initial differences in the dependent variables and other extraneous factors which could confound the treatment effect. Analysis of covariance was used to estimate the effects of the independent variables and the moderator variables on the observed differences in the pre and post treatment scores of the participants. In the case of significant main effect, estimated marginal means of posttest achievement and attitude scores of students by treatment and control, gender and mental ability was used to detect the differences in performance level. Scheffe post hoc statistical test was used for treatment group to detect the direction of significant main effect. Charts were used for illustrating the nature of the effects.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

This chapter presents the data and interpretation of the outcomes of their statistical analysis. The general sequence of presentation follows the order of the hypotheses. In order to estimate the effects of the independent variables and the moderator variables on the dependent measures, the Analysis of Covariance (ANCOVA) was run with the pretest scores used as measure of control (covariates). Scheffe post hoc analysis was done where there were significant differences among the groups. All hypotheses were tested at level 0.05 level of significance.

4.1 Testing of hypotheses

4.1.1 Hypothesis 1a: There is no significant main effect of treatment on Students' achievement in Basic Science.

Table 4.1: Posttest Achievement Scores of Students by Treatment, Gender and Mental Ability

Source	Type III Sum of Squares	Df	Mean Square	F	Sig	Partial Eta Squared
Corrected Model	4793.665	18	266.315	57.833	0.000	0.737
Intercept	5188.588	1	5188.588	1126.759	0.000	0.752
Pretest*	33.367	1	33.367	7.246	0.007	0.019
Treatment	1861.848	2	930.924	202.160	0.000*	0.521
Gender	18.363	1	18.363	3.988	0.047*	0.011
Mental ability	46.390	2	23.195	5.037	0.007*	0.026
Treatment ×Gender	9.022	2	4.511	0. 980	0.376	0.005
Treatment×Mental ability	30.020	4	7.505	.630	0.166	0.017
Gender×Mental ability	20.325	2	10.163	2.207	0.111	0.012
Treatment×Gender×Mental ability	11.707	4	2.927	0 636	0.637	0.007
Error	1708.409	371	4.605			
Total	73955.000	390				
Corrected Total	6502.074	389				

R Squared=0.737 (Adjusted R Squared=0.725) *significant at p<.05

Table 4.1 revealed that treatment had a significant main effect on students' posttest achievement scores [$F_{(2,389)}$ =202.160; $p< .05$; partial eta squared=.521]. The effect size of 52.1% was fair. The hypothesis is therefore rejected. This means that there was a significant difference in the mean achievement scores of students exposed to Crossword-Picture Puzzle Based teaching, Enhanced Explicit Teaching and Conventional Lecture Method. On the basis of this finding, hypothesis 1a was rejected. To find out the magnitude of the mean scores of the groups' performance, Table 4.2 is presented

Table 4.2: Estimated Marginal Means of Posttest Achievement Scores by Treatment and Control Group.

Grand Mean=13.518

Treatment	Mean	Std.Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Crossword-Picture Puzzle				
Enhanced Explicit Teaching	16.921	.323	16.286	17.556
Conventional Lecture Method	14.816	.257	14.312	15.321
	8.817	.286	8.254	9.380

Table 4.2 revealed that students in the Crossword-Picture Puzzle Based Teaching treatment group had the highest adjusted posttest mean achievement scores ($\bar{x}$ =16.921) followed by Enhanced Explicit Teaching treatment group ($\bar{x}$ =14.816), while students in the Conventional Lecture Method group had the least adjusted mean achievement score ($\bar{x}$ =8.817). The grand mean being 13.518. Further, the source of significant difference obtained in 4.1 was traced using Scheffe Post-hoc test in Table 4.3

Table 4.3: Scheffe Post-Hoc Analysis of Posttest Achievement Score According to Treatment Group.

Treatment	N	Mean	1.Crossword-Picture Puzzle	2.Enhanced Explicit Teaching	3. Conventional
1.Crossword-Picture Puzzle	135	16.921		*	*
2.Enhanced Explicit Teaching	126	14.816	*		*
3. Conventional	129	8.817	*	*	

*Pairs of group significantly different at p<.05

The result from post-hoc analysis in Table 4.3 revealed that group 1 (Crossword-Picture Puzzle Based Teaching) was significantly different from Enhanced Explicit Teaching and Modified Conventional Teaching strategies in their achievement scores. Enhanced Explicit Teaching was significantly different from Crossword-Picture Puzzle Based Teaching and Conventional Lecture Method in their achievement scores. These revealed that the direction of increasing effect of instructional strategy (treatment) on students' achievement was Conventional Lecture Method < Enhanced Explicit Teaching< Crossword-Picture Puzzle Based Teaching

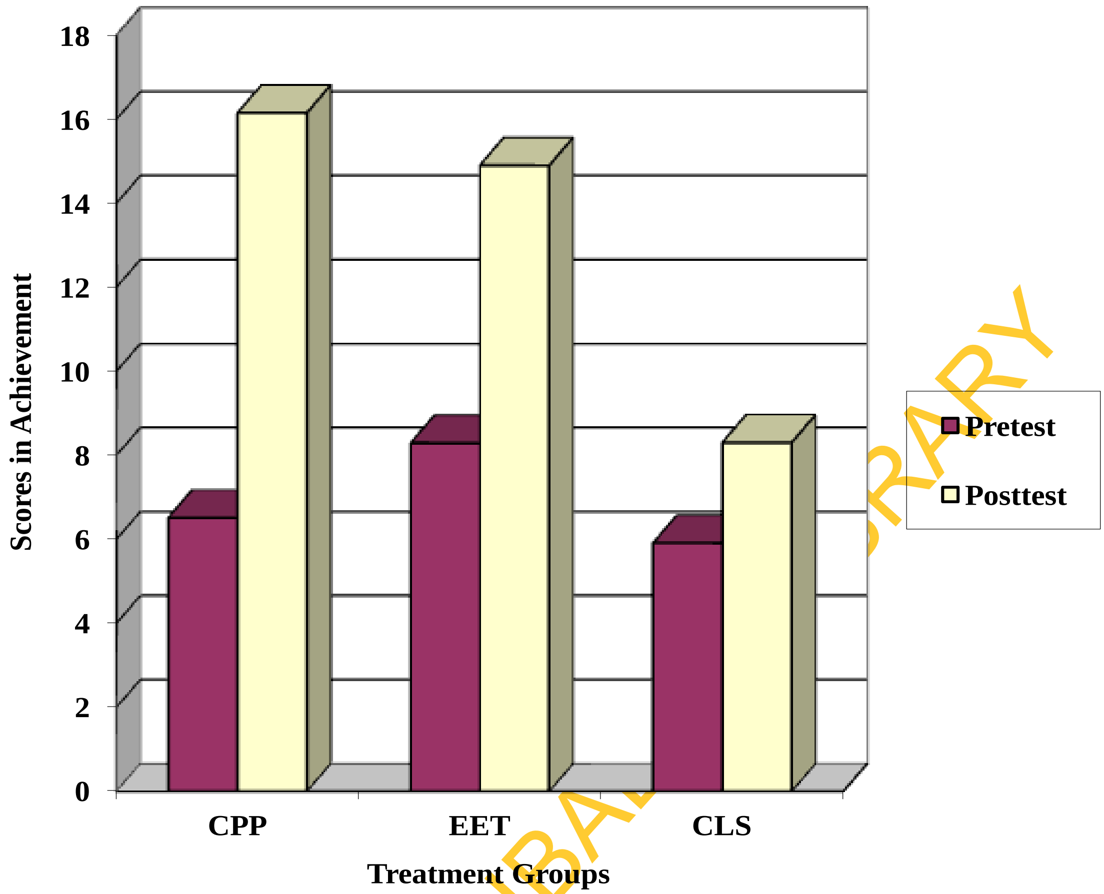

Fig. 3.1: Chart Showing Achievement According to Treatment

Hypothesis1b: There is no significant main effect of treatment on Students' attitude to Basic Science.

Table 4.4 Posttest Attitude Scores of Students by Treatment, Gender and Mental Ability

Source	Type III Sum of Squares	Df	Mean Square	F	Sig	Partial Eta Squared
Corrected Model	2543.864	18	141.326	3.302	0.000	0.140
Intercept	31162.117	1	31162.117	728.159	0.000	0.665
Preattscore	8.997	1	8.997	0.210	0.647	0.001
Treatment	984.711	2	492.356	11.505	0.000*	0.059
Gender	17.281	1	17.281	0.404	0.526	0.001
Mental ability	43.059	2	21.530	0.503	0.605	0.003
Treatment×Gender	40.842	2	20.421	0.477	0.621	0.003
Treatment×Mental ability	54.855	4	13.714	0.320	0.864	0.004
Gender×Mental ability	76.842	2	38.421	0.898	0.408	0.005
Treatment×Gender×Mental ability	107.741	4	26.935	0.629	0.642	0.007
Error	15663.242	371	42.796			
Total	1168904.000	390				
Corrected Total	18207.106	389				

R Squared=0.140 (Adjusted R Squared=0.097) *significant at p<.05

Table 4.4 revealed that there was a significant main effect of treatment on students' attitude to Basic Science [$F_{(2,389)}$ =11.505; p<.05; partial eta squared=.059]. The effect size of 5.9% was fair. On this basis, hypothesis 1b was rejected. This means that the difference between the students' attitude score exposed to Crossword-Picture Puzzle Based Teaching, Enhanced Explicit Teaching and that of control group was significant.

Table 4.5: Estimated Marginal Means of Posttest Attitude score by Treatment and Control Group.

Grand Mean=54.885

Treatment	Mean	Std.Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Crossword-Picture Puzzle	58.433	1.001	56.465	60.400
Enhanced Explicit Teaching	54.142	.758	52.651	55.632
Conventional Lecture Method	52.081	.896	50.319	53.843

Table 4.5 revealed that students in the Crossword-Picture Puzzle Based treatment group had the highest adjusted posttest mean attitude score ($\bar{x}$ =58.433), followed by the Enhanced Explicit Teaching treatment group ($\bar{x}$ =54.142), while students in the Conventional Lecture Method group had the least adjusted attitude score ($\bar{x}$ =52.081). The grand mean was 54.885. Further, the significant difference obtained as traced using Scheffe post-hoc test is in Table 4.6

Table 4.6: Scheffe Post-Hoc Analysis of Posttest Attitude Score According to Treatment Group.

Treatment	N	Mean	1.Crossword-Picture Puzzle	2.Enhanced Explicit Teaching	3. Conventional
1.Crossword-Picture Puzzle	135	58.433		*	*
2.Enhanced Explicit Teaching	126	54.142	*		
3. Conventional	129	52.081	*		

*Pairs of group significantly different at p<.05

The result from Table 4.6 Scheffe post-hoc revealed that group 1 (Crossword-Picture Puzzle Based Teaching) was significantly different from Enhanced Explicit Teaching and Conventional

Lecture Method in their attitude scores. Enhanced Explicit Teaching was significantly different from Conventional Lecture Method in attitude scores. This revealed that the increasing effect of instructional strategy (treatment) on attitude was Conventional Lecture Method <Enhanced Explicit Teaching< Crossword-Picture Puzzle Based Teaching strategy.

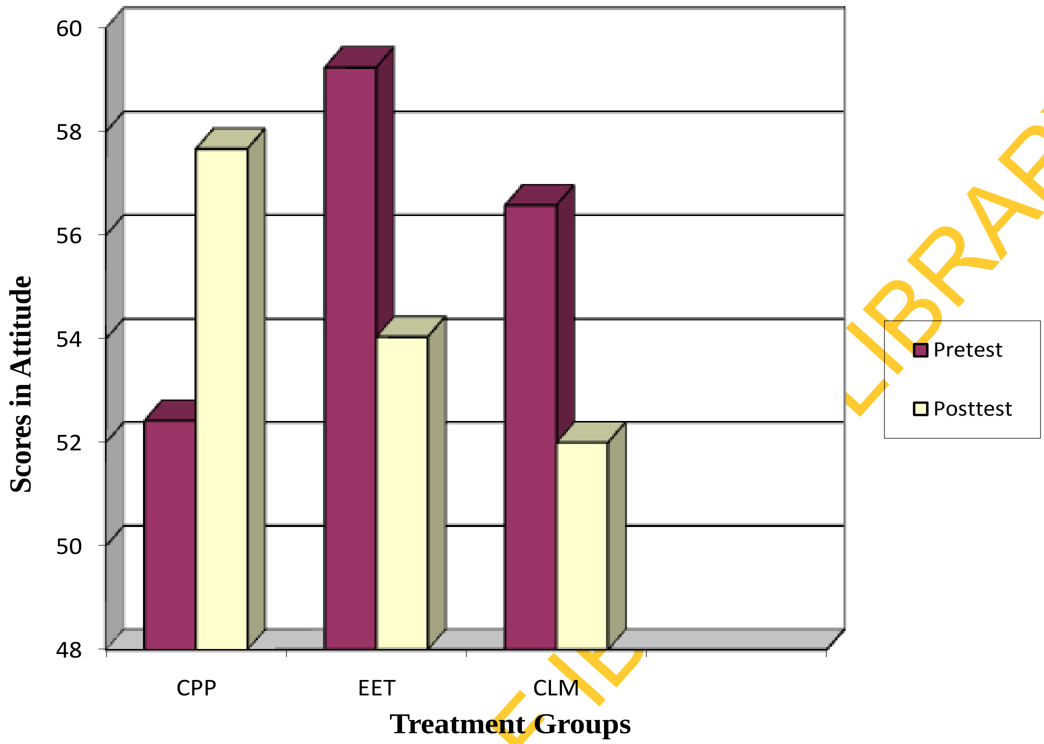

Fig.3.2: Chart Showing Attitude Scores According to Treatment

4.1.2 Hypothesis 2a: There is no significant main effect of Gender on Students' achievement in Basic Science.

Table 4.1 revealed that gender had significant effect on students' achievement [$F_{(1,389)}$ =3.988; p<.05; partial eta squared=.011]. The effect size of 1.1% was fair. Hypothesis 2a was therefore rejected. This implies that there was significant difference in the achievement scores of male students and their female counterparts.

Table 4.7: Estimated Marginal Means of Posttest Achievement Scores by Gender.

Grand Mean=13.518

Gender	Mean	Std.Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Male	13.848	.239	13.378	14.318
Female	13.188	.228	12.740	13.636

Table 4.7 revealed that male students had higher mean=13.848 while the female students had lower mean=13.188. It shows that the male achievement score was significantly different from their female counterpart.

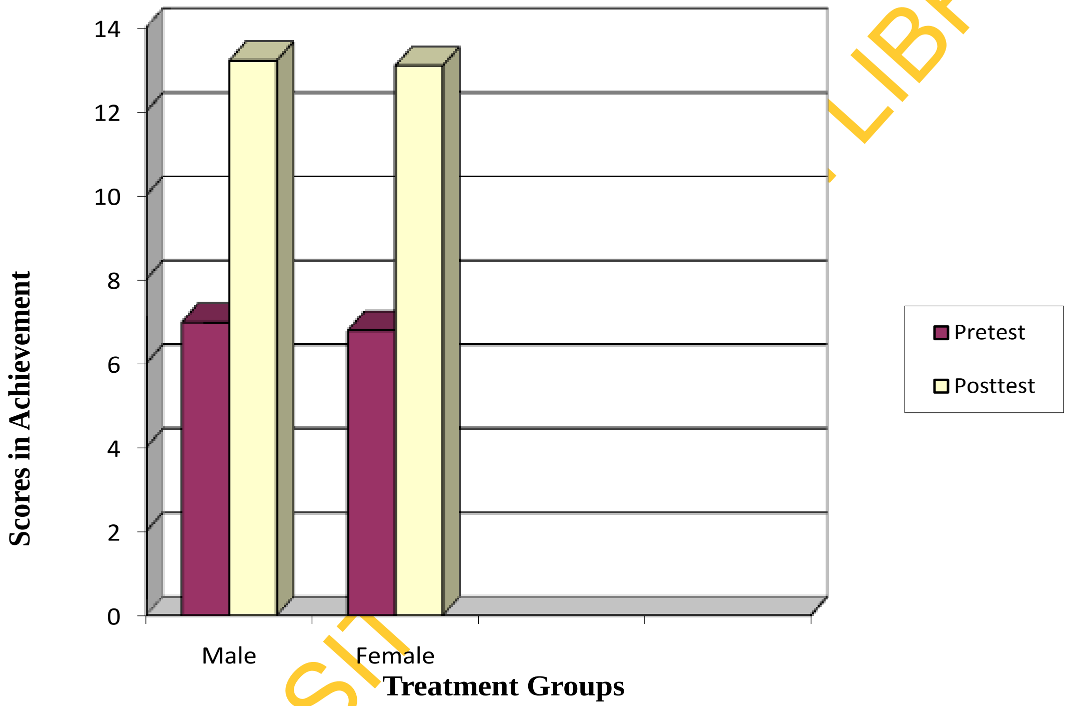

Fig. 3.3: Chart Showing Achievement According to Gender

Hypothesis 2b: There is no significant main effect of Gender on Students' attitude towards Basic Science.

Table 4.4 revealed that there was no significant main effect of students' gender on their attitude scores [$F_{(1,389)}$ =.404; p>.05; partial eta squared=.001]. Hence, hypothesis 2b was not rejected.

Table 4.8: Estimated Marginal Means of Posttest Attitude scores by Gender.

Grand Mean=54.885

Gender	Mean	Std.Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Male	55.210	.747	53.741	56.679
Female	54.560	.697	53.190	55.931

Male students had higher mean=55.210 while the female students had a lower mean=54.560, but the difference was not significant.

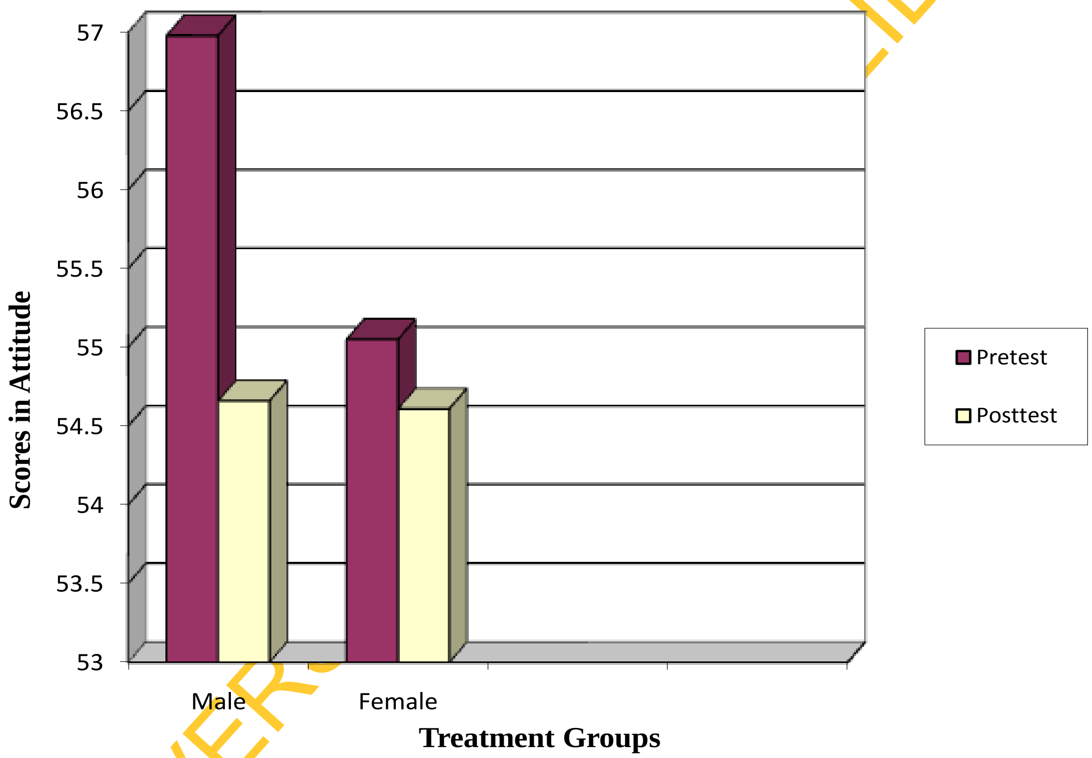

Fig. 3.4 Chart Showing Attitude According to Gender

4.1.3 Hypothesis 3a: There is no significant main effect of Mental Ability on Students' achievement in Basic Science.

Table 4.1 revealed that mental ability of students had significant main effect on their achievement scores [$F_{(2,389)}$ =5.037; p<.05; partial eta squared=.026]. The effect size of 2.6% was fair. Hypothesis 3a was therefore rejected. This implies that there was significant difference in the achievement scores of students with high, moderate and low mental ability.

Table 4.9: Estimated Marginal Means of Posttest Achievement Scores by Mental ability.

Grand Mean=13.518

Treatment	Mean	Std.Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Low	12.963	.129	12.709	13.217
Moderate	13.440	.294	12.862	14.017
High	14.151	.378	13.407	14.895

Table 4.9 revealed that there was significant main effect of mental ability of students on their achievement scores. The magnitude of their contributions to the significance are high ($\bar{x}$ =14.151) > moderate ($\bar{x}$ =13.440) > low ($\bar{x}$ =12.963).

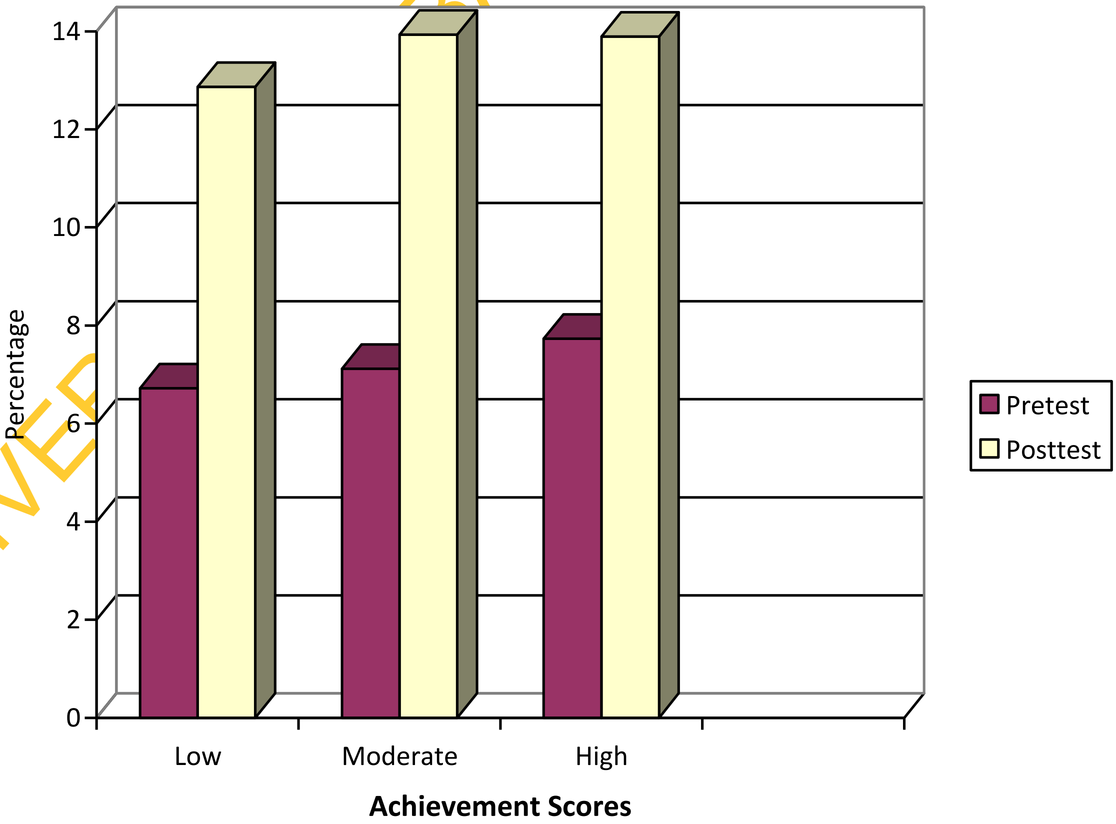

Fig. 3.5: Chart Showing Achievement According to Mental Ability

Hypothesis 3b: There is no significant main effect of Mental Ability on Students' attitude towards Basic Science.

Table 4.4 revealed that mental ability had no significant main effect on students' attitude [$F_{(2,389)}$ =.503; p>.05; partial eta squared=.003]. Therefore, hypothesis 3b was not rejected.

Table 4.10: Estimated Marginal Means of Posttest Attitude scores by Mental ability.

Grand Mean=54.885

Treatment	Mean	Std.Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Low	54.478	.396	53.699	55.257
Moderate	55.491	.929	53.664	57.318
High	54.686	1.152	52.421	56.952

Students with moderate mental ability had highest mean=55.491, followed by students with high mental ability ($\bar{x}$ =54.686), while students with low mental ability had the lowest mean of 54.478, but the difference was not significant.

