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THE IMPLEMENTATION OF BIOLOGY PRACTICAL WORK IN SELECTED GENERAL SECONDARY SCHOOLS IN EAST WALLAGA ZONE

BY

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LIST OF ABBREVIATIONS

EMPDA	Education Material Production Distribution Agency
EWZ	East Wolega Zone
ICDR	Institute for Curriculum Development and Research
ILI	Inquiry Level Index
MOE	Ministry of Education
MOEFA	Ministry of Education and Fine Arts
NETP	New Education and Training Policy
NGO	Non Governmental Organization
OEB	Oromia Education Bureau
PTV	Plasma Television
PW	Practical work
TGE	Transitional Government of Ethiopia
WEO	Woreda Education Office
ZEO	Zone Education Office

Abstract

Practical work was considered to be one of the hallmarks of teaching science. The purpose of this study was to assess the extent to which practical work was implemented and investigating the factors affecting its proper implementation in teaching biology in general secondary schools of East Wollaga Zone. In line with this, the study attempted to analyze and evaluate all the experimental activities included in grade 9 and 10 biology textbooks in terms of nurture of practical work, participation of students in PW, attitude and interest of teachers and students towards PW, existing practice in using practical work and factors affecting its proper implementation. In order to carry out this study, the researcher employed descriptive survey design. The study was conducted in selected six general secondary schools from five woredas and one town administration in East wallaga zone of Oromia region. For this study woredas were identified using purposive sampling techniques. The source of data for this study were Grade 9 and 10 biology textbooks, biology teachers, students, biology department heads, school directors and observation of lab room. Data were collected from six general secondary schools using stratified sampling technique based on the access to plasma TV and year of establishment. All biology teachers' department heads and school directors from selected schools participated as source of data. To select respondent students stratified sampling procedure and systematic random sample techniques was employed. Accordingly, 88 grade 10 and 119 grade 9 students were selected. To gather data from the respondents, questionnaires consisting 34 items and 20 items for teachers and students respectively were used. To validate the data 10 interview questions to all departments head and school directors and also observation check list consisting of 86 items were used. The data collected were analyzed and interpreted in series of table using frequency distribution and percentage scores. Content analysis was done to analyze the nature and kinds of practical work and to see the enquiry level of each activity suggested in the text book. Accordingly, in both text books it was found that all the activities suggested were well identified and well defined- problems and procedures were given. Findings of the study indicate that practical work method was not put in to practice and most teachers used lecture and demonstration in teaching biology and the same was to in plasma TV instruction that focused on content coverage. Observation of laboratory room in line with the materials and apparatus stated in the textbooks reveled that the schools have no potential, even to perform demonstrations as the only methods of practical teaching let alone individual or group experimentation. This study recommends the need to revise and refine general secondary biology curriculum and concerned body has to give due emphases to arrange laboratory rooms for effective implementation of practical work. Teachers must also encourage students to use practical work in teaching biology.

CHAPTER ONE

1. INTRODUCTION

1.1 Background of the Study

Practical work has gradually acquired increasingly prominent place in the school science curriculum (Tamir, 1991). It is one of the major changes advocated by the curriculum reforms in the U.S.A, U.K and else where, especially over the last three decades (Wollnough, 1991). Practical work is a new conception of the role of the school laboratory no longer as a merely illustrative and confirmatory adjunct to the learning of science concepts but, instead, as the centre of the instructional process (Tamir, 1991). Practical work in science education is relatively recent in the mid-nineteenth century. According to Kerr in Akalewold (2003), towards the end of the nineteenth century the promise more enlightened approach to science teaching arose through the works of researchers in the field. Practical work has undergone various reformations from the late 1950s and during the Later 1970's developed to a trend towards a various approach to learning in school laboratories (Ajeyalemi, 1990).

In the 1950s the kind of science teaching emphasized acquisition of factual knowledge. This was presented by an authoritarian teacher to students who learned through rote memorization and regurgitated the facts back during examinations. Needles to say, a similar situation exist in African countries (Ajeyalami, 1990). The launching of the sputnik I, the first orbiting satellite by the Soviet Union in 1957, essentially awakened authorities, scientists, and general public in the West to focus on practical work method of teaching science. Since early 1960s and 1970s, emphasis shifting away from learning science as immutable facts by rote to learning science by inquiry with the active participation of students (Parkingan, 1994). Thus a teaching approach considered as most appropriate for achieving the goals of science teaching and consistent with its nature has been to teach science as enquiry (Nuffield Biology project, cited in Mekuanent, 1992). One of the most significant trends in the teaching of science which reflect this basic approach whether it be in Biology, Chemistry or Physics has been an increased emphasis on

students involvement in scientific investigation through laboratory work and field study (Mekunent, 1992).

Educators provided a number of reasons for carrying out practical activities. The prime assumption is that learning in general and science in particular is more effective if the pupils are actively involved in obtaining information by active involvement (Temechegn, 2001; 2002; Akalewold, 2001; 2003). This emphasis stems from the view that science can not be effectively learnt from books and lectures or taught by merely telling students about it. To learn science, one must do it. Learning science is about doing science, and that the best way to learn science is by doing practical activities in science (Wollnoug, 1994). The kind of learning that result from this experience, students involvement in a real scientific investigation help them to acquire knowledge and also some understanding of scientific process (Ajeyalem, 1990; Woolnough, 1991; 1994; Mekuanent, 1992).

Similarly, Parkinson (1994) indicates reasons for carrying out practical work in science lesson. Same of them are: motivates pupils to do science and helps to keep them interested; teaches skills to pupils (e.g the ability to make accurate observations, manipulation skills); helps students to promote logical thinking; helps pupils to understand (or accept) the theory; provides an opportunity for pupils to develop communication skills and to learn through group discussion; provides an opportunity for pupils to work together as part of a team. It could also be said that the more practical work pupils do, the greater their skills will be and the higher will be their level or grade in any assessment scheme (Ibid).

Several researchers in the field and science teachers believed and recognized the importance of practical work in science education. They placed great emphasis on laboratory work arguing that students should have first hand experience in order to acquire skills in handling apparatus, to measure and illustrate concepts and principles (Layton 1990; Friendlier and Tamir 1990; Martin et. al. 2001 cited in Olani 2008 and Woolnough, 1991, 1994). Others similarly stated that, as with out water fish can not survive; with out doing laboratory work a science students can not learn fully (Reddy et al, 2001).

More clearly, Woolnough and Allsop (1985) suggest that practical/laboratory work should involve *exercise*, by which practical skills and techniques are developed, *investigations*, based

on problem solving activities and *experiences*, by which pupils get a feel for phenomena be strengthened in science. Thus, biology as a part of natural science, its teaching methodology shares many characteristics with other fields of natural science even though it has its own unique possibilities and demands. Practical work in teaching biology must be challenge to create thought, meaningful and concrete and not just a process of looking, drawing and doing, because it is problem solving task, it must be undertaken to solve a problems (Gleen, 1965).

In Ethiopia context this approach to a science teaching seems to have been recognized long ago. The science commission established in January 1967 to evaluate the then curricula notes that … science teaching is to a large extent ineffectual if the student does not see and do things for himself. Science is observation and experimentation (MOEFA, 1967 in Mekunent, 1992). Siyum (1996) indicated that, in secondary school curriculum many efforts has been done at different time in view of achieving these aims either by designing new or by revising existing curricula.

The new education and training policy of Ethiopia (TGE, 1994) implies a shift in educational paradigm and declares problem solving as a guide line for framing curriculum development. It has identified five general objectives (TGE, 1994: 7-8) but, two of them which are listed below were considered as more relevant to the topic under investigation. Develop the physical and mental potential and problem solving capacity of the individual by expanding education and in particular by providing basic education for all. Cultivate the cognitive, creative, productive and appreciative potential of citizens by appropriately relating education to environmental and societal needs. As the general objectives portray and it is further explained in the policy, the intent was to develop curriculum materials that would improve the problem solving capacity of the students.

The policy document acknowledges and emphasizes also the importance of science education. The education and training strategy (TGE 1994 b: 15) states that, the teaching and learning of science should enable students to understand scientific concepts and there by inter-dependability develop rational thinking and problem solving in their daily life. Develop scientific skills to achieve scientific judgments (MoE, 2002). For this, it reasoned out that giving special, due concern to natural science subject will enable students to understand nature, enrich their scientific out look and employ scientific knowledge to solve environmental and

social problems (TGE, 1994). This is evident at least in the "70/30" plan in which it was envisaged that as of 2008/09 academic year where 70% entrants to higher education institutions will be natural science/technology students and 30% will be social science or humanities students (Amdissa, 2008:53).

The new biological science curriculum was prepared aimed on the stated objective and profiles of the policy (Solomon, 1998 in Akalawold, 2005). It incorporates practical activities as one of the major essential tasks in teaching biology (MOE, 2005). Accordingly, biology textbook of grade 9 and 10 (MoE, 2005 a, b) incorporated practical work teaching strategies such as projects work, practical activities, field trips, and laboratory work to help meet the objectives. Laboratory activities are considered as an integral part of the Biology textbook, starting from grade 7. However the activities often took the form of cookbook recipes (verification lab) in which students follow prescriptions to obtain pre determined out comes. As a result the practical activities fall short of achieving the potential to enhance students learning with understanding (Akalewold 2005).

Despite biological science have strong practical bases and practical work is pillar of effective teaching many researchers and educators in the area notes that, due to several factors practical work is not fully implemented (Parkinsan, 1994). Literatures show that teacher's motivation, capability, willingness to use the materials, lack of laboratory and laboratory equipments, available time allocation and attitude of teachers and students to wards the method can affect extent of implementation (Miller and Blaydes, 1962; Mekuant, 1992; Akalewold, 2001, 2003). Gleen (1965) reported that biology tends to be learned too much from books and black board and too little from specimen (especially from living once), field work rare to be cursory and merely observation, lacking analytical recording and experimentation.

Plasma TV program was introduced to demonstrate practical activities from one centre to all secondary school. However, teaching biology through plasma TV made the instructional time to end with out any live interaction of students among them selves and with their teachers (Aman, 2009). Temechegn (2001) stated that, the teaching of Biology in secondary schools was found to be subject-mater- centered, though Biology curriculum claimed to follow the inquiry model. Therefore, the aim of this study was to assess the extent to which practical work was implemented in teaching biology and to identify factors affecting implementation of

practical work in teaching biology in general secondary school (Grade 9 and 10) of East Wallaga Zone of Oromia Region.

1.2 Statement of the Problems

Science has a unique value as a means of education (Kerr, 1963). It provides the opportunity to acquire knowledge through experiment, observation and problem-solving (Osborne, 2000). Science is seen as practical subject and practical work is fun (Parkion, 1994). So laboratory work are indispensable to good science teaching, because they provide first hand experiences in observation, experimentation and manipulation of scientific materials (Matiru, et.al, Brown, Hegarty cited in Olani, 2008; Woolnoug, 1994; Akalewold, 2003). Similarly other educators indicate that; teaching natural science with out experimental work is synonymous with drawing a picture on a piece of paper with out a black pencil. This is to say a picture is not seen clearly (Reddy et al, 2001). Today, practiced work has a prominent place in science education, based on the assumption that learning by doing is best for acquiring practical skills (Woolnough, 1991; 1994). The old adage, I hear and I forget, I see and I remember, I do and I understand" (Osborne, 2000).

In recent decades researches in science education, inform us appropriate use of school practical work promote important science learning outcomes (Direver, 1986). Practical activities have the distinct advantage of enabling students to work directly with materials and phenomena in the student's biological and physical environment. It creates pupils power of observation, manipulative skills, and creates a special atmospheres that suggests activities and affects student's perception of science (Ajeyalemi, 1990). Layton (1990) stressed that science education with out practical experience is unthinkable. In support of this, Kerr (1963) presents that the practical work sets science a part from most school subjects it gives science teaching a special character providing many teachers and student liveliness and fun that are hard to obtain in other. Tamir in Lazarowitz and Tamir (1994) emphasizes that, the practical work is certainly expected to provide for the development of motor and intellectual skills as well as problem solving abilities and affective out comes since the major learning mode is direct experience in science teaching.

In Ethiopia context, science teaching has undergone continuous change in its objectives, contents, teaching learning methods and curriculum materials (Berhanu in Olani 2008). The new education and training policy of Ethiopia (TGE, 1994:4) emphasis the development of problems solving capacity in the content of education, curriculum structure and approach, focusing on acquisition of scientific knowledge to be used in solving personal and societal problems. The policy document admits the existing basic educational inputs and demand for such as qualified teachers, laboratory equipment and laboratory room and other facilities for quality education and also promises for its fulfillment. So to solve the problems of education in general, and science teaching learning in particular, the Ethiopian government to same extent has exerted an on-going effort to make available adequate inputs for quality improvement of science education. For example to enhance the quality of education at secondary level, ICT infrastructures are provided to secondary schools to receive satellite education transmission (MoE, 2002). Yet the government is still confronted with challenge of providing quality education especially in the science fields.

Even though some researchers had already been conducted in the area of science teaching (Temechegn 2001; Akalewold, 2001; Olani, 2008) there are still gaps in the area of practical work in teaching biology. The biology textbooks of grade 9 and 10 incorporated practical work such as project work, ; practical activities, field trips and laboratory.

The effectiveness of biology instruction in fulfilling these tasks demand on how laboratory is used; the way students interact in practical work, the nature of practical work included in the textbook, the inquiry level of practical work and the laboratory facilitates, the attitude and interest of both teacher and students at general secondary school level was not addressed. Hence, the researcher believes that this study would contribute to filling the existing gap. To this end how practical work could be practiced in general secondary school to be an area of focus of this research.

1.3 Objective of the Study

1.3.1 General Objective

The main objective of the study was to assess the extent to which practical work was implemented in biology and to identify those factors that affect the existing level of implementation in General secondary school (Grade 9-10) of East Wallage Zone of Oromia region.

1.3.2 Specific Objective

The study do have the following specific objectives

- To identify that nature of practical work incorporated in Grade 9 and 10 Biology textbooks.
- To assess and examine the degree to which biology teachers and students implement practical work.
- To identify teachers and students interest/attitudes/ toward practical work.
- To identify the extent to which students participate in Biology practical work.
- To identify the factors that influence implementation of practical work in biology.

1.4 Research Questions

To attain these objectives the following basic questions were formulated

1. What is the nature of practical work included in Grade 9 and 10 biology text books?
2. How often biology teachers use practical work in teaching biology?
3. What were the attitudes of biology teachers and students towards practical work?
4. Did students engage to practices those practical activities implemented by teacher?
5. What factors did affect teachers and students use of practical work method in teaching biology in the secondary schools?

1.5 Significance of the Study

As indicated earlier this study was designed to investigate implementation of Biology practical work in the general secondary schools, thus, the study would have the following significance.

1. The findings of the study help MOE and OEB to indicate the status of biology practical work implementation in relation to the NETP intention. Hence, they can devise sound means for the factors that impede the proper implementation
2. The curriculum workers also get some benefits out of this study, because it helps them to get some information on the nature of practical work suggested in the textbook, so that by using it as a clue on the strength and weakness in existing condition and there by take corrective measure.
3. It gives some insight about attitude and interest of teachers and students towards PW
4. The findings of this study help also to awakened officials at different level, educational office (Zone or Woreda), school administration, teacher and other concerned, bodes on problems of PW at general secondary level, so that, they can set their own relevant strategies to solve the problems.
5. It gives possible way of enhancing biology teachers' awareness, attitudes and practices for the effective implementation of practical work.
6. Moreover, it may be used as a stepping stone for those who are interest in this area to conduct further investigation.

1.6 Delimitation of the Study

Although, there can be other educational issues which affect the quality of education, this research focused to assess the extent to which practical teaching methods were used and to identify those factors that influence practical work in teaching biology for Grade nine and ten of East Wallaga Zone of Oromia Region. The scope of this study was delimited to six general secondary schools.

1.7 Limitation of the Study

The study should have included all zones of the Oromia region to reach up on sound generalization at regional level. However, it was limited to East Wallaga Zone because of financial and time constraints. Lack of adequate and exhaustive research works on the topic in the Ethiopian context restricted the researcher to rely on using the available few materials repeatedly as sources of the study.

1.8 Organization of the Study

The study was organized in to five chapters. The first chapter deals with background of the study, statement of the problems, objective of the study, significant of the study, scope and delimitation of the study, limitation of the study, organization of the study and operational definition of terms. The second chapter presents the review of related literature and chapter three deals with research methodology and design. Chapter four focuses on presentation, analysis and interpretation of data. The last chapter deals with summary, conclusion and recommendation.

1.9 Operational Definition of Terms

Practical work: It refers to the doing of experiment, practical exercises and observation exercises with scientific apparatus in science laboratory or out of the classroom.

Investigation: A specific type of problem solving defined as a task for which a pupil can not immediately see an answer or recall a routine method for finding it.

Implementation: in this study refers to the actual use of practical work/put what has been planned in to use.

Skill: Those activities which are necessary but not sufficient in themselves to the carrying out of most practical work (e.g., the capability of using microscope).

General secondary school: in this study it indicates first cycle (Grade 9 and 10) of secondary school.

CHAPTER TWO

2.REVIEW OF THE RELATED LITERATURE

2.1 Meaning and Concept of Practical Work

Practical work has long been a distinctive and central role in science curriculum, and science educators have suggested the many benefits accure from engaging students in laboratory activity (Woolnough, 1991). A term practical work for the united Kingodm (UK) and literature off its previously affiliated countries corresponds to the term laboratory work used in U.S.A literature (Lazarowiz and Tamir, 1994). Lunetta (1998) also indicates that laboratory experiments as terminology in the U.S.A corresponds to the terminology practical activities used in UK literature. These terms have embraced an array of activities but normally they refer to experiments in school setting in which students interact with materials to observe and understand the natural world.

Yager, (1991) stated that practical work as typical laboratory work where students encounter ideas and principles at first hand. To some it merely means "hands on" science. Similarly, Hegarty, stated that student laboratory work is a form of practical work taking place in a purposely assigned environment where students engage in the planned learning experiences and interact with the materials to observe and understand phenomena (Hegarty, 1990). Woolnough (1991) also added that, though it is difficult to define the term practical work in science it is defined as the doing of experiment, or practical exercises with scientific apparatus, usually, in a science laboratory. Practical work has long been an area of contention. It was observed that educators still faced the problem of defining activities as an essential of the science curriculum, due to the complexity of factors related to practical work and the use of assessment procedures that have often been inadequate (Woolnough, 1991).

Husen and Postlethwite (1994) stated that, with in a science course the term "practical work" may be taken to include any activity involving students in real situations using genuine materials and properly working equipment. In many of the Biological science and physical science, practical work takes place in a laboratory and this is often known as laboratory work. In line with this Kerr, (1963) describes demonstrations, co-operated demonstration by groups as well as experiments and observational exercises carried out by pupils in laboratory or else

where. As to Hodson practical work need not always comprise activities at the laboratory bench. It is any learning methods that require being active rather than passive, accords with the belief that students learn best by direct experience (Hodson, 1990). Akalewold, (2001), argues that PW as activities especially designed in the students textbooks, where students are required to interact in some way from through observation (in demonstration) to employ some problem-solving skills in doing science.