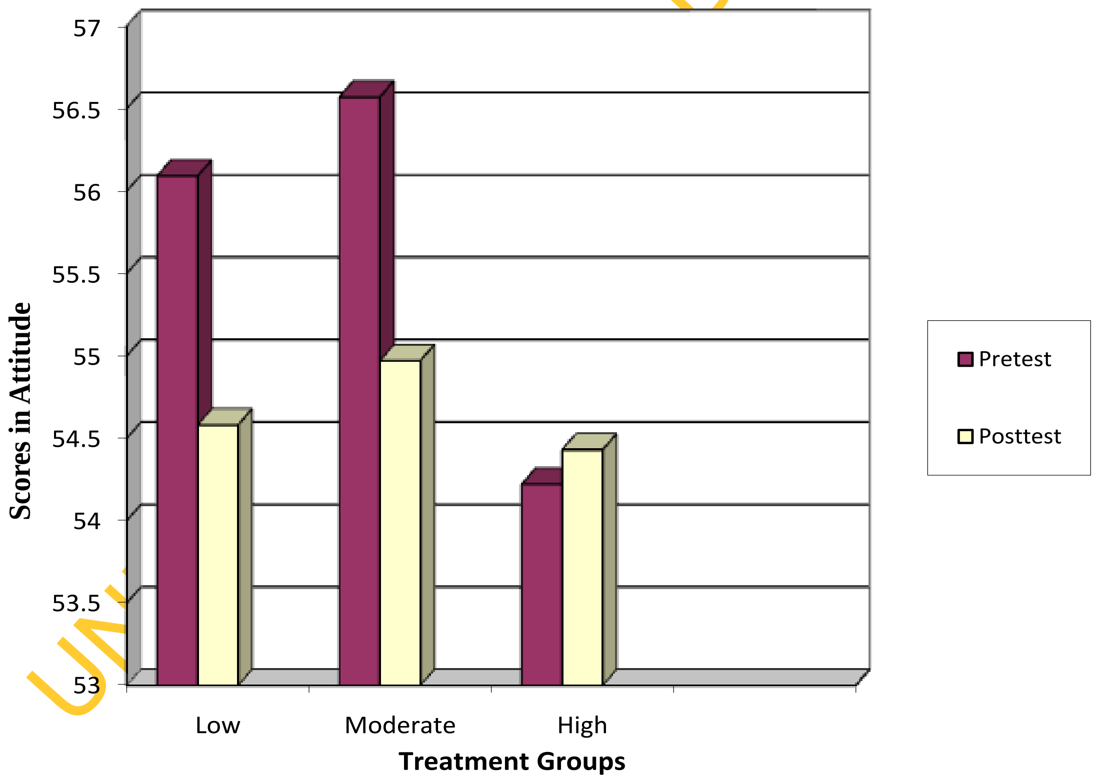

Fig. 3.6: Chart Showing Attitude Scores According to Mental Ability

4.1.4 Hypothesis 4a: There is no significant interaction effect of treatment and Gender on Students' achievement in Basic Science.

Table 4.1 revealed that the two-way interaction effect of treatment and gender was not significant on students' achievement scores [$F_{(2,389)}$ =.980; p>.05; partial eta squared=.005]. The effect size of 0.5% was negligible. Therefore, hypothesis 4a was not rejected.

Hypothesis 4b: There is no significant interaction effect of treatment and Gender on Students' attitude towards Basic Science.

Table 4.4 revealed that the interaction effect of treatment and gender on attitude scores was not significant [$F_{(2,389)}$ =.477; p>.05; partial eta squared=.003]. The effect size of .3% was negligible. Hence, hypothesis 4b was not rejected.

4.1.5 Hypothesis 5a: There is no significant interaction effect of treatment and Mental Ability on Students' achievement in Basic Science.

Table 4.1 revealed that there was no significant two-way interaction effect of treatment and mental ability on students' achievement scores [$F_{(4,389)}$ =1.630; p>.05; partial eta squared=.017]. The effect size of 1.7% was negligible, on the basis of this finding, hypothesis 5a was not rejected.

Hypothesis 5b: There is no significant interaction effect of treatment and Mental Ability on Students' attitude towards Basic Science.

Table 4.4 revealed that there was no significant interaction effect of treatment and mental ability on students' attitude scores [$F_{(4,389)}$ =0.320; p>.05; partial eta squared=0.003]. The effect size of 0.3% was negligible. Hence, hypothesis 5b was not rejected.

4.1.6 Hypothesis 6a: There is no significant interaction effect of Gender and Mental Ability on Students' achievement in Basic Science.

Table 4.1 revealed that there was no significant interaction effect of gender and mental ability on students' achievement scores [$F_{(2,389)}$ =2.207; p>.05; partial eta squared=0.012].The effect size of 1.2% was negligible. Hence, hypothesis 6a was not rejected.

Hypothesis 6b: There is no significant Interaction effect of Gender and Mental Ability on Students' attitude towards Basic Science.

Table 4.4 revealed that there was no significant interaction effect of gender and mental ability on students' attitude scores [$F_{(2,389)}$ =0.898; p>.05; partial eta squared=0.005]. The effect size of 0.5% was negligible. Hence, hypothesis 6b was not rejected.

4.1.7 Hypothesis 7a: There is no significant interaction effect of treatment, Gender and Mental Ability on Students' achievement in Basic Science.

From Table 4.1, the three-way interaction effect of treatment, gender and mental ability on students' achievement scores was not significant [$F_{(4,389)}$=0.636; p>.05; partial eta squared=0.007]. The effect size of 0.7% was negligible. Hence, hypothesis 7a was not rejected.

Hypothesis 7b: There is no significant interaction effect of treatment, Gender and Mental Ability on Students' attitude to Basic Science.

From Table 4.4, the three-way interaction effect of treatment, gender and mental ability on students' attitudinal score was not significant [$F_{(4,389)}$=0.629; p>.05; partial eta squared=0.007]. The effect size of 0.7% was not significant. Hence, hypothesis 7b was not rejected.

4.2 Discussion

4.2.1 Effects of Treatments on Students' Achievement

The result obtained revealed that treatment had a significant effect on students' achievement in Basic Science. This indicated that there was a significant difference in the mean achievement scores of students exposed to Crossword-Picture Puzzle Based teaching, Enhanced Explicit Teaching and Conventional Lecture Method. Students in the Crossword-Picture Puzzle Based Teaching treatment group had the highest adjusted posttest mean achievement scores ($\bar{x}$ =16.921), followed by Enhanced Explicit Teaching treatment group ($\bar{x}$ =14.818), while students in the Conventional Lecture Method group had the least adjusted mean achievement score ($\bar{x}$ =8.817). The results obtained here could be because children naturally enjoy engaging in activities. The classroom experience they were exposed to was in line with their natural curiosity to engage in activity which crossword-picture puzzle and enhanced explicit teaching strategies had satisfied. Following the constructivists, when children are provided with tools to work with and gainfully engage in meaningful activities, they easily construct their own knowledge. The reasons for these results might be the game strategy and peer interaction employed, which allowed the students to interact directly with puzzles that provided them with activity-stimulated environment and learn among the peer groups. The use of crossword puzzle for independent practice and picture puzzle for group practice in form of game stimulated their interest to learn, consequently enhancing their achievement.

The results from this study departed from earlier study by Afuwape (2002), that revealed no significant effect of treatment on students' achievement in Integrated Science. However, the result of this study lends credence to most researchers that recorded a significant contributions of treatment on students' achievement in Integrated Science (Martins and Oyebanji, 2000; Shaibu and Usman, 2002; Ige and Arowolo, 2003). The result obtained also supports Ajila (2003), who found that students exposed to Enhanced Explicit Teaching strategy performed significantly better than students in the lecture group. Bolorunduro (2005) also carried out a study on the Impact of the Instructional Strategies of the Nigeria Integrated Science Teacher Education Project on Students' Learning Outcomes at Junior Secondary School Level, and reported a significant contribution of puzzle-based teaching strategy to students' achievement in Integrated Science which is in support of the result of this study.

4.2.2 Effects of Treatments on Students' Attitude

The result of the study in Table 4.4 also revealed that treatment had a significant effect on students' attitude towards Basic Science. This means that the difference between the attitude scores of students exposed to Crossword-Picture Puzzle Based Teaching, Enhanced Explicit Teaching and that of control group was differentially significant. Students in the Crossword-Picture Puzzle Based treatment group had the highest adjusted posttest mean attitude score ($\bar{x}$ =58.433), followed by the Enhanced Explicit Teaching treatment group ($\bar{x}$ =54.142), while students in the Conventional Lecture Strategy group had the least adjusted attitude score ($\bar{x}$ =52.081). Students, on exposure to crossword-picture puzzle teaching strategy, were all excited when they saw various crossword puzzles and picture puzzles. They were all joyfully anticipating to be given one to work with. Immediately the instructions on how to complete the puzzle were given, they were keenly interested in the exercise. The puzzle greatly appealed to their emotion.

Enhanced explicit teaching strategy also enhanced students' attitude probably because it was highly welcoming to them to have been acting like their teacher and given opportunity to teach and learn among their peer groups. They saw themselves being fulfilled. Teaching, instructing, demonstrating and presenting instructions like their teachers, to them, was like a magic. This promoted their interest to learn. This agreed with Bolorunduro (2005), who reported that using Puzzle-based instructional strategy significantly enhanced attitude of students towards Integrated Science. This result also lends credence to Afuwape (2002), who reported that game significantly contributed to achievement of students in Integrated Science.

Adedoja, Abidoye and Afolabi (2013) also carried a study on effects of two puzzle-based instructional strategies on primary school pupils' learning outcomes in social studies, the result revealed that puzzle-based strategies improved students' attitude, which supports the result of this study. Converse result was obtained by Agboola and Oloyede (2013), who investigated effects of concept mapping and peer tutoring instructional strategies on learning outcomes of students in chemistry. The population for the study consisted of senior secondary school chemistry students. A total of 57 senior secondary school II (SSS II) chemistry students in two intact classes constituted the population. The results revealed that the use of concept mapping and peer-tutoring instructional strategies did not significantly influence the attitude of students to the learning of chemistry.

4.2.3 Influence of Students' Gender on Achievement

The results obtained showed that gender had significant effect on students' achievement. Male students had higher mean=13.848 while the female students had lower mean=13.188. It showed that the male achievement score was significantly different from their female counterpart. This means that the result of this study was in favour of male students. The findings of this study could probably be attributed to girl's pre-thinking and misconception that science is difficult to learn. This view supports Ezirim's (2006) when comparing reasons for girls' and boys' poor performance in science: that girls think that science is a difficult and demanding job; the boys are action-oriented, problem-solvers, while girls are helpful observers; the boys are in charge of the inquiry, while the girls are in charge of reporting the team's results; while girls generally prefer painting, drawing and writing stories, boys prefer building and modeling with construction kits and being physically active. This researcher, because of her observation, concluded that girls are called less often to lead in class. The result of this study is consistent with the study of Asante (2012), who reported that males' achievement in Integrated Science significantly is better than their female counterparts. Ugwungwu (2006) worked on a Meta analysis of gender differences in students' performance in physics. Twenty-three research studies conducted all over Nigeria were collated. The result revealed that being a male enhanced performance in physics.

Also, Olaniyi (2009) examined the effects of Jigsaw II and group-investigation cooperation learning models on pre-service teachers' learning outcomes in selected environmental concepts in Integrated Science. The study involved four hundred and fifty 200-level Integrated Science pre-service teachers participated in the study (225 male and 225 female). The study revealed a significant effect of gender on pre-service teachers' achievement with male respondents performing better than their female counterparts.

Although, Busari's (2012) finding revealed that gender had significant main effect on achievement, the result was in favour of female students. Converse results of several studies showed that gender had no significant effect on achievement (Afuwape, 2002; Raimi and Adeoye, 2002; Ajila, 2003; Oshodi, 2006; Okoruwa, 2007; Ekine, 2009; Aremu and Sangodoyin, 2010; Oludipe, 2012)).

Afuwape (2002) studied simulation game assisted instruction, student cognitive style and numerical ability as determinants of learning outcomes in Integrated Science. Three hundred and five junior secondary III students participated. The result revealed no significant main effect of gender on students' achievement in Integrated Science. The work of Raimi and Adeoye (2002) on gender differences among college students as determinants of performance in Integrated Science involving fifty one (51) Integrated Science students, drawn from two colleges of Education in Oyo State, revealed no significant main effect of gender on students' cognitive achievement.

In his study, Ajila (2003) investigated comparative effects of explicit and enhanced-explicit teaching on learning outcomes in primary science. Three from twelve randomly selected classes in six public primary schools were adopted for the study. The study found no significant main effect of gender on science achievement. Furthermore, Okoruwa (2007) investigated effects of conceptual change and enhanced explicit teaching strategies on learning outcomes in primary science. One hundred and ninety primary six pupils participated. The result revealed no significant moderating effect of gender on achievement, but it was significant on attitude.

4.2.4 Influence of Students' Gender on Attitude

Also, the result revealed that gender had no significant effect on attitude. However, Male students had higher mean=55.210, while the female students had a lower mean=54.560, but the difference was not significant. This negated the work of Ajila (2003) and Okoruwa (2007), who reported that gender, has significant effect on attitude of students in Integrated Science and Primary Science respectively. Males having higher performance than their female counterparts in this work could be probably attributed to males' domineering tendencies during instructional process. This is further explained on the basis of their tendencies to dominate discussions, always to lead and not ready to be led, their confidence and enthusiasm to approach new situation, while the reason for females' underachievement in this study could be that they are easily discouraged and depressed when they are exposed to new situation.

4.2.5 Influence of Students' Mental Ability on Achievement

The results obtained in Table 4.1 revealed that mental ability of student was significant on their achievement scores but not on their attitude scores. The study is consistent with that Oshodi (2006), who found that ability was significant on learning outcomes in primary science and Oyeniran (2010) showed that ability was significant on achievement in Mathematics, but was not significant on attitude. Students with high mental ability performed high; moderate mental ability students performed moderately, while students with low mental ability obtained the least achievement score. The reason for this result could perhaps be attributed to the capacity to acquire and apply knowledge, which may vary from person to person depending on the factors of heredity and environment. A student whose intelligent quotient is very high and is given an enabling environment to learn is likely to achieve highly. The same reason could be attributed to students with moderate intelligence and low intelligence quotients. This view is in line with that Sophie, Benedikt, Chamorro-Premuzic and Tomas (2011) that students with higher mental ability tend to achieve highly in academic settings.

In the theory of intelligence propounded by Carol (2009), the scholar presents what could be the reason for differences in achievement based on mental ability in a different way. To this researcher, some students believe that their intelligence is a fixed trait_that they have been given a certain amount of intelligence (entity theory of intelligence) and students with this view become very concerned with how much intelligence they have. Other students believe that their intelligence is a quality they can develop through their effort and education (incremental theory of intelligence), and students with this view are more focused on learning and becoming smarter. This researcher concluded that each theory affects not only students' motivation to learn, but also their success in learning and their achievement in school. Obseriving from this dimension, the study of Aremu and Sangodoyin (2010) revealed that students with low mental ability tend to have low level of motivation towards learning, and their attitude towards learning may be negative but the result negates Ajila (2003), who found that students' academic ability was not significant on their achievement.

4.2.6 Influence of Students' Mental Ability on Attitude

Also, mental ability was not significant on attitude of students to Basic Science. However, Students with moderate mental ability had highest mean=55.491, followed by students with high mental ability ($\bar{x}$ =54.686), while students with low mental ability had the lowest mean of 54.478, but the difference was not significant. The implication of this finding is that students' attitude to Basic Science does not depend on their mental ability. If students could have a moderate level of positive attitude, they could record a substantial achievement. The reason for the result obtained in this study could be because of the type of method of instruction and appropriate materials used in this study, which promoted motivation to learn and which invariably had a positive effect on achievement as students with high, moderate and low mental ability learn with ease. Supporting the potential role of method of instruction on students' learning, Patan (2010) investigated the effects of four methods of teaching on achievement in basic mathematics. The result showed that the methods of teaching and mental ability had interacted with each other, which resulted in high performance level among students. The reason could also be hinged on availability of materials for learning during the study.

Constructivist theory emphasizes that knowledge is constructed through the process of adapting to the events and ideas a child experiences, and that the construction of knowledge is significantly influenced by the child's environment, symbols and materials available. These symbols and materials become the tools to think with, which affect how the child perceives, interprets and functions in his/her environment. This theory sees puzzle activity as the child's engagement with his own development. Materials (pictures, puzzle, and laboratory apparatus) constructed or made available by the instructor stimulated the thinking process and made learners active. As learners were effectively engaged, they were able to discover hidden knowledge and skill, making them scientifically literate. The instructor or child's peer and the learners engaged in active learning environment (Bruner, 1973). The practical activities, that is, picture puzzles, crossword puzzles and class activities/experiments provided learners with meaningful experience through the manipulation of materials in such a manner that led to students' learning.

4.2.7 Two-Way Interaction

Results of the study revealed no significant two-way interaction effects of (i) treatment and gender, (ii) treatment and mental ability, and (iii) gender and mental ability on students' (a) achievement in Basic Science and (b) attitude to Basic Science. These findings show that while treatment is neither sensitive to gender nor sensitive to mental ability, mental ability is not sensitive to gender on achievement in Basic Science and attitude to Basic Science.

The results tend to suggest that treatment, especially crossword-picture puzzle and enhanced explicit teaching strategies, account for the improved performance of students in Basic Science and then should be adopted by the practicing teachers. Teachers' choice of instructional strategies matters a lot, in terms of students' learning outcomes. Appropriate method of instruction employed by the teacher, coupled with an enabling environment, has the possibility to enhance students' learning outcomes. Inappropriate selection of instructional methodology may not have strong affinity to students' instructional success. The result is consistent with some previous studies by Aremu and Tella (2009); Oyeniran (2010) on achievement in Mathematics; and Agoro (2012) on Basic Science achievement; and Ukoh (2012) on Physics achievement. But, it is at variance with others (Ajila, 2003; Oshodi, 2006) who worked on primary science and Patan (2010) on Basic Mathematics respectively.

4.2.8 Three-Way Interaction

The results of this study in Table 4.1 and Table 4.4 showed that the interaction effect of treatment, gender and mental ability on students' achievement scores and attitude scores was not significant. This indicated that the effect of treatment recorded on students' achievement and attitude was not based on students' gender and their mental ability. This implied that being male or female students with high, moderate or low mental ability do not matter, what really determines their achievement in Basic Science and their attitude is their exposure to the appropriate type of instructional strategies (treatment). The result of the study is consistent with several studies (Oshodi, 2006; Aremu and Sangodoyin, 2010; Oyeniran, 2010) but negates the result of the study conducted by (Ajila, 2003).

4.3 Summary of Findings

The findings of this study are summarized thus:

1. There is a significant main effect of treatment on students' achievement in and attitude to Basic Science. Students in the Crossword-Picture Puzzle Based Teaching treatment group had the highest adjusted posttest mean achievement and attitude scores followed by Enhanced Explicit Teaching treatment group, while students in the Conventional Lecture Method group had the least adjusted mean achievement and attitude scores.
2. Gender has a significant main effect on students' achievement but there is no significant main effect on their attitude.
3. Mental ability has a significant main effect on students' achievement but there is no significant main effect on their attitude.
4. The two-way interaction effect of treatment and gender on students' achievement and attitude is not significant.
5. There is no significant two-way interaction effect of treatment and mental ability on students' achievement and attitude.
6. There is no significant interaction effect of gender and mental ability on students' achievement and attitude.
7. The three-way interaction effect of treatment, gender and mental ability on students' achievement and attitude is not significant.

CHAPTER FIVE:

SUMMARY, CONCLUSION, IMPLICATIONS AND RECOMMENDATIONS

This chapter presents the summary of findings, conclusion, educational implication of findings and recommendations. The limitations of the study and suggestions for further research are also presented.

5.1 Summary

The study was carried out to determine the effects of Crossword-Picture Puzzle (CPP) and Enhanced Explicit Teaching (EET) on students' learning outcomes in Basic Science in Southwestern Nigeria, while the moderating effects of gender and mental ability were also examined.

The study adopted a pretest-posttest control group quasi-experimental design with 3x3x2 factorial matrix. Multi-stage sampling technique was adopted. Three hundred and eighty nine JSS 2 students from nine junior secondary schools were randomly selected in three states (Oyo, Ogun and Ondo). The schools were randomly assigned to experimental (CPP and EET) and control (CLM) groups, and the treatments were for 13 weeks. Seven instruments used were: Crossword-Picture Puzzle Teaching Strategy (r=0.76); Enhanced Explicit Teaching Strategy (r=0.72) and Conventional Lecture Method (r=0.74); Basic Science Students' Achievement Test (r=0.70); Basic Science Students' Attitude Scale (r=0.80); Australian Council for Educational Research Test (r=0.86) and Evaluation sheets for assessing research assistants. Seven hypotheses were tested at 0.05 level of significance. Data were analysed using ANCOVA and Scheffe post hoc test.

The findings of this study are presented below:

1. There was a significant main effect of treatment on (a) achievement in Basic Science and (b) attitude to Basic Science. There were significant main effects of (i) gender and (ii) mental ability on students' achievement in Basic Science, while no significant effects were found on attitudes to Basic Science.
2. There were no significant interaction effects of (i) treatment and gender (ii) treatment and mental ability (iii) gender and mental ability, on students' (a) achievement in Basic Science and (b) attitude to Basic Science.
3. There was no significant interaction effect of treatment, gender and mental ability on students' (a) achievement in Basic Science and (b) attitude to Basic Science.
4. Posttest achievement and attitude mean scores for students exposed to crossword-picture puzzle and enhanced explicit teaching strategies were significantly higher than for those exposed to conventional lecture method.

5. Posttest achievement mean score of male students was significantly higher than their female counterparts', while no significant effect was found on attitude to Basic Science although Male students had higher mean, while the female students had a lower mean, but the difference was not significant.
6. Posttest achievement mean scores of students with high mental ability were significantly higher than their moderate and low mental ability counterparts.
7. Treatment and gender accounted for 52.1% and 1.1% respectively of the variation in Basic Science achievement.
8. Also, treatment and gender accounted for 5.9% and 0.1% respectively of the variation in attitude to Basic Science.
9. Mental ability accounted for 2.6% and 0.3% of the variation in Basic Science achievement and attitude respectively.
10. Taking the independent variable (treatment) and the two moderator variables (gender and mental ability) together, they all accounted for 72.5% and 9.7% (adjusted R squared=0.725 and 0.097) of the variation in students' achievement in and attitude to Basic Science respectively.

5.2 Educational Implications

The study reveals that motivating students to learn science in an interesting environment is a great task for teachers and of paramount concern to curriculum planners. This can only be achieved through well-planned instructional activities and teachers' know how, in matters relating to instructional delivery. Strategies that will not encourage students' active participation during instructional processes and make them only to be 'auditory learners' are still traditional in nature. It then follows that teachers should adopt strategies that will improve students' motivation and learning in a collaborative environment through meaningful activities.

The study also shows the potential roles of game in students' learning of Basic Science. Students are very much familiar with game on mobile phones; they play with game toys bought for them by their parents; and they watch their parents and peers when playing with all sorts of game in their respective home environments. They would be motivated when they see their teachers in school using game, especially puzzle game to teach them. This exposure to game strategy in the classroom situation will make them to immediately connect their already existing ideas on game with the game strategy employed by their teachers. Hence, the experience will create an atmosphere of excitement for learning Basic Science. It further assists to overcome the tendency in hating Basic Science and the perception that some science concepts are difficult to learn.

The study further confirms the potentials of social interaction. By nature, lower animals associate together to achieve a common goal. This is observed in their attempts to search for food, build shelter and provide security/protection. This instinct follows the common saying that birds of the same feather flock together. Also, the same experience is observed in human beings being higher animals especially children, they are seen moving in groups: to play, to go for break/lunch or go home after school hours. During their social interaction, they learn either directly or indirectly. They learn directly by sharing ideas on what they have learnt in the class. They learn indirectly when they play together or share their home experiences. Children from good educational background where English Language is spoken interact with children from poor educational background. Their interactions improve children from poor educational background. Hence, students learn through social interaction.

The peer interaction/tutoring session of the strategy used has implication for class activities and laboratory tasks, where students are faced with the challenge of inadequate apparatus and large class size. Students can be put into groups of 4-5 members so that learning becomes a social activity through students' meaningful interaction, and consequently ameliorate the problem of inadequate materials and large class size.

The findings of the study would also assist the students to have an improved attitude to Basic Science, Basic Science teacher, Basic Science assignments and scientific activities. Students' attitude is either a 'promoter' or 'inhibitor' of their achievements. It becomes a promoter when it is positive and inhibitor when it is negative. The results of the study would motivate teachers to adopt and use strategies that promote Basic Science achievement and positive attitude.

The study further reveals the importance of interest and ability in choosing life career. High ability students in the study performed highly, students with moderate ability performed moderately and low ability students recorded low performance. Students should therefore match their interest with ability in order to produce a desirable effect on their career aspirations.

From the findings of this study, it is evident that it is possible to use crossword-picture puzzle as an alternative strategy of instruction at Junior Secondary school level. This game strategy encourages individual and group participation during Basic Science delivery. It gets students excited, improves their enthusiasm and promotes their interest in Basic Science. Hence, crossword-picture puzzle could produce a better level of achievement in Basic Science than the conventional lecture method that is often used.

The study has implication for the curriculum planners. They are encouraged to make use of these strategies: Crossword-picture puzzle and enhanced explicit teaching for effective Basic Science delivery in schools. Concepts in science subjects especially Physics, Chemistry and

Biology are contained in Basic Science at Junior Secondary School (JSS) level. Then, there should be the need for curriculum planners to accommodate strategies such as crossword-picture puzzle and enhanced explicit teaching that will present diverse science concepts in a stimulating atmosphere for students learning.

The findings of the study also have implication for the education sector in the area of training and retraining of teachers for professional developments. Teachers face the challenge of the changing world in terms of science, technology and innovations. Teachers must then be equipped with the corresponding strategies in order to face these challenges for improving students' learning.

5.3 Recommendations

Based on the findings of this study, the following recommendations are made.

1. Because educational game has the potential to foster learning during classroom instructional process, teachers should incorporate the use of game especially puzzle game for effective Basic Science delivery.
2. To improve students' achievement in and attitude to Basic Science, crossword-picture puzzle and enhanced explicit teaching strategies should be adopted in secondary schools.
3. Teachers of Basic Science should find out about the mental abilities of their students and bear these varied abilities in mind when planning and executing instruction in science classes.
4. To encourage girls' participation in science especially Basic Science, strategy that would not promote their motivation to learn, and consequently, improve their achievement is grossly inadequate.
5. On matters of students' choice of career, school counselors should continue to emphasize interest and ability for students not to make a wrong choice.

5.4 Limitations of the Study

In the process of conducting this study, there are constraints that may limit the generalization of the findings. These constraints are highlighted as follow:

1. The present study was carried out in nine public junior secondary schools in three states in Southwestern Nigeria (Oyo, Ogun and Ondo). This implies that other public and private junior secondary schools in other five geo-political zones were not covered. There is therefore the need for this study to be replicated in other geo-political zones of the federation.
2. Gender and mental ability were the moderator variables investigated in the study. However, it is anticipated that some other moderator variables such as students' home background, computer

proficiency, school location, school type etc. could limit the extent to which the findings of this study could be generalized.

The afore-mentioned limitations notwithstanding, it is hoped that the results of this study would serve as a basic foundation for further studies on Crossword-Picture Puzzle and Enhanced Explicit teaching strategies and their proper utilization for effective Basic Science delivery in schools.

5.5 Areas for Further Research

With respect to the findings and limitations in this study, the following suggestions are hereby made:

1. The study was carried out in only three states in Southwestern Nigeria. The study could be replicated in more states in other five geo-political zones of the federation.
2. The study could also be replicated at other levels of educational settings.
3. It is also suggested that similar studies could be carried out with attention on other moderator variables such as students' home background, computer proficiency, school location and school type.
4. This study could also be conducted in other areas of science like Physics, Chemistry, Biology, Animal Husbandry and Agricultural Science, etc.

5.6 Conclusion

This study was conducted as part of the efforts by educational researchers in promoting the right type of foundational attitude in learners to Basic Science (and other science disciplines), science teachers, scientific activities, Basic Science assignments. It was also an effort at improving the state of science teaching and learning in schools and consequently, promoting students' achievement in Basic Science. The study determined the effects of Crossword-Picture Puzzle-Based Teaching and Enhanced Explicit Teaching Strategies on students' learning outcomes in Basic Science. The study found that Crossword-Picture Puzzle-Based Teaching Strategy was more effective than Enhanced Explicit Teaching Strategy. However, Enhanced Explicit Teaching Strategy was more effective than the Conventional Lecture Method in teaching the selected concepts in Basic Science. Hence, Crossword-Picture Puzzle-Based Teaching and Enhanced Explicit Teaching Strategies can be used to foster the learning of selected concepts in Basic Science, irrespective of students' gender and mental ability levels.

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APPENDIX IA

SCIENCE EDUCATION UNIT
DEPARTMENT OF TEACHER EDUCATION
FACULTY OF EDUCATION
UNIVERSITY OF IBADAN, IBADAN

BASIC SCIENCE STUDENTS' ACHIEVEMENT TEST (BSSAT)

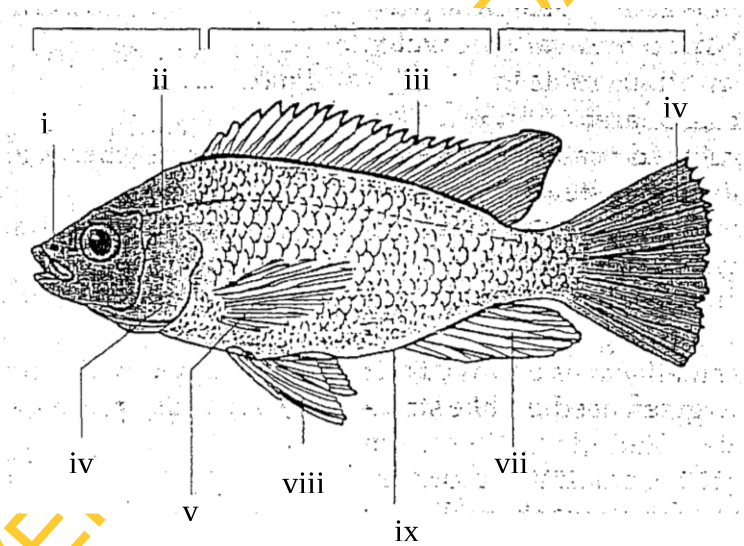
INSTRUCTION: Circle the correct option from options a – d

1. The following ways are means of contracting (getting) HIV except (a) transfusion of infected blood (b) hand shake (c) Using sharp unsterilized object e.g. needles (d) coming in contact with fluid of an infected person

2. Virus that causes AIDS is called? (a) virus (b) AIDS (c) bacteria (d) HIV

3. Which of the following is a place on land or underground where organisms live? (a) Aquatic habitat (b) river (c) terrestrial habitat (d) Mountain

4. Terrestrial habitat refers to (a) space environment (b) land environment
(c) Water environment (d) earthworm



Use the diagram above to answer question 5

5. The parts labelled – iii, vi, vii and viii are used for (a) breathing in water (b) adjusting changes in water pressure (c) ceremony (d) swimming and balancing in water

6. Physical changes include the following except (a) burning paper (b) ice changing to water (c) water changes to vapour (d) bleaching of skin

7. The changes that occur when new substances are formed are called? (a) Physical change (b) chemical change (c) social change (d) material change

8. Rusting of iron is an example of (a) chemical change (b) temporary change (c) physical change (d) expansion

9. Decaying of plants and animals is an example of? (a) Chemical change (b) geophysical change (c) physical change (d) economic change

10. The parts responsible for the supply of oxygen to the body cells and removal of carbon (iv) oxide include the following except (a) nostril (b) trachea (c) lungs (d) finger

11. Which of the following is a problem associated with breathing (a) sleeping sickness (b) cholera (c) pneumonia (d) typhoid

12. What are two types of respiration? (a) Excretion and ejection (b) fertilization and ovulation (c) sexual and asexual respiration (d) external and internal respirations

13. Which of these is not associated with the respiratory system? (a) Pneumonia (b) asthma (c) anemia (d) tuberculosis

14. The world is fast becoming a global village through the use of (a) camera (b) telescope (c) VDU (d) ICT

15. Mouse is an example of (a) output device (d) automobile car (c) input device (d) children toy

16. Heat can be transferred through (a) radiation (b) heating (c) boiling (d) temperature

17. The method of heat transfer that allows heat to travel through vacuum (empty space) is? (a) Convection (b) conduction (c) radiation (d) heating and cooling

18. Why do you think heat is different from temperature? (a) Because heat and temperature are the same concepts (b) because heat is hot and temperature is cold (c) because the unit of heat is joule (J) while the unit of temperature is ^{o}c (d) because both heat and temperature are forms of energy

19. Energy from the sun reaches the earth through (a) radiation (b) convection (c) coordination (d) conduction

20. Heat is a form of energy that flows from (a) a cold area to a hot area (b) a hot area to a cold area (c) a cold area to a cold area (d) a hot area to a hot area

APPENDIX IB

SCIENCE EDUCATION UNIT
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FACULTY OF EDUCATION
UNIVERSITY OF IBADAN, IBADAN

Answer to question 1 – 20

1. b
2. d
3. c
4. b
5. d
6. a
7. b
8. a
9. a
10. d
11. c
12. d
13. c
14. d
15. c
16. a
17. c
18. c
19. a
20. b

APPENDIX IC

SCIENCE EDUCATION UNIT
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UNIVERSITY OF IBADAN, IBADAN

ANSWER SHEET FOR BASIC SCIENCE STUDENTS' ACHIEVEMENT TEST (BSSAT)

INSTRUCTION: Circle the correct option from options a – d

Question No	Options: a-d			
1	a	b	c	d
2	a	b	c	d
3	a	b	c	d
4	a	b	c	d
5	a	b	c	d
6	a	b	c	d
7	a	b	c	d
8	a	b	c	d
9	a	b	c	d
10	a	b	c	d
11	a	b	c	d
12	a	b	c	d
13	a	b	c	d
14	a	b	c	d
15	a	b	c	d
16	a	b	c	d
17	a	b	c	d
18	a	b	c	d
19	a	b	c	d
20	a	b	c	d

APPENDIX IIA

SCIENCE EDUCATION UNIT
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UNIVERSITY OF IBADAN, IBADAN

BASIC SCIENCE STUDENTS' ATTITUDE SCALE (BSSAS)

Please fill or tick as appropriate

SECTION A

Name (optional) ---

Age ----------------------------------

Class --

Gender -------------------------- Male ☐ Female ☐

Name of School ---

SECTION B

The purpose of this questionnaire is to let students tell us what they think about Basic Science teacher, Basic Science assignments, scientific activities and Basic Science Subject. Please, give your own opinion for each statement by ticking the column ( ) that corresponds to your opinion.

S/N	STATEMENTS	SD	D	A	SA
	BASIC SCIENCE TEACHER				
6	I hate Basic Science teacher.				
7	I like the absence of Basic Science teacher from the class.				
8	I feel Basic Science teacher seems not competent to teach us.				
9	I feel Basic Science teacher comes to the class always.				
10	I like Basic Science teacher because he always teach us using science practical and materials.				
	BASIC SCIENCE ASSIGNMENTS				
11	I don't always do my Basic Science assignments.				
12	I think Basic Science assignments are a waste of time.				
13	I rarely participate in group assignments.				
14	I am always happy whenever Basic Science assignments are given to me.				
15	I feel Basic science assignments help to understand science better				
	SCIENTIFIC ACTIVITIES				
16	Lack of Basic science activities/practical makes me feel				

	unhappy.				
17	I think Basic Science class activities are not necessary.				
18	I feel Studying basic science with the use of science activities gives me better understanding.				
19	I like group activities.				
20	I hate to be involved in science activities.				
	BASIC SCIENCE SUBJECT				
21	I am happy anytime I fail Basic science.				
22.	I hate Basic science.				
23	To speak the truth, I like to write notes on Basic science.				
24	I feel Basic science is a difficult subject.				
25	I think Basic Science is for the Brilliant students.				

APPENDIX IIB

SCIENCE EDUCATION UNIT
DEPARTMENT OF TEACHER EDUCATION
FACULTY OF EDUCATION
UNIVERSITY OF IBADAN, IBADAN

ANSWER SHEET FOR BASIC SCIENCE STUDENTS' ATTITUDE SCALE (BSSAS)

SECTION A

Please fill or as appropriate

1. Name (optional) --
2. Age -----------------------------------
3. Class --
4. Gender -------------------------- Male ☐ Female ☐
5. Name of School --

SECTION B

The purpose of this questionnaire is to let students tell us what they think about Basic Science teacher, Basic Science assignments, scientific activities and Basic Science Subject. Please, give your own opinion for each statement by ticking the column ( ) that corresponds to your opinion.

S/N		STRONGLY DISAGREE (SD)	DISAGREE (D)	AGREE (A)	STRONGLY AGREE (SA)
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

APPENDIX IIIA

SCIENCE EDUCATION UNIT
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FACULTY OF EDUCATION
UNIVERSITY OF IBADAN, IBADAN

ACER TEST

Name---

School---

Gender: ----------------------------Male/Female

Age Now--

Birthday---

Class---

Date of Test--

This is a test to see how well you can think. It contains questions of different kinds. Some examples and practice questions will be given to show you how to answer the questions.

Example A:

Question 1:

Find out how the following numbers go. Write the missing numbers in the brackets:

2 5 8 - 14 17 - 23 (11 & 20)

Question 2:

Find out how the following numbers go. Write the missing numbers in the brackets:

4 3 6 5 - 7 10 - (8 & 9)

Question 3:

Find out how the following numbers go. Write the missing numbers in the brackets:

1 3 5 7 - 11 15 (9& 13)

Question 4:

Find out how the following numbers go. Write the missing numbers in the brackets:

26 23 20 17 14 - 8 - (11 & 5)

Example B:

Question 5:

Find the number which should be in the square with the question mark and write it in the brackets:

3	5	7
6	8	10
9	11	?

(13)

Question 6:

In this table two numbers are missing. Find the number which should be in the square with the question mark and write it in the brackets:

2	5	7
6	-	10
11	14	?

(18)

Question 7:

Find the number which should be in the square with the question mark and write it in the brackets:

1	3	5
3	-	7
5	7	?

(9)

Question 8:

Find the number which should be in the square with the question mark and write it in the brackets:

17	13	9
15	11	?
9	-	1

(7)

You will have 20 minutes to do the test. Some questions are easier than others. Try each question as you come to it, but if you find any question is too hard, leave it out and come back to it later if you have time. Do not spend too much time on any one question. Try to get as much right as possible. DO NOT TURN THE PAGE OVER UNTIL YOU ARE TOLD.

(Published by Australian Council for Educational Research. 147 Collins Street Melboume Copy right)

1. Find out how the following numbers go. Write the missing numbers in the brackets.

1 5 - 13 - 21 25 29 -

2. What change should I get from ₦10 note if I buy two theatre tickets at ₦2.50 each

3. Find the number which should be in the square with the question mark and write it in the brackets:

2	1	5
8	6	-
12	?	15

4. Find out how the following numbers go. Write the missing numbers in the brackets.

19 9 18 8 - 7 16 - -

5. Oliver is three times as old as his sister Pat. Their father, who is 85, is seven times as old as Pat. How old is Oliver?

6. Find the number which should be in the square with the question mark and write it in the brackets:

6	10	17
8	-	19
12	16	?

7. Find out how the following numbers go. Write the missing numbers in the brackets.

512 256 128 64 - 16 - 4

8. Which one of the following prices for oranges is the cheapest?

(1) 3k each

(2) 27 per doz

(3) 5 for 12k

(4) 8 for 18k

(5) 8 for 6k ( )

9. Find the number which should be in the square with the question mark and write it in the brackets:

32	8	2
-	16	4
96	24	?

10. Find out how the following numbers go. Write the missing numbers in the brackets.

87 78 76 67 - 58 54

11. The total cost of ten books bound in leather is ₦200. Each book in ordinary edition costs ₦10. How much extra do I pay on each book for the leather binding?

12. Find the number which should be in the square with the question mark and write it in the brackets:

2	3	8
6	-	24
8	36	?

13. John and Mary are twins whose ages together are half their mother's. Their father who is three years older than their mother is 51. How old is John?

14. Find the number which should be in the square with the question mark and write it in the brackets:

1	3	9
2	-	10
5	7	?

15. It took me four times as long to climb mountain 6,000 metres high as it took me to come down. I descended 6,000 metres in an hour. How many hours did it take to climb up?

16. Find the number which should be in the square with the question mark and write it in the brackets:

1	-	9
4	12	36
?	48	144

17. What are two numbers whose sum is 16 such that the first divided by the second gives three?

18. Find out how the following numbers go. Write the missing numbers in the brackets.

0 - 8 5 3 8 - 11

19. Find the number which should be in the square with the question mark and write it in the brackets:

13	9	5
7	5	?
1	-	1

20. Find out how the following numbers go. Write the missing numbers in the brackets.

4 8 7 - 13 26 - 50

21. If nine framed pictures cost ₦130.50 and each picture unframed only costs one third as much, how many unframed pictures could I buy for the same money?

22. Find the number which should be in the square with the question mark and write it in the brackets:

13	9	5
7	5	?
1	-	1

23. Find out how the following numbers go. Write the missing numbers in the brackets.

1 3 - - 81 243 729

24. I bought a number of 6k magazines and 8k exercise books which cost me ₦40.60 together. How many of each did I buy?

25. Find out how the following numbers go. Write the missing numbers in the brackets.

41 35 30 36 - 21 - 20

26. A greengrocer finds that by selling at 4k per N2, he makes exactly the same profit as by selling as 3k per bunch. What is the average weight of each bunch of his carrot?

27. A furniture dealer bought some chairs at ₦48 per dozen. In selling them he received as much as two chairs as he had paid for three chairs. What was the selling price per dozen?

28. Find the number which should be in the square with the question mark and write it in the brackets:

18	3	6
2	-	2
9	3	?

GO STRAIGHT ON WITH THE NEXT PAGE

29. I can buy 5 grams of potatoes for ₦20.90. How much do I pay for ½ gram?

30. In a class of 48 pupils there are 8 more boys than girls. How many boys are there?

31. Find the number which should be in the square with the question mark and write it in the brackets:

-	1	8
18	2	7
27	?	24

32. Two new books cost ₦4.60 and ₦10.60 respectively. If I buy them second hand I only pay two third of the new price. How much money do I save?

33. A piece of wood 35 centimetres long is to be cut in three parts, each successive part being twice as long as the previous part. What is the length of the longest part?

34. A kitten is three days old a puppy is 11 days old. How many days will puppy be twice as old as the kitten?

35. A dairy serves mixture of two parts cream and three parts milk. How many pints of cream will it take to make 15 pints of the mixture?

36. Find out how the following numbers go. Write the missing numbers in the brackets.

87 74 63 54 47 - 39 -

LOOK BACK OVER YOUR WORK

APPENDIX IIIB

SCIENCE EDUCATION UNIT
DEPARTMENT OF TEACHER EDUCATION
FACULTY OF EDUCATION
UNIVERSITY OF IBADAN, IBADAN

ANSWER SHEET FOR ACER TEST

Name--

School--

Gender: ------------------------------Male/Female

Age Now---

Birthday--

Class---

Date of Test--

This is a test to see how well you can think. It contains questions of different kinds. Some examples and practice questions will be given to show you how to answer the questions. Follow the examples and the practice questions. Write the answers in the brackets in line with the question number.

1. ( )	( )	( )	
2. ( )			
3. ( )			
4. ( )	( )	( )	
5. ( )			
6. ( )			
7. ( )	( )		
8. ( )			
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APPENDIX IV

SCIENCE EDUCATION UNIT
DEPARTMENT OF TEACHER EDUCATION
FACULTY OF EDUCATION
UNIVERSITY OF IBADAN, IBADAN

TEACHERS' INSTRUCTIONAL GUIDE FOR CROSSWORD-PICTURE PUZZLE-BASED TEACHING STRATEGY, TIGCPPTS

LESSON 1

INSTRUCTIONAL STRATEGY: GAME (CROSS WORD PUZZLE)

TOPIC: DRUG ABUSE

DURATION: 80 Minutes

LEARNER'S INITIAL CAPABILITY (PREVIOUS KNOWLEDGE):

Students are familiar with Kola nut, must have been seeing people smoking cigarette, people drinking alcohol, people taking paracetamol etc.

INSTRUCTIONAL MATERIALS: Samples of some drugs (e.g. Vitamin C, Paracetamol, Kola nut) or empty containers of some drugs e.g. bottle (which must be handled with great care) of any alcoholic drink etc.

BEHAVIOURAL OBJECTIVES: At the end of the lesson, students should be able to:

1. List methods of drug use
2. Identify some common ways youth misuse drugs;
3. Discuss social risk factors in drug abuse.
4. Recognize that sharing injection needles make HIV/AIDS infection rate higher among drug users.

INTRODUCTION: Make a list of some drugs used either at home or elsewhere.

Did you include in your list the following?

1. Kola nut
2. Palm wine
3. Alcohol
4. Cocaine
5. Beer etc.

PRESENTATION:

STEP I: Students are guided to the meaning of drug abuse and methods used by drug addicts to introduce drugs into the body.

STEP II: Students are put into small groups of five members each.

STEP III: Students participate in the group discussion on:

1. The contributing factors that they feel motivate many adolescents (youths to engage in indiscriminate use of drugs.
2. What they think should be done to reduce this problem.

3. Common ways youths misuse drugs.

STEP IV: Brief lecture is presented on common ways youths misuse drugs, social risk factors in drug abuse, drug use and HIV/AIDS.

EVALUATION: Students practice the crossword puzzle game (individually).

CONCLUSION: Teacher corrects the students where necessary and gives the students a copy of the content note.

ASSIGNMENT: Define the following.

(a) Drug (b) drug use (c) drug abuse (d) drug misuse.

LESSON 2

INSTRUCTIONAL STRATEGY: GAME (CROSSWORD AND PICTURE PUZZLE)

TOPIC: HABITAT

DURATION: 80 Minutes

LEARNERS' INITIAL CAPABILITY (PREVIOUS KNOWLEDGE):

Students have home where they live. They must have been seeing birds living on trees, animals like rat living under the soil, organism living in water (e.g. fish), stagnant water around the school premise where organisms live etc.

INSTRUCTIONAL MATERIALS: Diagram of water plant, diagram of fish,; school garden, pond etc.

BEHAVIOURAL OBJECTIVES: At the end of the lesson, students should be able to:

1. Mention the different habitats of living things

2. Identify the living organisms found in different habitats.

3. List the distinguishing characteristics of organisms found in the different habitats.

INTRODUCTION: Previous lesson is briefly reviewed with the students by asking the following questions.

1. List methods of drug use.

2. What are some common ways youth misuse drugs?

PRESENTATION:

STEP I: A brief lesson is presented on habitat.

STEP II: Activity 1: students visit the school environment (or school garden) to identify different habitats and make a list of organisms found in different habitats.

STEP III: Students are instructed to withdraw to their class and draw various diagrams displayed by the teacher

EVALUATION: The following games are given to students to practice.

1. Cross word puzzle (Individual)

2. Picture puzzle (Group)

CONCLUSION: The performance of students is judged accordingly, teacher goes over the lesson in brief again and gives the students the content note.

ASSIGNMENT: The students are instructed to study and draw the diagrams in the content note given to the students.

LESSON 3

SUBJECT: BASIC SCIENCE

CLASS: JSS 2

INSTRUCTIONAL STRATEGY: INDIVIDUAL AND GROUP EXPERIMENT.

TOPIC: CHANGE IN MATTER

DURATION: 80 Minutes

LEARNERS INITIAL CAPABILITY (PREVIOUS KNOWLEDGE): Students have been boiling water, using ice block, seeing decaying organism/substances, seeing substances burnt, using sugar and salt in liquid playing with magnet, seeing corrugated iron sheet etc.

INTRUCTIONAL MATERIALS: Spoilt fish, fresh fish, decaying leaves of plant (for plant stem), fresh leaves of plant, water, salt, candle wax, rusted iron rod, new iron rod, matches, pieces of dry wood (or paper), magnet, iron filings, sand, evaporation dish, tripod stand, wire gauze, burner, beaker, tablespoon.

BEHAVIOURAL OBJECTIVES: At the end of the lesson, students should be able to:

1. Describe different ways matter changes;
2. Identify the changes as temporary or permanent;
3. Distinguish between temporary and permanent changes;
4. Group changes in non-living matter as physical or chemical;
5. State the causes of such changes.

INTRODUCTION: Learners are guided on the review of the previous lesson and the objectives of the lesson are presented in a concise form to the class.

PRESENTATION OF THE LESSON

SET 1: Spoilt fish, Rusted iron and Decayed leaves/plants

Fresh fish new iron rod, Fresh leaves/plants.

SET 2: Crucible, dry pieces of wood (or paper), Matches

SET 3: Salt, Sand, Evaporating dish, Water, Iron filings, Candle wax, Beaker, Magnet, Tablespoon

STEP I: Activity 2 (Individual)

Observe the materials provided, record the color, odor (where applicable) and the state of the substance.

STEP II: Activity 1.2: Observe the following pairs of substance and record the type of change noticed.

A - Fresh fish, Spoilt fish

B - New iron rod
Rusted iron rod

C - Fresh leaves/plants
Decayed leaves/plants

STEP III: Activity 1.4: Given the following set of materials students will be required to carry out the following experiments.

Materials: small piece of dry wood or paper, matches, crucible and tripod stand.

(i) Place the piece of wood or paper in the crucible.

(ii) place the crucible on a tripod stand.

(iii) Strike the match and light the word (or paper)

(iv) Allow the wood (or paper) to burn out and record your observation. Question (i) was you able to get your wood (or paper) back?

(v) What type of change do you observe and the cause of the change?

STEP IV: Activity 1.3: Given the following materials –iron filings, magnet, sand; students will be required to carry out the following experiment.

A - Magnet

B - Sand

C - Iron filings

i) To few quantity of B, add C. Ensure that they are properly mixed.

ii) Place A nearer the mixture and record your observation. What type of change do you observe?

STEP V: Student are not into small groups of five members each.

STEP VI: Activity 2.1 (Group Experiment)

Given the following set of materials, students will be required to do the following:

SET I: Common salt, evaporating dish, beaker, water, tripod stand, burner, tablespoon.

(i) Dissolve a tablespoonful of salt in $5cm^3$ of water in a beaker and record your observation.

(ii) Pour what is formed into an evaporating dish.

(iii) Heat gently over the burner until the water evaporates completely and record your observation.

Question: (i) Were you able to get your salt?

(ii) What type of change do you observe?

SET 2: Small piece of candle wax, evaporating dish, tripod stand, burner, gauze.

(i) Place the piece of wax into your evaporating dish.

(ii) Place the evaporating dish on the gauze over the burner.

(iii) Heat gently till there is a change in state and record your observation.

(iv) Keep the wax in the dish to cool for about five minutes and record your observation.

Question: What type of change do you observe?

STEP VII: Students submit their individual report to the teacher. Teacher interacts with the students on the report as it affects individual students.

EVALUATION: Every student is given rapt attention during the experiment and graded using the mark sheet.

CONCLUSION: Brief explanation and notes are given on change in matter (physical/temporary and chemical/permanent change) using various students' experimental reports.

LESSON 4

INSTRUCTIONAL STRATEGY: Game (Crossword and Picture Puzzle)

TOPIC: Respiratory System.

DURATION: 80 Minutes

LEARNERS' INITIAL CAPABILITY (PREVIOUS KNOWEDGE); Students can breathe in and breath out. Students have part of the body that is connected with respiration.

INSTRUCTIONAL MATERIALS: Students' body, diagram of human respiratory system, stop watch.

BEHAVIOURAL OBJECTIVES. At the end of the lesson, students should be able to:

1. Identify parts of the respiratory system
2. Distinguish between breathing and respiration
3. Discover that pulse rate and breathing rate increase with exercise.
4. Identify breathing problems

INTRODUCTION: The following questions are asked on previous lesson from the students.

1. Differentiate between physical change and chemical change.
2. Give two examples each of physical change and chemical change.

PRESENTATION:

STEP I: Students breathe in and out.

STEP II: Learners are guided to the concepts of breathing and respiration and the diagram of human respiratory system is used to explain parts of the respiratory system.

STEP III: Students go round to draw diagram of human respiratory system displayed by the teacher.

STEP IV: Students are instructed to pair up with a partner.

STEP V: Students demonstration: Effect of exercise on pulse rate and breathing.

1. Choose your partner
2. Take the pulse rate of your partner by placing your right thumb at the lower end of the left thumb to observe the pulse for one minute. The pulse is calculated as number of pulses per second.
3. Observe the breathing of your partner.
4. Allow your partner to run round the school field as fast as he or she can.
5. Take the pulse rate again
6. Observe the breathing of your partner again
7. Record your observation.
8. Take your own turn and let your partner follows step 1-7
9. Check your records.

After the exercise, what happens to your pulse rate and breathing?

STEP VI: The effect of exercise on pulse rate and breathing is briefly explained based on students' findings and students are guided to the problems associated with breathing.

EVALUATION: Game is given to students to practice:

1. Crossword Puzzle (Individual)
2. Picture puzzle (Group)

CONCLUSION: Students are allowed to ask questions, they are given the content note and instructed to study the diagram in their content note as home work.