In more general sense, Kerr (1963) stated that, practical works, can be done in either ways of demonstrations, that verify facts and principles, experiments, problem solving or discover experiments, investigation projects and the activity set to develop skills in techniques. Therefore for this research as it is defined by educators above, the term practical work is assumed that students engage in group or individually and in laboratory classroom or out of the classes; observations, laboratory experiments and field trips indicated in the general secondary biology curriculum .

2.2 The Nature of Practical Work in Science Education

Practical work is said to be a sine qua non of school science by a number of researchers in the filed (Woolnough and Allsop, 1985, Tamir, 1991). They suggest that .... In practical activities students teach themselves and each other and learn essentially through their own efforts under the careful preparation and guidelines of teachers.

According to Tamir (1991) a study of the literature enables taxonomy of aims and objectives for practical work to be established. This can be structured under five main headings; understanding concepts (declarative knowledge); acquiring habits and capacities; gaining skills (procedures knowledge) including planning and design, performance, organization, analysis and interpretation of data, and application to new situations; appreciating the nature of science and developing attitudes. However, these can be achieved only if students are provided with the opportunity to be involved in the necessary experiences.

A number of researchers (Harron, 1971; Tamir 1991), compared a typical (school lab) laboratory lesson with that of a typical investigation carried out by a scientist in term of who does what and he concludes that what students are actually doing in a typical laboratory is like technicians and not like scientists. Tamir, suggested that, openness can occur at different stages

of an investigation in the problem to be solved; in the planning, and operation of the investigation and in the possible solutions to the problems. Based on this he produces a four-way classification of investigations, depending on weather each stage is open-that is left to the students to decide or closed (Tamir, 1991)

Table 2.1: level of inquiry in the science laboratory

Level of inquiry	Problem	Procedures	Conclusions
Level 0	Given	Given	Given
Level 1	Given	Given	Open
Level 2	Given	Open	Open
Level 3	Open	Open	Open

Source: Tamir (1991) practical work in school science an analysis of current practice. In Woolnough (ed) practical science.

In level Zero (0), problems, procedure and conclusions are all given and hence there is no experience of scientific inquiry. At this level one may find exercise involving practice in same techniques and/or confirmation where the answer is already provide to the students. They may provide opportunities for students to learn accuracy in the process of trying to replicate a known answer. In level 1 both problems and procedures are given and they have to collect data and draw the conclusion. In level 2 only the problem given and the students has to design the procedure, collect data and draw conclusions. Akalewold (2003) called these level investigative practicals. In level 3 the highest level of inquiry the students has to do every thing by themselves, beginning with problem formulation and enduring with drawing conclusion Tamir, 1991)

Similarly, Simons and Jones in Akalewoled, (2005) in order to analysis the laboratory tasks suggested in the textbooks, assigned a stage by reading the script or outline of the activities and noted the level of openness on the basis of the freedom the activities give to students to engage in the central process of scientific inquiry.

The scheme provides three stage in doing the activity (a) defining the problem (b) choosing the method, and (c) arriving at a solution. In analyzing the activities, the first two stage (defing the problem and choosing the methods of investigation) range from closely 'defined' to 'not

defined' and the third stage (arriving at solution) is positioned from the activity that has only one solution to those having several alternative solutions.

As we have seen so far, the main criticism of practical work has been its undue, emphasis on the lower levels, "0" and "1". The described above indicates that when the practical work was properly designed and employed at the secondary school level, many of the expected out comes were realized.

2.2.1 Type of Practical Work in Science

Akalewold (2003) stated that in designing a course for practical work the major part of the design next to decisions of aim and objective is to make a right balance of concept development, skills development, and motivations aspect.

Many attempts have been made to classify practical work in order to define their respective roles and purposes. Woolnough and Allsop (1985), identify three distinct type of practical work; *experiences*, which are intended to give pupils a 'feel' for phenomena; *exercise*, which are designed to develop practical skills and techniques; and *investigation*, which give pupils the opportunity to tackle a more open-ended task as a problem –solving scientist (in Millar, 1991:44). Woolnough (1991) also classified the practical work into four major types: *exercises*. *experiences*, *demonstrations* and *investigations*. Each of this type of practical has its own place in science teaching. Field works are likely to include aspects of all these functions (Akalewold, 2003). Similarly Parkinson indicates that practical work generally falls into one of the following four categories: (1) learning basic practical skills (2) illustrating a theory or concept (3) proving theory and (4) investigative work.

According to Gott and Duggan (1995), five type of practical work developed by Gott et al (1988). These are (1) *skills* to acquire a practical skill (2) *observation;* frame work in relating real objectives and events to scientific idea (3) *Enquiry* to discover a concept law or principles (4) *illustration*; to verity a particular concepts, law or principles (5) *investigation*; to provide opportunities for pupils to use concepts, cognitive and skills to solve a problem. In the same way Woolnough, (1994) recognize four type of practical work in science which does not all have to be investigations. It can also include *exercises*, which development specific practical skills; *experiences*, which introduce students to particular phenomenon, *demonstrations*; which

allows the teachers to develop a scientific argument or to create a dramatic impression, and there will be scientific *investigations* either of the hypothesis testing type or of the problem solving types

Table 2.2: Types of Practical Work

Exercises	To develop practical skills
Experiences	To gain experience of a phenomena
Demonstrations	To develop a scientific argument or cause an impression
Investigations	Hypothesis testing to reinforce theoretical understanding Problem solving to learn the ways of working as a problem solving scientist.

Source: Woolnough (1994:107). Effective science teaching: Developing science and technology educations series.

Each of these types PW has its place in science teaching each will be effective if its aim is appropriately targeted and students are active, mentally as well as physically through out. Educators also indicted that the boundaries are not claimed to be water tight; practical activities can clearly include more than one aspect particularly skills and observation are implicit to some degree in the other types (Gott and Duggan 1995).

From these explanations, it is possible to identify that practical work is classified differently by different educators in different time. For this study Gott and Duggan (1995) classification were considered.

2.3 Rationales for Inclusion of Practical Work in Science Education

A number of writers in the field offered many reasons as a rationale for students' practical work. For example, Matiru et al, (1995) summarized the current roles of practical work to be four major statements (1) *teaching technical skills* relevant to the subject (2) *understanding principles and the process of scientific enquiry* (3) developing systematic problem solving skills (4) nurturing the development of professional studies practical and commitment. Tamir, (1991) analyzed the works of Lawson, Schwab, Ausbel, Bruner, Gagne, and others into five major reasons offered as a rational for the students laboratory experience in school into (1) science involves highly complex and abstract subject matter (2) students participation in actual investigations, employing and developing procedural knowledge often referred as skills, is an essential component of learning science as inquiry (3) practical experience, whether manipulative or intellectual are qualitatively different from non-practical experiences and are

essentially for the development of skills and strategies with a wide range of generalizable effects, (4) the laboratory has been found to offer unique opportunities, conducive to the identification, diagnosis and remediation of students' conception (5) students usually enjoy activities and practical work and when they are offered and given a chance to experience meaningful and non-trivial experience that become motivated and interested in science.

Tamir, (1991) states that the new conception of the role of the school laboratory was one of the major changes advocated by the curriculum reform movement in the UK, USA and also where, i.e. it was not to be a more illustrative confirmative adjunct to the learning of science but instead was to become the centre of the instructional process. Arzi (1998) in his works entitled, *Enhancing science education through laboratory environments*: indicate that, more than Walls, Benches, and Widgets assume that ... laboratory work is both a means and an end in science education and that some of school science teaching should be carried out in a flexibly designed laboratory, Similarly Woolnough (1991), point outs that, pupils learning to do science as scientists do is the most appropriate models for school science. Thus, it is generally accepted that practical work teaching will be at the heart of science education. Layton (1990) underlies that: Science education with out some laboratory experience is unthinkable but, equally, students' laboratory practice is not general panacea, the universal means to a multiplicity of ends.

Kerr (1963) claimed that, laboratory work led to many different desirable out comes in cognitive, psychomotor, and effective domains. Such out comes included better understanding, familiarity with techniques and operates and manipulative skills respectively. Similarly, Tamir in Woomough (1991) emphasized that, laboratory is expected to provide for the development of motor and intellectual skills as well as problem-salving abilities and effective out comes since the major learning mode is direct experience. Driver, (1986) indicts that the content of science course has been up dated and their structure change to reflect recent developments in the conceptual structure of the discipline. Paradoxically, this has been coupled with a shift in pedagogy towards a greater amount of practical work; practical work which in most cases is introduced to be illustrative or provide confirmatory evidence for the presented theories. We tend to think that this 'practical' approach makes the subject more relevant and easier for pupils to understand (Ibid).

The laboratory sets science apart from most schools subject. It gives science teaching a special character, providing many teachers and their students liveliness and fun that are hard to obtain in other ways. That character is almost sufficient alone to justify the capital and recurrent cost of laboratories (White, 1988).

According to Shulman and Tamir (1973) and Friedler and Tamir (1990), a rationale for student laboratory work includes these features: Science involve highly complex and abstract subjective mater. Even high school students may fail to grasp science concepts without the concrete props and opportunities for manipulation afforded in the laboratory. The laboratory also offers unique opportunists to identify student misconceptions (Driver and Bell, 1986: Friedler, 1984). Students' participation in actual investigations that develop their inquiry and intellectual skills is an essential component of the inquiry curriculum. It gives students an opportunity to appreciate the spirit of science (Ausbel, 1968) and promotes understanding the nature of science-for instance, the multiplicity of scientific methods, and the interrelationship between science, technology and society (Shulman and Tamir, 1973).

Laboratory work promotes the development of cognitive abilities such as *problems solving, analysis*, *generalizing* (Ausbel, 1968), *critical thinking* applying synthesizing, evaluating, decision making and creativity (Shulman and Tamir, 1973). Laboratory work is essential for developing skills of various kinds' manipulative, inquiry, investigative, organizational, and communicative (Shulman and Tamir, 1973). A goal rarely discussed in the literature understands the concepts that underlie scientific research, such as the definition of a scientific problem, hypothesis, assumption, prediction, conclusion, and models (Shulman and Tamir, 1973). An important goal that captures both the cognitive and effective domains is the development of scientific attitudes, such as honesty, readiness to admit failure, critical assessment of the result and their limitation, curiosity, risk taking, objectivity, precision, confidence, perseverance, responsibility, collection, and readiness to reach consensus (Shulman and Tamir, 1973).

Students usually enjoy practical work in the laboratory and when offered a chance to experience meaningful, nontrivial but not too difficult experiences, they become motivated and interested not only in their laboratory assignment but also in studying science.

2.4 The Aim of Practical Work in Science Education

According to Brown et. al., (1986) science is not just natural history, and education in science involves more than simply extending the range of pupils sense experiences. It is about introducing students to the conventional scientific interpretation of events and helping them to re-organized their ideas accordingly, they stated as:

> *(Science teachers) believed that pupils should have first hand practical experience in laboratory in order to acquire skills in handling apparatus, to measure constants and to illustrate concepts and principles unfortunately, PW often did not go farther than this and few opportunities where provided for pupils to conduct challenging experimental investigation (Brown et. al. 1986:278).*

Similarly, Kerr (1963) indicate that, there are certain functions of science teaching which can be best be fulfilled through PW. For the purpose of the schools inquiry, the following ten statements referring in particular to PW on science, teaching method:(1) to encourage accurate observation and careful recording; (2) to promote simple commonsense, scientific methods of thought; (3) to develop manipulative skills; (4) to give training in problem solving; (5) to fit the requirements of practical examination regulation; (6) to elucidate the theoretical work so as to aid comprehension; (7) to verify facts and principles already taught; (8) to be an integral part of the process of finding facts by investigation and arriving at principle; (9) to arouse and maintain interest in the subject; (10) to make biological and physical phenomena more real through actual experience." Besides, Kerr (1963) notes that out of the above ten aims of practical work the first four refers the possible effects of practical work, the last two are possible effects on one's general attitude to science and the rest four refer to the actual teaching process.

Pakinson (1994) said about the aim of PW in science education, they are a whole host of reasons for carrying out practical work in science lesson. Some of which are listed below. Practical work: Motivates pupils to do science and helps to keep them interested; to leaches skills to pupils (e.g., the ability to make accurate observation, manipulation skills; to helps to promote logical thinking accepts the theory (i.e. the idea of seeing is believing); to provides an opportunity for pupils to develop communication skills and to learn through groups discussion; to provides an opportunity for pupils to work together as part of a team.

It could also be said that the more practical work pupils, do, the grater their skills will be and the higher will be their level or grade in any assessment scheme. In general Parkinsan, clearly states that, the pupils will be presented a variety of types practical work, but they should all fulfill three major aims (1) they should motivate the pupils to do science (2) pupils should learn something from the experience and (3) they should be safe.

2.5 Attitude and Interests of Teachers and Students towards Practical Work

According to Toh, (1991) attention to affective variables seems to stem from the belief that they are as important as cognitive variable in influencing learning out comes. In support of this, Head (1985) in Toh (1991) argued that "the ability to perform a task and a willingness to do so are necessary for successes." Of the two, the latter may be the more import since it determines the personal response of the individual to the learning situation. The development of positive attitudes towards science has been regarded as a legitimate goal of science education and is well reflected by the inclusion of affective aims in most science curriculum materials (Toh, 1991).

Gardiner and Gauld (1990) stated that students generally enjoy lab work... not all enjoy it equally. Hodson (1988 in Woalnough 1991) argues that, we should "prioritize the affective" and use practical experiments in science to build up pupils confidence and self esteem, for with-out that is no success in science will be achieved. Hodgkin in Woolough, (1991) asserts that believing is where leaving starts. We know first, action such knowledge and then get to know more ...the activity of getting to know is a compounded of feelings and as well as of intellectual curiosity of hunches as well as facts". The ability to integrate the laboratory with other instructional strategies and to motivate students will both make significant contributions to up grading learning in the laboratory (Tamir, 1991). Gardner and Gauld (1990) indicate that, laboratory work obviously occurs as a result of the attitudes and decisions of educators. They suggest that...

> *Laboratory work, not only provides science students with experiences which faster cognitive development and psychomotor skills it also provide opportunities for enhancing their scientific attitudes and their enjoyment of science as well.*

Generally, researches confirm that, students have generally enjoyed lab work of course, the generalization, however, very sweeping, not all enjoy it. Hodson (1993) agreed that... while

many pupils enjoy practical works and develop positive attitudes to its, there are many who dc not, and some others also expresses a "dislike" for patricidal work. Among the physical conditions, laboratory facilities can have effects an arousing attitude to science. Many studies found a positive association of students and teachers attitudes with school laboratory facilities. The availability and quality of lab facilities, together with the quality of the educational events that take place with in the laboratory practices, do affect students and teachers, interest in science (Gardiner and Gaula, 1990).

2.6 Method and Approaches to Science Teaching

Parkinson (1994) stated that, science teaching has existed for about a century and the approach has undergone many changes during this time. During that early time there has been emphasis in turn on clear demonstration; than on laboratory work through "heuristic" system, and in the last on a blend of demonstration lessons and laboratory training (Gleen, 1965).

According to Parknson (1994) there are two distinct types of science course, those that are essentially knowledge based and those that are process based. Traditionally science courses have laid the greatest emphasis on the recall of knowledge and the understanding of content. It has been depicted in schools as a list of statements, rules and laws to be copied down and learned by rote (McCompas, 1998). Similarly, Mkunent (1992) stated that, the traditional approach to science teaching was based on the view that science consists of stable and immutable body of facts which are final and absolute. As a result its teaching has focused on helping students learn scientific facts, concepts and principles. Romey, comparing the traditional and modern approaches to science teaching stated that:

> *...the (traditional) teaching of science can be compared to the teaching of art. Some art schools stress the history of art, where as other are more concerned with studio art; actual painting or sculpture. The difference between the two approaches is that one produces art historians where as the other produces artists. The some is true to science (Romey, 1968:4).*

The teaching of science based on this understanding fails to convey the real nature of science subject. Thus the traditional approach typically constitutes lectures supported by few practical demonstration and the students remains a passive receiver of information who is supposed to reproduced it in an examination or when ever demanded by the teacher. The nature of practical work in such view has the purpose to illustrate or refine a concept. They were designed to help

students see the concepts in actions. Such practical do not aim to help students knowledge discovery process, but on giving understanding of particular concept or theory (Woolnough, 1991).

However, the inclusion of science education in the curriculum and science teaching in school has several functions to perform. (Gleen, 1965; Romey, 1968) stress that, Science teaching must have to give a student a systematic training, careful observation experimentation and the estimation of the relative of results. In support of this, Kerr, indicate that, during the present period of rapid technological change, we must do more than satisfy the demands for greater numbers of scientist and technologists. Science for all is not longer a dream in a scientific way is associated with the experimental approach. We should ensure the effective use is made of practical work (Karr, 1963:11).

With regard to the method of teaching martin at al (2001) stated that, the emerging beliefs based on changing attitude towards science as researchers and educators imply is that, what we teach may be less important that how we teach. He also recognizes that, though no single method of teaching has been found exclusively, to meet all needs all the time, literature emphasize the importance and benefits of inquiry based teaching and learning. Other writers in the fields also claim the important of inquiry approaches in teaching science (Ajeyalem; 1990; Romey, 1968; Temechegn; 2001, Mekunent, 1992). McComas, (1998) notes that, inquiry based teaching methods tend to focus on developing pupils abilities to think than on more acquisition of subject matter. Recent research verifies the superior affect of students centered constructivist approaches over traditional text based teaching methods for science achievement, attitudes and skills of scientific enquiry.

Money literature stress that science is a practical subject, and should be taught at all stages in a way which emphasizes practical investigative and problems solving activity. For example parkison, advocating, practical work approach state that....

> *.... Science is not a catalogue of facts that have been fed to pupils so that they can regurgitate it at the next examination. There is information to be learned, explanation to be understood, skills to be mastered and the procedures of science to be grasped (Parkinson, 1994:14).*

According to Yager (1991), practical work is essential for successful science teaching. However such "practical work" most be carried out from a student's stand pointes opposed to the stand point of teachers and/or text book authors. To teach basic concepts and process and then to proceed with illustrating practicality and applicability is to rob students of direct experience Yager further stated that ....

> *....So-called practical work which is teaches or book directed a mater which is primarily maters of following directions and verifying what students have been told is not much of an improvement over learning concepts and process skill by rote. Quality science instruction means utilizing quality practical work (Ibid).*

Science is most effectively taught and learning when both teachers and pupils practice the skill of problem solving by engaging in group and individual students (McComas 1998). Based on this reality most science educators proposed and claim practical work method the best ways of teaching and learning science, arguing that the first –hard experience through practical work is believed to be essential (Keer, 1963; Romey, 1968; Woolnough, and Allsop 1985; Wopolnough 1991,1994).