LESSON 5

INSTRUCTIONAL STRATEGY: GAME (CROSSWORD AND PICTURE PUZLE)

TOPIC: Information and Communication Technology (ICT)

DURATION: 80 Minutes

LEARNERS' INITIAL CAPABILITY (PREVIOUS KNOWLEDGE) Students are familiar with television, radio, mobile phone etc.

INSTRUCTIONAL MATERIALS: Diagrams of computer system, telephone/mobile phones, Fax machine, radio and internet; Real object (Mobile phone).

BEHAVIOURAL OBJECTIVES: At the end of the lesson, students should be able to:

1. State the full meaning of ICT
2. Identify the components of ICT

3. Describe the use of ICT components

4. Discuss the importance of ICT.

INTRODUCTION: Students answer the following questions:

1. Mention two respiratory problems.

2. What is the effect of exercise on pulse and breathing rates?

PRESENTATION:

STEP I: Various diagrams of ICT components (computer system, telephone/mobile phones, Fax machine, radio and internet) are displayed.

STEP 2: Students go round and draw the various diagrams.

STEP 3: Brief discussion is coordinated on Information and Communication Technology.

STEP 4: Demonstration:

1. Identify the components of GSM such as the hand set, SIMS card, and recharge card and battery charger.

2. Fix the Sims-card

3. Recharge the phone with recharge card.

4. Fix the battery charger in order to keep the battery active.

EVALUATION: Game is presented to the students to measure the degree of change in their behaviour.

1. Crossword puzzle (Individual)

2. Picture Puzzle (Group)

CONCLUSION: Teacher allows the students to ask questions and gives them a copy of content note.

ASSIGNMENT: Students further study the diagrams and their content notes as home work.

LESSON 6

INSTRUCTIONAL STRATEGY: Experiment and Game.

TOPIC: Heat Energy

SUB-TOPIC: Transfer of Heat by Conduction

DURATION: 80 Minutes

LEARNER'S INITIAL CAPABILITY (PREVIOUS KNOWLEDGE): Students are familiar with cooking, fire, heat conductors such as cooking pots (metal), frying pan etc.

INSTRUCTIONAL MATERIALS: Bunsen burner (or kerosene stove), matches, piece of thick copper wire (about 15cm long), diagrams on conduction.

BEHAVIOURAL OBJECTIVES: At the end of the lesson, students should be able to:

1. Demonstrate that heat flows from the hot body to the cold one when the two bodies are in contact.
2. List the methods (modes) of heat transfer.
3. Describe heat conduction and at least two of its applications.

INTRODUCTION: Students are guided to answer the following questions on the previous lesson:
1. What is the full meaning of ICT?
2. List three ICT components
3. State two uses of ICT.

PRESENTATION:

STEP 1: Activity: (Individual experiment): The aim of the activity is to demonstrate heat transfer by conduction:
1. Hold a piece of thick copper wire at one end. How does that end feel, cold or hot?
2. Put the other end of the copper wire over a Bunsen burner (or stove) for some time.
3. Write your observations, and how long you could hold the copper wire, the direction of heat flow (i.e. either from cold end to hot end or from hot end to cold one).

STEP 2: EVALUATION:
1. The part played by individual students is noted and graded using the mark sheet.
2. Game (picture puzzle) to students to practice in the group.

STEP 3: Students submit their reports, graded accordingly and returned to students.

STEP 4: Brief lecture on transfer of heat by conduction and its applications is presented based on students' experimental reports.

CONCLUSION: A copy of content notes is given to the students and asked to find the difference between heat and temperature as their home work.

LESSON 7

INSTRUCTIONAL STRATEGY: Experiment and Game.

SUB-TOPIC: Transfer of Heat by Convection

DURATION: 80 Minutes

LEARNER'S INITIAL CAPABILITY (PREVIOUS KNOWLEDGE): Students are familiar with cooking, fire, body feeling of radiations from the sun, heat conductors such as cooking pots (metal), frying pan etc.

INSTRUCTIONAL MATERIALS: Bunsen burner (or kerosene stove), matches, Round-bottomed flask, water, potassium permanganate crystal, tripod stand, wire gauze, diagram on convection.

BEHAVIOURAL OBJECTIVES: At the end of the lesson, students should be able to:

1. Demonstrate and describe transfer of heat by convection.

2. State at least two applications of convection.

INTRODUCTION: Students are guided to answer the following questions on the previous lesson:

1. Mention three modes (methods) of heat transfer.

1. What is conduction?

2. List two applications of conduction.

PRESENTATION:

STEP 1: Activity: (group experiment): The aim of the activity is to demonstrate heat transfer by convection in a liquid:

STEP 2: Students are put into small groups of five members each.

1. Carefully place a small crystal of potassium permanganate at the bottom of the round-bottomed flask, through a glass tube.

2. Heat the flask gently, directly under the crystal.

3. Observe carefully what happens and record your observations.

How did the colored water travel?

STEP 5: EVALUATION:

1. The part played by individual students is noted and graded using the mark sheet.

2. Game (picture puzzle) to students to practice in the group.

STEP 6: Students submit their reports, graded accordingly and returned to students.

STEP 7: Brief lecture is presented on transfer of heat energy by convection and its application based on students' experimental reports.

CONCLUSION: A copy of content notes is given to the students and asked to find the unit for measuring heat and energy as their home work.

LESSON 8

INSTRUCTIONAL STRATEGY: Experiment and Game.

SUB-TOPIC: Transfer of Heat by Radiation

DURATION: 80 Minutes

LEARNER'S INITIAL CAPABILITY (PREVIOUS KNOWLEDGE): Students are familiar with body feeling of infra-red (heat) radiations from the sun, heat energy from fire.

INSTRUCTIONAL MATERIALS: Bunsen burner (or kerosene stove), matches, water, Two thermometers, T1 and T2, retort stand, tripod stand, wire gauze, beaker, diagram on radiation.

BEHAVIOURAL OBJECTIVES: At the end of the lesson, students should be able to:

1. Demonstrate and describe transfer of heat by radiation.

2.List at least two applications of radiation

INTRODUCTION: Students are guided to answer the following questions on the previous lessons:

1. Mention two modes of heat transfer.
2. What is convection?
3. List two applications of convection.

PRESENTATION:

STEP 1 Activity: (group experiment): The aim of the activity is to demonstrate heat transfer by radiation:

1. Pour about $300cm^3$ of water into a $500cm^3$ beaker
2. Measure that initial readings of thermometer, T_1 and T_2 in ^oC.
3. Place thermometer T_1 in the beaker.
4. Hold, by means of a retort stand and clamp, thermometer T2 about 5cm from the beaker.
5. Heat the beaker so that the water in it becomes hot.
6. Read and record the temperature of T_1 and T_2 again.
7. Write your observations.

How did heat get to thermometer T_2?

STEP 5: EVALUATION:

1. The part played by individual students is noted and graded using the mark sheet.
2. Game (crossword puzzle) is given to students to practice individually.

STEP 6: Students submit their reports, graded accordingly and returned to students.

STEP 7: Brief lecture on transfer of heat by radiation and its application is presented based on students' experimental reports.

CONCLUSION: A copy of content notes is given to the students and asked to find out how heat from the sun gets to us on earth which is about 93 million miles away from the earth as their home work.

APPENDIX V

APPENDIX VI

SCIENCE EDUCATION UNIT
DEPARTMENT OF TEACHER EDUCATION
FACULTY OF EDUCATION
UNIVERSITY OF IBADAN, IBADAN

TEACHERS' INSTRUCTIONAL GUIDE FOR CONVENTIONAL LECTURE METHOD, TIGCLM

LESSON 1

SUBJECT: Basic Science

CLASS: J.S.S 2

TOPIC: Drug Abuse

DURATION: 80 Minutes

PREVIOUS KNOWLEDGE: Students have been coming across those who drink alcohol, smoke cigarette, eat kola nut etc.

INSTRUCTIONAL MATERIALS: Samples of some drug e.g vitamin C, Kola nut, paracetamol or empty containers of some drugs.

BEHAVIOURAL OBJECTIVES: At the end of the lesson, students should be able to:

1. List methods of drug use
2. Identify some common ways youth misuse drugs;
3. Discuss social risk factors in drug abuse.
4. Recognize that sharing injection needles make HIV/AIDS infection rate higher among drug users.

INTRODUCTION: Teacher asks the learners to mention the previous topic and asks them questions based on this.

PRESENTATION:

STEP 1: Teacher states the new topic.

STEP 2: Teacher lists methods of drug use.

STEP 3: Teacher identifies some common ways youth misuse drugs.

STEP 4: Teacher discusses social risk factors in drug abuse.

STEP 5: Teacher explains that sharing injection needles make HIV/AIDS infection rate higher among drug users.

EVALUATION: Teacher asks the following oral questions from the learners.

Question 1: What are the methods of drug use?

Question 2: Identify some common ways youth misuse drugs.

Question 3: Discuss social risk factors in drug abuse.

Question 4: What makes HIV/AIDS infection rate higher among drug users?

CONCLUSION: Teacher presents a brief review of the lesson taught and allows learners to copy the note into their note books.

ASSIGNMENT: Teacher asks the learners to write the definition of the following concepts:

(a) Drug (b) drug abuse (c) Drug misuse

LESSON 2

SUBJECT: Basic Science

CLASS: J.S.S 2

TOPIC: Habitat

DURATION: 80 Minutes

PREVIOUS KNOWLEDGE: Students have home where they live. Students must have been seeing birds living on trees, animals like rat living under the soil etc.

INSTRUCTIONAL MATERIALS: Diagram of water plant, diagram of fish etc.

BEHAVIOURAL OBJECTIVES: At the end of the lesson, students should be able to:

1. Mention the different habitats of living things
2. Identify the living organisms found in different habitats.
3. List the distinguishing characteristics of organisms found in the different habitats.

INTRODUCTION: Teacher revises the previous lesson by asking the learners the following questions.

1. What are the methods of drug use?
2. Identify some common ways youth misuse drugs.
3. Discuss social risk factors in drug abuse
4. What makes HIV/AIDS infection rate higher among drug users?

PRESENTATION:

STEP 1: Teacher states the new topic.

STEP 2: Teacher lists the different habitats.

STEP 3: Teacher gives examples of the living organisms found in different habitats.

STEP 4: Teacher lists the distinguishing characteristics of organisms found in the different habitats.

EVALUATION: Teacher asks the following oral questions from the learners.

Question 1: List the different habitats of organisms.

Question 2: Identify the living organisms found in different habitats.

Question 3: What are the distinguishing characteristics of organisms found in the different habitats?

CONCLUSION: Teacher presents a brief review of the lesson taught and allows learners to copy the note into their note books.

ASSIGNMENT: List five organisms found in water (aquatic habitat).

LESSON 3

SUBJECT: Basic Science

CLASS: J.S.S 2

TOPIC: Change in Matter

DURATION: 80 Minutes

PREVIOUS KNOWLEDGE: Students have been boiling water, using ice block, burning firewood etc.

INSTRUCTIONAL MATERIALS: Chart

BEHAVIOURAL OBJECTIVES: At the end of the lesson, students should be able to:

1. Describe different ways matter changes;
2. Identify the changes as temporary or permanent;
3. Distinguish between temporary and permanent changes;
4. Group changes in non-living matter as physical or chemical;
5. State the causes of such changes.

INTRODUCTION: Teacher asks the following questions from the learners on the previous lesson.

1. What are the different habitats of organism?
2. Identify the living organisms found in different habitat.
3. What are the distinguishing characteristics of organisms found in the different habitats?

PRESENTATION:

STEP 1: Teacher states the new topic.

STEP 2: Teacher describes different ways matter changes.

STEP 3: Teacher identifies the changes as temporary or permanent.

STEP 4: Teacher distinguishes between temporary and permanent change.

STEP 5: Teacher puts the changes in non-living matter into physical or chemical change.

STEP 6: Teacher states the causes of such changes.

EVALUATION: Teacher asks the following oral questions from the learners.

Question 1: Describe different ways matter changes.

Question 2: Mention the two types of change matter undergo?

Question 3: What are the differences between temporary and permanent changes?

Question 4: Mention the two types of change in non-living matter?

Question 5: What are the causes of change in matter?

CONCLUSION: Teacher presents a brief review of the lesson taught and allows learners to copy the note into their note books.

ASSIGNMENT: Differentiate between physical and chemical change?

LESSON 4

SUBJECT: Basic Science

CLASS: J.S.S 2

TOPIC: Respiratory system

DURATION: 80 Minutes

PREVIOUS KNOWLEDGE: Students can breathe in and breathe out. Students have parts of the body that are connected with respiration.

INSTRUCTIONAL MATERIALS: Charts

BEHAVIOURAL OBJECTIVES: At the end of the lesson, students should be able to:

1. Identify parts of the respiratory system
2. Distinguish between breathing and respiration
3. Discover that pulse rate and breathing rate increase with exercise.
4. Identify breathing problems

INTRODUCTION: Teacher asks the following questions from the learners.

1. Describe the different ways matter changes
2. Mention the two types of change matter undergoes.
3. What are the differences between temporary and permanent changes?
4. Mention the two types of change in non-living matter
5. What are the causes of change in matter?

PRESENTATION:

STEP 1: Teacher states the new topic.

STEP 2: Teacher discusses parts of the respiratory system

STEP 3: Teacher distinguishes between breathing and respiration.

STEP 4: Teacher explains that pulse rate and breathing rate increase with exercise.

STEP 5: Teacher discusses the breathing problems.

EVALUATION: Teacher asks the following oral questions from the learners.

Question 1: Mention parts of the respiratory system

Question 2: State the difference between breathing and respiration

Question 3: What is the effect of exercise on pulse rate and breathing rate?

Question 4: List breathing problems.

CONCLUSION: Teacher presents a brief review of the lesson taught and allows learners to copy the note into their note books.

ASSIGNMENT: Mention two types of respiration.

LESSON 5

SUBJECT: Basic Science

CLASS: J.S.S 2

TOPIC: Information and Communication Technology

DURATION: 80 Minutes

PREVIOUS KNOWLEDGE: Students familiar with television, radio, mobile phone etc.

INSTRUCTIONAL MATERIALS: Charts, Chalkboard etc.

BEHAVIOURAL OBJECTIVES: At the end of the lesson, students should be able to:

1. State the full meaning of ICT
2. Identify the components of ICT
3. Describe the use of ICT components
4. Discuss the importance of ICT.

INTRODUCTION: Teacher asks the following questions from the learners.

1. Mention parts of respiratory system
2. What is the difference between breathing and respiration?
3. What is the effect of exercise on pulse rate and breathing rate?
4. List breathing problems

PRESENTATION:

STEP 1: Teacher states the new topic.

STEP 2: Teacher state the full meaning of ICT.

STEP 3: Teacher identifies the component of ICT.

STEP 4: Teacher discusses the use of ICT components.

STEP 5: Teacher explains the importance of ICT.

EVALUATION: Teacher asks the following oral questions from the learners.

Question 1: What is the full meaning of ICT?

Question 2: What are the components of ICT?

Question 3: Describe the use of ICT components

Question 4: Discuss the importance of ICT

CONCLUSION: Teacher presents a brief review of the lesson taught and allows learners to copy the note into their note books.

ASSIGNMENT: Draw a labelled diagram of a computer system.

LESSON 6

SUBJECT: Basic Science

CLASS: J.S.S 2

TOPIC: Heat Energy

SUB-TOPIC: Transfer of Heat by Conduction

DURATION: 80 Minutes

PREVIOUS KNOWLEDGE: Students are familiar with cooking, fire, iron pots, aluminium pots etc.

INSTRUCTIONAL MATERIALS: Chalkboard

BEHAVIOURAL OBJECTIVES: At the end of the lesson, students should be able to:

1. List the methods (modes) of heat transfer.

2. Define conduction

3.Mention at least two of it applications.

INTRODUCTION: Teacher asks the following questions from the learners on the previous lesson.

1. What is the full meaning of ICT?

2. What are the components of ICT?

3. Describe the use of ICT components?

4. Discuss the importance of ICT.

PRESENTATION:

STEP 1: Teacher states the new topic.

STEP 2: Teacher lists methods of heat transfer.

STEP 3: Teacher discusses transfer of heat by conduction.

STEP 4: Teacher explains applications of conduction.

EVALUATION: Teacher asks the following oral questions from the learners.

Question 1: What is conduction?

Question 2: What are the methods of heat transfer?

Question 3: Mention two applications of conduction.

CONCLUSION: Teacher presents a brief review of the lesson taught and allows learners to copy the note into their note books.

ASSIGNMENT: Differentiate between heat and temperature

LESSON 7

SUBJECT: Basic Science

CLASS: J.S.S 2

SUB-TOPIC: Transfer of Heat by convection

DURATION: 80 Minutes

PREVIOUS KNOWLEDGE: Students are familiar with boiling water.

INSTRUCTIONAL MATERIALS: Chalkboard

BEHAVIOURAL OBJECTIVES: At the end of the lesson, students should be able to:

1. Describe heat convection;

2.State at least two of its applications.

INTRODUCTION: Teacher asks the following questions from the learners on the previous lesson.

1. What is conduction?

2. State two applications of conduction

PRESENTATION:

STEP 1: Teacher states the new topic.

STEP 2: Teacher discusses the method of heat transfer by convection.

STEP 4: Teacher explains applications of convention.

EVALUATION: Teacher asks the following oral questions from the learners.

Question 1: Describe heat transfer by convection?

Question 2: State two applications of convection.

CONCLUSION: Teacher presents a brief review of the lesson taught and allows learners to copy the note into their note books.

ASSIGNMENT: Differentiate between conduction and convection.

LESSON 8

SUBJECT: Basic Science

CLASS: J.S.S 2

SUB-TOPIC: Transfer of Heat by Radiation

DURATION: 80 Minutes

PREVIOUS KNOWLEDGE: Students familiar with warming the body using fire and sun.

INSTRUCTIONAL MATERIALS: Chalkboard

BEHAVIOURAL OBJECTIVES: At the end of the lesson, students should be able to:

1. Describe heat radiation;

2. Mention at least two of its applications.

INTRODUCTION: Teacher asks the following questions from the learners on the previous lesson.

1. Describe convection.

2. State two applications of convection.

PRESENTATION:

STEP 1: Teacher states the new topic.

STEP 2: Teacher discusses the method of heat transfer by radiation.

STEP 4: Teacher explains applications of radiation.

EVALUATION: Teacher asks the following oral questions from the learners.

Question 1: Describe heat transfer by radiation?

Question 2: Mention at least two of its applications.

CONCLUSION: Teacher presents a brief review of the lesson taught and allows learners to copy the note into their note books.

ASSIGNMENT: What are the methods of heat transfer?

APPENDIX VII

SCIENCE EDUCATION UNIT
DEPARTMENT OF TEACHER EDUCATION
FACULTY OF EDUCATION
UNIVERSITY OF IBADAN, IBADAN

EVALUATION SHEETS FOR ASSESSING TEACHERS' PERFORMANCE DURING TRAINING, ESATPT

School: ---

Teacher's Name (optional):--

Gender: ---------male ( ) female ( )

Teacher Quality: ---PROFESSIONAL ( ) NON-PROFESSIONAL ( )

NB: PROFESSIONAL TEACHERS: Teachers with Diploma in Integrated Science, NCE in Integrated Science or university certificate in Integrated Science/Basic Science.

NON-PROFESSIONAL TEACHERS: Teachers with no Diploma in Integrated Science, no NCE in Integrated Science or university certificate in Integrated Science/Basic Science.

CHARACTERISTICS TO MEASURE	**PERFORMANCE**				
	VERY HIGH (5)	**HIGH (4)**	**MODERATE (3)**	**LOW (2)**	**VERY LOW (1)**
Appropriate Introduction of the Lesson by the Teacher.					
Teachers' Ability in the Use of Game with Picture Puzzle.					
Teachers' Ability in the Use of Game with Crossword Puzzle.					
Teachers follow the Rules of the Game Strictly.					
Teachers Ability to Praise the Students after an encouraging response.					
Teachers' presentation of the Summary and Conclusion					

Evaluation Sheets for Assessing Teachers' Performance on the Use of Enhanced Explicit Teaching Strategy, ESATPUEETS

School: --

Teacher's Name (optional):---

Gender: ---------male ( ) female ( )

Teacher Quality: --PROFESSIONAL ( ) NON-PROFESSIONAL ( )

NB: PROFESSIONAL TEACHERS: Teachers with Diploma in Integrated Science, NCE in Integrated Science or university certificate in Integrated Science/Basic Science.

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CHARACTERISTICS TO MEASURE	**PERFORMANCE**				
	VERY HIGH (5)	**HIGH (4)**	**MODE-RATE (3)**	**LOW (2)**	**VERY LOW (1)**
Teachers' Appropriate Introduction of the Learning Task.					
Teacher states the learning objectives clearly.					
Teachers' Presentation of Learning Task in a Condensed and Precise Form.					
Teacher's ability to pair teachers with students.					
Teacher guiding the peer teachers with students during tutoring session.					
Teacher checking for understanding and providing feedback.					

Evaluation Sheets for Assessing Teachers' Performance on the Use of Modified Conventional Strategy, ESATPUMCS

School: ---

Teacher's Name (optional):---

Gender: ---------male ( ) female ( )

Teacher Quality: ---PROFESSIONAL ( ) NON-PROFESSIONAL ( )

NB: PROFESSIONAL TEACHERS: Teachers with Diploma in Integrated Science, NCE in Integrated Science or university certificate in Integrated Science/Basic Science.

NON-PROFESSIONAL TEACHERS: Teachers with no Diploma in Integrated Science, no NCE in Integrated Science or university certificate in Integrated Science/Basic Science.

CHARACTERISTICS TO MEASURE	**PERFORMANCE**				
	VERY HIGH (5)	**HIGH (4)**	**MODERATE (3)**	**LOW (2)**	**VERY LOW (1)**
Teacher's assessment of students' previous work.					
Teacher's revision of previous work.					
Teacher's step-by-step presentation of the learning task.					
Teacher asking questions from the learners.					
Teacher gives homework to students.					

APPENDIX VIII

SCIENCE EDUCATION UNIT
DEPARTMENT OF TEACHER EDUCATION
FACULTY OF EDUCATION
UNIVERSITY OF IBADAN, IBADAN

BASIC SCIENCE CONTENT NOTE

TOPIC 1: DRUG ABUSE

Drug abuse is taking a drug without doctor's advice or direction in a way that can damage a person's health (or ability to function). Drug is abused if somebody takes the prescribed drugs for another purpose other than that for which it was intended, takes a dosage other than that recommended, takes drug to induce sleep without prescription from a qualified medical doctor, takes drug to gain confidence or boldness, and shares a prescribed drug with other people.

Methods of Drug Use

Methods used by drug addicts to introduce drugs into the body are:

1. **Ingestion (Swallowing):** Drugs in form of capsules, tablets and syrups are taken in this form.
2. **Inhalation:** This is method of introducing the drug to the body through respiratory system. Inhalants (anesthetic gases) such as aerosols, petroleum products, or solvents, including cocaine are inhaled or sniffed into the body through nostrils.
3. **Injection:** This is a method of introducing the drugs directly to the body through the capillaries, arteries or veins. Syrups (drugs in liquid form) and some drugs in powdered form (e.g. cocaine) is mixed with a liquid and injected directly into the vein.
4. **Smoking:** Drugs like marijuana (Indian hemp) are smoked either rolled in paper, leaf or put in a pipe.
5. **Absorption through the skin:** Drugs used in this form are mild body creams.

Common Ways Youth Misuse Drugs

Drug misuse is the taking of a drug for its medically intended purpose, but not in the appropriate amount, frequency, strength or manner. Youths misuse drug in the following ways:

1. Sharing a prescribed drug with a friend or family member (for whom the drug was not prescribed).
2. Taking the prescribed drugs for a purpose which it was not intended.

3. Taking a dosage other than that recommended (overdose or under dose).

4. Misunderstanding the directions for use of prescribed drugs e.g. not taking the drugs at the stipulated times, periods or intervals.

5. Taking drugs to induce sleep without doctor's prescription.

6. Taking drugs to gain confidence or boldness to commit crimes (e.g. suicide, rape, assault, hurting someone or oneself).

7. Taking drugs to attain full sexual satisfaction.

Social Risk Factors (consequences of drug abuse) in Drug Abuse

1. Broken home: A child that hails from broken home has tendency to form bad habit with the use of drug. This type of child exercises independent freedom since he/she doesn't receive sufficient support of his/her parents.

2. Peer Influence: Some groups take drugs as part of social events. A child that will join the group will have to conform to the norms or rules of the group.

3. Experience family disruption: A drug abuser may withdraw from family and friends as he or she becomes more dependent on drugs.

4. Being brought up in a drug dependent family: A child that grows up in a drug dependent family will see nothing wrong in using drugs anyhow.

5. Drug users reaction and sense of reasoning and judgment are often impaired e.g. alcohol and marijuana users.

6. Materialistic Value: Many drug users want to acquire wealth. Therefore, they engage in the use of drug.

DRUG USE AND HIV/AIDS

Human Immunodeficiency Virus (HIV) lives within body cells and body fluids. There are various ways (means) of contracting HIV. Some of these ways are:

- transfusion of infected blood;

- using sharp unsterilized objects e.g. needles, knives, razor blades, syringes Unprotected sex in adult individual.

Needles, syringes or cotton wool used to inject drugs such as heroin and cocaine are sometimes contaminated with the blood of the user. In sharing such needles, a small amount of one person's blood can be directly injected into another person's blood stream. Therefore, sharing injection needles make HIV/AIDS infection rate higher among drug users.

TOPIC 2: HABITAT

A habitat is a place where organisms live. Some organisms live on land and some live in water.

Types of habitat

Majorly, there are two types of habitat.

a. **Terrestrial habitats:** The terrestrial habitat refers to a place on land or underground where organisms live (Terrestrial habitat refers to land environment). Living organisms found here are human beings, domestic animals, wild animals and plants. The terrestrial habitats can be arboreal (in or on trees e.g. monkeys, birds and ants), on the ground (e.g. grass cutters or under the ground (e.g. earthworms)

b. **Aquatic Habitat:** Aquatic habitat refers to water environment. The aquatic habitat contains different kinds of animals (e.g. fish, whale, turtles, crocodiles, tadpoles) and plants (e.g. water lettuce, water lilies etc) which are called aquatic organisms. Aquatic habitat can be:

Estuarine: The River mouths where salt and fresh water meet. E.g. bays and lagoons. Organisms found here include: periwinkles and lobsters.

Marine: This refers to the sea and ocean. Marine plants and animals are weeds, fish, whales etc.

Fresh water: These include lakes, rivers, ponds and streams. Fresh water organisms are fish, crayfish and crabs etc.

Adaptation of Organisms to their Habitats

Organisms have special features that help them to survive in their particular habitats. Special features which help organisms to survive in a particular habitat are called adaptations.

a. Adaptation of plants in relation to water

i. Plants have taproot (to penetrate deep into the ground to tap the available water),

ii. Some plants have adventitious roots. These spread widely to cover large areas.

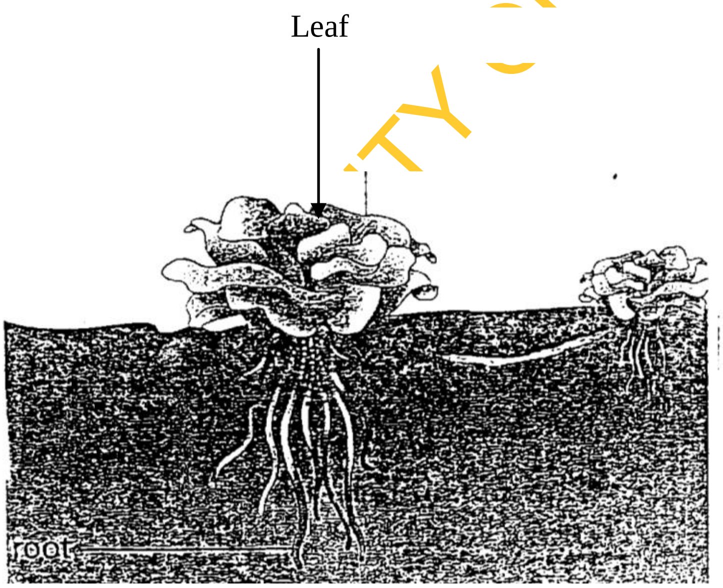
iii. Developed water storage tissues in leaves and stems. They use the water stored in their tissues to survive during the long dry season. Plants that develop storage tissues are called succulents.

iv. Some plants have tiny small leaves or have their leaves reduced to green needle-like structures or tiny scales. This adaptation helps reduce the amount of moisture that will be lost to the atmosphere during transpiration.

v. Plants that live on water do not have to depend on their roots to absorb water: They have poorly develop root system.

They have their leaves and stem covered with thin layer of cuticle that is permeable so that water, oxygen, mineral salts, carbon dioxide are easily absorbed into the whole surface of the plant.

Leaves of aquatic plants have large air spaces. The air spaces keep the plants buoyant, and help them absorb oxygen.



Water plant with reduced root system

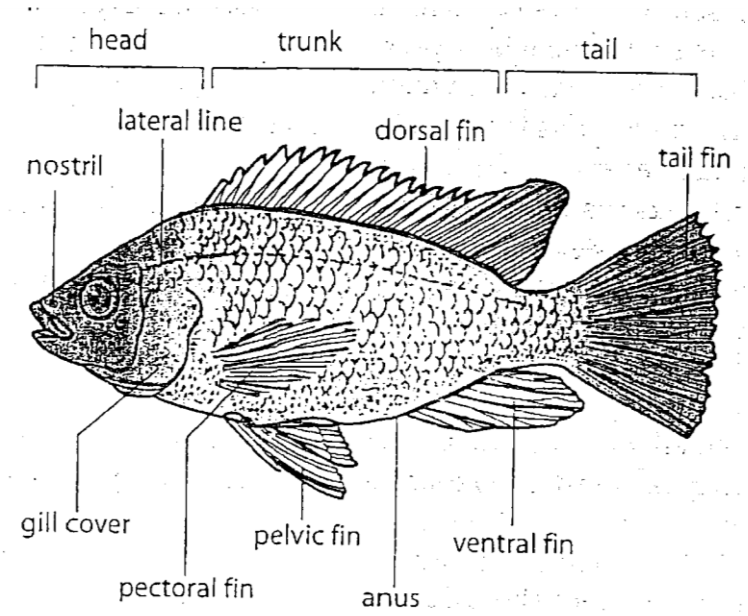
Adaptation of aquatic animals (fish)

i. Possession of tail and fins for swimming and balancing in water.

ii. Possession of streamlined body shape, which allows them to move smoothly through water.

iii. Possession of gills for breathing in water.

iv. Possession of swim bladder for adjusting to changes in water pressure at different depths of ater.



TOPIC 3: CHANGES IN MATTER

Matter generally exists in three states: solid, liquid or gas. Matter can be living or nonliving matter. Matter can undergo changes when exposed to heat, air, light, water or pressure.

Changes in matter can be classified into:

(a) Temporary change: These are the changes that occur but the original substance can easily be recovered. They are reversible, e.g. (i) Water changes into ice (ii) Water and oil are mixed (iii) Skin or hair is bleached (iv) Iron rod is heated in flame (v) A substance is dissolved in water

b. Permanent change: These are the changes that occur but the original substance cannot be recovered. The changes cannot be reverted e.g. (i) Yellowing of leaves of plants (ii) Decaying of plant and animal body (iii) Growth in plant and animal body (iv) Iron rust (v) Burning of substances

CHANGES IN NON-LIVING THINGS

Non-living things can be made to change from one state to another. Change of 'state' is also called change of ‘phase’. There are two major changes that take place in matter.

a. Chemical changes: These are changes in which new substances are formed. The original substance cannot easily be recovered. Change is permanent e.g.

(i) Rusting of iron

(ii) Burning of substances e.g. wood

(iii) Fermentation of palm wine etc.

b. Physical changes: These are changes in which no new substances are formed. The original substance can easily be recovered. Change is temporary e.g.

(i) Melting of ice

(ii) Magnetization of iron

(iii) Vaporization of liquid e.g. water

(iv) Melting of wax etc

EXPERIMENT/ACTIVITY 1:

Aim: To find out the effect of heat on sugar solution.

Materials required: sugar, evaporating dish, water, tripod stand, burner (stove) tablespoon, wire gauze.

PROCEDURE:

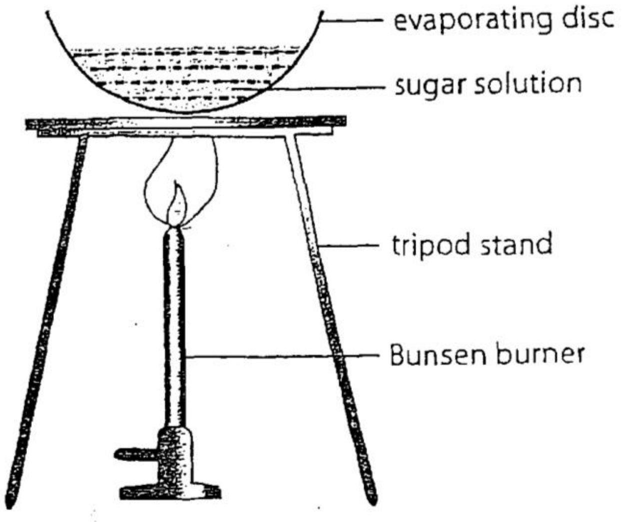
STEP I: Dissolve a tablespoonful of sugar in $5cm^3$ of water in a beaker and record your observation.

STEP II: Pour what is formed into an evaporating dish

STEP III: Heat gently over the burner until the water evaporates completely and records your observation.

Question: What *type* of change do you observe?

Activity	**Observation**	**Inference (Type of change)**



Heating sugar solution

Result: It is observed that sugar dissolved in water to form a solution. When heated, the water evaporated and the sugar solidified again. No new substances were formed. Therefore, the change is physical.

EXPERIMENT/ACTIVITY 2: HEATING SALT SOLUTION

Materials Required: Common salt, evaporating dish, beaker, water, tripod stand, burner, and tablespoon.

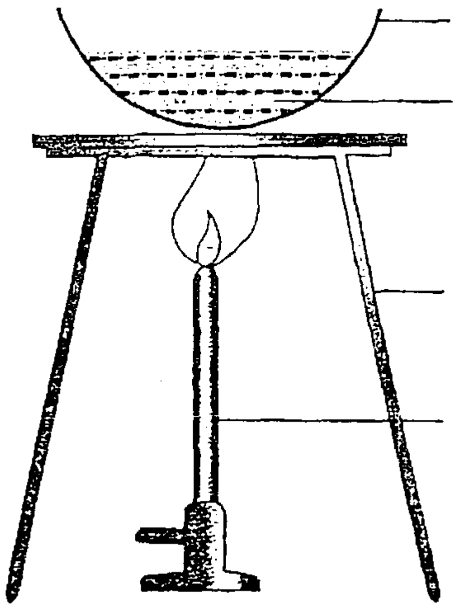
PROCEDURE

STEP I: Dissolve a tablespoonful of salt in 5cm3 of water in a beaker and record your observation.

STEP II: Pour what is formed into an evaporating dish.

STEP III: Heat gently over the burner until the water evaporates completely and records your observation.

Question: What type of change do you observe?



Heating salt solution

Result: The common salt dissolved in water. When heated, the water evaporated leaving only the solid salt in the dish. No new substance is formed. This is a physical change.

EXPERIMENT/ACTIVITY 3: HEATING PARAFFIN WAX (CANDLE)

Materials Required: A piece of white paraffin wax, tripod stand, burner, gauze, evaporating dish.

PROCEDURE:

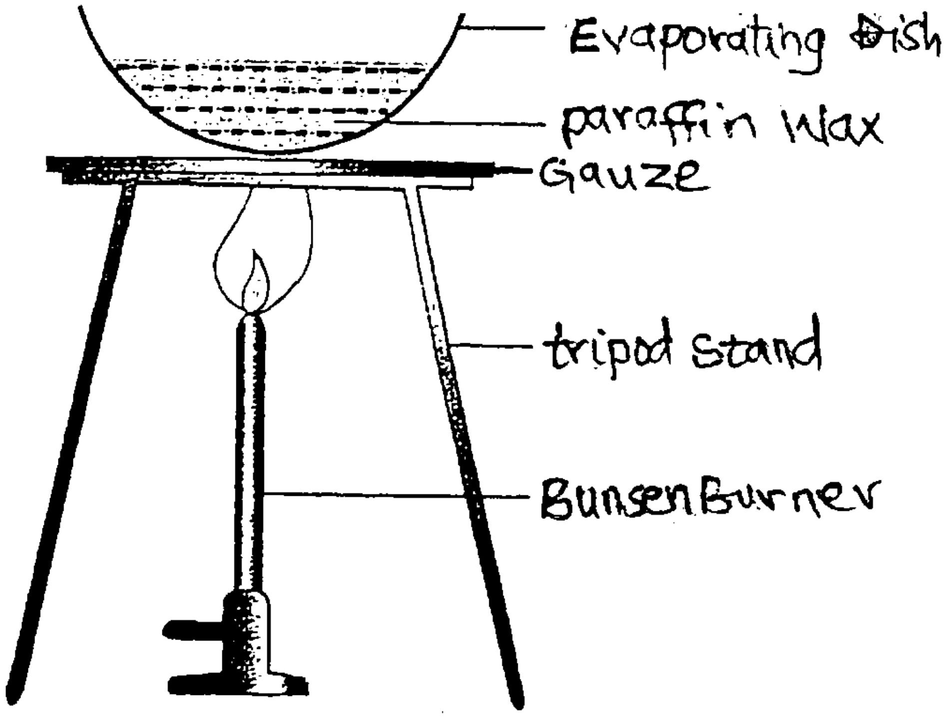
STEP I: Place the piece of wax into your evaporating dish.

STEP II: Place the evaporating dish on the gauze over the burner

STEP III: Heat gently till there is a change in state and record your observation

STEP IV: Keep the wax in the dish to cool for about five minutes and record your observation?

Question: What type of change do you observe?



Heating Paraffin wax

Result: The wax melted into a liquid when heated. When cooled, the wax solidified again into a solid white wax. No new substance is formed. The change is physical.

EXPERIMENT/ACTIVITY 4: BURNING WOOD

Materials Required: A small piece of dry wood that can burn easily, matches, a crucible and tripod stand.

PROCEDURE:

STEP I: Place the piece of wood in the crucible

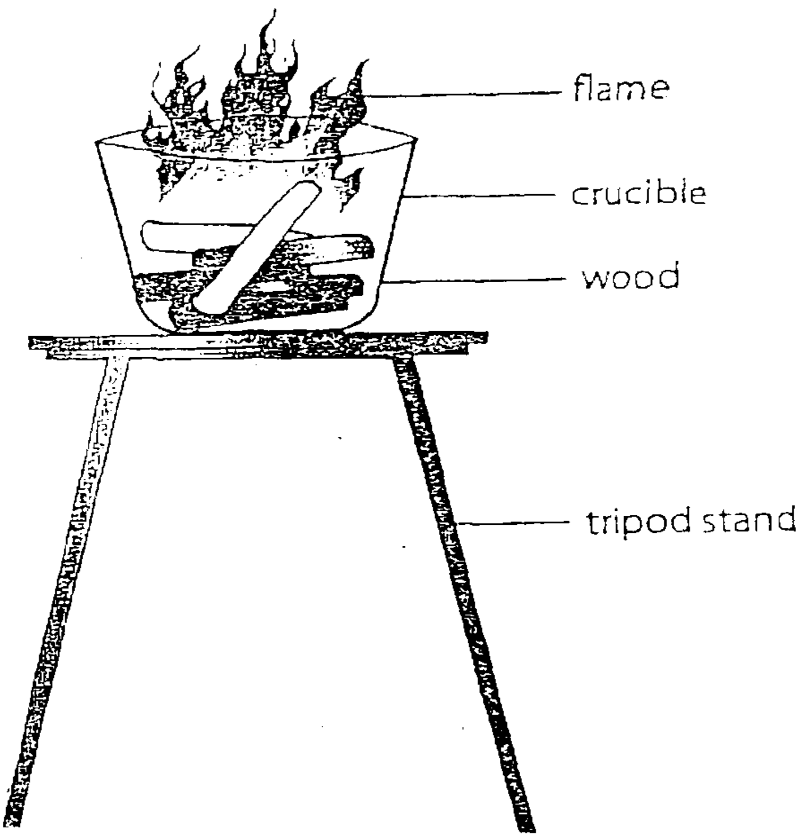
STEP II: Place the crucible on a tripod stand

STEP III: Strike the match and light the wood.

STEP IV: Allow the wood to burn out and record your observation.

Question: What type of change do you observe?

Experiment/Activity	**Observation (e.g. new substance/no new substance)**	**Inference (Type of change)**
		.



Result: It is observed that the wood burnt out into a black substance (charcoal). The original wood cannot be recovered. New substance is formed. The change is chemical.

EXPERIMENT/ACTIVITY 5: Burning of magnesium ribbon

Materials Required: A length of magnesium ribbon.

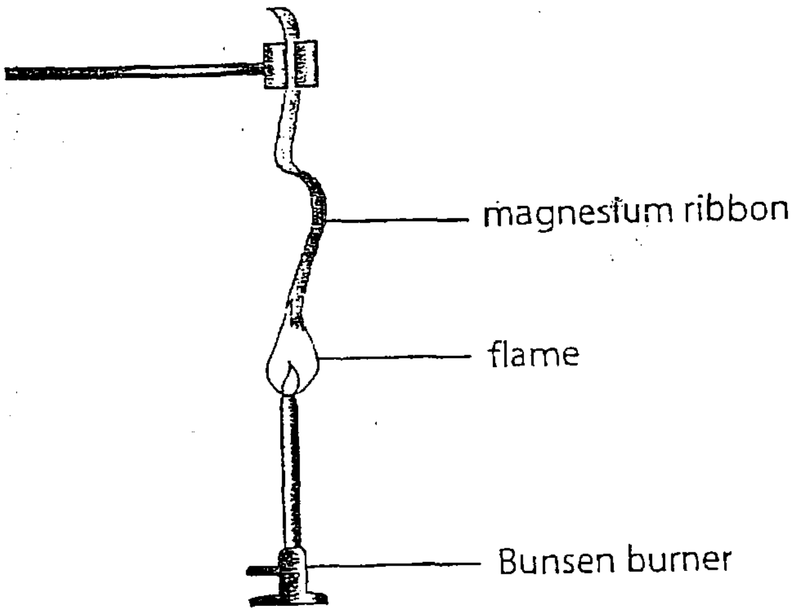
PROCEDURE:

STEP I: Light the burner

STEP II: Hold a length of the magnesium ribbon on a pair of tongs.

STEP III: Hold the magnesium bearing tongs over the burner and record your observation.

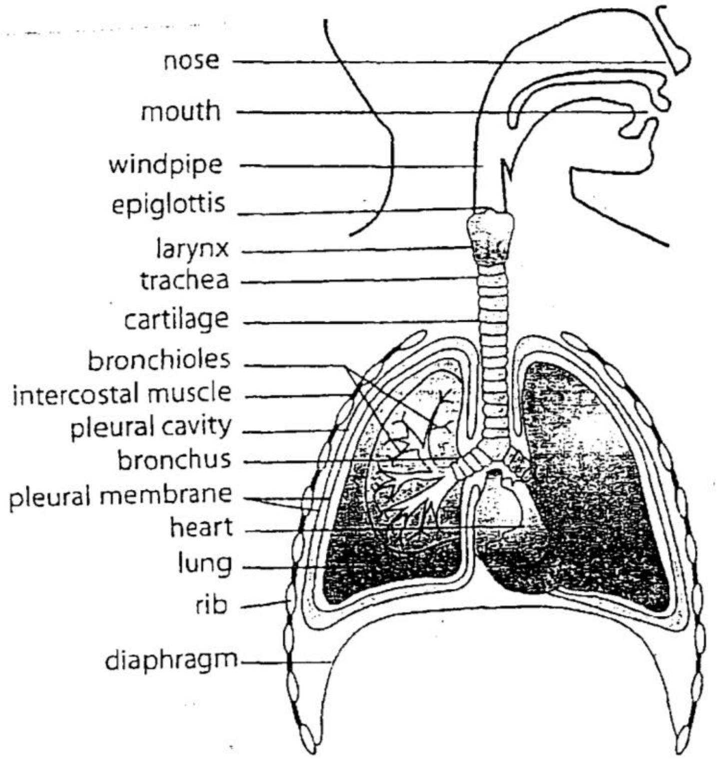
Question: What type of change do you observe?



Result: It is observed that the magnesium burnt and turned into a white substance called ash. The original magnesium ribbon cannot be recovered. New substance is formed. The change is chemical.

TOPIC 4: RESPIRATORY SYSTEM

a. Parts of the human respiratory system: There are parts that are responsible for the supply of oxygen to the body cells and removal of carbon (IV) oxide from the cells. These parts are: nostrils, larynx (voice box), pharynx, trachea (wind pipe), bronchi, lungs, bronchioles, alveoli and sometimes mouth.



The human respiratory system

(i) **The nostrils:** These are the openings of the nose through which air enters the body Mucus in the nostrils moistens the air we breathe while the hairs inside the nostrils filter the air allowing the dust particles to stick on the mucus membrane. Nostrils lead into the pharynx.

(ii) **The Pharynx:** This is the lower end of mouth cavity. Pharynx leads into the larynx.

(iii) **The Larynx:** This is also called the voice box. The Larynx leads into the trachea.

(iv) **The trachea:** This is also called the wind pipe. The trachea branches into two bronchi. The trachea and bronchi appear like rings of soft bones. Each bronchus leads into a lung.

(v) **The Lungs:** The lungs are two identical organs located in the chest cavity, placed on the two sides of the heart. They are red and covered with membrane called pleural membrane. Inside the lungs, the bronchi branch into tiny tubes called bronchioles. The bronchioles branch into many sacs called alveoli.

(vi) **The alveoli:** The alveoli communicate with the external atmosphere in a continuous system of tubes, which follow the reverse order to remove carbon (IV) oxide -and water as waste products from the body.

b. FUNCTIONS OF RESPIRATORY SYSTEM

The main functions of the respiratory system are:

- breathing and
- cellular respiration

Breathing: Breathing is the taking in of oxygen and the release of carbon (IV) oxide. It is an exchange of gases in which oxygen is breathed in and carbon dioxide is breathed out. **Respiration:** Respiration is the process by which oxygen breathed in from the atmosphere is used in breaking down food substances in our body cells to release needed energy with carbon (IV) oxide and water as the waste products. Respiration is made up of two types:

- **External Respiration:** This involves exchange of gases and this takes place in the lungs.
- **Internal Respiration:** This involves the breaking down of food substances and release of energy. It takes place within the cells of the body.

c. **Effect of Exercise on pulse Rate and Breathing.** Exercise can increase both the pulse and the breathing rates of human beings.

Activity:

Aim: To observe the effect of exercise on pulse rate and breathing.

PROCEDURE:

Step 1: Choose your partner

Step 2: Take the pulse rate of your partner by placing your right thumb at the lower end of the left thumb to observe the pulse for one minute. The pulse is calculated as number of pulses per second.

Step 3: Observing the breathing of your partner

Step 4: Allow your partner to run round the school field as fast as he or she can

Step 5: Take the pulse rate again

Step 6: Observe the breathing of your partner again

Step 7: Record your observations

Step 8: Take your own turn and let your partner follows steps 1-7.

Step 9: Check your records

Result: It would be observed an increase in the pulse rate. The breathing also becomes faster after the exercise.

d. Problems Associated with Breathing

The problems associated with breathing may be caused by heredity or environment. Some of these problems are:

(i) **Pneumonia:** This is a disease of the lungs in which the air sacs of the lungs are clogged up with mucus, making gaseous exchange difficult. It is caused by bacteria. Sufferers experience pains on the chest and difficulty in breathing.

(ii) **Tuberculosis:** This is also a disease of the lungs in which the lungs lose their elasticity and are unable to allow gaseous exchange. It is caused by bacteria. Sufferers experience prolonged cough and pains.

(iii) **Asthma:** This is a disease of the bronchi in which the sufferers experience shortness of breath or temporary breathlessness. It is triggered off by dusty environment.

(iv) **Bronchitis:** This is cough arising from difficulty in breathing. It is also a disease of the lungs.

TOPIC 5: INFORMATION AND COMMUNICATION TECHNOLOGY (ICT)

Meaning of ICT

The world is fast becoming a global village. Individuals can interact freely with .one another. They can communicate freely as if they were staying at close range. They can exchange ideas, information regardless of the long distances separating them. All these innovations and more are made possible because of Information and Communication Technology Information and communication Technology covers any product that will store, retrieve, manipulate, transmit or receive information electronically in a digital form e.g. personal computers, digital television, email, robots etc. So, ICT is concerned with the storage, retrieval, manipulation, transmission or receipt of digital data.

Information and Communication Technology (ICT) is defined as the entire process involved in processing, sending and receiving, storing and retrieving of information using electronic devices. The three key words in ICT are information, communication and technology. Information may be in the form of messages or sets of data concerning an issue. For instance, one may wish to know the meaning of HIV/AIDs or the number of people in a community who are HIV-positive. Communication is the passing of information from one person to another. Communication may be passed verbally by body or sign language, through writing, and through the printed or electronic media. Print media are: textbooks, newspapers etc while electronic media are radio, television and computer. Technology describes the various methods and devices involved in passing and receiving information.

COMPONENTS OF ICT

The devices involved in passing and receiving information is referred to as components of ICT. The components are:

(i) **The Computer:** Computer is an electronic machine used in processing, storing and retrieving information with a set of prescribed instructions (program). Computer is made up of:

(a) Input device (the data capturing device) e.g. mouse, keyboard, microphone, light pen, joystick, punch cards.

(b) Output device (used for bringing out information) e.g. monitor, speakers, printer and plotters.

(c) Processing unit (for processing and storage of information). The central processing unit (CPU) forms the main brain of the whole set-up.

Diagram of a computer system

(ii) Telephone/Mobile phones: Telephones and mobile phones are devices that can be used:

- To send and receive audio information.
- To send and receive text messages and even pictures.
- Sometimes as mini calculators.
- Sometimes in accessing the internet. *GSM means global system of mobile telecommunications

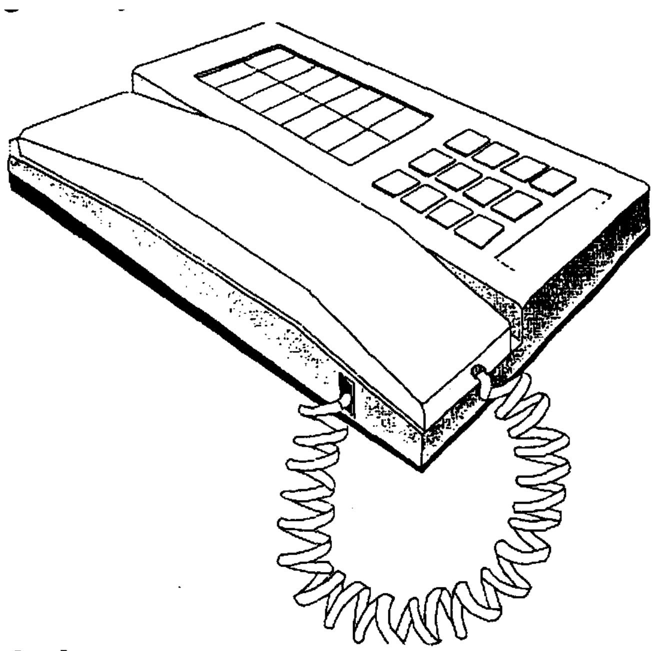


Diagram of telephone

(iii) **Fax machines:** Fax machines are electronic devices used to send and receive copies of written information across distant locations.