2.7 The Emergency and Development of Practical Work in Science Education

In 1657, when the first society was established in Florence, they enabled groups of men to: consult and debate, concerning the promoting of experimental learning. Early in the nineteenth century a few schools conducted exceptional until about 1860. Since the later 1950s schools in the UK have moved from the standard. "Cookbook" exercises to verity theory, through guiding discovery of the physical science study committee (PSSC). Biological science Curriculum students (BSCS), Nuffield courses initiatives (Ibid). The experimental method as a means of study originated through the activities of scientific societies. According to Layton (1987, in Woolnough, 1991) historically, PW has established a larger and influential place in the science teaching. But so of its existence its nature and practice have changed considerably, especially over the last three decades.

Through out the history of science teaching although over-emphasis on the learning of facts has always been deplored and an experimental approach recommended, doubts about the methods used in laboratories have regularly recurred (Kerr, 1963). Practical work began to

emerge, in England when the department of science and Art was established in 1854 and state support grants to set up and equip school science laboratories (Gott and Dugan, 1995).

Practical work in science was a result of the 19thC. In the second half of the 19th century in both the UK and USA the ideology of pure science was considered strongly (Parkinsan, 1994; Tamir, 1991). According to Kerr in Akalewold, (2003) towards the end of the nineteenth century, the promise more enlightened approach to science teaching arose through the works of researchers in the field. Practical work has undergone various reformations form the late 1950 and during the later 1970s developed to a trend towards of various approach to learning in school laboratories (Ajeyalem, 1990). Consequently, there was a progressive curriculum shift in emphasis from science as useful knowledge to science as activity which required no extrinsic justification (Layton, 1990; Parkinson, 1994).

In the 1960s in both the USA and the UK, major curriculum of science aimed to engage students in investigation and enquiry as a central part of their study of science. And the issue practical work continues to have a prominent place in the rhetoric of science to day (Layton 1990). During this time, the emphasis was much on demonstration by the teachers with a focus on illustration of particular concepts (Gott and Dugan, 1995). Gott and Dugan (1995) further stated that:

> *Most of the practices at the time was consisted of following recipes to verify theory or to illustrate concepts and towards the end of this period there was growing concern that much of this practical work routine and repetitive. Nevertheless, practical work had already established itself as a vital part of the science curriculum."*

According to Tamir (1991), a comprehensive literature review up to the begging of the 1980s indicated that research had still failed to support the effective of the laboratory as indicated in (Hofsten and Lunetta, 1982). The reviewers suggested that the reason for this failure might be that "past research study generally examined a relatively narrow range of teaching techniques, teachers and students characteristics and students out come. Another reason may be the ineffective use of practical work: Science courses at all academic level are… organized so that students waste many valuable hours in the laboratory collecting and manipulating empirical data, which at the very best, help them rediscover or exemplify principles that the instructor

could present verbally and demonstrate visually in a mater of minutes (Ausubel, 1968 in Tamir, 1991).

Similarly, Lunetta (1998) and Matiru et al (1995 cited in Olanim, 2008) describes that, the progressive education movement in the early 20th century advocated on investigative approach. By the middle of the century, however, practical activities were used largely for illustrating and confirming information presented by the teachers and text book. Brown (1995), stated that during the past twenty five years, though a major re-appraisal of uses and methods in practical work teaching has taken place, there is considerable controversy about it. In the debate several areas of serious concern have been expressed. This includes: 1) The high cost of laboratory work making it difficult to continue providing facilities and resources to the standard felt necessary; 2) Time constraints and over loading to serious problems in meeting syllabus requirement in quality and quality; 3) Dissatisfaction with the effectiveness of conventional laboratory work which does not foster the understanding of scientific concepts and application of scientific principia in solving problems

A number of researches posited in support of practical work in school science at the end of 20th century. For example Wollnough and Allsop provide evidence in support of separating content from the process and concerting PW on the development of process skills.

2.8 Purpose of Practical Work in Teaching Biology

Practical work has a profound place in teaching biology. It is a pillar of biology teaching wisdom (Dallas, 1980). According to Parkinsan (1994) science subject is generally seen as practical subject and practical work is fun. Pure science are interrelated, interconnected running into one an other in many areas and some times all joining together to give full explanation for some occurrence in nature, despite the fact than each has its own specific field (Brown, 1995). As a result teaching a biology subject involves considering the same procedure issues discussed in teaching science education. In other words, the methods of teaching science and what is suggested for teaching science education in school is equally important in any science in which "doing" make teaching-learning effective (Parkinson, 1994).

Ajaleyami (1990:8) stresses that:

> *...biology is a science and that science is based on investigation which produces enduring facts which become knowledge so the right approach to giving biological knowledge must be through investigation which comprises observation, experimentation and deduction through all the stages of learning-preschool elementary secondary and tertiary).*

On the other hand, Miller and Blaydes (1962) show that the most frequent fault with biology as taught in many schools. This is the content is presented in a formal lecture and its methods of teaching in most school is unpractical. Pupils instead of developing attitudes and interests, they are far more often struggling to learn details, especially of structure, and are over loaded with works beyond their comprehension. Thus teaching of biology suffers from the kind of verbal approach teaching. According to millar and Bllaydes, 1962; Dallas, 1980) the purpose of practical work in biology are (1) developing and understanding of (a) structures (b) process in living organisms (2) developing skills in (a) manipulation (b) the process of science (c) conducing whole scientific, investigations, clearly, teaching biology, will results on sound general principles of effective teaching, but, additionally, it carries unique possibilities and demands of the subject matter with which it is concerned. Thus as it can be understood from the discussion practical work method of teaching is an essential and central to biology teaching.

2.9 Development of Science Education in Ethiopia Context

It has been about a century since; modern education took root in Ethiopia. The religious education, that preceded it, albeit its limited objectives had lived for many centuries (Amare, 1998). Ethiopia has a long and rich history of educational traditions. Ethiopian's early Christian heritage starting from forth century represents an important element of education in the country that become a formal indigenous institution. The mosques in the Muslim area, like church and run Quranic School that probably appeared in the eleventh century in Ethiopia. The aim of traditional education was to provide moral and religious education. The curriculum of both Church and Qurance is largely unchanged and contested i.e., the contests are considered to be true, ever lasting and worth while (Woube, 2005; Girma Amare 1982 in Akalewold 2001) indicates that...

Its curriculum too did not remain strictly religious but also highly conservative, discouraging inventions, curiosity and critical mindedness its function was to facilities man's understanding of the world but rather accepting the existing order of things as it is to preserve what ever has been handed dawn through the years and in turn to pass it on unchanged to the next generation?

In Ethiopia modern education was officially stated in 1908 by the opening of Menelik II school of Addis Ababa. This late introduction of modern education was not accepted easily because of the opposition from the clergy and aristocracy but it the year mentioned above, several factors such as post- Adwla situation necessitated the need of introducing of modern education in the country (Woube 2005). Temechegn (2001:70) indicates that, there is no adequate literatures published on Ethiopian science education that would give a general picture of science education and science subject in particular. However the following works would present some major events on Ethiopia science education.

The introduction of science and technology in Ethiopia can be traced back to the 1940s. During the period of (1908-1946) there was no single, uniform and standard Ethiopia school curriculum developed and implemented by Ethiopian for Ethiopian. Subjects taught, period assigned to teach subject area and many other things showed a good deal of variation from one school to another in the country (Marew, 2000). Science education during this period of time was characterized as imported or colonial type of education.

The year 1947-48 is a unique in the history of curriculum, development and implantation in Ethiopia. It was during this time that the first formal written curricula for six year elementary and six years secondary education where published. Researchers note that, science appeared as a subject first in the 1946 curriculum version. Since then it continued as a part of the school curriculum. History of science and technology education in Ethiopia shows that science teaching has undergone continuous change in its objectives contents teaching and learning methods and curriculum materials (Berhanu, in Akaleword 2001).

After the late 1950s the structure of education changed to 6-2-4 structure. There are various reasons necessitated this change. Among the various reasons was the need to adopt the imported text books to national needs started in the year 1955 by the MOE (Woube, 2005). Since 1960s, science education has undergone worth while changes globally. U.K and U.S.A initiate curriculum innovation in the field of science. According to Berhanu (1999) since 1970

science comes to life for primary and junior secondary school was written locally the teaching materials were known by its inquiry approach. As to Woube (2005) and Seyoum (1996) after the 1974, when Derg replaced the Hailesilassie regions, the transitional curriculum consists of academic, vocational and technical subjects was prepared on effect to campy with the new ideology of socialism. Marew (2000) indicates that, after 1975 the most obvious changes in the polytechnic education, the amount of time given for science teaching over all is increased, science curriculum in the secondary school is taught as separate subject (Biology, chemistry and physics).

2.10 Science Education in Ethiopia post 1991

Both of the monarchy and the military periods had educational system which suffered "dependence, on outside curriculum which did not correspond to the local peculiarities" (TGE, 1994). May 1991 was when the change of government takes place (the replacement of military government by the transitional government. Education was one of the areas of reform focuses of change. Corresponding to the far-reaching change and reconstruction of state and society the education system radically turned in to a new one. As Woube (2005:67-68) indicates, two major policy guidelines were in place; (a) policy guide lines produced based on the charter adopted by the conference, for peace and democracy in 1991 and (b) the education and training policy adopted in 1994.

The policy consists of general and specific objectives with special areas of priority. Concerning science education, the policy document emphasizes the development of problem solving capacity and acquisition of scientific knowledge. The ETP policy intends to make science teaching and learning based on problem solving approach in away that the students can acquire the problem solving skills and scientific methods and appraisal to solve their personal and society problems.

According to the policy, science education starts from the primary level, as environmental science and the separate subject approach in science begins at grade 7 and continue through secondary level education. Therefore, biology starts to be offered as one component of natural science at grade 7 and continues into subsequent grade levels (TGE, 1994).

The ETP policy document did not state the objectives of school subject specifically, i.e., there is not definite purpose assigned to the different subject of different level of education. However, some selected curriculum developers of the country identified the objectives of biology for grade 9 and 10. Thus the suggested objectives of biology education for grade 9 and 10 include (1) to develop understanding and acquire knowledge of structure and functions of different parts of organism and how it functions (2) to develop skills and abilities of using scientific instatements, performing experiments and interpreting result, investigation in their environment and applying biological knowledge in daily life, (3) to develop the attitude of relying on scientific experimental methods and interest in nature and love of all living things due to their role in nature. Hence, the contents of biology for grade 9 and 10 reflected the practical work teaching methods. The textbooks incorporate PW methodology such as projects activities, experimentation, observations, field trips and demonstration (ICDR, 2004).

2.11 Factors Affecting Practical Work Implementation

A number of researchers and educators in the field state a number of factors affecting the implementation of practical work in science teaching. Lack of laboratory and laboratory equipment, school facilities and resources, curricular, larger class size, shortage of time, attitudes towards practical activity, teachers methodology of teaching and preparation are some to be mentioned (Miller and Blaydes, 1962; Akalewold, 2001, 2003; Mekunent, 1962), particularly at secondary level (Allsop (1991). Karr (1963) identified obstacles impeding achievement of the possible records of learning science through PW. He fond out that, the efficiency of laboratory work in science teaching is impaired by a verity of causes; of these causes the series one are (a) shortage of well trained science teachers; (b) the full time tables of science teachers (c) insufficient laboratory facilities (d) shortage of time curricula, resources, learning environment and teaching effectiveness are same factors to be mentioned. Parkinsan (1994) similarly, indicates that the difficult schools found to implement practical work in science education is that: Lack of qualified staff, insufficient equipment or laboratory specie unavailability of suitable teaching resources.

Generally, factors that influence proper implantation of the practical work in science teaching are diverse. The concern here, however, is with same main factors, curriculum, time, resources and schools facilities and methodology of teaching.

2.11.1 Curricula

People have different conceptions of what is meant by curriculum. One approach to avoid this ambiguity is to identify distinct phases of curriculum, such as the intended, perceived, and implemented. The goals and objectives represent the intended. Teachers' and students' views reflect the perceived curriculum. Teaching learning and the learning environment describe the implemented curriculum (Lazarawitz and Tamir, 1994). Here the focus is made on the implemented curriculum, namely instructional materials, the text books, selected activities and integration of laboratory with other learning experiences. Akalewold (2001) clearly indicates that the nature of classroom transactions is strongly dependent on the curriculum, materials, in (1) a laboratory manual consisting of a series exercise or investigations that may or may not be integrated with non-practical exercises, or (2) work sheet, or (3) text books that includes laboratory exercises. Temechegn (2001) showed the several points of critics of African science education lack of relevance to the needs and interests of pupils and the need of including indigenous knowledge and native technology to science curriculum is much stressed.

Several research in the field point out that.... Even curricula clamming to be enquiry- orented, such as BSCS, PSSC and CHEM study offer by and large, practical, exercises which reflect a very low level of enqiry (Herron, 1971, Lunetta and Tamir 1981). They all reveal series deficiencies in these exercises in terms of opportunities to practice and develop major inquiry problem, formulating hypothesis, planning experiments and identifying limitations of an experiment. Friedler and Tamir, (1990) suggest that... "While some confirmatory laboratory exercises which aim a developing self confidence as well as basic processes and techniques may be necessary, the majority should require student to engage in real-problem solving investigations, reflecting different levels of scientific enquiry according to particular goals and local conditions

Gardener and Gauld (1990) point out that, designing high quality curriculum materials is not easy. It is especially demanding with regard to inquiry –oriented laboratory investigations because of the need to try to experiments to make sure they "work" as well as the importance of having, "balanced" exercises in terms of their "cognitive challenge".

In general the above literature depict that the curriculum has contribution for the status of practical work in teaching biology. Therefore, as the teaching materials, particularly the textbook is the basic tool of instruction in school curriculum. Thus, it is essential to consider the approaches to be used in the curriculum materials that would suite practical work implementation

2.11.2 Time Allocation

Time allocation and its effective use are major factors to consider in planning curricula for practical work. Doing practical work by nature is time consuming. In addition, the higher the level of inquiry or the lower the level of guidance provided for open-ended problem solving investigation, the more the time is needed to make the work meaningful (Shulman and Tamir, 1973).

Driver (1985) stressed that, students not only do need time to under take practical activities but also more time is need to make the most of those that are under taken. Where activities are intended to illustrate some concepts or principles, then time is required for pupils to consider their results and generalize the findings. If one accept the need to ofer balanced curriculum in terms of content and process (Ausubel, 1968), theory and pracrtical work (Woolnough and Allsop, 1985), the question remains the optimal proportion of time that should be allocated to practical work. According to Lunetta and Hofstein (1991) the laboratory activities are generally constrained by school realities adequate time have a positive correlation with effective preparation and work with laboratory for the teachers and students who are engaged in practicing.

2.11.3 School Facilities and Resources

Showalter (1984) showed the importance of facilities, by saying "researches can show that with out adequate laboratory facilities and materials, most students can not learn biology in any meaningful way". Several scholars agreed on, in order to get the best out of pupils, science laboratory needs to establish a happy and encouraging working environment that portrays positive image of science (Parkinson, 1994). Akalewold (2001) from Ainley (1979) Davis (1972) summarized that in the absense of sufficient laboratory facilities there would be no meaningful learning and purposeful involvement of students. Thus, the provision of equipment and materials improve patterns of teaching science.

serving as co-inquirer who models appropriate problem solving in facilitating discussion of scientific practices, concepts and theories in sensitively sharing strategies and explanations of the scientific community and in engaging students in relevant concept building discussion.

Similarly, Tamir (1991) agreed that, the teachers is undoubtedly the key factors in realizing the potential of the practical work. In order to be able to accomplish this mission, teachers need to be aware of the goals, potential, merits and difficult of the school laboratory. Teaching in the laboratory requires a special approach to science (for example, science as inquiry), special instructional skills (running discussions before and after laboratory work) and special attitudes (Patience, tolerance of uncertainty) readiness to encounter failure, open mindedness).

Teaching sciences is on-going learning process where practice is constantly reviewed and new, more effective technique used many of the teaching techniques used in the past are valuables but there are many new ways helping pupils to learn (Parkinson, 1994). Here the question that will be dealt with is what (Brown, 1995) recognized are central what are we going to teach (what will be the outcomes of the lesson? What will the pupils gain as a result of it? And how are uses going to do it? What teaching methods will us to employ?) It is essential that through good teaching i.e., having a sound knowledge of the subject and making a work interesting through variety of approaches and patterns of working teachers can encourage pupils to study science (Brown 1995). Much more important is the question of whether the pupils are activity engaged in their learning. It is essential that science teachers should think clearly about what he/she wishes pupils to gain from the lesson and then select the most appropriate means of achieving that.

Laboratory practical activities have long players a central role in the science curriculum. Yet, to conduct practical activities well require energy time and resources. Lunetta and Hotstein (1991) states that, one of the ways to improve the science curriculum is to complement school laboratory activities with simulations. To simulate means to imitate areal system. Laboratory practical activities in school science are themselves simulations of scientific practice.

Lunetta and Hofstein further stated that, Good practical and good simulations engage students in dynamic problem salving and inquiry. Laboratory activities have distinct advantage of enabling students to work with real materials and phenomena and to experience their biological

environment. Students need direct experiences with organisms, material and phenomena. Research on learning suggests that experiences with real materials are an essential element in cognitive development. Simulations are often misunderstood by learners, and often they are inadequate substitution for work with materials objectives. Since simulations provided experiences with representation of reality its is not appropriate to replace important experiential work in science with simulations (Luneatta and Hofstein, 1991). Yager (1991) also agreed that, simulation practical activities, that direct coverage of concepts, for the sake of coverage is not an efficient mode for practical activity. Students are recipients instead of active participants. They do not prepare for doing science, they never get to do it. Similarly, Lazarowitz and Tamin, (1994) stated that the role of a simulation is not to replace a laboratory experiments but to give students on opportunity to gain more experience with the manipulation of variable than is possible in real experiments. Bates (1978) in Lunetta and Hofstein (1991) indicated that studies suggest that instructional simulation were generally, not as effective as hands-an experiences in promoting manipulative skills.

Simulations, like laboratory demonstrations are appropriate to use, at times in a large groups demonstration mode. They may be particularly appropriate when a teachers wishes to demonstrate how to conduct a special kind of inquiry before releasing students to work with a lab or with a simulation independently. Out side class a teachers may also wish to use simulation to engage on entire class in observing relationships and formulating hypothesis to explain those observations. Using a simulation to fciliate post lab discussion can also be helpful on occasion (Simons and Lunetta, 1987) in Lunetta and Hofstein (1991).