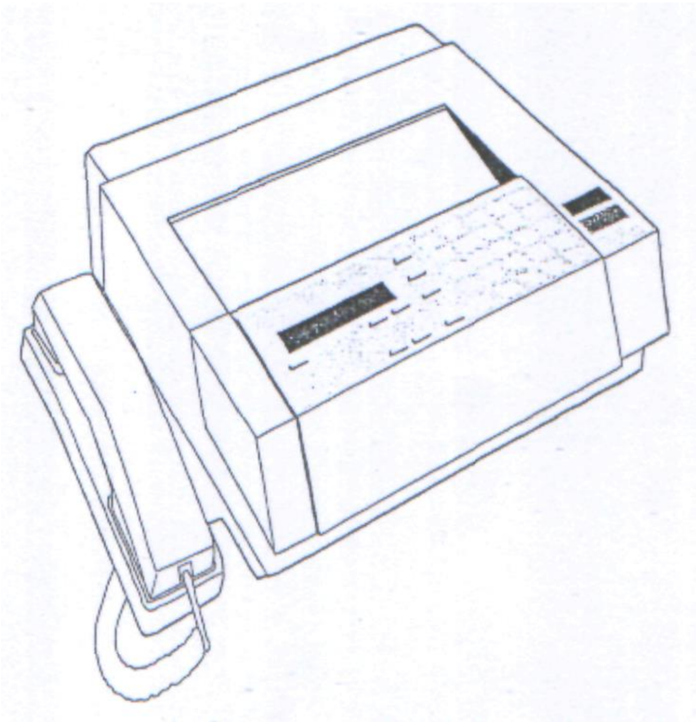


Diagram of fax machine

iv. The internet: Internet consists of inter-connected computers all over the world. This makes it possible for all connecting computers to send and receive information from each other simultaneously irrespective of the location around the globe. The Internet helps to link the whole world, thereby making it possible to access different information on all human issues political, economic, social, educational and even technological. With the help of Internet, access to any information is possible. It is possible to view people in distant places and communicate with them verbally through the internet.

Importance of ICT

1. ICT can be used for sending and receiving information from many parts of the world at cheaper and faster rates.
2. It can be used for collection, collation and analysis of large quantities of data with ease, speed and accuracy.
3. It can be used to replace local banking system with electronic banking.
4. It improves access to libraries around the world
5. It aids quick communication of information in terms of news relay to all parts of the world

6. It enhances innovational design and manipulation of structures

7. It reduces human movements as business transactions can be accomplished through the mobile phone or e-mail.

8. It improves teaching and learning in schools as students can have access to current information on any topic form the internet.

Class Activity/Teacher Demonstration

a. Identify the components of GSM such as the hand set, Sims-card, recharge card and battery charger.

b. Observe how to fix the Sims-card

c. Observe how to recharged the phone with recharge card

d. Observe how to fix the battery charger in order to keep the battery active.

e. Practice steps (a-d)

TOPIC 6: THERMAL (HEAT) ENERGY

a. Heat Flow: Heat is a form of energy that flows from one body (hot) to another body (cold) as a result of temperature difference between the two bodies. Heat usually flows from a hot area to a cold one:

- From the sun through the atmosphere to human skin
- From the fire source (e.g. stove) through the kettle into cold water.

These experiences show that heat can flow through space (vacuum), through the kettle (solid) and through water (liquid). The various ways heat flows (travels) are:

i. conduction

ii. convection

iii. radiation

B. Heat Transfer

(i) **Transfer of heat by Conduction:** Conduction is a mode of heat transfer where heat is handed over from one particle to the next in a solid material. The movement of heat through the material takes place without any obvious movement of the material. Materials that allow heat to pass through them are known as conductors. Metals are good conductors of heat.

Experiment

Aim: To demonstrate heat transfer by conduction

Materials: Bunsen burner, piece of thick copper wire (about 15cm long).

Procedure:

Step 1: Hold a piece of thick copper wire at one end

Step 2: Put the other end of the copper wire over a Bunsen burner

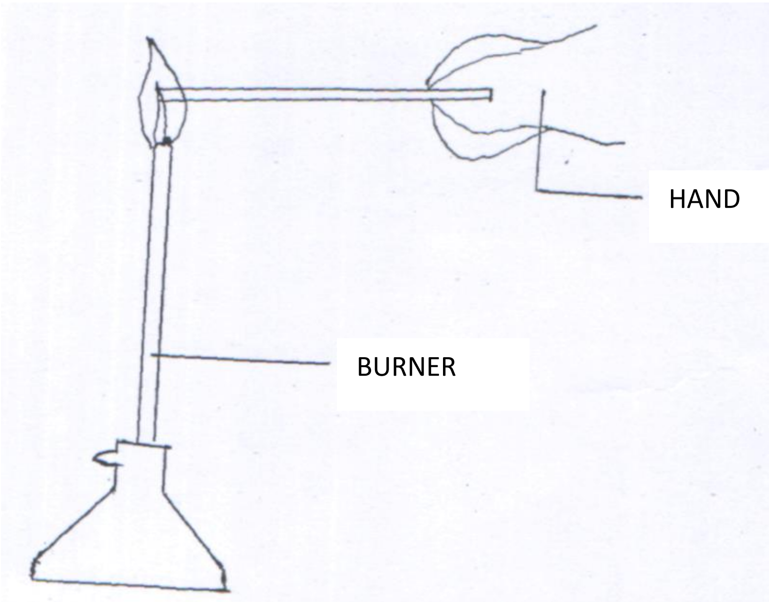
Step 3: Write your observations, and how long you could hold the copper wire.

Result: The end of the piece of copper wire held soon became hot because of heat reaching there. The heat moved along the body of the copper wire. The heat was passed on from one part of the wire to the next part until the heat reached the other end of the wire.

Heat conduction and its uses

(i) Heat conduction is applied in the manufacturing of frying pan.

(ii) It is applied in thermo flask:



(ii) Transfer of heat by convection: Convection is the method of heat transfer from one place to another by the movements of fluids (fluids e.g. liquids, gases, plasmas etc). Convection is usually the dominant form of heat transfer in liquids and gases. It occurs on large scale in atmospheres, oceans (and planetary mantles).

Heat Convection and Its Uses

(i) It is applied in capillary action (where liquid spontaneously rises in a narrow space such as a thin tube or in porous materials). This effect can cause liquids to flow against the force of gravity.

(ii) It is applied in stack effect or chimney effect (which is the movement of air into and out of buildings, chimneys, a structure flue for venting hot flue gases or smoke from a boiler, stove furnace or fireplace to the outside atmosphere) gas stacks or other containers).

(iii) It is applied in hurricane (a storm system characterized by a large low-pressure center and numerous thunderstorms that produce strong winds and heavy rain).

Group Experiment

Aim: To demonstrate transfer of heat by convection in a liquid

Materials: Round-bottomed flask, water, Bunsen burner, potassium permanganate crystal.

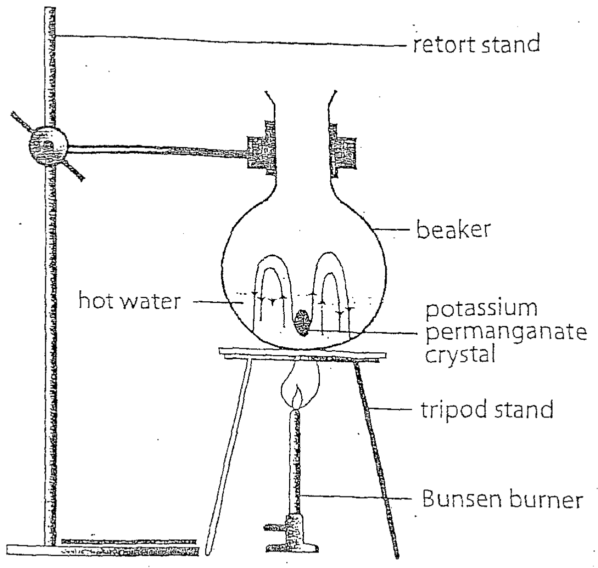
Procedure:

Step 1: Set up the apparatus as in the figure below

Step 2: Carefully place a small crystal of potassium permanganate at the bottom of the round-bottomed flask, through a glass tube.

Step 3: Heat the flask gently, directly under the crystal

Step 4: Observe carefully what happens and record your observations.



Result: The color of potassium permanganate helped to observe the way in which heated water moved in the flask. Heat flowed from the bottom of the flask to the top of the water. It is observed that as the heated (colored) water rises to the top through the middle of the flask, the water at the top flows down along the sides of the flask to take the place of water that has risen. This transfer (flow) of heat by the movement of liquid or air is called convection.

(iii) Transfer of heat by radiation: Radiation is the method of heat transfer which does not involve any medium between source of heat the object heated. How does energy from the sun reach us? Can it be by conduction or convection? No. It cannot be by conduction or convection. Heat energy from the sun reaches us by radiation. Conduction and convection need material medium before heat transfer takes place. Radiation does not need any material medium (like solid, liquid or gas). Heat travels in invisible waves from hot places to cooler places. By radiation, heat .can even travel through a vacuum (a space in which there is nothing at all, not even air).

A vacuum exists in space between the earth and the sun. The heat from the sun travels through this vacuum to the earth and through the earth to other objects.

Radiation and Its Applications

i. Radiation is applied in warming ourselves by staying near fire especially during the cold season.

ii. Radiation is applied in drying our clothes in the sun.

Group Experiment

Aim: To demonstrate transfer of heat by radiation.

Materials: Beaker, water, Bunsen burner, two thermometers TI and T2, retort stand and clamp.

Procedure: Step 1: Pour about $300cm^3$ of water into a $500\ cm^3$ beaker.

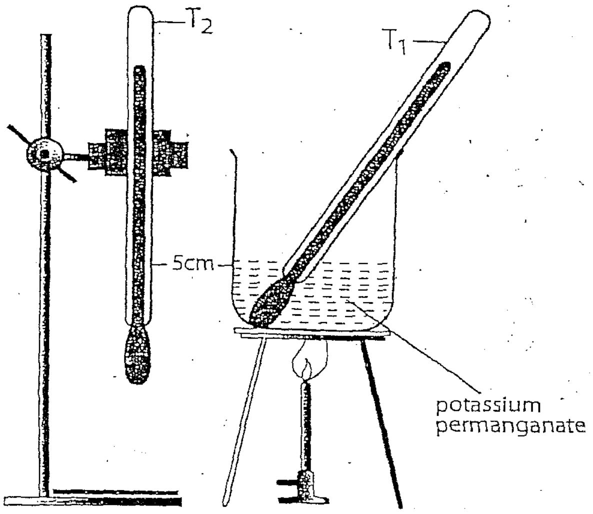
Step 2: Place thermometer TI in the beaker

Step 3: Hold, by means of a retort stand and clamp, thermometer *"£2* about 5cm from the beaker

Step 4: Heat the beaker so that the water in it becomes hot

Step 5: Read the temperatures of Tj and TI

Step 6: Write your observations



Result: The temperature of Ta could not have risen by conduction or convection. No medium was involved. Heat was transferred to the thermometer T2 by radiation. The method of heat transfer which does not involve any material (or medium) between the source of heat and the part heated is called radiation.

APPENDIX IX

CROSSWORD PUZZLE

APPENDIX X

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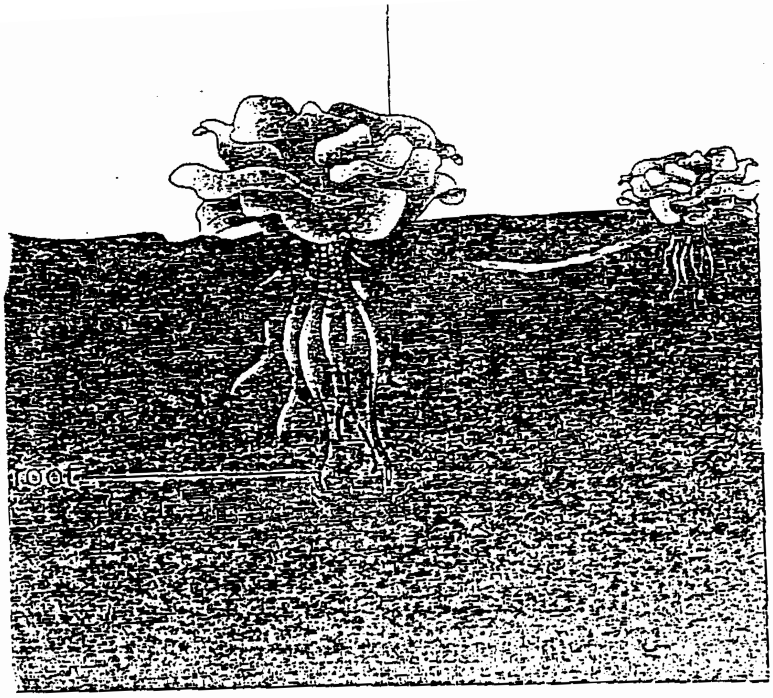
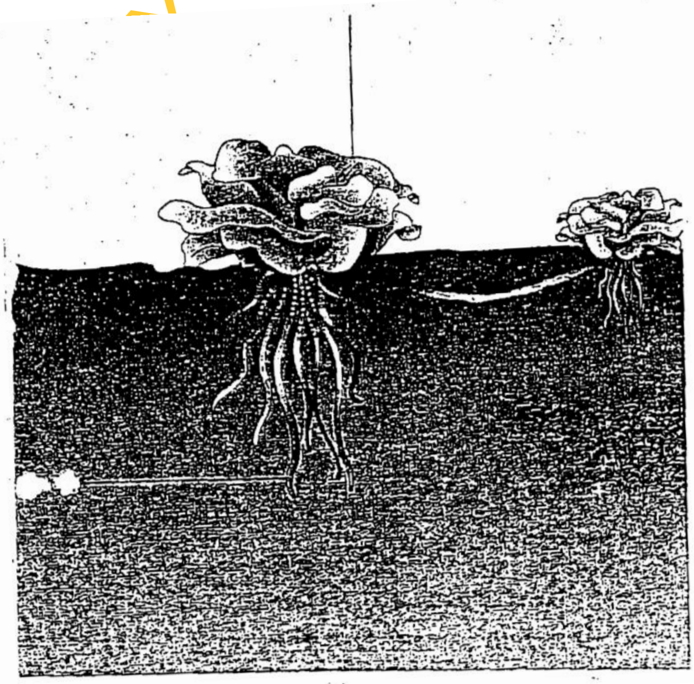
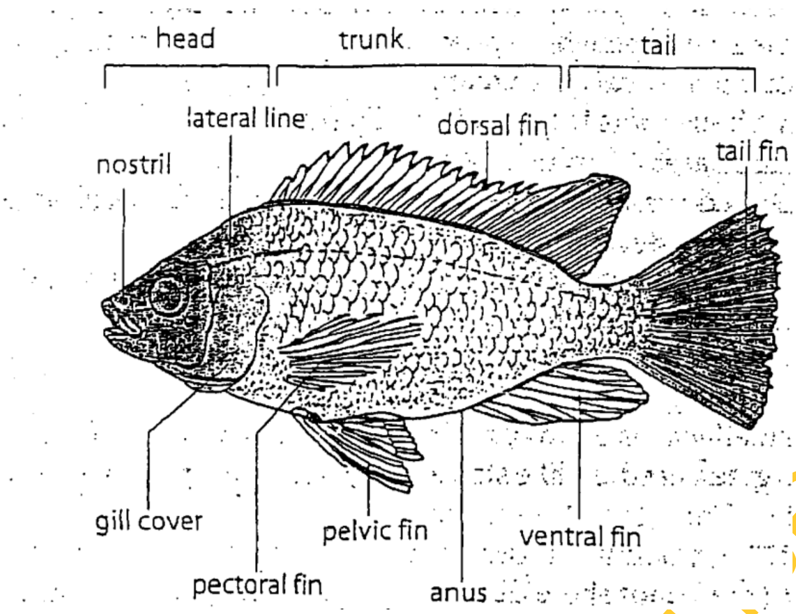
FACULTY OF EDUCATION
UNIVERSITY OF IBADAN, IBADAN
PICTURE PUZZLE

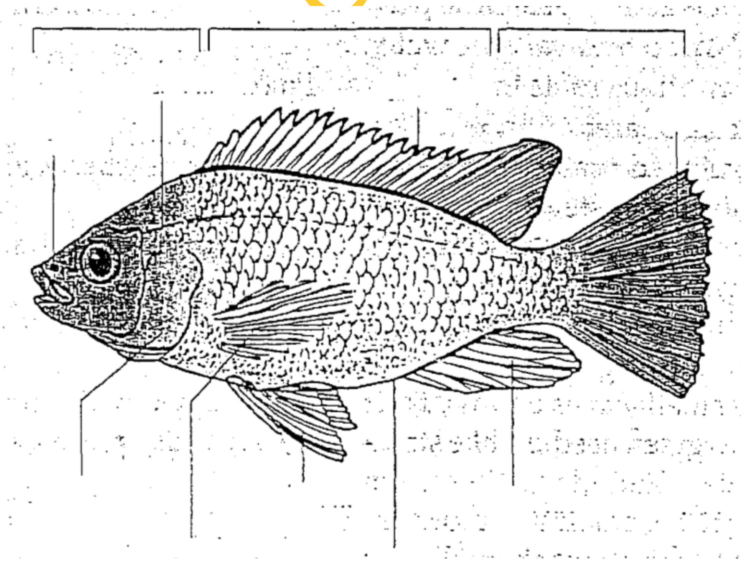


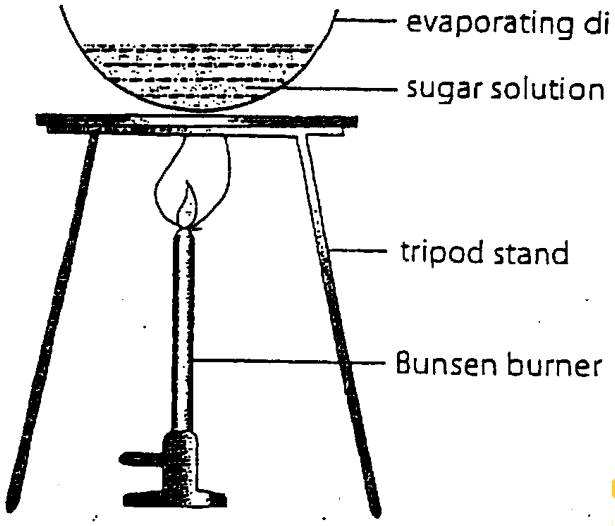
Water plant with reduced root system



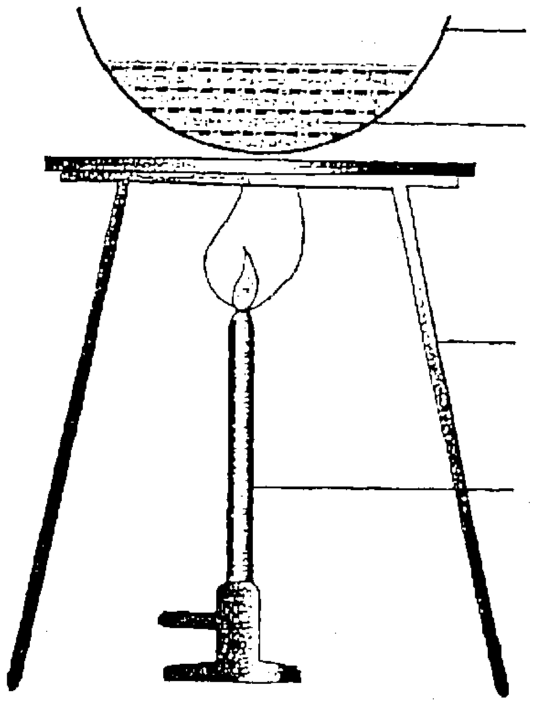

head
trunk
tail
lateral line
dorsal fin
nostril
tail fin
gill cover
pelvic fin
ventral fin
pectoral fin
anus