While simulations are not always suitable substitutes for practical activities in the school laboratory, they can enhance concept learning and provide a sense of scientific practice. The Ethiopia Government introduced, "plasma TV programs, to present abstract concepts in a simplified manner and to demonstrate laboratory equipments found in one place through out all secondary schools. However, studies shows that PTV broad cast do not addressing critical and creative thinking skills (Ali, 2005). On the other hand it is also important to ensure that students have an appreciation of the steps involved in demonstration. And also some basic and important concepts are not especially amenable to direct experimental manipulation due to constraints of time, size, danger or the lack of appropriate resources (Tewdros, 2006).

CHAPTER THREE

3. METHODOLOGY AND RESEARCH DESIGN

3.1 Design of the Study

The purpose of this study was to asses and determines the status of Biology practical work implementation in selected general secondary schools of East Wallage Zone of Oromia region. To realize the objective of the study, descriptive survey design was used. The use of this design was well supported by Best and Kahan (2006) as descriptive survey design is appropriate to describe conditions that exist, opinions that are held, process that are going on, trends that are developing and also to access the opinions of large sample size. Similarly, Cohan and Manion (1994) stated that descriptive survey inquiry gathers data at a particular point with the intention of describing the entire nature of existing conditions in generalizing from sample to population. So it is intended with the assumption that it could help to get a description of current status of the problem by examining and describing the extent and the major problems in relation to general secondary school (Grade Nine and Ten) biology practical work implementation.

3.2 Source of Data

The sources of data used in this study include: biology teachers, students, school administrators (directors) and biology department heads of the selected secondary school, laboratory room observation and Biology textbook of Grade 9 and 10.

3.3 Sample and Sampling Techniques

This research was under taken in East Wallaga Zone of Oromia regional state. The researcher selected East Wallaga administrative zone as sample area of this study, because he was familiar with the area and has also been worked in the area for many years. In this zone there were 24 general secondary schools in 17 woredas and one city administration. For this study five (5) woredas and one town administration, representing 33.3% of the total woredas, namely (Diga, Gute, Leka Dulacha, Sibu Sire, Gobu Sayo woredas and Nekemte town administration) were selected using purposive sampling techniques. The researcher decided to employ purposive sampling for selecting these woredas and town administration is due to the following reasons. The researcher would like to include schools which have access of plasma TV and schools

3.4.2 Interview

For this research, individual semi-structured questions consisting of 10 items was prepared and conducted at school level to 6 biology department head teachers and 6 school principals. The researcher conduct the interview with the school administration and biology department heads regarding the implementation of biology practical work laboratory facility, budget allocation, time allocation for practical work and general school facilities for effective implementation of practical work.

3.4.3 Observation Check Lists

For this study, observation cheek lists was prepared to find out the availability of laboratory rooms, laboratory materials and equipments, and school facilities such as water and electricity services. It consists of 86 items prepared in accordance with the curriculum demand of both Grade 9 and 10 textbooks (MoE 2005) and other pertinent school facilities to investigate the extent of implementation and constraints in actual teaching biology.

3.4.4 Content Analysis

Content analysis is sued as a descriptive research when current documents or text issues are the focus; the analysis is concerned with the explanation of the status of same phenomena at a particular time (Best and Kahan, 2008; Creswell, 2009).

The actual learning depends on the nature of the tasks assigned and the opportunities offered to students to learn (Lazarowlz and Tamir 1994). Textbooks often determine the nature of the assigned task. Therefore, in order to investigate the nature of practical activities in the biology textbooks of grade 9 and 10 (MoE, 2005) each activities would be analyzed. Different schemes were available to see the nature and kinds of practical activities in science. For this study, Gott and Duggan (1995) scheme was employed. The degree of openness and demand for activities were estimated through the inquiry level index by Herron (1971) and revised by Tamir (1991). Therefore Tamir (1991) scheme was used for this study.

3.4.4.1 Selection of Unit Analysis

In this study each practical activity would be evaluated as a single unit analysis, Wimmer (2006) states that unit analysis is the smallest element of content analysis, it can be a single theme, word, activity or symbol.

3.4.4.2 Category of Activities

Constructing categories that are pertinent to the objective of the study, functional and manageable are crucial and major task in analyzing, content (Wimmer 2006). Categories can be established before the data are collected, based on some theoretical or conceptual rationale. Therefore, (1) to analyze the nature and kinds of practical activities, *observation*, *skill*, *enquiry illustrative* and *investigative* (Gott and Dugan 1995) were employed. (2)The degree of openness and the demand for activities were level '0' level '1', level '2' level '3' (Tamir 1991).

3.4.4.3 The Coding Process

A number of researcher analyze the science practical activity based on the coding they designed (Akalewold, 2001; 2003; 2005; Temecheng, 2001; Mehari 2007). Similarly, the coding of the activities in this study was done by the researcher.

3.5 Pilot Test

Pilot test was conducted to check the workability of questionnaire prepared for the study. That was to test whether the items were appropriate to gather necessary information. Accordingly, a draft questionnaire was administered to12 teachers (7 Biology and 5 English) teachers from two secondary schools outside sampled schools in the same zone. After having told them the objectives of this pilot test, they were informed how to fill and give feed-back on the relevance of content, types of questions and lay out of questionnaire. Some questions were also modified to improve their clarity and others provided with necessary alternatives for they were incomplete. Furthermore, both teachers and students questionnaires were given to English teachers and they commented on improving the instruction, conceptual integration and grammatical aspects.

3.6 Data Collection Procedures

Review of related literatures was made in advance to get information from what has been done in relation to the problem and different factors which influence practical work implementation were thoroughly reviewed. Before distributing to the sample respondents, it was checked essential correction. Then during questionnaires distribution and collection process follow up were made. To enhance the quality of response and the rate of responses convenient time for

the respondents were arranged. The objectives of the study were cleared to all of the sample respondents at the beginning of questionnaires administration in order to a void confusion. Data particularly from most teachers and some students were collected on the spot during which the data collector gave the necessary clarifications. The rest were collected after a certain period.

3.7 Data Analysis

In order to analyze the data generated using various instruments both quantitative and qualitative methods were utilized. As to the quantitative approach, the output of this analysis was tabulated in various arrangements and explanations have been given on the summarized outputs. The outputs are given in tables of frequencies and percentages.

On the other hand, qualitative data generated through open- ended questionnaires, interviews and observation were written in explanation from. The data collected were organized and analyzed in away appropriate to answer the research questions, posed problem, on the basis of implementation of PW and factors influencing proper implementation of PW.

CHAPTER FOUR

4.PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

The objective of this study was to assess the implementation of biology practical work in general secondary school of East Wallaga Zone. To this effect, this part of the research deals with the presentation, analysis and interpretation of the data gathered.

First, backgrounds of respondents were discussed followed by the items which focus on the nature of practical work in biology text book, existing practice in using practical work; attitude and interest of teachers and students to practical work; students engagement in practical work; role of teacher in biology PW and those factors influencing practical work implementation in the general secondary school.

4.1 General Information of Respondents

The main sources of the data of this study were biology teachers, grade 9 and 10 students, biology department heads and school principals who have direct role in the implementation of practical work. Identifying the characteristics of the informant was very important in the analysis and interpretation of data for it tells from whom the data was collected.

Table 4.1 Personal characteristics of respondents

No		Teacher				Bio-Dep head				Director				Student			
		M	F	T	%	M	F	T	%	M	F	T	%	M	F	T	%
1	Sex	25	9	34	100	5	1	6	100	6	-	6	100	119	88	207	100
2	**Educational Level:**																
	Diploma	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	BSC/BED	25	9	34	100	5	1	6	100	6	-	6	100	-	-	-	-
	Ma/MSc	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	25	9	34	100	5	1	6	100	6	-	6	100	-	-	-	-
3	**Major**																
	Biology	25	9	34	100	5	1	6	100	1	-	1	16.7	-	-	-	-
	other subject	-	-	-	-	-		-	-		-	5	83.3	-	-	-	-
	Total	25	9	34	100	5	1	6	100	6	-	6	100				
4	**Service in teaching Biology in years**																
	1-5 years	7	2	9	26.5	-	-	-	-	-	-	-	-	-	-	-	-
	6-10 years	8	3	11	32.4	3	-	3	50	1	-	1	16.7	-	-	-	-
	11-15- years	3	1	4	11.8	1	1	2	33.3	3	-	3	50	-	-	-	-
	16-20 years	5	3	8	23.5	1	-	1	16.7	2	-	2	33.3	-	-	-	-
	21 and above	2	-	2	5.8	-	-	-	-	-	-	-	-	-	-	-	-
	Total	25	9	34	100	5	1	6	100	6	-	6	100	-	-	-	-
5	No of periods he/she teaches per week																
	<12 periods	2	-	2	5.8	4	1	5	83.3	-	-	-	-	-	-	-	-
	13-16 periods	17	6	23	67.6	1	-	1	16.7	-	-	-	-	-	-	-	-
	17-20 periods	4	2	6	17.8	-	-	-	-	-	-	-	-	-	-	-	-
	21-24 periods	2	1	3	8.8	-	-	-	-	-	-	-	-	-	-	-	-
	25-28 periods	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	>29 periods	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	25	9	34	100	5	1	6	100	-	-	-	-	-	-	-	-

As can be seen in Table 4.1, 25 (73.5%) of the respondent teachers had above 6 years of service in the teaching biology where as only 9 (26.5%) of teachers served from 1-5 years.

As indicated in the same table concerning educational level, all of respondent teacher 34 (100%) were BSc/BED holders in biology. The table also shows that 73.5% of respondent teachers were males and 25.5% of respondents were females. As far as the number of periods

per weak was concerned about 23 (67.6%) of teachers taught 13-16 periods per weak, others 17.8%, 8.8% and 5.9% have 17-20 periods, 21-24 periods and less than 12 periods per-weak respectively. In line with this, as stated in the 1994 education and training policy, for a teacher to teach in general secondary school, he/she should have a minimum qualification of first degree.

Therefore, the educational level of all of the teachers in the sample schools seems to comply with the requirement of the new education and training policy. Moreover, the fact that all of the respondent teachers have the required qualification and teaching experiences which contributes to the reliability and dependability of the conclusion to be made out of this study. As to the major area of teaching also all of respondent's teachers 34 (100%) were biology majors and majority of teachers' teaches 13-16 periods per-weak which was not over loaded.

4.2 The Nature of Practical Work in Biology Textbooks

In the Ethiopia context, curriculum guide is a national document (Anbasu; Berhanu, in Akalewold 2001) where the subject content, objective, hint for teaching practical activities, time allotment and materials required are set for the particular grade and subject. Textbook writers are expected to consult this document and present the concept and activities mentioned in this guides (ICDR, 1996). Textbook, in the Ethiopia context were almost the major instructional materials available in most case. Analysis of such materials was therefore, mandatory to know what students were actually doing and what kinds of activities were contend.

4.2.1 The Biology Textbooks

Following the implementation of the 1994 NETP, the first publications of Biology textbook for general secondary education was done in the year 1999 and 2000. Nevertheless, the current biology textbook in use was revised in 2005(EMPDA, 2005b).

The biology textbook for grade 9 and 10 was organized so that each units start with objectives and an introductory section (MoE, 2005). Therefore to investigate weather the biology textbook provide sufficient practical activities or not and to investigate engagement of students in practical work. Questions were asked for both biology teachers and students. Then, the response of both teachers and students were analyzed in table 4.2 below.

Table 4.2: Response of Teachers and Students on Inclusion of practical work in the Biology Textbook for Grade 9 and 10

S. No	Item	Choices	Teachers		Students	
			Frequency	%	Freq	%
1	Does the biology text book provide sufficient practical activities?	Yes	30	88.2	189	91.3%
		No	4	11.8	18	8.7%
		Total	**34**	**100**	**207**	**100%**
2	How often do you engage in PW stated in Biology text book?	a. Always	-	-	-	-
		b. Inmost	-	-	-	-
		c. Some times	13	38.2	98	47.3
		d. No at all	21	61.8	109	52.9
		Total	**34**	**100**	**207**	**100**

As it can be seen from table 4.2 above, 30 (88.2%) teachers and 189 (91.3%) of students have respond that the biology textbook for general secondary school (Grade 9 and 10) provide sufficient practical activities to be done by the students. In each unit or sub-unit practical activities were included to illustrate the topic under discussion. Researchers of this study also analysis these textbook focusing on the inclusion of practical work and nature of practical work.

Actually each unit of the biology textbooks they commonly begin with list of learning objectives and proceed with scientific description and definition of the concepts, present practical activities, exercises (Check points) and towards the end of the chapter involving project work. The total numbers of practical activities in each of the textbook were N=32 and N=41 for grade 9 and 10 biology textbook respectively. This shows that there are practical activities suggested in the text book. Never the less, most of the activities presented in the biology textbooks, students were told exactly what they should measure, observe, investigate and conclude.

Also as shown in the above Table 4.2 item 2, even though biology textbooks provided practical activities, only 13 (38.2%) of respondent teachers and 98 (47.3%) of students reported that, only some times (very limited time) students get chance to engaged in practical work where as 109 (52.7%) of students responded that no teachers engage students in doing PW indicated in biology textbooks. Similarly majority 21 (61.8%) of respondent teachers reported that, most of the time we uses teacher's demonstration. We do not give much attention to practical activities

because there is no adequate laboratory room with necessary laboratory materials and chemicals. Particularly one biology teacher named as Gamachu stated that:

> *Yes there are activities in biology textbook, but in those activities there are stated materials to conduct the given activities, but in our school as you can see no laboratory materials and equipments. Because of this we can't do noting (March 6, 2010).*

In this regard three teachers from different school give similar response. Especially one teacher anonymously named Tolasa said that in the absence of laboratory room with necessary laboratory materials, it is not expected PW teaching from teachers. Another biology teacher Amsalu responded as:

> *...teacher use lecture in teaching biology like history or geography due to lack of necessary laboratory materials and equipments. The same is to also in televised class. Only the televised teacher demonstrates practical work. The students does not get chance to practiced it (March 2, 2010).*

4.2.2. Types of Practical Work Included in Biology Textbooks

In this study the nature and kinds of all practical activities suggested in the two biology student textbooks were analyzed. Each activity was analyzed using the scheme suggested by Gott et.al. (1988), Gott and Duggan (1995). They classified practical work into five: *inquiry, illustrative, skills, observations* and *investigative* Gott and Duggan showed that the boundaries between them are not watertight. For example, skills and observational practical are almost implicit to some degree in other types. Enquiry practical are designed and structured to make the students discover a particular concept for him. Illustrative practical are aim to demonstrate or illustrate a particular concept which was introduced by the teacher or textbook in advance. Students, hence, 'see' the concept in action. Skills practical aims to help pupils learn or practice a particular skill, like using instrument (microscope), they are designed to equip the basic skills necessary to carryout other practical sciences. Observation was described as "theory-laden", in that, whenever pupils do observe in science, they use their conception to an event or objects in question. In observation practical, pupils do apply their ideas to the observed phenomena. Investigative practical aims to allow pupils use concepts, cognitive processes and skills to solve problem. They are less structured than enquiry or illustrative

practical. Table 4:3 summarize the result of the types of practical activities found in the two Biology textbooks.

Table 4.3: Types of practical work in grade 9 and 10 biology textbooks based on Gott and Duggan (1995) scheme.

Kinds of practical activities	Grade 9 biology		Grade 10 biology	
	Freq.	%	Freq.	%
Skills	-	-	-	-
Observation	5	15.6	9	21.9
Enquiry	9	28.1	13	31.7
Illustrations	18	56.3	19	46.4
Investigation	-	-	-	-
Total	32	100	41	100

As it can be seen from the above table, the most frequent types of practical activities were found to be illustrative practical activity in both Grade 9 and 10 Biology. They account 56.3% and 46.4% respectively from practical activities suggested in the textbooks. Observation practical activities account about 15.6% and 21.9% for both Grade Biology texts respectively. Where as, Enquiry type of practical activities were 28.1% in grade 9 biology and 31.7% in Grade 10 Biology. There is no skill and investigational practical activity in these textbooks.

From this we can say that, though the NETP have intentions to practice and engaged students in problem solving approaches, in general secondary level much of the activities in biology textbook are designed to promote concept acquisition through illustration. These illustrative practical works were found usually after the treatment of the concept, and are designed to show it to the students and consolidate and hammer the theoretical part dealt in advance. In doing activities students are required only to follow a certain number of prescribed procedures to reach at the required result. Students usually know the answer before they start especially in illustrative practical, since they have dealt with the topic before, they are doing the activities.

These discussions will clearly show that in those textbooks practical activities were considered as subservient to theory. Their purpose was to illustrate the scientific concept taught, and not considered mainly as a means of learning or means of identifying and testing misconceptions.

4.2.3 Analysis of Practical Activities for Inquiry Level of Index (ILI)

To find the inquiry levels index for the practical activities of grade 9 and 10 biology the activities were evaluated using the Tamir (1991) index. The inquiry level index was first deigned by Herron 1971 cited in (Akalewold, 2001). The scheme has (0, 1, 2, 3) levels depending on the tasks that students have to accomplish problem, materials and methods and conclusion. At level zero, all the problem, procedures and conclusion were provided and the students have to follow instructions and obtain the results specified by the text. At level one, the questions and methods are given and the student has to find the answer. At level two, the question is given; the student has to design a method and find an answer. At level three, the student is presented with phenomena, she/her had to formulate a relevant question, design, method and find answer to the question Tamir (1991) added a fourth dimension to the Herron's scheme called collection of data and such scheme was employed for this study (Tamir, 1991; in Akkalewold, 2001).

Therefore, to find the inquiry level index, for activities suggested in the biology textbooks all the activities were evaluated at four levels: Aims, materials and method, collection of data and conclusion. Whenever each level was stated by the textbook, they are considered as 'given' and if not; they are rated as 'open'. Open level gives chance for the students to use his/her knowledge.

As it can be shown in Appendix G table 3, the aim of activity was stated as: Testing for starch, apparatus and procedure to carryout the practical was suggested. The book itself gave conclusion. This activity verifies the change of color in the presence of starch that iodine is an amber-colored solution, turns to blue black in the presence of starch (see Appendix G Table 3).

Similarly, in table 4, the problem of the activity was stated in the textbook. As investigating the lung structure and all the procedures was stated in the textbook and students are expected to collect data and given conclusion (see Appendix G Table 4).

In table 5 the aim of activity was given as: experiments to show how hormones operate plants growth. Materials and procedures to conduct the activities were given and the answer was stated in the textbooks (see Appendix G table 5).