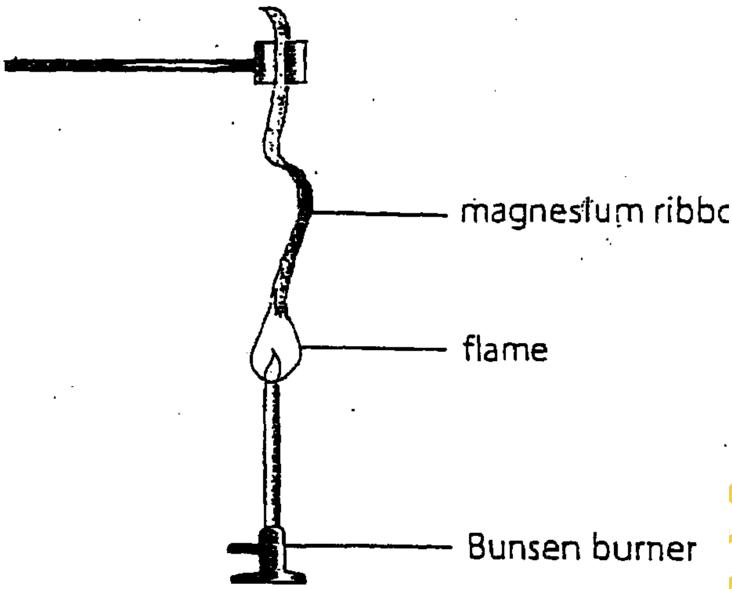
FISH



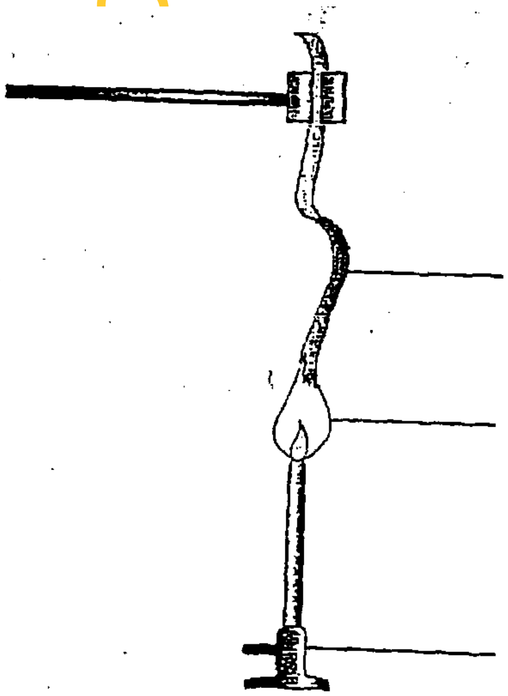


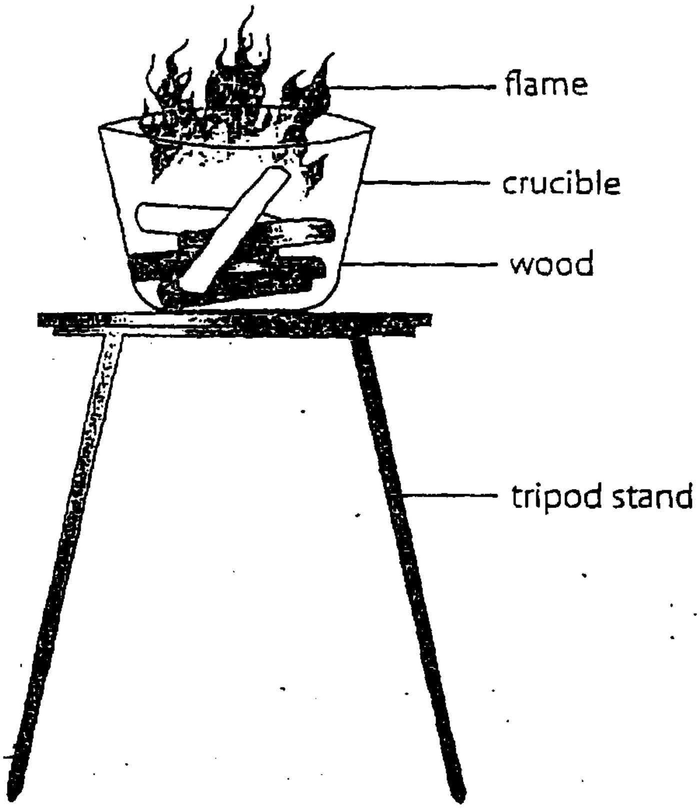
Heating sugar solution



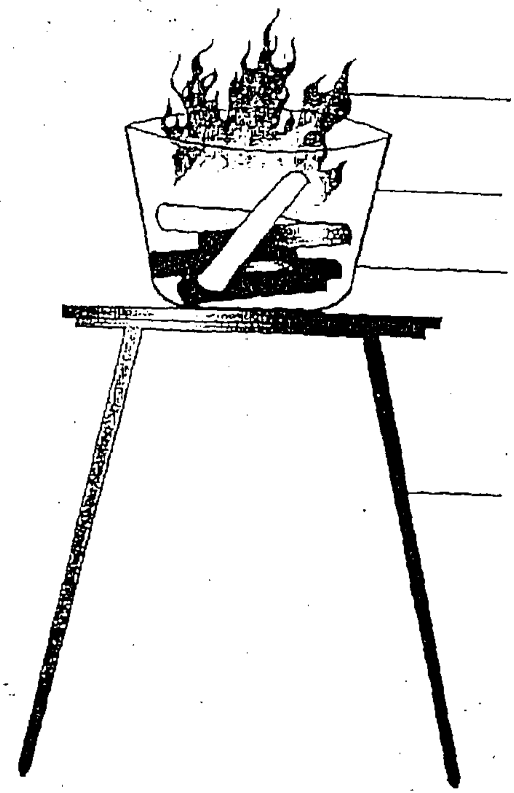


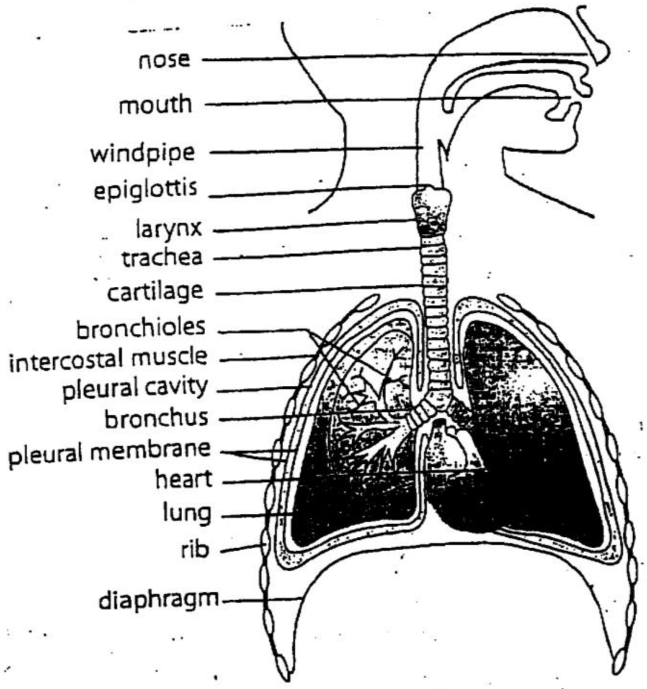
Burning of magnesium ribbon



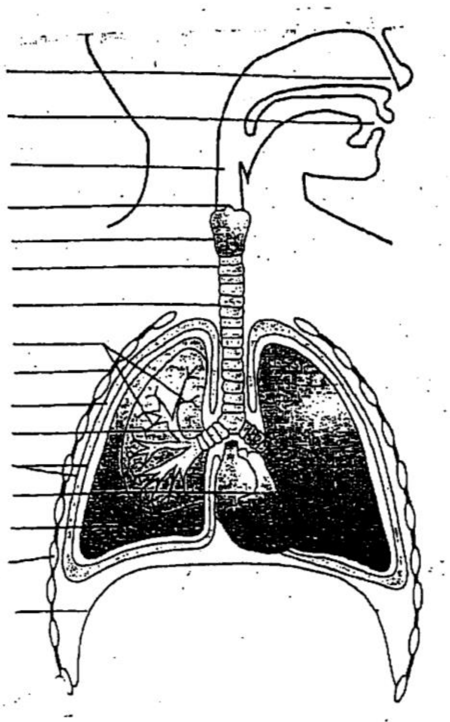


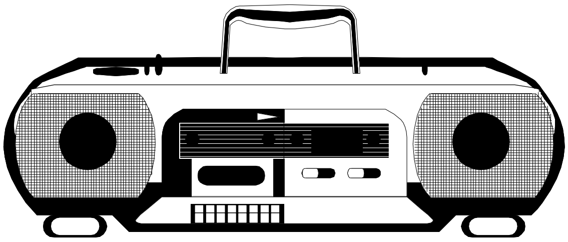
Burning wood



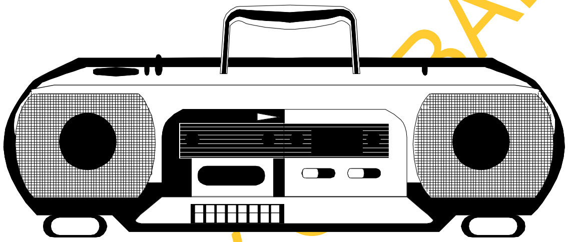


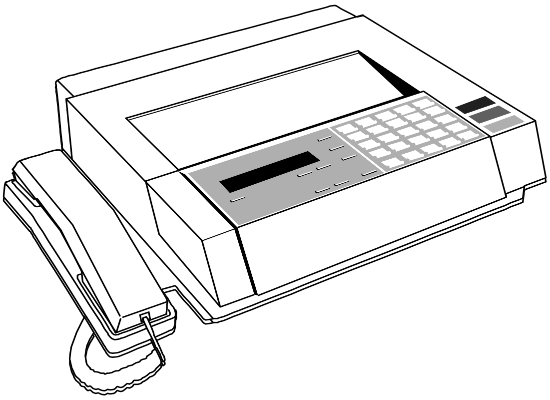
The human respiratory system

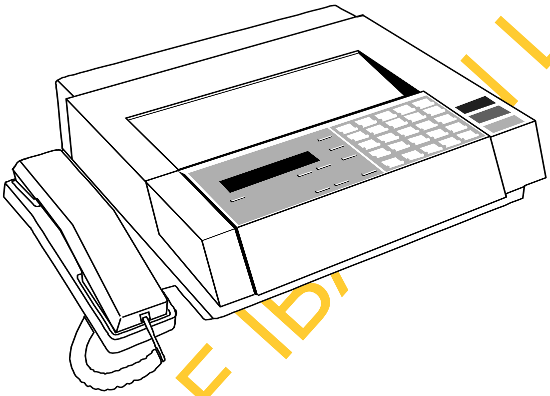




Radio

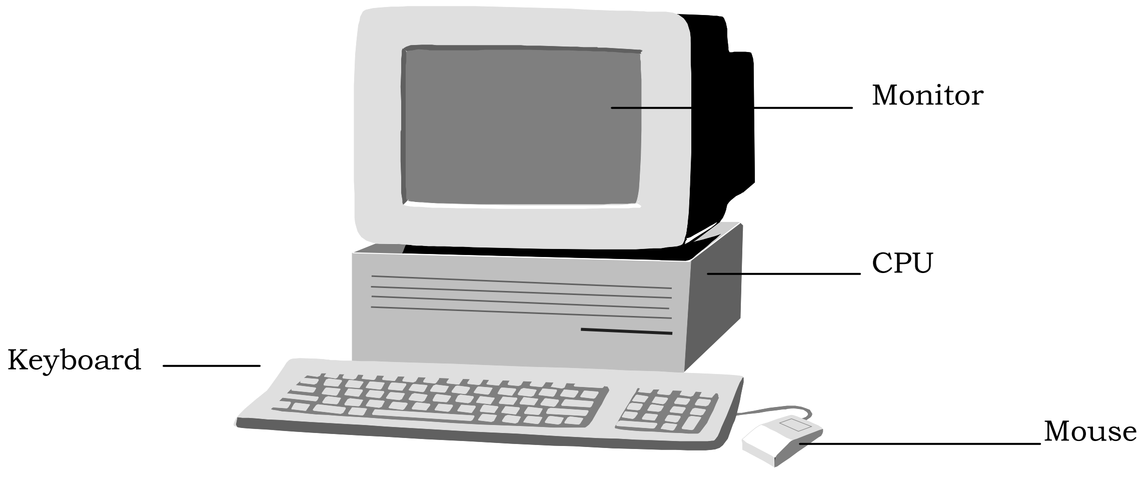




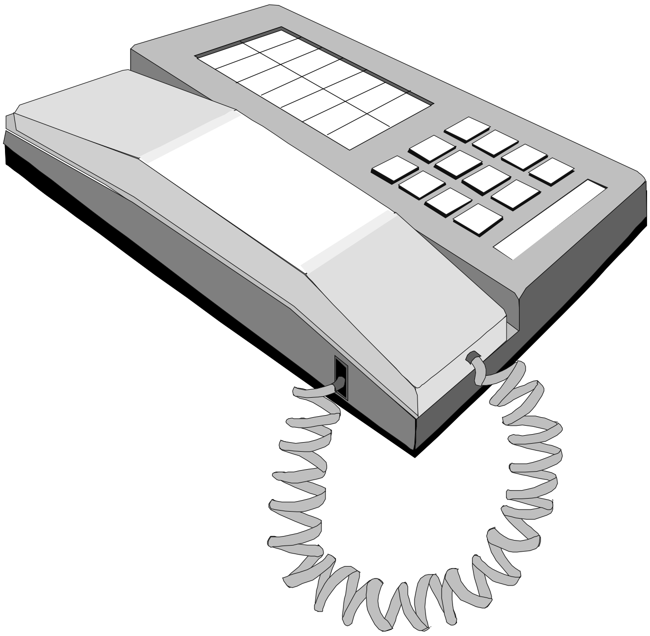


Fax Machine

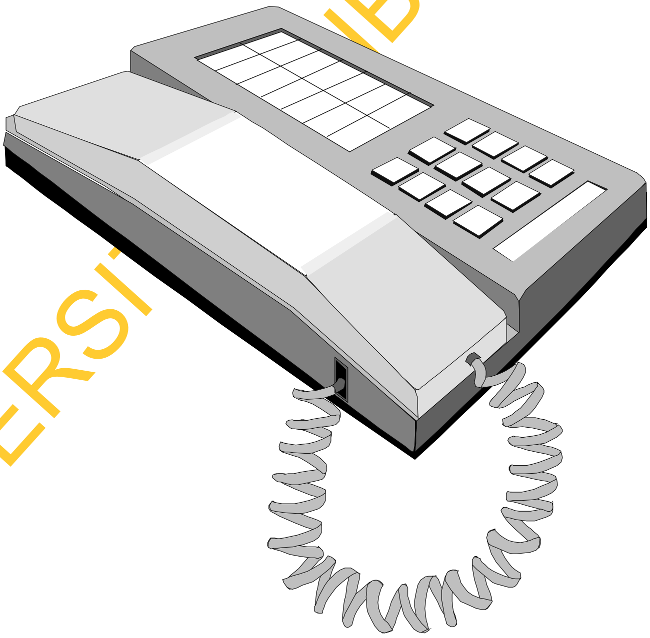
Internet

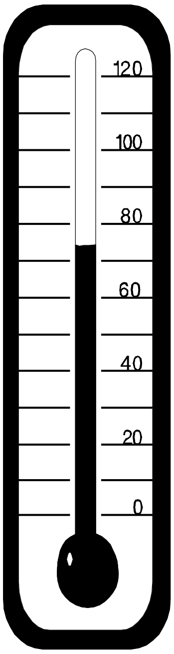


Computer

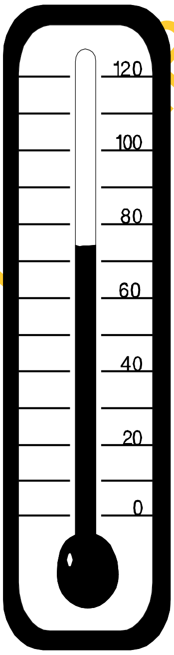


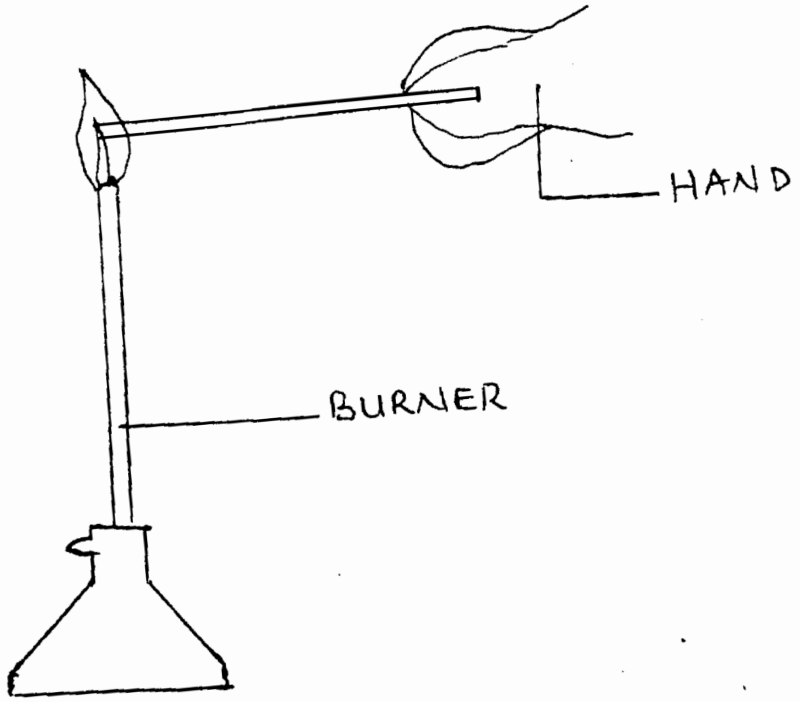
Telephone



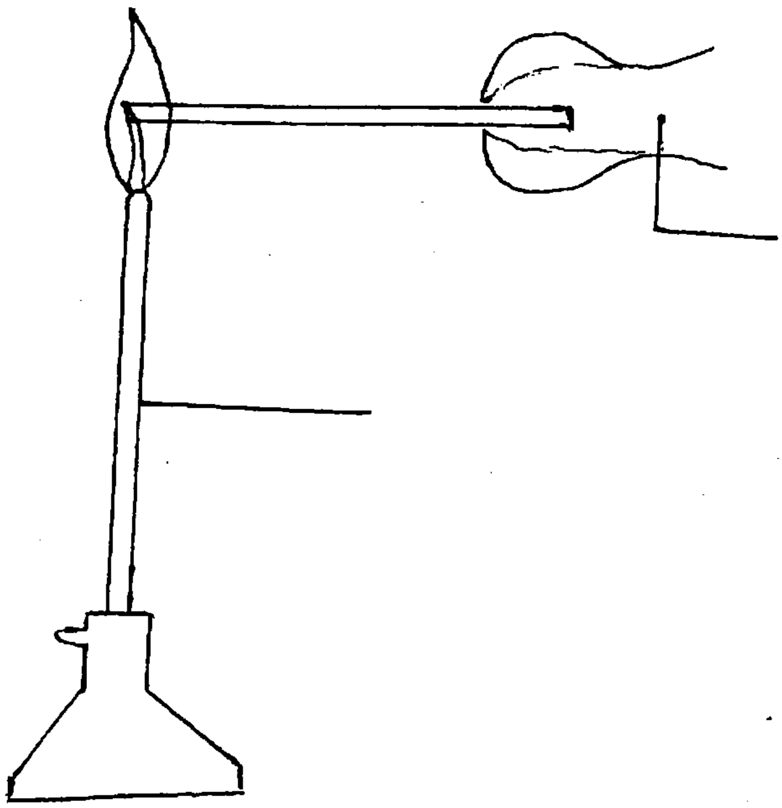


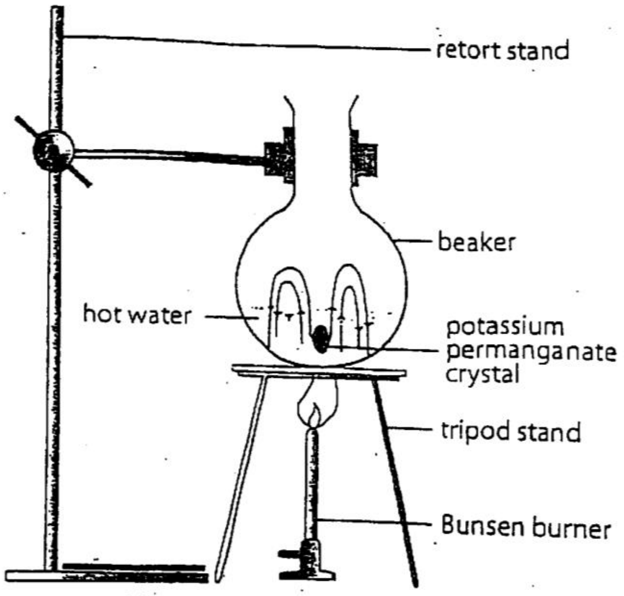
Thermometer



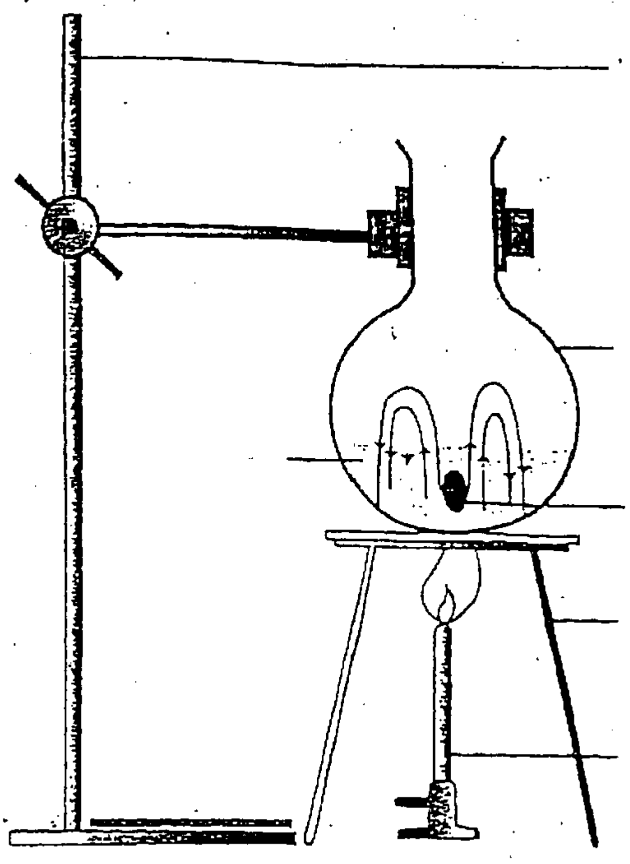


CONDUCTION





Transfer of heat by convection



Students in small groups in the First Phase (Inquiry, Question and Answer) of Crossword-Picture Puzzle Teaching Strategy

Students in the Second Phase (Puzzle Stage) of Crossword-Picture Puzzle Solving the Puzzle in Groups using Picture Puzzle

Students Manipulate the Picture Puzzle Raising up Hands Indicating That They Are Getting the Solution to The Puzzle with the Teacher Supervising Them

Students Solving the Crossword Puzzle Individually

Teacher Demonstrating During Enhanced Explicit Teaching (Explicit Teaching+Peer Tutoring) Process

Students Are in Their Different Peer Groups with their Peer-Teacher (Student Acting in the Capacity of the Teacher) Coordinating Group Instructional Activities

Peer Tutoring Session Coordinated by the Peer-Teacher

Students in Conventional Group with Their Teacher Discussing the Content of the Lesson

Students in the Conventional Lecture Class with Their Teacher Giving a Brief Oral Review of the Lesson Taught

APPENDIX V

SCIENCE EDUCATION UNIT
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FACULTY OF EDUCATION
UNIVERSITY OF IBADAN, IBADAN

TEACHERS' INSTRUCTIONAL GUIDE FOR ENHANCED EXPLICIT TEACHING STRATEGY, TIGEETS

(Explicit Teaching + Peer Tutoring)

LESSON 1

SUBJECT	**CLASS**	**DURATION**	**TOPIC**	**OBJECTIVES**	**PREVIOUS KNOWLEDGE**	**REFERENCE BOOK**
Basic Science	JSS 2	80 MINUTES	Drug Abuse	At the end of the lesson, students should be able to: 1. Define drug abuse 2. List methods of drug use 3. Identify some common ways youth misuse drugs 4. Discuss social (risk) factors leading to drug abuse 5. Recognize that sharing injection needles make HIV/AIDS infection rate higher among drug users.	Students must have been seeing some pharmaceutical shops, people who are addicted to alcohol (drunkards inclusive) and perhaps familiar with the use of some pain relief drugs e.g. paracetamol.	Ndu, F.O. C. & Somoye, E.O. 2008. <u>Basic Science for Junior Secondary Schools.</u> (UBE Edition) 2, Longman Nigeria Plc Page 24 – 27

PRESENTATION:

	TEACHER ACTIVITIES	STUDENTS' ACTIVITIES	MATERIALS
I	(a) **DAILY REVIEWS** (i) Objectives of the lesson are presented. (ii) Duration of lesson is explained. (iii) The reason for the lesson is explained. (b) Assessment on Students Previous Work. Students will be asked some questions e.g. (i) What is the topic for the previous lesson? (ii) Do you need any area for further explanation? (c) Brief Introduction The students are asked to do the following: Make a list of substances in the home or that you can easily buy in a shop, which can alter the action of the body and so change a person's behaviour (e.g. substance that can make you sleepy, make you excited, keep you awake, take away pain etc). Did you include some of the following?	Students listen to the teacher's explanation with full attention and concentration. Students are to answer the teacher's questions with the teacher's guidance where necessary. Students respond to teacher's request and questions with teacher's guidance where necessary	Chart, paracetamol (syrup or tablet), syringe and needle, empty bottle of alcoholic drink (which must be handled with great care) etc.

II	Whisky (Alcohol) Gin (Alcohol) Beer (Alcohol) Palm wine (Alcohol) Kola nuts Tobacco Aspirin & Paracetamol etc. **LESSON DEMONSTRATION** Step 1: Students are guided to define the term drug abuse. Step 2: Teacher guides the learners into the various methods used to introduce drugs into the body: ingestion (swallowing), inhalation (through respiratory system: inhaled or sniffed into the body through nostrils), injection (directly to the body through the capillaries, arteries or veins), smoking (smoked either rolled in paper, leaf or put in a pipe) and absorption through the skin (in form of body creams). Step 3: Teacher asks the students to mention ways youth misuse drugs and defines drug	Students listen to teacher's demonstration, respond where necessary and write down important points.	Chalkboard, workbook and writing materials.

	misuse: Drug misuse is the taking of a drug for its medically – intended purpose, but not in the appropriate amount, frequency, strength or manner. The common ways youth misuse drugs are: Taking a dosage other than that recommended (overdose or under dose), taking the prescribed drugs for a purpose which it was not intended, sharing a prescribed drug with a friend or family member, taking drugs to induce sleep without doctor's prescription, taking drugs to gain confidence or boldness to commit crimes etc. Step 4: Students are guided to social risk factors leading to drug abuse: broken home, peer influence, being brought up in a drug dependent family, thirst to acquire wealth (materialistic value) etc. Step 5: Teacher guides discussion on the effect of sharing injection needles as it affects HIV/AIDS among drug users: Needles, syringes or cotton wool used to inject drugs such as heroin and cocaine are sometimes		

	contaminated with the blood of the user. In sharing such needles, a small amount of one person's blood can be directly injected into another person's blood stream. Therefore, sharing injection needles make HIV/AIDS infection rate higher among drug users.		
III	**<u>PROVISION OF GUIDED PRACTICE</u>** Students are instructed to go to the site of school health facility. Students identify some facilities such as first Aid Box and identify different types of drug/equipment inside the box (in the absence of school health facility, an improvised first Aid Box can be used). What are the various ways these drugs can be misused? Some students that have been informed and trained to stage short drama on the influence of drug and its effects are asked to stage the drama: Stage 1: A family setting: Father, mother and four children. The family is poor in	Students are to identify different types of drug inside the box. Students stage short drama.	First Aid Box (or improvised First Aid Box) syringe without needle, costumes. Visit to school health facility site.

	everything. A child is sick in the family, is given half of vitamin C tablet to use but uses one tablet (overdose). Another child goes outside the family setting to join a bad group (peer influence) Stage 2: A peer group addicted to drug introduces a new member into the group by introducing drug into his body through a doctor. They all begin to dance after they have drunk (water inside keg or bottle). Stage 3: The new member in the group falls sick and visits a medical doctor. The doctor recommends that he will go for medical test. The test reveals HIV/AIDS positive.		
IV	**<u>CHECKING FOR UNDERSTANDING AND PROVIDING FEEDBACK.</u>** Students are asked to flash back on the short drama and later asks them the following questions: What is drug abuse? List five methods used in introducing drug into the body.	Students are to flash back on the short drama and provide answers to the questions asked by the teacher. Teacher is to guide the students where necessary.	Needle and syringe, materials for the short drama and chalk board.

	State three ways in which drugs are misused. Mention two social factors leading to drug abuse. Explain the dangers in wrong use of injection needles.		
ACTIVITY	**TEACHERS ACTIVITIES**	**STUDENTS' ACTIVITIES**	**MATERIALS**
I **II**	**PAIRING OF TEACHERS WITH STUDENTS** (a) Peer-teachers are selected among the students who will direct tutoring session and present peer summaries of learning activities. (b) Peer-teachers are paired with students based on the ability and social interaction of teachers to other students in the class to enhance active participation of peers. **TUTORING SESSION BY TEACHERS WITH STUDENTS** (a)Each peer goes into tutoring session (b) Peer-teachers explain the objectives of the lesson and the learning task to the students. (c) Peer-teacher asks students probing	Students' listen to the teachers' explanation and give answers to the teachers' question. Students' discuss in the group Methods of drug use, ways in which drugs are misused, social factors leading to drug abuse, dangers in wrong use of injection needles, consequences of taking the drug without doctor's prescription. Students repeat the learning activities where error has occurred.	Charts, workbook and writing materials. Charts, workbook and writing materials.

	questions and offer assistance where needed. (d) Peer-teacher records vital points observed.		
III **IV**	**<u>TEACHER GUIDES STUDENTS</u>** (a)Students carry out certain activities as directed by the Peer-teacher e.g. i. to discuss in the group methods of drug use. ii. To identify ways in which drugs are misused. iii. To identify social factors leading to drug abuse. iv. To explain the dangers in wrong use of injection needles. (b) Peer-teachers ask questions from tutees and give assistance where necessary e.g. i. What are the methods used in introducing drugs into the body? ii. What are the various ways in which drugs are misused? iii. What are the consequences of taking the drug without doctor's prescription? iv. Mention social factors leading to drug	Students write down the points on the chalk-board in their books.	Chats, workbook

	abuse. v. Explain the dangers in wrong use of injection needles.		
V	**CHECKING FOR UNDERSTANDING AND PROVIDING FEEDBACK.** (a) Peer-teacher summed up the total activities performed by the students and relay them to the students. (b) Peer-teacher corrects errors and asks students to repeat the learning task in which an error has occurred. (c) Peer-teacher prompts students to participate actively in the task by: (i) Encouragement and praises for correct responses. (ii) Waiting for students to attempt a problem independently before offering assistance. (d) Teacher goes round the peers to		

VI	monitor their activities. **<u>CLASS CONCLUSION AND DECISION MAKING</u>** (a) Each Peer-teacher presents summary of discussions. (b) Each class member asks questions. (c) Teacher writes important points on the chalkboard. (d) Teacher reconciles peer differences. (e) Teacher rewards well behaved peers by: (i) Clapping for them and (ii) Offering them verbal praises		

LESSON 2

SUBJECT	CLASS	DURATION	TOPIC	OBJECTIVES	PREVIOUS KNOWLEDGE	REFERENCE BOOK
Basic Science	JSS 2	80 MINUTES	Habitat	At the end of the lesson, students should be able to: 1. Mention the different habitats of living things. 2. Identify the living organisms found in different habitats. 3. List the distinguishing characteristics of organisms found in the different habitats.	Students are familiar with land, water and the use of the word 'home'. They must have been seeing different plants and animals.	Ndu, F.O.C & Somoye, E.O 2008. <u>Basic Science For secondary school (UBE Edition) 2</u>, Longman Nigeria plc. Page 28-33

PRESENTATION:

ACTIVITY	TEACHERS' ACTIVITIES	STUDENTS' ACTIVITIES	MATERIALS
I	Learning tasks are presented in a condensed and precise form to the class following		

	the same procedures in phase 1-4 of explicit teaching: lesson plan 1		
II	**PAIRING OF TEACHERS WITH STUDENTS** (a) Peer-teachers are selected among the students who will direct tutoring session and present peer summaries of learning activities. (b) Peer-teachers are paired with students based on the ability and social interaction of teachers to other students in the class to enhance active participation of peers.		
III	**TUTORING SESSION BY TEACHERS WITH STUDENTS** (a) Each peer goes into tutoring session. (b) Peer-teachers explain the objectives of the lesson and the learning task to the students. (c) Peer-teacher asks students probing questions and offer assistance where needed. (d) Peer-teacher records vital points observed.	Students give answers to questions asked by the teachers.	Charts, diagrams, writing materials, polythene bags.
IV	**TEACHER GUIDES STUDENTS** (a) Students carry out certain activities as directed by the Peer-teacher e.g. (i) To visit an aquatic habitat (e.g. pond, stream, small river etc) and observe the	Teachers give the major habitats, give examples of living things found in the different habitats and state the differences between	Different plants and animal, water, land (soil).