Table 4.4: The Sampled Practical Activity in Biology Textbooks using Tamir (1991) index

Grade	Activity number	Problem identification	Procedure	Collection of data	Draw conclusion	Level of inquiry
Grad 9 biology	A-2.1(P.35)	Given	Given	Open	Given	0
Grade 9 biology	A-3.1(P.65)	Given	Given	Open	Open	1
Grade 10 biology	A-2.4(P.31)	Given	Given	Open	Given	0

As it can be seen in the above table 4.4, A-2.1(P.35) from grade 9 biology and A-2.4(P.31)from grade 10 biology, they are level '0' in ILI. The students were expected to verify the concepts based on the given aim, procedures and answer by the textbook. In A-3.1(P.65) of grade 9 Biology the problem and procedure was stated by the textbook and students collect data and draw conclusion. Therefore it is level '1' in ILI. In the same way to determine the degree of openness of the activity and their demands for enquiry level, all the practical activities suggested in Grade 9 and 10 Biology textbooks were analyzed by the researcher using the Tamir (1991) index. The results of these analyses can be shown in table 4.5 and 4.6 below.

Table 4.5 The Degree of Openness of each Activity Suggested in grade 9 Biology Textbook using Tamir (1991) ILI

Chapter	Topic	Level of inquiry				Total
		Level '0'	Level '1'	Level '2'	Level '3'	
1	Cells	3	2	-	-	5
2	Nutrition and digestion	8	3	-	-	11
3	Breathing and respiration	3	2	-	-	5
4	Transport in living things	1	4	-	-	5
5	Organisms and their environment	2	2	-	-	4
6	Micro organisms and diseases	1	1	-	-	2
7	The diversity of life and classification	-	-	-	-	-
	Total	18	14	-	-	32
	Percent	56.3%	43.7%	-	-	100%

As reveled in the above table in grade 9 biology totally (N=32) practical activities were included. From the activities included 18 (56.3%) were level 'zero' and 14 (43.7%) activities were level one. The distribution of activity was not uniform in each chapter. For example, in chapter two there are eight 'zero' level activities and three level one practical work and in chapter four only one zero level practical activity and four were level one practical activity. There are no practical activities in chapter 7 and also there are no level 2 and level 3 practical activities in the textbook.

Table 4. 6. The Degree of Openness of Activities Suggested in grade 10 Biology Textbook using Tamir (1991) ILI

Chapter	Topic	Level of inquiry				Total
		Level '0'	Level '1'	Level '2'	Level '3'	
1	Response in plants	4	2	-	-	6
2	Food manufacture in Green plants	5	6	-	-	11
3	Coordination	4	5	-	-	9
4	Body regulation	-	3	-	-	3
5	Reproduction	3	2	-	-	5
6	Genetics and evaluation	2	1		-	3
7	Natural resource and their conservation	-	2	-	-	2
8	Bio-technology	1	1	-	-	2
Total		19	22	-	-	41
Percent (%)		46.3	53.7	-	-	100%

As it can be indicated in table above, 22 (53.7%) of the total practical activities included in grade 10 biology were level 1, and 19(46.3%) were zero level. Similar to grade 9 Biology in grade 10 biology level 2 and level 3 were not included.

Generally, all the practical activities found in the text were well defined. The practical suggested in biology textbook were structured to guide students thinking in one direction and limit divergent thinking suggested by NETP. No provisions were left for students to plan and hypothesize; always the procedural demands of the activities were given by the textbooks. Contrary to this, problem solving in reality requires the application of both conceptual and procedural understandings to the problem.

4.2.4 Existing Practice in use of Practical Work in Biology

Akalewold (2003) stated that, in designing a course for PW the major part of the design next to decisions of aim and objective is to make a right balance of concept development, skills development, and motivations aspect. As suggested by several researchers, the realization of the students learning in biology depends largely on the careful matching of the practical activities to the different objectives of the subject. That is why because different kinds of practical activities potentially represent an interesting and effective strategy for achieving the goals.

Parkinson (1994) indicates that, PW experiences play a significant role in helping students acquire skills or development the various scientific inquiry skills. The biology students become aware of the various approaches and process involved in biological lessen by conducting purposeful practical activities. To investigate the types of activities used towards the accomplishment of the PW methods and kinds (observational, illustrative or experimental) the various approaches to be used for the activities stated in the biology text book, questions were posed to both teachers and students.

Table 4.7 Teachers and Students Response on the existing practice in using different types of practical work

S/ No	Item	Respondents		Likert scale type				
				Most frequently	Frequently	Moderately	Rarely	Never
1	Teachers lecture and demonstration while students were listing and observing	Teacher	Freq	18	11	-	5	-
			%	52.9	32.4	-	14.7	-
		Student	Freq	134	45	-	19	9
			%	64.7	21.7	-	9.2	4.4
2	Individuals students activity	Teacher	Freq	-	-	7	17	10
			%	-	-	20.6	50	29.4
		Student	Freq.	11	23	-	67	106
			%	5.3	11.1	-	32.4	51.2
3	Pair of students activities	Teacher	Freq.	4	3	-	19	8
			%	11.8	8.8	-	55.9	23.5
		Student	Freq.	14	34	-	78	81
			%	6.8	16.4	-	37.7	39.1
4	Group of 3-5 practical activity	Teacher	Freq	-	2	2	22	8
			%	-	5.9	5.9	64.7	23.5
		Student	Freq	26	37	-	86	58
			%	12.6	17.9	-	41.5	28
5	Writing reports and notes on the activities	Teacher	Freq	-	-	-	-	-
			%	-	-	-	-	-
		Student	Freq	-	7	-	72	128
			%	-	3.4	-	34.8	61.8
6	Observing whenever other doing experiment.	Teacher	Freq	-	-	-	-	-
			%	-	-	-	-	-
		Student	Freq	9	55	-	69	74
			%	4.4	26.6	-	33.3	35.5

Biology teaching also offers substantial emphasis to inquiry learning. Thus teaching and learning biology in the absence of PW method and use of real specimen would not bring the desired biological knowledge (Brown, 1995).

As indicated in chapter one the major objectives of the biology textbook for Grade 9 and 10 (MoE, 205) aims to enable students take active participation in solving personal and social problems. However as the majority of teachers and students responded, they scarcely use /no practical work teaching methods. In other words verbal presentation of facts and few demonstrations by the teachers on the black board dominates the teaching of biology in general secondary schools. Therefore, the biology teaching learning process did not explicitly foster students thinking of scientific methods and doing science. Thus, there was a mismatch between what the biological science curriculum wants and what the school done for students.

The issue PW as discussed by many scholars has a distinct advantage of enabling students to work directly with materials and phenomena in the student's biological environment. It is claimed that different types of scientific knowledge require different teaching strategies for intended learning out comes to be achieved. In biology educators typically place great importance on PW method of teaching. Because when students have exposure to the real-life situation they would understand the role of the lesson in their local life. In support of this, Arzi (1998) suggest that:

> *.... Thinking in science is often associated with creativity and problem solving. The experiences in science are only possible through implementing various PW methods purpose fully and if students are provided with the opportunity to be involved in the necessary experiences in science... but not merely reading about of science.*

Similarly, Hegarty (1990) also describes that.... One possible strategy for enhancing students is by active involvement rather than watching demonstration. Therefore, teaching biology must depend up on the possibility of dealing with certain, at least compulsory practical activities, as there is a wealth of materials to use in the subject. This led to many different desirable out comes such as understanding and familiarity with techniques and apparatus.

4.3 Attitude and Interests of Teachers and Students to Practical work

Toh (1991) argued that "the ability to perform a task and a willingness to do so are necessary for success." Of the two, the latter may be the more importance since it determines the personal response of the individual to the learning situation. Hodoson (1993) also confirm the important of attitudes and interest towards PW that, PW occurs as a result of attitudes and interest of both teachers and students by saying that: "... while many teachers and students enjoy in PWs and develop positive attitudes to it, there are many who do not, and some others also expresses a dislike for PW.

Similarly Gardiner and Gauld (1990) stated that students generally enjoy lab work but not all enjoy it equally. Therefore to investigate attitude and interests of both teachers and students towards PW methods i.e., weather or not they were enthuse in doing biology PW, three questions for teachers and two questions for students were posed as they have implication on its ineffectiveness. Basically, both items used seems similar but as it were intended to explore the extent to which teachers and students are interest and what they feel in doing the activities, this was helped to cross check and imagine beyond their responses, to reach up on the reality. Accordingly, their responses were analyzed in table 4.8 below.

Table 4.8 Attitude and interest of Teachers and Students towards Biology Practical Work

S.No	Item	Choices	Teacher		Students	
			Freq	%	Freq	%
1	What do you feel when you engage in practical work activities in biology text book?	a. Very interested	27	79.4	117	56.5
		b. Interested	7	20.6	64	30.9
		c. Less interested	-	-	12	5.8
		d. In different	-	-	4	1.9
		e. I don't like it at all	-	-	3	1.5
		f. Need to get help of others	-	-	7	3.4
2	To what extent do you enjoy PW teaching learning methods in Biology?	a. To very great extent	23	67.6	72	34.8
		b. To a great extent	9	26.5	98	46.9
		c. To a limited extent	2	5.9	28	13.5
		d. In different	-	-	6	2.9
		e. I don't like it at all	-		4	1.9

As it can be indicated in table 4.8 above item one, all of respondent teachers responded that they were interested in doing practical work. Similarly, 56.5% students responded that they were very interested and 30.9% of students responded that they were interested. On the other hand

only (5.8%, 1.9%), 1.5% and 3.4%) of respondent students replied that they were less interested, in different, don't like it and need to get help of others respectively in biology PW.

Thus this implies that teachers and students have generally interested in doing PW, of course, very few or not all students enjoy it. Gadiner and Gauld (1990) stated that, among the physical conditions laboratory facilities can have effects on arousing attitude to doing science. Many studies found a positive association of teachers and students attitudes with school laboratory facility.

Similarly, as it can be seen from table 4.7 item two above, 23(67.6%) and 9(26.5%) of teachers (94.1%) and 72.34-8% and 98(46.9%) of students have reported that they enjoy to very great extent in practical work respectively. Very few teachers (5.9%) responded that they enjoy in practical work to a limited extent where as (13.5%, 2.9% and 1.9) of students have also replied that they enjoy to a limited extent, feel indifferent and do not like PW at all respectively.

4.3.1. Opinion of Teachers and Students on the Importance of Practical Work in Biology

The analysis of importance of PW was done in order to determine the extent to which both the biology teachers and students becomes aware of the importance of PW in order to gain the maximum benefit of biological knowledge than any other approach. Even though, not all types of practical activities were equally important in helping students to grasp Biological knowledge and skills. Accordingly, three items, which support each other were posed to both teachers and students. Therefore their response were indicated in Table 4.8

Table 4.9 Response of Teachers and Students on Importance of Practical Work

S.No	Item	Choices	Teacher		Students	
			Freq.	%	Fre.	%
1	To what extent do you believe that PW methods helped in gaining biological knowledge?	a. To a very great extent	30	88.2	164	76.2
		b. To great extent	3	8.9	32	15.5
		c. To limited extent	1	2.9	4	1.9
		d. I don't like it	-	-	3	1.5
		e. I don't believe	-	-	4	1.9
		Total	**34**	**100**	**207**	**100**
2	What is your opinion to PW in teaching learning Biology?	a. Very vital	28	82.4	180	87%
		b. Vital	6	17.6	20	9.7%
		c. Less vital	-	-	5	2.4
		d. I don't know its vitality	-	-	2	0.9
		Total	**34**	**100**	**207**	**100**

As indicated in the above table Item one, the majority of teachers and students believe and claim that practical work teaching methods was very important to obtain biological knowledge. The findings in these sections showed that, majority the respondent teachers 33(97.9%) and 196 (94.7%) of sampled students believed that PW is an essentials way of teaching biology. Where as 1(2.9%) of teachers and 4(1.9%) of students responded that, they believed to limited extent on the importance of practical work. Still 3(1.5%) and 4(1.9%) of students replied that, they don't like it and don't believed in its importance respectively.

In item 2 Table 4.9 teachers and students opinion to PW was analyzed. Similarly 82.4% teachers and 76.2% of students have reported that PW was very vital in teaching and learning biology. Where as 17.6% of teacher and 9.7% of students responded that PW teaching and learning in biology was vital. Here, very few 5 (2.4%) and 2(0.9%) students respectively respond that PW method is less vital and do not now whether it is vital or not. From this it is possible to understand that both teacher and students were aware of the importance of PW for teaching biology.

4.4 The Role of Teacher in Biology Practical Work

As to Tamir (1991) the teacher is undoubtedly the key factor in realizing the potential of the laboratory. In order to be able to accomplish this mission teachers need to be a ware of the goals, potential, merits and difficult of the school laboratory. Teaching in the laboratory, requires especial approach to science, careful preparation and planning on the part of the teachers, as well as assessment of performance and understanding of students through observations, diagnostic questioning, adequate home work and practical examinations are all essential. The ability to integrate the laboratory with other instructional strategies and to motivate students will both make significant contributions to up grading learning in the laboratory (Tamir 1991). Therefore as to several scholars, to make the maximum use of the practical work teachers are expected to run and facilitate the many of the effort. Parkinson (1994) indicated that, becoming a good science teacher is not just a matter of mastering a few survival skills, but an on going process where practice is constantly reviewed and new, more effective techniques used. Eventually, the extent to which a given science environment in effect and enhance education depends on the teacher subject matter knowledge, pedagogical

knowledge, believes and genius to use of the available resources, more than on the particular physical features of any facility. In this regard Lnuetta (1998) cited in Olani (2008) stated that

> *... the teacher has many challenging roles to pay in engaging students in appropriate practical activities, in serving as a con-inquirer who models appropriate problem solving in facilitating discussion of scientific practical concepts and theories, in sensitively sharing strategies and explanations....Engaging students in relevant concept building discussions.*

Keer (1963) also stressed that, most teachers held the view that the primary requirement for effective use of practical work was to create conditions under which it could be practiced. Therefore the analysis of teachers duet and assessment technique was basically to find the degree to which they serve the purpose for which they are responsible in helping students grasp the process involved in scientific methods. In this, regard teachers were asked about their role and the assessment techniques they use in teaching practical work.

Table 4.10 Teachers' Response concerning their Role while Students are Practicing Biology Practical Work

Item	Choices	Respondent teachers	
		Freq.	%
What do you think is the role of the teacher whenever students carry out practical activities?	a. Correcting errors on spot	1	2.9
	b. Facilitating encouraging and guiding in practice	30	88.2
	c. Discussing with them after words	3	8.8

As it can be see from table 4.10, majority of teachers 30 (88.2) reported that, the roles of teacher, whenever students carry out practical activities, were facilitating, encouraging, and guiding students practical activities whereas 3 (8.8) and 1 (2.9) of respondent teachers respectively reported that, the roles of biology teachers were discussion with them after words and correcting errors on spot. This result indicates that teachers have awareness about their role in teaching PW, i.e., facilitating, encouraging students in practicing practical work. However in table 4.7 the actual process going on or teacher used have been reported that they use lecture and demonstration methods while students were observing and listening. This implies that, despite knowing their role they did not work towards the implementation. On the other hand

what was expected from teachers was making his approaches interesting by using Varity of approaches to enable his/her student reach the frontiers of the field, and increase the extent of PW implementation in school condition to which students do experiments individually or in a groups, nevertheless, these was not employed.

Woolnough and Allsop (1985 in Tamir 1991) stated that most teachers at present are ill prepared to teach effectively in laboratory. A major reason is that, most science teacher have themselves been brought up on a diet of content dominated cookery book type practical work and many have got in the habit of propagating it themselves. Similarly Temechegn (2001:71) said that, researchers also emphasized that teacher unfamiliarity with the method was one factor for the prevailing weakness. Parkinson (1994) stated that, in order to get the best out of your pupils you need to establish a happy, encouraging working environment that portrays a positive image of science. You, as a teacher, are part of the image that pupils have of science and scientists and your role is important in determining whether or not pupils like science and would wish to continue studying it. Finally, Lawson et al. (1989 in Tamir 1991) stated that, if you help students improve their use of the creative and critical thinking skills you have helped them become more intelligent and helped them learn how to learn.

As indicated in table 4.11, teachers were also asked about the technique they use for the assessment of students mastery of practical activities. A number of researches here suggested that perhaps the most important issue is the clear definition of the purpose of assessment to improve instructional practice and students learning. Toh (1991), describes that, students performance in laboratory work can be measured either by teacher observation, written tests or by the use of some form of report submitted by the students on completion of the project or investigation. As to Tamir (1991), educator's possess need of knowing whether their educational intentions are realized, to what extent, their activities achieved their goals, how best to plan for continues optimal instruction. Accordingly, teachers were asked about weather they evaluate students' ability in PW and the methods commonly used to assess his/her students performance in biology PW.

Table 4.11 Teachers' Response Concerning Practical Work Assessment techniques

S.No	Item	Methods of evaluation	Respondent teacher			
			Yes		No	
			Freq.	%	Freq	%
1	Do you evaluate students' ability in practical biology?	-	29	85.3	5	14.7
2	What method do you commonly use to assess students' mastery of practical work ?	a. Observation	6	20.7	-	-
		b. Written tests	22	75.9	-	-
		c. Actual practical activities	1	3.4		

As it can be seen in table 4.11, this item wants to investigate the PW assessment, questions were posed to explore whether biology teachers evaluate students ability in practical biology or not, accordingly, 29 (85.3%) of respondent teachers' reported that they evaluate their students ability using different methods of evaluation techniques where as 5 (14.7) teachers responded that they do not evaluate students in practical work. This implies that majority of teacher were evaluate students performance, however the evaluation methods was not focus on practical skills but give more emphasis to theoretical understanding of PW.

As to the techniques of assessment on the same table item two majority of teacher 22 (75.9%) reported that, they used written test items as the techniques to evaluate their student's mastery of PW. Whereas, 6 (20.7%) and 1 (3.4%) teachers respectively reported that, they used observation and actual practical activities. Therefore, this indicates that, majority of teachers used paper pencil examination to evaluate and know students mastery of practical work.

4.5 Factors Affecting Biology Practical Work Implementation

There are different factors that play in the school context and potentially affect school science particularly in biology. Though there are many factors affecting practical work teaching in school science this study explore some factors like laboratory rooms and lab equipments, school facilities and resources, method of using simulation, shortage of time, teachers teaching methodology and Budget allocation and were same to be explored.

To explore major factors influencing, PW implementation in teaching biology at secondary level, questions regarding laboratory room, equipments and school facilities, use of PTV, time,

budget and other related factors were posed to both teachers and students. The response will be presented as follow as.

4.5.1 Availability of Laboratory Room, and Laboratory Equipments

A number of researchers showed that with out adequate laboratory facilities and materials, most students can not learn biology in any meaningful way. In order to get the best out of pupils, science laboratory needs to establish a happy and encouraging working environment that portrays positive image of science (Parkinson, 1994). Similarly Akalewold summarized that in the absence of sufficient laboratory facilities there would be no meaningful learning and purposeful involvement of students (Davis; and Ainlley; in Akalewoled, 2001).

Accordingly, biology teachers and students were asked about the availability of lab materials and equipments for doing practical activities stated in biology text book for grade 9and10.

Table 4.12: Teachers and students response on the availability of laboratory materials and equipments

Item	Choices (Alternatives)	Teachers		Students	
		Freq.	%	Freq.	%
To what extent do you think that biology laboratory is equipped for the practical activities in the text books ?	a. To a very great extent	-	-	-	-
	b. To a great extent	-	-	-	-
	c. To a limited extent	2	5.9	6	2.9
	d. No at all	32	94.1	201	97.1

Therefore, as shown in table 4.12 above, majority of 32 (94.1%) teachers and 201 (97.1%) students have responded that there is no materials and equipments at all. Only 2 (5.9%) teachers and 6 (2.9%) Of students reported that it is equipped to a limited extent from local materials by teachers and students. As it can seen from the table almost all of the responded teachers and students have replied that there is not materials and equipments in lab room.

The data gathered from principals and biology department head concerning the resources, laboratory room's equipment in the lab room and their facilities indicate the same result with teachers and students. They responded as even though their was laboratory room, the lab room is not equipped with necessary materials and equipments.

Particularly one school Director (Ato "Fufa") stated that:

> *This secondary school was established before four years. However the laboratory room is built-up only to fulfill the requirement of criteria for establishing secondary school. He elaborates his response more in Amharic "ሆድ ስያውቅ ዶሮ ማታ" (March 7, 2010).*

Similarly from school D, one biology department head teacher (Gemeda) responded that. "Yes I agree with the importance of PW in teaching biology, but we have no materials and chemicals in lab room "ከአቅም በላይ ሆነብን እንጂ አብዛኛዎች ተማሪዎች በPTV የሚተላለፈውም መከራ መከታተል በፍፁም አይችሉም" because of this the PW teaching methods are not properly implemented as required in biology text book.

The observation check lists made in laboratory room concerning the availability of materials and equipments in accordance to the curricular demand, as it can be seen from Appendix E, indicates the same reality. The findings of the observation also shows that, the sampled secondary schools, they all have no important lab materials, equipments and chemicals required for teaching practical activities in the subject under the study. Lazarowitz and Tamir (1994) stated that, adequate supply of materials and equipment made teaching more convenient and more effective, increased the involvement of student's experimental work. In contrast shortage and/ or lack of lab materials students can not learn biology in meaningful way. So from the above data and the discussion one can understand influence the impact of the problem on the implementation of PW teaching Biology in Grade 9 and 10.

4.5.2 The Method of Plasma TV instruction of Practical Work

Laboratory practical activities have long played a central role in the science curriculum. Yet, to conduct practical activities will require energy, time, and resource. Lunette and Hofstein (1991) states that, one of the ways to improve the science curriculum implementation is to complement school laboratory activities with simulations. Therefore two items were posed to both students and teachers. To investigate the extent to which plasma TV help students to practice PW in biology. Accordingly as shown in table 4.13 below it was intended to identify availability of plasma TV in the selected secondary school and the extent to which the practical activities demonstrated through PTV helps students to practice practical work to meet the objectives as stated in biology textbook.

Table 4.13. The Response of Teachers and Students on Use of Plasma TV Program in Biology Practical Work

Item	Choices	Respondents							
		Teachers				Students			
		Yes		No		Yes		No	
		Frqu.	%	Frqu.	%	Frqu.	%	Frqu.	%
Does your school currently use plasma TV program in teaching biology?	-	21	61.8	13	38.2	134	64.7	73	35.3
To what extent the practical activities demonstrated through PTV help students to conduct practical activity (those schools?	a. To a very great extent	1	4.8	-	-	12	9	-	-
	b. To great extent	3	14.3	-	-	15	11.2	-	-
	c. To a limited extent	11	52.4	-	-	38	28.4	-	-
	d. we can't follow it because it is so fest	6	28.6	-	-	69	51.5	-	-

As indicated in the above table 4.13, 61.8% of teachers and 64.7% of students reported that, plasma TV is available in their school. On the other hand 13 (38.2) teachers and 73 (35.3%) students from three secondary school reported that totally no plasma TV access in their school, because the installation process is not completed. In the same table item 2 similarly, teachers and students response were analyzed to investigate the extent to which PW demonstrated through plasma TV help students to conduct practical activities. Accordingly from those which have PTV access 28.6% teachers and 51.5% of students reported that the plasma TV transmission is so fast because of these it is difficult for students to follow the demonstration process, where as 52.4% of teachers and 28.4% of students responded that plasma TV transmission help students to a limited extent. This implies that only very few students can follow the practical activities demonstrated through plasma TV. In other word much of students can't follow any information and practical procedures presented by the plasma TV.

Lunette and Hofstein (1991) stated that students need direct experiences with organisms, materials and phenomena. Researcher on learning suggests that experiences with real materials are an essential element in cognitive development. Representations are often misunderstood by learners, and often they are inadequate substitutes for work with material object since simulation provide experiences with representations of reality, it is not appropriate to replace important experiential work in science with simulation. In simulation program even though,

teaching dialogs can allow more extending type of exercises, the student can not in any real sense, place, his own construction on the problem set out of his methods of solution and also the problems of language which were used did not permit this.

4.5.3 Time Dedication for Practical Work

Most teachers held the view that the primary requirement for effective use of PW was to create conditions under which it could be practiced. Kerr (1963) point out that, the major factors in the neglect of practical work in schools are lack of adequate time and assistance to enable those teaching science properly. Osborne (2000) stated that, both teachers and students require adequate time. Sometime teachers may not have time to collect and prepared all the necessary materials and set up an apparatus for an experiment or demonstration. As a result many teachers are ill-prepared. Therefore, in order to investigate the time allocation and the feasibility of time required completing each activity in relation to the amount of time allotted for biology in each grade level, teachers and students were asked about the adequacy of time. In considering adequacy of time, it was judged in relation to the procedures used to conduct the activities (observation, teachers' demonstration and experimentation). In this way the following result was reached up on.

Table 4.14. Biology Teachers & Students Responses on time Allocation for Practical work

S.No	Item	Choices (Alternatives)	Teachers		Students	
			Freq.	%	Freq.	%
1	Is there time dedicated in the school schedule for conducting laboratory activity?	a. Yes	-	-	-	-
		b. No	34	100	207	100%
2	What is your opinion on time allowed for PW activities in Biology text book?	a. Very adequate	-	-	-	-
		b. Adequate	-	-	-	-
		c. In adequate	3	8.8	8	3.9
		d. No time regular scheduled for PW	31	91.2	199	96.1
		Total	**34**	**100**	**207**	**100**

As it can be seen from table 4.14, above in the first item all teacher 34 (100%) and students 207 (100%) responded that there is no time dedicated in the school schedule for conducting laboratory work. Similarly in the second item, majority 32 (91.2%) teachers and 96.1% (199)

students reported that there is no time regular scheduled for PW in teaching biology. Where as, few teachers 3 (8.8%) and 8 (3.9%) students have replied that the time allocated is inadequate. Therefore this result indicated that there is no adequate time allotted for PW in teaching biology. In the same way school principals and biology department head also have indicates this truth. No school allows particular time schedule for practical activities. Hence these have influence on implementation of PW properly.

4.5.4 Allocation of Budget for Purchasing of practical work Materials

In the implementation of PW appropriate investment and facilities are necessary. Therefore, in order to investigate budget allocation of school for purchasing necessary materials for PW two questions was posed to teachers. Accordingly the following results were obtained.

Table 4.15: Budget Allocation of Schools for Purchasing of lab Materials and Equipment

S.No	Item	Choices	Teachers Frequency	%
1	Does your school allocates budget for purchasing of materials necessary for implementing PW stated in biology text book?	a. Yes	-	-
		b. No	34	100
2	What is your opinion on the amount of budget allocated for PW?	a. Very adequate	-	-
		b. Adequate	-	-
		c. Inadequate	-	-
		d. No regular budget allocation	34	100

Thus, as it can be seen from table 4.15 in item one, 34 (100%) teachers have reported that, no budget was allocated for purchasing laboratory materials. Similarly in item two all of the participant biology teachers 34 (100%) reported that there is no regular budget allocation for purchasing of laboratory materials. Biology department head and school directors also gave similar response, all the respondents replied that budget allocation for purchasing laboratory materials and equipment is not a familiar process in their schools.

Particularly one school director Ato Tadasse stated his idea as follows.

> *... in the case of our secondary school it is more complex we have very limited budget, which is not sufficient for purchasing chalk. In this condition the school PTA has seen laboratory equipments as luxury materials. (March 6, 2010).*

This is to mean that school do not allocated budget for purchasing lab materials and equipments required for conducting practical activities stated in biology text book.

As this several studies showed that, lack of materials, equipments and poor school facilities was major impediment factors to laboratory activities. Accordingly, the major hampering factors of practical work in secondary school level, questions consisting of different influencing alternatives were posed to both teachers and students to ranked according to the most hampering factors ranked (1) to least influencing factors ranked (12). Therefore the result gathered from the respondents was presented in table 4.16 below.

Table 4.16 Response of Teachers and Students on factors Affecting PW Implementation from the most Problem to the last

Item	Choices (Alternatives)	Teachers		Students	
		Fre.	%	Fre.	%
What factors do you think, that inhibit PW implementation in teaching biology in your school? (please order them the most influencing ranked (1) to the least ranked (11)	a. Lack of lab room	-	-	-	-
	b. Lac of lab materials, equipments, chemicals and school facilities	34	100	203	98
	c. Lack of adequate time	21	61.8	182	87.9
	d. Teachers methodology of teaching not inviting for PW	-	-	-	-
	e. Large no of students	-	-	-	-
	f. Lack of teachers motivation in PW				
	g. The activities are not inviting students				
	h. Lack of students motivation in PW	-	-	-	-
	i. Work load				
	j. Fast demonstration of plasma TV	20	58.7	155	74.8
	k. Lack of plasma TV	4	11.8	48	23.1

As it can be seen from table 4.16 above, teachers and students were asked to point out factors that they think influencing PW teaching in biology in their schools. Accordingly, 34 (100%) of teachers and 203 (98%) of students responded that lack of laboratory materials, equipments, chemicals and schools facilities affect implementation of practical activities. Hence, the respondents were given the chance to respond to more than one alternative by taking from the most influencing ranked (1) to the least influencing ranked (12). Here as significant number of respondents 20 (58.7%) teachers and 155 (74.8) students have responded that the way PTV demonstrate practical activities were not inviting students. Still other respondents 21 (61.8 %) teachers and 182 (87.9) students reported that lack of adequate time to practice practical activities.

In general the data gathered under this section shows that though number of factors influencing PW in teaching biology, the major factors are lack of lab equipment, chemicals and school facilities and because of lack of lab materials and equipments both teachers and students were

not motivated in PW. The subject centered methods of PTV instruction that focused only covering the content was not encouraging students to practical activities in their real environment are problems they raised. As it can be seen from the same table above teachers and students has reported that there was no time scheduled for practical activities in the school time table. Although teachers and students appeared to value laboratory activities they did not implement it in the manner that facilitated the type of learning that was planned. Therefore, the above discussions show that teachers and students appear to avoid laboratory work in teaching biology.

The students and teacher were asked their opinion on how to improve PW implementation in teaching biology at secondary level. Almost all respondent teacher and students have reported that adequate supply of lab materials, equipment and chemicals with lab assistance is the key factors to implement PW properly.

In general the extracted summary lies on the provision of laboratory equipment and materials with facilitated lab room that could be solved step by step, other wise it is difficult in the present situation form of the sampled schools.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This study was generally aimed at investigating the extent of implementation of biology practical work and identifying some influencing factors in general secondary school of East Wallaga Zone of Oromia region (EWZOR). This section will therefore, present summary of the major results, the conclusions reached on and the recommendation made on the basis of the findings.

Specifically, in the study an attempt had been made to address the following basic questions.

1. What was the nature of PW included in biology text book?
2. How often biology teachers use practical work in teaching biology?
3. What were the attitudes of teachers and students towards practical work?
4. Did students engaged to practice practical work stated in biology textbook?
5. What factors did affect teachers and students use of practical work in teaching biology at the general secondary school in the EWZ?

To serve this purpose descriptive survey design was employed. In order to achieve the stated objectives and to find answer for basic research questions raised, both qualitative and qualitative data were gathered. For collecting relevant data the sources used were Biology teachers, students', biology department head, school principals, observation of laboratory rooms and Grade 9 and 10 Biology textbooks. The data collecting instruments employed in this study were: questionnaire (closed and open ended), interview, observation check list and content analysis.

The numbers of schools involved in the study were six (6) in which three of them were selected from secondary schools which have PTV access and they are serviced for more that 7 years (old secondary school) and the other three secondary schools were selected from schools established after 1995 and have not using PTV and they are new secondary school. Schools were selected by stratified random sampling technique.

The data obtained were analyzed quantitatively and qualitatively and interpretation was made, and from what was analyzed and interpreted the following findings/summaries were drown.

5.1 Summary of the Findings

The summary of the findings was presented hereunder by categorizing them into themes.

5.1.1 Nature of Practical Work in Biology Textbook

The Biology textbooks of grade 9 and 10 were analyzed from the direction of inclusion of practical work in the textbook and nature of activities suggested in the textbook. The first attempt was made to identify sufficient practical activities were included or not and then the nature and kinds of practical activities included in the materials were analyzed and the following results were discovered.

As to the result replied by biology teachers and students indicated that, the biology textbook for grade 9 and 10 provide sufficient practical activities to be done by students. Sufficient here was seen in relation to the given objectives of the lesson under each unit. The researchers also analyze this Grade 9 and 10 Biology textbooks to identify the nature of PW and ILI. Thus, researcher observed that, each unit of the textbooks being with list of learning objectives. Under each topics and sub-topics present practical activities, exercises and project work. Practical activities in grade 9 biology were totally 32 and in grade 10 totally 41 activities were given. The biology textbooks were analyzed from the nature and kinds of practical point of view, using Gott and Duggan (1995) Scheme. Therefore, the following results were discovered.

The majority 56.3%and 46.4% of the activities in grade 9 and 10 biology respectively were found to be illustrative. In the biology text also 15.6 and 21.9% of practical activities in the two grades respectively found to be observational. Enquiry activities were 28.1% and 31.7% in grade 9 and 10 respectively were found in the textbook. As the result of this study shows there is no skill and investigational practical activities in both biology textbooks.

The practical activities were analyzed in ILI. The inquiry level index was revised by Tamir (1991). Using such scheme each activity was analyzed at for levels. To see what kind of chance was left for the student in each practical activity. Therefore, [56.3% and 46.3% biology practical activity of grade 9 and 10 respectively was identified to have an inquiry level index of zero and 43.7% and 53.7% of grade 9 and 10 biology respectively was found to have inquiry level idea

of one. No practical activities were found with ILI of two or three. All the practical activities found in the two biology were well defined and structured to guide students in one direction and limit divergent thinking intended by NETP.

5.1.2 Summary of Existing Practice in using practical work in Biology

Almost all teachers have reported that they seldom use individual and pair or small group experimentation. Majority 83.3% teachers honestly responded that they often employed lecture and demonstration by the classroom teacher or by televised teacher PTV through television screen. In other words the features observe in this study show that PW teaching methods have given less emphasis and students are not engaged to carry out the different kinds of practical activities either individually or in pair or small groups. Similarly, majority 64.7 and 21.7% of students responded that very often and quite often teachers use demonstration and lecture methods.

Majority of teachers responded and believed that, their role in teaching biology PW whenever student carry out practical activities were facilitating encouraging and guiding student in practicing. However, in actual practice they did put it into practice. Moreover, 75.9% teachers also replied that, the method of PW evaluation was also limited to written test type. Almost all teacher agreed that, theoretical questions was used as the means of assessment technique of the students' mastery of the PW. There is no other type of practical assessment technique to evaluate the practical performances of the students.

5.1.3 Summary of the student engagement in the practical work

Even though biology textbook provided practical activities majority of teachers and students reported that teachers do not engaged students in doing PW suggested in biology textbooks. The findings of the study have revealed that PW teaching methods in Grade 9 and 10 seem to be neglected and practical activates were considered as some thing additional that could be omitted, or not as an integral part of the subject matter. Most of the sample school biology teachers have using lecture and rarely demonstration method. Students have not opportunity to practice and participate in the practical activity.

5.1.4 Summary of attitude and interest of teachers and students on practical work

As to the result of the response replied by teachers and students, they have positive attitude and interested towards, biology practical activity. However, to the contrary the practical activities were almost not practiced in actual teaching learning process under the school condition.

According to the response reported by the 94.1% of teachers and 81.7% students, they feel interested in doing practical activities and they feel happy in participating or practicing PW in biology. Similarly, biology department head teachers and the school directors responded similar idea, which they believed PW, is an effective way of teaching biology. Concerning the importance of practical work almost all the teachers 97.1% and 94.7% of students' beliefs and have reported that PW is important in teaching learning biology. However, all teachers' and students have agreed that, the current teaching learning method in biology is dominated by teachers lecture.

5.1.5 Summary of factors affecting biology practical work

Another focus of this study was identifying the factors that affect implementation of biology practical work in general secondary school.

5.1.5.1 The majority of teachers 94.1% and 97.1% of students respond that materials and equipment were not available for doing practical activities in the school. As it was conformed by observation all schools lack important materials and chemicals suggested in the textbook. All secondary schools have functionless lab room (empty) with out any materials and equipment in their laboratory room.

5.1.5.2 The PTV used now days in secondary school was focused on content coverage and makes students passive listeners because of this the use of plasma TV in teaching practical work as to the response replied by teachers and students did not focus on practical skills. It does not prepare students for doing science. The plasma TV transmission was also so fast which is difficult to follow the demonstration process. Almost all teachers and students responded that plasma TV did not help students to practice biology PW or help to a very limited extent. The languages which were used by PTV teacher also not permit learners to follow the practical activities.

5.1.5.3 No regular schedule was found in all schools time table for doing practical work. As 91.2% of teachers and 96.1% of students respond that no time is dedicated in their school time table to do practical activities. The school directors also agreed in this idea by saying that it is not familiar process in the secondary school to arrange time for practical activities. .

5.1.5.4 All of the teachers (100%) witnessed that, their school has not allocated budget for the purchasing materials and equipment required for practical work. As it was asserted by the school principles "the school PTA has seen laboratory equipment as luxury materials."

5.2 Conclusions

Based on the major findings of this study presented in the preceding chapter, it is possible to safely conclude that, poor implementation of practical work teaching method in biology continue to probe a challenge for problem solving intention of the education system. This studv has found out that a number of factors play a pivotal role in hindering practical work implementation in general secondary school biological science.

1) The findings of this study revealed that, biology textbooks for grade 9 and 10 provide a number of practical activities under each chapter to be practiced by the student. The practical activities in biology textbook were structured and majority of practical activities were present the aim of the activities, material required and procedures to be followed. Open aim or problems were not part of the activities in this teaching material. This means most PW in the textbook was presented to confirm the theory that had already been taught in advance.