V	size, identify plants and animals seen in the area, note where each plant or animals live in the habitat (e.g. at the bottom of the water, at the surface, at the edge between water and land, in the mud at the bottom, floating etc), the adaptation of the plants and animals in the water, observe the water whether coloured or clear, polluted or not, smells, flows fast or slow-flowing and summarize your observation on a table. (ii) Mention the various habitats of living things. (iii) State differences between - Plant found on land and water - animal that live in water **<u>CHECKING FOR UNDERSTANDING AND PROVIDING FEEDBACK</u>** (a) Peer-teacher sums up the total activities performed by the students and relay them to the students. (b) Peer-teacher corrects errors and asks students to repeat the learning task in which an error has occurred. (c) Peer-teacher prompts students to participate actively in the task by providing: (i) Encouragement and praises for correct responses.	plants found on land and water, animals that live on land. Teacher gives assistance where needed. Students repeat the learning task where error has occurred.	

VI	(ii) Waiting for students to attempt a problem independently before offering assistance. (d) Teacher goes round the peers to monitor their activities. **<u>CLASS CONCLUSION AND DECISION MAKING</u>** (a) Each Peer-teacher presents summary of discussions. (b) Each class member asks questions. (c) Important points are written on the chalkboard. (d) Peer differences are reconciled. (e) Teacher rewards well behaved peers by: (i) Clapping for them. (ii) Offering them verbal praises.	Students write down the points on the chalkboard in their book.	Charts, diagrams, workbook.

LESSON 3

SUBJECT	**CLASS**	**DURATION**	**TOPIC**	**OBJECTIVES**	**PREVIOUS KNOWLEDGE**	**REFERENCE BOOK**
Basic Science	JSS 2	80 MINUTES	Changes in Matter	At the end of the lesson, students should be able to: 1. Describe different ways matter changes. 2. Identify the changes as temporary or permanent, physical or chemical. 3. Distinguish between temporary and permanent changes, physical and chemical changes. 4. State the causes of such changes.	Students must have been seeing sugar/candle/ice melting, water boiling, paper/wood burning, nail/iron sheet rusting, and tree growing.	Ndu, F.O.C. & Somoye, E.O. 2008. <u>Basic Science for Junior Secondary schools (UBE Edition) 2,</u> Longman Nigeria Plc Page 39-47

PRESENTATION:

ACTIVITY	TEACHERS' ACTIVITIES	STUDENTS' ACTIVITIES	MATERIALS
I	Learning tasks are presented in a condensed and precise form to the class following the same procedures in phase 1- 4 of explicit teaching: lesson plan 1		
II	**PAIRING TEACHERS WITH STUDENTS** (a) Peer-teachers are selected among the students who will direct tutoring session and present peer summaries of learning activities. (b) Peer-teachers are paired with students based on the ability and social interaction of teachers to other students in the class to enhance active participation of peers.		
III	**TUTORING SESSION BY TEACHERS WITH STUDENTS** (a) Each peer goes into tutoring session. (b) Peer-teachers explain the objectives of the lesson and the learning task to the students. (c) Peer-teacher asks students probing questions and offers assistance where necessary. (d) Peer-teacher records vital points observed.	Teachers give answers to the questions asked by the students.	Ice block, common salt, water, beaker, kerosene, firewood.

IV	**TEACHER GUIDES STUDENTS** (a) Students carry out certain activities as directed y the Peer-teachers e. g (i) To find out the effect of heat on sugar solution by dissolving a table spoonful of sugar in a given volume of water, the solution formed is poured into an evaporating dish, heat gently over the burner until the water evaporates completely, observations are recorded. (ii) To find out what happens when salt solution is heated by dissolving a table spoonful of salt in a given volume of water, the solution is poured into an evaporating dish and heated gently over the burner until the water evaporates completely, and observations are recorded. (b) Teachers ask questions from students and give assistance where necessary e. g (i) What type of change do you observe? (ii) What causes the change? (iii) What are the characteristics of the change?	Teachers give the types of change they observed, what causes the change and the characteristics of the change.	Sugar, salt, tablespoon, water burner, tripod stand, evaporating dish.

V	**<u>CHECKING FOR UNDERSTANDING AND PROVIDING FEED BACK</u>** (a) Peer-teacher sums up the total activities performed by the students and relay them to the students. (b) Peer-teacher corrects errors and asks students to repeat the learning task in which an error has occurred. (c) Peer-teacher prompts students to participate actively in the task by providing: (i) Encouragement and praises for correct responses. (ii) Waiting for students to attempt a problem independently before offering assistance. (d) Teacher goes round the peers to monitor their activities.	Teachers repeat the learning task where error has occurred.	Sugar, salt, water, burner, evaporating dish, tripod stand, spoon.
VI	**<u>CLASS CONCLUSION AND DECISION MAKING</u>** (a) Each Peer-teacher presents summary of discussions. (b) Each class member asks questions.		

	(c) Important points are written on the chalkboard. (d) Peers differences are reconciled. (e) Well behaved peers are rewarded by: (i) Clapping for them. (ii) Offering them verbal praises.		

LESSON 4

SUBJECT	CLASS	DURATION	TOPIC	OBJECTIVES	PREVIOUS KNOWLEDGE	REFERENCE BOOK
Basic Science	JSS 2	80 MINUTES	Respiratory System	At the end of the lesson, students should be able to: 1. Identify parts of the respiratory system 2. Distinguish between breathing and respiration 3. Discover that pulse rate and breathing rate increase with exercise 4. Identify breathing problems	Students must have been engaging in some physical exercises such as running, walking, dancing, jumping and playing football or volleyball.	Ndu, F.O.C. & Somoye, E.O. 2008 Basic Science for Junior Secondary Schools (UBE Edition) 2: Longman Nigeria Plc. Page 55 – 57

PRESENTATION:

ACTIVITY	TEACHERS' ACTIVITIES	STUDENTS' ACTIVITIES	MATERIALS
I	Learning tasks are presented in condensed and precise form to the class following the same procedures in phase 1- 4 of explicit teaching: lesson plan 1		

II	<u>**PAIRING TEACHERS WITH STUDENTS**</u> (a) Peer-teachers are selected among the students who will direct tutoring session and present peer summaries of learning activities. (b) Peer-teachers are paired with students based on the ability and social interaction of teachers to other students in the class to enhance active participation of peers.		
III	<u>**TUTORING SESSION BY TEACHERS WITH STUDENTS**</u> (a) Each peer goes into tutoring session (b) Peer-teachers explain the objectives of the lesson and the learning task to the students. (c) Peer-teacher asks students probing questions and offers assistance where necessary (d) Peer-teacher records vital points observed.	Students give answers to the questions asked by the teachers.	Charts, stopwatch, model, writing materials.
IV	<u>**TEACHER GUIDES STUDENTS**</u> (a)Students carry out certain activities as directed by the Peer-teacher e.g. (i) Observe the respiratory system from the model provided: identify the parts of the system, the branching out of the trachea into bronchi, the numerous tubes in the lungs, the parts of the system according to the	Students identify the parts involved in breathings distinguish between breathing and respiration, explained differences in thing rate before and after exercise and give	Charts, model, stopwatch, writing materials.

	order in which air passes through them. (ii) Observe the effect of exercise on pulse rate and breathing by: Choosing your partner, take the pulse rate of your partner, observe the breathing of your partner, allow your partner to run round the school field as fast as he or she can, take the pulse rate again, observe the breathing of your partner again, record your observations. Take your own turn, your partner takes your pulse rate and observes your breathing, run round the school field as fast as you can, let your partner take your pulse rate and observe your breathing again, check your records. (b) Peer-teachers ask questions from students and give assistance where needed. (i) List the parts involved in breathing (ii) Distinguish between breathing and respiration (iii) Explain differences in breathing rate before and after exercise (iv) Name two respiratory problems	two respiratory problems.	
V	**<u>CHECKING FOR UNDETRSTANDING AND PROVIDING FEED BACK</u>**		

	(a) Peer-teacher sums the total activities performed by the students and relay them to the students. (b) Peer-teacher corrects errors and asks students to repeat the learning task in which an error has occurred (c) Peer-teacher prompts students to participate actively in the task by providing: (i) Encouragement and praises for correct responses. (ii) waiting for students to attempt a problem independently before offering assistance (d) Teacher goes round the peers to monitor their activities.	Students repeat the learning task where error has occurred.	Charts, model, stopwatch, writing materials.
VI	**<u>CLASS CONCLUSION AND DECISION MAKING</u>** (a) Each Peer-teacher presents summary of discussions with his students. (b) Each class member ask questions (c) Important points are written on the chalkboard (d) Peers differences are reconciled. (e) Well behaved peers are rewarded by (i) Clapping for them (ii) Offering them verbal praises.		

LESSON 5

SUBJECT	CLASS	DURATION	TOPIC	OBJECTIVES	PREVIOUS KNOWLEDGE	REFERENCE BOOK
Basic Science	JSS 2	80 MINUTES	Information and Communication Technology	At the end of the lesson, students should be able to: 1. Explain the meaning of ICT 2. Identify the components of ICT 3. Describe the use of ICT components 4. Discuss the importance of ICT	Students must have been seeing mobile phones, television, radio and perhaps computer.	Ndu, F. O. C. & Somoye, E.O. 2008. <u>Basic Science for Junior Secondary School 2 (UBE Edition), Longman Nigeria Plc. Page 81-84.</u>

PRESENTATION:

ACTIVITY	TEACHERS' ACTIVITIES	STUDENTS' ACTIVITIES	ATERIALS
I	Learning tasks are presented in condensed and precise form to the class following the same procedures in phase 1- 4 of explicit teaching: lesson plan 1		

II	**<u>PAIRING TEACHERS WITH STUDENTS</u>** (a) Peer-teachers are selected among the students who will direct tutoring session and present peer summaries of learning activities. (b) Peer-teachers are paired with students based on the ability and social interaction of teachers to other students in the class to enhance active participation of peers.		
III	**<u>TUTORING SESSION BY TEACHERS WITH STUDENTS</u>** (a) Each peer goes into tutoring session (b) Peer-teachers explain the objectives of the lesson and the learning task to the students. (c) Peer-teacher asks students probing questions and offers assistance where necessary (d) Peer-teacher records vital points observed.	Students give answers to the questions.	Posters, pictures, mobile cell phone.
IV	**<u>TEACHER GUIDES STUDENTS</u>** (a) Students carry out certain activities as directed by the Peer-teachers e.g. (a) Identify the components of the GSM (Global system of Mobile telecommunication) such as the hand set, Sims-card, recharge card, battery charger. Observe how to fix the SIM-card, how to recharge the phone with	Students explain the term ICT, give two ICT components, list three uses of ICT components and explain how ICT has made	Posters, pictures, mobile cell phone.

	recharge card, how to fix the battery charger. Tutees practice the steps above. (b) Peer-teacher asks question from students and give assistance where needed. (i) Explain the term ICT (ii) Name two ICT components (iii) List three uses of ICT components (iv) Explain how ICT has made the World a Global Village.	the world a global village.	
V	**<u>CHECKING FOR UNDETRSTANDING AND PROVIDING FEED BACK</u>** (a) Peer-teacher sums the total activities performed by the students and relay them to the students. (b) Peer-teacher corrects errors and asks students to repeat the learning task in which an error has occurred (c) Peer-teacher prompts students to participate actively in the task by providing: (i) Encouragement and praises for correct responses. (ii) waiting for students to attempt a problem independently before offering	Students repeat the learning task where error has occurred.	Posters, pictures, mobile cell phone.

	assistance (d) Teacher goes round the peers to monitor their activities.		
VI	**<u>CLASS CONCLUSION AND DECISION MAKING</u>** (a) Each Peer-teacher presents summary of discussions with his students. (b) Each class member ask questions Important points are written on the chalkboard. (d) Peers differences are reconciled. (e) Well behaved peers are rewarded by (i) Clapping for them (ii) Offering them verbal praises.	Students write down the point on the chalkboard in their book.	

LESSON 6

SUBJECT	CLASS	DURATION	TOPIC	OBJECTIVES	PREVIOUS KNOWLEDGE	REFERENCE BOOK
Basic Science	JSS 2	80 MINUTES	Thermal (Heat) Energy	At the end of the lesson, students should be able to: 1. Illustrate that when two bodies are in contact, heat flows from the hot to the cold one. 2. State the methods of heat transfer 3. Describe heat conduction and its applications	Students are familiar with fire, sun, hot food, cold food, hot water and cold water. They are also familiar with cooking food using metal pot, boiling water etc.	Ndu, F.O.C & Somoye, E.O. 2008 <u>Basic Science for Junior Secondary School 2 (UBE Edition),</u> Longman Nigeria Plc. Page 112-114

PRESENTATION:

ACTIVITY	TEACHERS' ACTIVITIES	STUDENTS' ACTIVITIES	MATERIALS
I	Learning tasks are presented in condensed and precise form to the class		

	following the same procedures in phase 1- 4 of explicit teaching: lesson plan 1		
II	**PAIRING TEACHERS WITH STUDENTS** (a) Peer-teachers are selected among the students who will direct tutoring session and present peer summaries of learning activities. (b) Peer-teachers are paired with students based on the ability and social interaction of teachers to other students in the class to enhance active participation of peers.		
III	**TUTORING SESSION BY TEACHERS WITH STUDENTS** (a) Each peer goes into tutoring session (b) Peer-teachers explain the objectives of the lesson and the learning task to the students. (c) Peer-teacher asks students probing questions and offers assistance where necessary (d) Peer-teacher records vital points observed.	Students give answers to the questions.	Bunsen burner, matches, piece of thick copper wire.
IV	**TEACHER GUIDES STUDENTS** (a) Students carry out certain activities as directed by the Peer-teacher e.g. to demonstrate heat transfer by conduction given necessary apparatus (b) Peer-teacher asks question from students and give assistance where	Students show how heat flows from a hot body to a cold one, they mention three methods of heat	

	needed. (i) How can you show that heat flows from a hot body to a cold one when in contact? (ii) Mention three methods of heat transfer (iii) State two applications each of conduction.	transfer, give two applications each of conduction.	
V	<u>**CHECKING FOR UNDETRSTANDING AND PROVIDING FEED BACK**</u> (a) Peer-teacher sums the total activities performed by the students and relay them to the students. (b) Peer-teacher corrects errors and asks students to repeat the learning task in which an error has occurred (c) Peer-teacher prompts students to participate actively in the task by providing: (i) Encouragement and praises for correct responses. (ii) waiting for students to attempt a problem independently before offering assistance (d) Teacher goes round the peers to monitor their activities.	Students repeat the learning task where error has occurred.	Work book.

VI	**<u>CLASS CONCLUSION AND DECISION MAKING</u>** (a) Each Peer-teacher presents summary of discussions. (b) Each class member ask questions Important points are written on the chalkboard (d) Peers differences are reconciled. (e) Well behaved peers are rewarded by (i) Clapping for them and (ii) Offering them verbal praises.		

LESSON 7

SUBJECT	CLASS	DURATION	TOPIC	OBJECTIVES	PREVIOUS KNOWLEDGE	REFERENCE BOOK
Basic Science	JSS 2	80 MINUTES	Transfer of Heat by Convection	At the end of the lesson, students should be able to: 1. Demonstrate and Describe heat convection. 2. State at least two applications of convection.	Students are familiar with boiling liquid (water).	Ndu, F.O.C & Somoye, E.O. 2008 <u>Basic Science for Junior Secondary School 2 (UBE Edition),</u> Longman Nigeria Plc. Page 112-114

PRESENTATION:

ACTIVITY	TEACHERS' ACTIVITIES	STUDENTS' ACTIVITIES	MATERIALS
I	Learning tasks are presented in condensed and precise form to the class following the same procedures in phase 1- 4 of explicit teaching: lesson plan 1		
II	**PAIRING TEACHERS WITH STUDENTS** (a) Peer-teachers are selected among the students who will direct tutoring session and present peer summaries of learning activities. (b) Peer-teachers are paired with students based on the ability and social		

	interaction of teachers with other students in the class to enhance active participation of peers.		
III	**<u>TUTORING SESSION BY TEACHERS WITH STUDENTS</u>** (a) Each peer goes into tutoring session (b) Peer-teachers explain the objectives of the lesson and the learning task to the students. (c) Peer-teacher asks students probing questions and offers assistance where necessary (d) Peer-teacher records vital points observed.	Students give answers to the questions.	Bunsen burner, round-bottomed flask, water, potassium permanganate, crystal, wire gauze, tripod stand
IV	**<u>TEACHER GUIDES STUDENTS</u>** (a) Students carry out certain activities as directed by the teacher e.g. to demonstrate transfer of heat by convection in a liquid (b) Peer-teacher asks question from students and give assistance where needed (i) Mention three methods of heat transfer (ii) state two applications of convection	Students mention three methods of heat transfer, give two applications of convection	

V	**<u>CHECKING FOR UNDETRSTANDING AND PROVIDING FEED BACK</u>** (a) Peer-teacher sums the total activities performed by the students and relay them to the students. (b) Peer-teacher corrects errors and asks tutees to repeat the learning task in which an error has occurred (c) Peer-teacher prompts students to participate actively in the task by providing: (i) Encouragement and praises for correct responses. (ii) waiting for students to attempt a problem independently before offering assistance (d) Teacher goes round the peers to monitor their activities.	Students repeat the learning task where error has occurred.	Work book.
VI	**<u>CLASS CONCLUSION AND DECISION MAKING</u>** (a) Each Peer-teacher presents summary of discussions. (b) Each class member ask questions (c) Important points are written on the chalkboard.		

	(d) Peers differences are reconciled. (e) Well behaved peers are rewarded by: (i) Clapping for them and (ii) Offering them verbal praises.		

LESSON 8

SUBJECT	**CLASS**	**DURATION**	**TOPIC**	**OBJECTIVES**	**PREVIOUS KNOWLEDGE**	**REFERENCE BOOK**
Basic Science	JSS 2	80 MINUTES	Transfer of Heat by Radiation	At the end of the lesson, students should be able to: 1. Demonstrate heat radiation; 2. Define radiation; 3. State two of its applications.	Students are familiar with sun.	Ndu, F.O.C & Somoye, E.O. 2008 <u>Basic Science for Junior Secondary School 2 (UBE Edition),</u> Longman Nigeria Plc. Page 112-114

PRESENTATION:

ACTIVITY	**TEACHERS' ACTIVITIES**	**STUDENTS' ACTIVITIES**	**ATERIALS**
I	Learning tasks are presented in condensed and precise form to the class following the same procedures in phase 1- 4 of explicit teaching: lesson plan 1		
II	**<u>PAIRING TEACHERS WITH STUDENTS</u>** (a) Peer-teachers are selected among the students who will direct tutoring session and present peer summaries of learning activities. (b) Peer-teachers are paired with students based on the ability and social interaction of teachers with other students in the class to enhance active		

	participation of peers.		
III	**<u>TUTORING SESSION BY TEACHERS WITH STUDENTS</u>** (a) Each peer goes into tutoring session (b) Peer-teachers explain the objectives of the lesson and the learning task to the students. (c) Peer-teacher asks students probing questions and offers assistance where necessary. (d) Peer-teacher records vital points observed.	Students give answers to the questions.	Bunsen burner, water, thermometers, wire gauze, tripod stand, retort stand, Beaker.
IV	**<u>TEACHER GUIDES STUDENTS</u>** (a) Students carry out certain activities as directed by the teacher e.g. to demonstrate transfer of heat by radiation. (b) Peer-teacher asks question from students and give assistance where needed. (i) How can heat flow from a hot body to a cold one when in contact? (ii) Mention three methods of heat transfer.	Students show how heat flows from the beaker to thermometer T2; they mention three methods of heat transfer, give two applications of radiation.	

	(iii) State two applications of radiation.		
V	**<u>CHECKING FOR UNDETRSTANDING AND PROVIDING FEED BACK</u>** (a) Peer-teacher sums the total activities performed by the students and relay them to the students. (b) Peer-teacher corrects errors and asks students to repeat the learning task in which an error has occurred (c) Peer-teacher prompts students to participate actively in the task by providing: (i) Encouragement and praises for correct responses. (ii) waiting for students to attempt a problem independently before offering assistance (d) Teacher goes round the peers to monitor their activities.	Students repeat the learning task where error has occurred.	Work book.
VI	**<u>CLASS CONCLUSION AND DECISION MAKING</u>** (a) Each Peer-teacher presents summary of discussions. (b) Each class member ask questions (c) Teacher writes important points on the chalkboard		

	(d) Peers differences are reconciled. (e) Well behaved peers are rewarded by: (i) Clapping for them and (ii) Offering them verbal praises.		

APPENDIX IX

SCIENCE EDUCATION UNIT
DEPARTMENT OF TEACHER EDUCATION
FACULTY OF EDUCATION
UNIVERSITY OF IBADAN, IBADAN

CROSSWORD ON THE DRUG ABUSE

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CLUES: DRUG ABUSE

1. CHEMICAL SUBSTANCE →
2. INHALATION →
3. BLOOD TRANSFUSION ↓
4. ALCOHOL ↓
5. SMOKING ↓
6. AIDS ↓
7. INJECTION →
8. HIV ↓
9. PARACETAMOL →
10. INJESTION →
11. ASPIRIN ↓
12. DRUG ABUSE →
13. SEX ↓
14. KOLA NUT →
15. MISUSE ↓
16. WINE ↓
17. UNPROTECTED SEX ↓
18. COCAINE ↓

ACROSS (HORIZONTAL) →

DOWN (VERTICAL) ↓

CROSSWORD ON HABITAT

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CLUES: HABITAT

1. PECTORIAL FIN ↓
2. PLANT →
3. AQUATIC ↓
4. LAND ENVIRONMENT →
5. HABITAT →
6. ORGANISM ↓
7. TERRESTRIAL HABITAT →
8. HOME ↓
9. SOIL ↓
10. FISH ↓
11. ARBOREAL →
12. PELVIC →
13. SCALE ↓
14. WATER ↓
15. NOSTRIL ↓
16. MOUTH ↓
17. TOAD ↓
18. OPERCULUM →
19. POND →
20. ECOLOGY ↓

ACROSS (HORIZONTAL) →

DOWN (VERTICAL) ↓

CROSSWORD ON CHANGE IN MATTER

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CLUES: CHANGE IN MATTER

1. SKIN →
2. BURNING ↓
3. DECAY →
4. MATTER →
5. MAGNETIZATION →
6. SOLUTION →
7. TEMPORARY →
8. PHYSICAL CHANGE →
9. RUSTING →
10. BOILING →
11. SUGAR ↓
12. EVAPORATION ↓
13. REVERSIBLE →
14. HEAT ↓
15. BURNER ↓
16. ICE BLOCK ↓
17. WAX ↓
18. LEAF ↓
19. CHEMICAL ↓
20. SALT ↓
21 SUBSTANCES →
22. NEW ↓
23. IRON ↓
24. PLANT →

25. MELTING ↓

ACROSS (HORIZONTAL) →

DOWN (VERTICAL) ↓

CROSSWORD ON RESPIRATORY SYSTEM

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CLUES: RESPIRATORY SYSTEM

1. PNEUMONIA →
2. ASTHMA →
3. EXTERNAL ↓
4. LUNG →
5. EXERCISE ↓
6. PROBLEM ↓
7. NOSTRIL →
8. LARYNX ↓
9. MOUTH ↓
10. BREATHING →
11. RATE →
12. OXYGEN ↓
13. SYSTEM →
14. INTERNAL →
15. RESPIRATION ↓
16. VOICE BOX →
17. TUBERCULOSIS ↓
18. CARBONDIOXIDE →
19. TRACHEA →
20. BRONCHITIS →
21. PHARYNX ↓
22. ENERGY →
23. ALVEOLI ↓
24. PULSE →

ACROSS (HORIZONTAL) →
DOWN (VERTICAL) ↓

CROSSWORD ON INFORMATION AND COMMUNICATION TECHNOLOGY

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CLUES: ICT

1. RADIO →
2. COMPUTER ↓
3. GLOBALISATION →
4. OUTPUT ↓
5. COMMUNICATION →
6. INFORMATION ↓
7. INTERNET ↓
8. TECHNOLOGY →
9. POWER →
10. WEB ↓
11. FAX MACHINE ↓
12. NETWORK ↓
13. WORLD →
14. PRINTER →
15. GLOBAL ↓
16. ONLINE ↓
17. SOURCE ↓
18. STORAGE ↓
19. MOUSE ↓
20. MOBILE ↓
21. SYSTEM →
22. CPU →
23. TELEPHONE ↓
24. INPUT →
25. ICT ↓

ACROSS (HORIZONTAL) →
DOWN (VERTICAL) ↓

CROSSWORD ON HEAT ENERGY

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CLUES: HEAT ENERGY

1. MATERIAL MEDIUM ↓
2. CONDUCTION ↓
3. CONVECTION →
4. RADIATION ↓
5. FRYING PAN →
6. TEMPERATURE →
7. HEAT ↓
8. KETTLE →
9. THERMOMETER →
10. HOT ↓
11. EMPTY →
12. TRANSFER ↓
13. CONVECTIONAL CURRENT ↓
14. BOILING →
15. FIRE ↓
16. EFFECT ↓
17. SPACE ↓
18. VACUUM ↓
19. COLD →

ACROSS (HORIZONTAL) →
DOWN (VERTICAL) ↓