2) No practical activities for skill development were identified in both grade biology textbooks. All the activities were too much structured in such away that students have on opportunity for doing these activities. Hence, this could hamper the development of practical skill among students.

3) The result of this study shows that, the biology textbook provides different practical activities under each chapter; however, the students were not engaged in doing practical work in lab room or out of lab room. Thus, it could be conclude that both the class room

teachers and televised teachers did not give chance to students to practice in practical activities stated in the biology textbooks.

4) As the results of this study revealed that, even though PW is regarded as a key to biology teaching, the provision of practical opportunities for students falls a sort of the desired. Thus, teachers' extents of use of different types of PW were found to be limited to lecture and demonstration. Hence, the lack of application of other methods such as group or individual work, field trips, laboratory work, etc, suggested in the teaching material would negatively affect students' practical skills in a biology adequately.

5) As the result of this study shows teachers have the notion of their role and responsibility, despite putting it into practice have problem. The assessment technique that most of the teachers employed to evaluate the students' mastery of practical activities was found to be the type of written test or paper pencil strategies. Hence, focusing only on theoretical knowledge in evaluating students' performance would not be adequate.

6) This study reveled that majority of biology teachers and students have positive attitude and interest toward practical activities. However, they did not put in to practice in actual teaching learning biology. Hence, it can be concluded that having interest alone can't work as long as their is lack of equipment and materials.

7) The findings of this study also revealed that, no time regularly scheduled for practicing PW in biology. Budget allocation to biology laboratory is not a familiar process in all sampled schools. Hence, lack of allocation of adequate time for practical work hampers the development of practical skills among students.

8) Generally, what was desired to bring about though exercising practical activities and what have been going on in teaching biology at general secondary level is far from the kinds of pedagogy suggested by the teaching material of biology science curriculum.

5.3 Recommendations

Finally, based on the findings of the study, the researcher forwards the following recommendation for the improvement of implementation of practical work in biology in the case of general secondary school grade (9 and 10).

Major problem for poor implementation of PW might be the problems of the nature of PW the low development of PW teaching methods of teachers and school facilitates absence of laboratory materials, equipments and chemicals as the whole and subject centered instruction of PTV. Therefore, dealing with this and other problems are seems to be an urgent issues. With this in mind the implementation of Biology PW in general secondary schools could take the following suggestions.

1. Revision of biology textbooks for grade 9 and 10 was required in the light of the new problem solving paradigm. Emphasis must be given in providing the different kinds of practical activities to give biological knowledge and skills development side by side. The appropriate challenge (level of inquiry) given their experience and maturity levels of students to investigate and develop practical skills which can be feasible under the resource were recommended. This means that students must have given sufficient autonomy. Therefore, make an appropriate balance between providing structured activities (to support pupils thinking) and providing pupils to perform an investigation, not in order to establish an important principle but to gain some experience in planning an experiment using their own initiative, so as to respond to the intention of NETP were recommended.
2. To make biological knowledge its maximum contribution to the well being of students and society, teaching biological science must be based on practical activities. This is to say, it must be practical process in which the students at every stage is an active participant who deals with things and organisms instead of being merely a passive recipients of instruction. Students must have to get opportunity and freedom to explore and discover, observe and experiment in laboratory and field works planned purpose fully. Hence if you help students improve their use of these creative and critical thinking skills you have helped them become more intelligent and helped them learn how to learn. Therefore, schools must have to have

laboratory room and basic lab materials, equipments, chemicals, and other related facility to implement practical work in the general secondary school.

3. Biology teachers and students have positive attitude and interest towards practical activities. Nevertheless, they did not practice PW in actual teaching learning process. Therefore, teachers should have to plan to deliver biology lessons where students are actively engaged in practicing and obtaining information. Being a ware of the various problems which could only be solved step by step in the process of development and also teachers have to put much effort and be creative enough to effectively use the resource in hand. On the part of Biology teacher, also carful preparation and planning as, well as should have to use different assessment technique to evaluate students' performance in practical work. That is Continuous assessment on several activities through out the year is necessary to cover adequately the variety of tasks, skills and techniques which comprise a total program of PW. Therefore, I recommend the need to have a clear assessment technique at the national levels that show the essence of practical assessment.
4. Most science teaching in general and biology in particular need adequate laboratory facilities and materials. Practical work was an integral part of biology textbook of grade 9 and 10. Therefore such activities demand provision of equipment chemicals and facilities. The school facilitics, basic biology teaching materials, equipments and laboratory technician and chemicals, storage facilities should be provided and facilitated. However, these are most of the times beyond the scope of the school budget. So the concerned bodies (MOE, OEB, ZEO WEO and NGOs) has to give due concern in providing and arranging necessary materials for biology laboratory work at secondary school level. Through combined effort it is possible to collect biological specimen at school without any cost. School administration may also be sought the help and co-operation of individuals, government, and NGOs to over came problem of laboratory facilities. The best curriculum is worth less unless it is used effectively by the teachers' and students. Therefore, careful judgments needed to be made about the practicality of PW in biological science and appropriated investments in facilities were necessary.
5. Practical work is one of the hall marks of science education in general and biology in particular, i.e. with out practical work it fails to reflect the true nature of scientific activity. Therefore, practical work demonstrated through PTV must be supported by simple

laboratory activities which do not involve extensive instrumentation. That means it is important to conduct that activities in the school laboratory with real materials phenomena and organisms to experience their biological environment. So the state shall re-examine "Plasma TV" transmission not only as the main mode of practical work demonstration but as supplement to school laboratory that students and teachers can make a choice in implementing PW in biology.

6. Separate time table was recommended for practical activities in the school time table. Hence, time allocation and its effective use are major important factors to be considered in planning curricula for practical work in the laboratory. The school administration and PTA also should have to allocate a certain amount of budget for purchasing laboratory materials and equipment based on the list produced in the text book and depending on what the school can afford, for biology laboratories to be practiced.

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APPENDIX A

ADDIS ABABA UNIVERSITY

COLLEGE OF EDUCATION

DEPARTMENT OF CURRICULUM AND TEACHERS' PROFESSIONAL DEVELOPMENT STUDIES

SCHOOL OF GRADUATE

QUESTIONNAIRE TO BE FILLED BY BIOLOGY TEACHERS

Instructions: The purpose of this questionnaire is to gather teachers' opinion on the "implementation of practical works in teaching biology in some selected general secondary school of East Wallaga zone of Oromia region. The information you supply is used for academic purpose and your response will not be used for any other purposes. The success of this study is to a great extent depends on your complete and genuine responses. Therefore you are kindly requested to be honest in your responses, and to attempt to respond to all the items.

Thank you in advance for your cooperation!

Direction:

- Do not write your name
- Encircle your response out of the given choices
- Please given a brief comment for the questionnaire where your written suggestion is required
- Respond to all questions

I. General information

1. Name of the school _____Year of establishment _____

2. Personal data

   - Sex: Male ☐ Female ☐
   - Current academic qualification

   a) MA/M.Sc b) B.Sc/BED c) Diploma d) if other, specify_____

3. Year of experience in teaching

   a) 1-5 years b) 6-10 years c) 11-15 years d) 16-20 years

   e) 21 and above

4. Number of periods you teach per week

   1 Grade 9 a) Biology _____ b) Other subject _____

   2 Grade 10 a) Biology _____ b) Other subject_____

   3) Total _____

5. How many section/s per grade do you have at present in your school?

   a) G.9 _____ section b) G.10 _____ section

6. On average, how many students do you teach per class per grade?

   a) Average no of students in Grade 9 _____

   b) Average no of students in G.10 _____

II. Inclusion of practical work in Biology textbook

7. Does the biology text book provide sufficient activates

   a) Yes b) No

8. If your response to question no 7 is "no" indicate why? _____

III. Existing practice in using practical work in Biology

9. How often do you practice laboratory work method in teaching biology?

   a) to a very great extent b) to a great extent

   c) to a limited extent d) to a very limited extent

10. How often do you engage your students in activities stated in biology textbooks?

    a) Always b) In most case c) Only sometimes d) not at all

11. If your response to question Nº "10" is "c" or "d", what is the reasons_____

_____

12. How often do your practice the following approaches in teaching biology? Put a letter to indicate the extent of use in the appropriate space given for each kind of activities in accordance with the following key: a) very often b) Quite often c) Seldom d) not at all

I. Teachers demonstration while students are observing ☐
II. Individual students activities ☐
III. Pair of students practical activities ☐
IV. Group of 4-5 students practical activities ☐
V. If any please specify_____

IV. Attitude and interest of teachers in Biology practical work

13. What do you feel of engaging students in practical works in the textbooks?
    a) Very interested b) interested c) Less interested d) in different e) I don't like it at all (uninterested)
    f) if any other specify_____
14. To what extent do you enjoy in practical work method in teaching biology?
    a) To very great extend b) To a great extent c) to a limited extent d) in different
    e) I don't like it at all
    f) If any other specify _____
15. If you answer for question No 14 is d & e, what initiated you to become biology teacher
    a) Job opportunity b) by chance c) Interest in being biology teachers d) if any specify
    _____
16. If your answer for question 14 is 'd' what do you think is the reason.
    a) Teaching biology is difficult
    b) Teaching biology which is practical biased, can not be practiced due to various reasons
    c) Planning and preparation for teaching practical work is tiresome
    d) If any other "specify"_____
17. If your answer for question No 16 is 'b' what do you think is the reasons?

_____

V. Opinion of Teachers on the Importance of Practical Work in Biology

18. To what extent do you believe that practical work method is useful in gaining biological knowledge?
    a) To a very great extent b) To a great extent
    c) To a limited extent d) I don't believe e. I don't like

19. What is your opinion in the practical work method in teaching biology?

a) Very vital b) vital c) less vital

d) I don't agree with its vitality e) I don't know

20. If your answer for question No. 18 is "c" or "d" please give your reason briefly_____

VI. Role of teachers in Biology practical work

21. If your response to question no "20" above is II, III, and IV, what do you think the role of the teacher whenever students' carryout practical activities stated in biology textbooks?
    a) Correcting errors on spot
    b) Facilitating, encouraging and guiding in practice
    c) Discussing with them after words
    d) If other specify _____
22. Are you ever evaluate students ability in practical biology
    a) Yes b) No
23. If your answer to question no 22 is "yes" what method do you commonly use to assess your students master of practical work?

a) Observation b) written tests c) actual practical activities

d. if any other please specify_____

VII. Factors affecting practical work implementation in Biology

24. To what extent do you think that biology laboratory is equipped for the practical activities in the textbooks?

a) To a very great extent b) to a great extent

c) To a limited extent d) No at all

25. From where do you think that the r rials and equipment obtained for exercises in biology text books?
    a) Collected and prepared by t ers
    b) Collected and prepared by st ts
    c) Locally with no or low costs oth teachers and students
    d) Collected and organized by t elp of school budget
    e) Collected form organization like MOE, NGO
    f) If any specify _____
26. Are there sufficient school facilities, equipments, materials, chemicals and other similar resources available for the practical activities stated in biology textbooks?

a) Yes there are c) no there are not

b) Only for few exercises d) no at all

27. Does your school currently use plasma TV program in teaching Biology?

a) Yes b) No

28. To what extent the practical activities demonstrated through plasma TV help your students to conduct practical activities.

a) To a very great extent
b) To great extent
c) To a limited extent
d) Because it is to fast my students can't follow it

29. Is there time dedicated in the school schedule for conducting laboratory activity?

a) Yes b) No

30. If your response to the above question is "yes", what is your opinion of time allowed for practical activities in biology?
a) Very adequate b) adequate c) inadequate d. no regularly scheduled time for practical activities e) If any other option specify_____

31. Does your school allocates budget for purchasing of materials necessary for implementing practical work stated in the Biology textbooks?

a) Yes b) No

32. If your response to question no '29" is "yes" what is your opinion an the amount budget allocated for PW in Biology
a) Very adequate c) inadequate
b) Adequate d) not regular

e) if any other, please specify_____

33. What factors do you think that inhibit practical work implementation in teaching biology in your school? (Rank them from most important factors ranked (1) to the least important factor ranked (12).
a) Lack of laboratory room
a. Lack of laboratory equipment, school facilities, materials such as water electricity, etc are not conducive
b. Lack adequate time
c. teachers' methodology of teaching not inviting for PW
d. Large number of students
e. Lack of teachers' motivation and interest in practical exercise.
f. The activities are not inviting and experiments are beyond mental capacity of students
g. Lack of students' motivation and interests towards practical activities
h. Work load and shortage of time for teachers
i. Fast demonstration of plasma TV
j. Lack of plasma TV
k. If any other specify_____

34. What is your suggestion, on how to improve the use of practical work methods in teaching biology? _____

APPENDIX B

ADDIS ABABA UNIVERSITY

COLLEGE OF EDUCATION

DEPARTMENT OF CURRICULUM AND TEACHERS' PROFESSIONAL DEVELOPMENT STUDIES

SCHOOL OF GRADUATE

QUESTIONNAIRE TO BE FILLED BY STUDENTS

Instructions: Dear respondent student the purpose of this questionnaire is to gather opinion of student on the "implementation of practical works in learning biology in some selected general secondary school of East Wallaga zone of Oromia region. The information you supply is used for academic purpose and your response will not be used for any other purposes. So, responding to it will not affect you personally or your school. Rather, the success of this study to a great extent depends on your complete and genuine responses. Therefore, you are kindly requested to be honest in your responses, and to attempt to respond to all the items frankly.

Thank you in advance for your cooperation!

Direction:

- Do not write your name
- Encircle your response out of the given choices
- Please given a brief comment for the questionnaire where your written suggestion is required
- Respond to all questions

I. General information

1. Name of school _____ year of establishment _____
2. Personal data

Sex: Male ☐ Female ☐ Grade_____ section _____

II. Inclusion of practical work in Biology textbook

3. Does the biology text book provide sufficient activities
   a) Yes b) No
4. If your response to question no 3 is "No" indicated why?

   _____

III. Existing practice in using PW in Biology textbook

5. How often do biology teachers engage you in laboratory activities in learning biology?
   a) Always b) in most case c) only sometimes d) not at all
6. If you answer for question "5" above is a, b, and c, how did you conduct the activities?
   a) Doing practical work in group
   b) Doing practical work individually
   c) Observing/watching/ whenever other carryout.
   d) Watching whenever the teachers demonstrates
   e) No practical activity at all
   f) If any (specify)_____
7. How kinds often do you use the following activities in your biology classes for implementing practical activities in your text books? Give a number to indicate "extent of use" in the appropriate box for each kind of activities in accordance with the following key:

   1. Very often 3. Seldom
   2. Quite often 4. Never

   I. Listening to the teachers demonstrating, explaining, and summarizing the activities. ☐
   II. Doing practical activities individually ☐
   III. Doing practical activities in groups of 3-5 members ☐
   IV. Doing practical activities in pair ☐
   V. Having to write notes reports on the activities ☐
   VI. Observing whenever others doing experiments ☐

IV. Attitude and interest of students on Biology practical work

8. What do you feel when you participate in practical work activities in biology subject?
   a) Very interested d) indifferent
   b) Interested e) not interested at all
   c) Less interested f) need to get help of work
9. To what extent do enjoy practical work in leaning biology?
   a) To very great extent c) to limited extent
   b) To a great extent d) in different e) I don't like it at all
10. If your answer is C, D and E, Pease give your reason for the any of your answer for question No 13 briefly. _____

V. Opinion of students on the importance of Biology practical work methods of teaching

11. To what extent do you believe that practical work method helped you in gaining biological knowledge effectively?
    a) To a very great extent
    b) To great extent
    c) To a limited extent
    d) I don't like it
    e) I don't believe
12. What is your opinion to the laboratory work in learning biology
    a) Very vital c) less vital
    b) Vital d) I don't know

VI. Factors affecting practical work methods in Biology

13. Does your school currently use plasma TV program in biology
    a) Yes b) No
14. To what extent the practical activities demonstrated through plasma TV helps you to conduct practical. Activities.
    a) To a very great extent
    b) To great extent
    c) To a limited extent
    d) I can't follow it because it is fast
15. Is the time dedicated in the school schedule for conducting laboratory activity?
    a) Yes b) No
16. If your response to the above question is "Yes", what is your opinion of time allowed for practical activity in school biology?
    a) Very adequate b) adequate c) inadequate
    c) No time regular scheduled for practical activity.
17. Do you think that biology laboratory is well equipped for conducting exercises stated in biology textbook?
    a) To a very great extent b) To a great extent
    c) to a limited extent d) not at all
18. Where do you think that the materials, and equipments obtained for exercises in biology textbooks?
    a) Collected and prepared by teachers
    b) Collected and prepared by students
    c) Locally with no or low cost by both teachers and students
    d) Organized by the school budget
    e) Obtained from organization like MOE, NGO
    f) If any specific_____
19. What factors do you think affecting practical work method in learning or exercising practical activities stated in biology textbooks? (rank them from the most important factors ranked (1) to the last important factors ranked (9)
    a) Lack of laboratory room
    b) Lacks of laboratory material, equipments, chemicals, etc school facilities such as electricity, water, etc situations are not conducive.

c) Lack of adequate time
d) Lack of teachers methodology of teaching
e) Large class size or large number of students
f) Lack of teacher's motivation and interests in practical experiences.
g) The activities are not inviting and are beyond students' capacity.
h) Lack of students motivation and interests in practical experiences
i) Lack of due consideration by teachers'
j) Fast demonstration of plasma TV
k) Lack of plasma TV
l) If any other please specify_____

20. What is your suggestion an how to improve the implementation of practical work in biology teaching?_____

APPENDIX C (Afan Oromo Version)
Dabalee C

YUNIVARSITII ADDIIS ABBABBA

KOLLEEJJII BARNOOTAA

QU' ANNOOLEE BARRNOOTA

DIGRII LAMMAFFAA

Gaafannoo Barattootaan Gutamu

Qaajjelfama: kabjamtoota barattota kaayyoon gaafannoo kana Godinaa wallaga bahatti haala hojii irraa olumaa gochaan barachu barnoota baayoolojj irraatti ilaalchaa barattoni mana barumsa sadarkaa lamaaffaa (9-10) qaban raga walitti qabachuudhafi. Kanafuu yaada isin kenitani kunii dhimma barnoota qofaaf male dhimma biroofi hin oluu. Waan kana te'eef gaafannoo kanafi deebii keessani tokkon tokokko keeessa, dhunfaniss ta'e mana barumsa keesani irratti dhibba tokko ilee hin qabu. Irraa caalaa, milka'inii qurannoo kana yaada qajeela fi dhuggaa isinii kennitanii irratti hunda'. Kanaffu kabaajan kan isiin gaafatamatni gaafannoo dhiyaatani kana haala ammanamuafitti gaafafamma qabuun gaafii hundaafi deebii akka itti kenitani kabajaan isin gaafadha.

Degarsaa naa gootaanifi duran dursee Galattooma

Ajaajaa:

- Maqaa barressun hin barbachisuu
- Fillanoo kennamani keessa isaa sirii dha jetutti maruun deebii kennii
- Adaraa gafaano yaada barreefaman isin gaafatu irratti yaada qabdan barreffaman ibsa.
- Gaafilee huundafu deebii kennu yaala.

I. Yaada waligalaa

1. Maqaa m/B_____ bara hundefame _____
2. Ragaa dhunfaa

   Saala: Dhiraa ☐ Dhalaa ☐ Kutaa ☐ Daree ☐

II. Haala qabiyee Baayolojii fi Dalagale

3. Kitaabni barataa barnoota baayooloojii dalagalee addaa adda haala ga'a ta'een off keessatti qabteraa?

   a. Eeyye b. Lakki

4. Yoo deebiin ke lakkofsaa "3 ffaa lakki" dha ta'e malifi ibsii?

III. Baayooloojii goochaan barachuu irratti fedhii barattota

5. Barnoota baayooloojii keessatiti dalagalee gochaan yerro, hermatu maltuu sitii dhagama?

   a. Daran itti gamada c. xiqqoo ittii gamada \
   b. Itti gamada d. fedha adda adda qabna

   e. qutuman itti hingamadu f. gargarsani fedha

6. Dalagalee Goochan baayooloojii yeroo barataan amam isin bashanansisa

   a. Daran olaanaa d. garagaruman jira
   b. Olaana e. hinjaladhuyu
   c. Haama takko

7. Gaafii 6 ffaa yoo debinn kee "c,d, e " ta'e sababin isaa maliffi ibsi?_____

   _____

IV. Faayidaa baayooloojii gochaan barachuu irratt ammanta barattooni qaban ilaalehise

8. Beekumsa baayooloojii gudifachuufi barnoota baayooloojii goochaan barachuun ammam faayadajetee amanta?

   a. Baayee olaana d. hinjaladhuyu
   b. Olaana e. itti hinamaneu
   c. Hama tokko

9. Baayooloojii labooratoriin barachuufi ilaalcha akkami qabda?

   a. Baayee barbachisaadha c. barbachisuman isaxiqqoo dha
   b. barabachisaadha d. hinbeekuyu

V. Qabataman Yeroo amma haala hajii irra olumaa dalagaleee Gochaan baarachuu barroofa baayoolooji.

10. Barsiisoon: Barnoota Baayooloojii dalagalee kutaa laboratorii keessatti yeroo akamii isin hirman-chisu?
    a. Yeroohunda b. Irraa caalatti c. darbedarbe d. tasumayu
11. Deebiin kee Gaafii 10^{ffaa} dhafi "a, b, c," yoo ta'e haala akkamiin hirmacha jirtu.
    a. Dalagalee Gareen hojeechun
    b. Dalagalee dhunfaan hojeechun
    c. Yeroo namni birro hojeetu ilaalun
    d. Yeroo barsiisaan Gochaan agarsiisuu hordofuun
    e. Dalagalee Gochaan barachuun tasuma hinjiruu
    f. Yaada birroo yoo qabatee ibs_____

VI. Goosoola dalagalee baayooloojii barsiisuufi faayadama jiran

12. Yeroo baayooloojii barataa haamami dalagalee Gochaan barataman itti faayadama jirtu. Amam akka itti faayadamtani sadarkalee arman gaditti kennamani goosoota dalogaleefi haala furtuu kanan sadarka kennun ibsii
    a. Baayee yeroio hunda c. darbe darbe
    b. Yeroo hunda d. tasuma
    I. Agarsisafiibsia barsisaa dhageefachu
    II. Dalagalee dhufaan hojeechu
    III. Dalagalee lama laman hajechuu
    IV. Dalagalee garee nama (3-4) hojochuu
    V. Yeroo namni biro hojeetel ilaalu

VII. Sababoota baayooloojii goochaan barachuu irratti dhibba geessisani.

13. Yeroo amma m/b kee saganta plasma TV itti faayadama jira
    a. Eeyye b. Lakki
14. Yoo deebiin kee lakk "9" "Eeyye" ta'e dalagaleen gochaa plasmaan agarsifamu ammami gochalee adda addaa raawwachuufi si gargareera?
    a. Baayee olaanaa b . Olaanaa c. xiqqoo
    d. Baayee arifata waan ta'efi hordofuu hindandda'u.
    e. PTV m/B koo hinjiruu.
15. M/B kee Gabatee yeroo goachalee labooratariifi baasee qaba
    a. Eeyye b. Lakki
16. Gaafi 15^{ttaafi} deebiin kee "Eeyye" dha yoo ta'e yeroo kennamefi irraatti yaada mali qabda?
    a. Baayee ga'aadha c. ga'aa mitii
    b. Ga'aa dha d. saguntan dhabata hinjiru

17. Kutaan labooratorii baayooloojii haala akkamin meeshaleen guultame jira
    a. Haala baayee Gaariin c. haama tokko
    b. Haala gaariin d. tasuma hinqabu
18. Meeshaleen barabachisoo kitaaba baayooloojii irraat ibsamani eesa argamu qabu?
    a. Barsisaa walitti qabun qoophejsuu
    b. Barataan qoophessu
    c. Basii malee barsiisa fi baratan tuu qoophessu
    d. Basii m/b dhan qapha'uu
    e. Minsteraa barnootaafi mitil mootuman qopha'au
    f. Yaada biro yoo qabate ibsii
19. Gochaleefi dalagalee kitaba baayooloojii keessaa jiraan shakaluudhafi rakkoleen dhibba geesisaanni murasni tarrefamaniru. Rakkolee kana keessaa akka m/b keetti baayee cima kanjetu sadarkaa (1ffaa) rakko cima mittii kanjatu immoo sadarkaa (11ffaa) kennun tartibesii
    a. Kutaa laboratorii dhabuu
    b. Meeshalee laboratorii dhabuufi haalii keessoo m/b mijaachuu dhisuu
    c. Yeroo ga'aa dhabuu
    d. Mala barsiisuu barsiisootatu hin afferru
    e. Baayinaa baratoota
    f. Fedhaa dhabuu barsiisaa
    g. Dalagleefi goochaleen kennamani barattaa waan hin afeerufi
    h. Fedhaa dhabuu barataata
    i. Barsiisaan iyyefano kennou dhiisu
    j. PTV safisaan agarsisee dorbu
    k. PTV dhabuu
    l. Yaada birro ibsii
20. Baayooloojii gochaan barachaafi hojii irraa olumaa keessatti wanti fooya'uu qaba jetu yaada qabdeu balinaan ibsi

    _____

    _____

APPENDIX D

ADDIS ABABA UNIVERSITY

COLLEGE OF EDUCATION

DEPARTMENT OF CURRICULUM AND TEACHERS PROFESSIONAL DEVELOPMENT STUDIES

SCHOOL OF GRADUATE

3. Interview Gide Questions

To be presented to school principals vice principals and head teachers of Biology Department.

The aim of this interview is to gather necessary information for the study "Implementation of Biology practical work: The case of selected general secondary school in East Wollega zone of Oromia region." Therefore, your contribution to the success of this study is highly valued, so your are kindly requested to honestly respond to the interviews questions presented and the students researcher would like to assure that your responses are strictly confidential.

Thank you in advance!

Interview Guide Questions

1. How often do biology teachers engage students in laboratory works?
2. Do you think that laboratory work teaching is being practically implemented in biology? Please give your justification for any of your answer?
3. Do you think that the biology lab in your school is well equipped with sufficient and necessary equipments, chemicals, etc for teaching biology?
4. Does your school have annual budget allocated for purchase of materials, equipment and resources necessary for conducting practical activities?
5. Is there a regular schedules period for biology practical activities.
6. Does your school have lab assistant?
7. Do biology teachers, experience are required to provide laboratory activities for students?
8. Do you think that practical work demonstrated through plasma TV is enough for practicing practical activity? If you have plasma TV program.
9. What are the major factors that you think would affect practical work method in teaching biology in your school?
10. What is your suggestion on how to improve the implementation of practical work method in biology?

APPENDIX E
ADDIS ABABA UNIVERSITY

COLLEGE OF EDUCATION

DEPARTMENT OF CURRICULUM AND TEACHERS PROFESSIONAL DEVELOPMENT STUDIES

SCHOOL OF GRADUATE

4. Observation Check List

Availability of laboratory Room, Laboratory equipment, chemicals in according with the curriculum demand and other school facilities

No	Materials and chemicals	Observed secondary schools						Remark
		Arjoo Guddatu Secondary school		Bittu Nekamit Secondary school		Siree Secondary school		
		Available	Not available	Available	Not available	Available	Not Available	
1	Laboratory room	√		√		√		Empty class
2	Water supply	√		√		√		Not for lab. Room
3	Electricity	√		√		√		Not for lab. Room
4	Microscope	X		X		X		
5	Glass slides	X		X		X		
6	Cover slide	X		X		X		
7	Hand lens	X		√		X		
8	Burette reagent	X		X		X		
9	Syringe	X		X		X		
10	Formalin	X		X		X		
11	DCPIP solution	X		X		X		
12	Petridis	X		X		X		
13	Mounting needle	X		X		X		
14	Dropper	X		X		X		
15	Small knife	X		X		X		
16	Samples of herbivore dentition	X		X		√		
17	Test tubes (capillary tube)	X		X		X		
18	Thermometer	X		X		X		
19	Samples of carnivore dentition	X		X		√		
20	Lens	X		X		X		
21	Plastic bags	X		X		X		
22	Benzene burners	X		X		X		
23	Beaker (250ml)	X		X		X		
24	Stand and wire gauze	X		X		X		
25	Measuring cylinder	X		X		X		
26	String or forceps	X		X		X		
27	Killing jars	X		X		X		
28	Agra	X		X		X		
29	Different organs of plant and animals, small organisms	X		X		√		
30	Models, of different organs of plants and animals such as lung, heart etc.	X		X		X		
31	Specimens of different organs or plants and animals, micro-organism-protozoa	X		√		√		
32	Prepared slides	X		X		X		
33	Iodine solution	X		X		X		
43	Chloroform solution	X		X		X		

35	Formaldehyde	X		X		X		
36	Glucose solution (1%)	X		X		X		
37	Starch power	X		X		X		
38	Benedicts solution or feelings solution	X		X		X		
39	Millions of reagent	X		X		X		
40	Oil paper	X		X		X		
41	Plant grown in pot-fern, lichens, etc	X		X		X		
42	Laboratory manual	X		X		X		
43	HCI	X		X		X		
44	H_2SO_4	X		X		X		
45	Records of practical activities performed (if any)	X		X		X		
46	Scissors	X		X		X		
47	Dark paper	X		X		X		
48	Paper dips	X		X		X		
49	Salt	X		X		X		
50	Sugar	X		X		X		
51	Ethanol alcohol (dine solution)	X		X		X		
52	Forceps	X		X		X		
53	Food calorimeter	X		X		X		
54	Sodium bicarbonate	X		X		X		
56	Wax	X		X		X		
57	Water bath ($37c^0$)	X		X		X		
58	Dissecting kit	X		X		X		
59	Bell-jar or large bottle	X		X		X		
60	One-hold stopper	X		X		X		
61	Balloons	X		X		X		
62	Rubber sheet	X		X		X		
63	Flasks (125ml)	X		X		X		
64	Rubber stopper	X		X		X		
65	Y-tube	X		X		X		
66	Lime water (bicarbonate indicator)	X		X		X		
67	Window glass or blue cobalt chloride paper	X		X		X		
68	U-tube	X		X		X		
69	Rubber tubing	X		X		X		
70	Cotton wool	X		X		X		
71	Vaseline	X		X		X		
72	Eosin solution (5%)	X		X		X		
73	Razor blade	X		X		X		
74	Pencil	X		X		X		
75	Wrist watch	X		X		X		
76	Dip net	X		X		X		
77	Rubber band or string	X		X		X		
78	Plastic bags	X		X		X		
79	Distilled water	X		X		X		
80	Dye or stain	X		X		X		
81	Filter paper	X		X		X		
82	Scalpels	X		X		X		
83	Methyl red	X		X		X		
84	Methyl blue	X		X		X		
85	Tooth pick	X		X		X		
86	Thistle funnel	X		X		X		

Key: √: for available

X: For Not available

Appendix F

1. Types of practical work

2. Different classification schemes were designed for practical work by different authors. Gott et al (1988) and Gott Duggan (1995) they classify practical work into five categories

Type of practical work	Aims
Skills	To acquire particular skill
Observation	To provide opportunities for pupil to use their conceptual frame work in relating real objects and events to scientific idea.
Enquiry	To discover or acquire a concept. Law, principles
Illustration	To prove, or very a particular concept, law or principle
Investigation	To provide opportunities for pupils to use concepts, cognitive process and skills to solve problems

Types of activity	Grade 9 biology							Grade 10 biology							
	Chap.1	Chap.2	Chap.3	Chap.4	Chap.5	Chap.6	Chap.7	Chap.1	Chap.2	Chap.3	Chap.4	Chap.5	Chap.6	Chap.7	Chap.8
Skill	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Observation	A-1.4 (23)		A-3.1(65) A-3.5(73)	A-4.3(97)	A-5.1(129)			1.5(13)	A-2.2(25)	A-3.4(68) A-3.5(59) A3.6(70)	A04.1(94) A-4.3(101)		A-6.1(157)		A-8.2(228)
Enquiry	A 1.2 (7)	A-2.4(66) A-2.2(35) A-2.11(53)		A-4.1(89) A-4.4(101) A-4.5(105)	A-5.3(143)	A-6.2(160)		A-1.1(3)	A-2.1(22) A-2.3(30) A-2.8(36) A-2.6(35 A-2.11(43)	A-3.3(67) A-3.7(75)	A-4.2(97)	A-5.3(114) A-5.5(130)		A-7.1(190) A-7.2(191)	
Illustration	A-1.3(20) A-1.5(24) A. 1.1(6)	A-2.1(35) A-2.2(35) A-2.3 (36) A-2.6(37) A-2.7(46) A-2.8(47) A-2.9(51) A-2.10(52)	A-3.2(67) A-3.3 (69) A-3.4 (69)	A-4.2(88)	A-5.2(130) A-5.4(148)	A-6.1 (159)		A-1.4(11) A-1.2(5) A-1.3(7) A-1.6(16)	A-2.4(3) A2.10(39) A-2.5(34) A2.7(35) A-2.9(38)	A-3.1(59) A-3.2(59) A-3.9(78) A-3.876)		A-5.1(11) A-5.2(113) A-5.4(116)	A-6.2(163) A-6.3(167)		A-8.1(227)
Investigation	-	-	-	-	-	-	-	-	-	-	-		-	-	-

APPENDIX G
The Inquiry Level Index (ILI)

The ILI was designed by Herron (1971), and revised by Tamir (1991). It has four levels depending on the tasks that students have to accomplish level 0, 1, 2 3,. At level 'zero' the problem, the procedures and the conclusion are all provided. The student has to follow the instruction and obtain the results specified by the text. A practical activity at this level is referred to as verification or conformation activities. At level 'one', the problem and the procedures are given and the students has to find answer. At level two, the problem is given and the students has to design method to find answer; at level three, the students is presented with a phenomenon, she/he has to formulation a relevant question, design a method and find an answer to the problem.

Table 1.

Level of inquiry	Definition of Level		
	Question	**Material and method**	**Answer**
0	Given	Given	Given
1	Given	Given	Open
2	Given	Open	Open
3	Open	Open	Open

Table 2.

Level of inquiry	Grade 9 biology	Grade 10 biology
0	1.1 (6), 1.3 (20), 1.5(24), 2.1(35), 2.3 (36), 2.5 (37), 2.6 (37), 2.7(46), 2.8 (47), 2.9 (51), 2.10 (52), 3.2 (67), 3.3 (69), 3.4 (69), , 4.2(88), 5.2 (130), 5.4 (148), 6.1 (159)	1.4 (11) 1.2(5), 1.3(7), 1.5(12), 1.6(16), 2.4(31), 3.1(59), 3.2(59), 3.8 (760, 3.9(78), 5.1 (111), 5.2(113), 6.2 (163), 6.3 (167), 8.2 227,
1	1.2 (7), 1.4 (23), 2.2 (35), 2.4(36), 2.11 (52), 3.1(65), 3.5 (7.3)4.1 (87) , 4.3(97), 4.4 (101), 4.5 (105), 5.1 (129), 5.3 (143), 6.2 (130),	1.1(3), 2.1(22), 2.2(25), 2.3(30), 2.5(34), 3.6(35), 2.7(35), 2.8(36), 2.9(38), 2.10(39), 2.11(43), 3.3(67), 3.4)68), 3.5(69), 3.6(70), 3.7(75), 4.1(94), 4.2 (97), 4.3 (101), 5.3 (114), 5.4 (116), 5.5 (130), 6.1 (157), 7.1 (190), 7.2 191, 8.1 B (227)
2	-	-
3	-	-

Table 3: Activity 2.1 (P. 35) in the grade 9 Biology textbooks.

Activity 2: *carbohydrates testing for starch*

Materials: *Iodine or potassium Iodide Solution, Dropper, Potato or* ***Starch*** *powder.*

Procedure: ***1.*** *Cut a thin slice of potato from a tuber*

1. *Add a few drops of dilute iodine ore potassium iodide*
2. *Note the colour change*

Result: *what colour change do you see? Iodine is an amber-coloured solution that turns blue-black in the presence of starch.*

Conclusion: *this is positive results because the change in colour indicates that starch is present.*

Table 4: activity (1.4(P.10) in the grade 10 biology textbook,

Activity 1.4: *Investigating the lung structure*

In order to examine the structure of the lungs, obtain lungs of sheep or goat from the butcher and do the following investigation

Materials: *Dissecting Kit, Hand lens, Glass tubes, Lungs of sheep, goat or cow .*

Procedure: ***1.*** *Put a glass tube into the trachea and blow the lungs up see what happens when you stop blowing*

2. Divide the lungs into two. Now start cutting along the main bronchus of one lung. As you do this, note the structure of the walls of the tracheas, bronchi and smaller bronchioles.

3. *Keep cutting into smaller and smaller bronchioles, note how the bronchioles branch. Cut until you can not cut any further and examine with a hand lens*
4. *Examine also the blood vessels of the lungs. Cut and follow the smaller ones as far as possible and examine using a hand lens*

Result: *based on the above investigation, answer the following questions.*

a. *What do you notice about the structure of the walls of the teachers, bronchi ad bronchioles?*
b. *Why did the lungs collapse after being blown up in step. 1*

Table 5: Activities 2.4 (P.31) in the grade 10 biology textbook,

Activity 2.4: *looking at the stomata*

Materials: *A leaf, forceps, a microscope, slides, cover slips, dropper and water.*

Procedure: ***1.*** *Obtain a thin and semi-transparent leaf which is ideal for looking at stomata. If you can not easily find a thin leaf, you should carefully peel a small piece of epidermis from the underside of a thick leaf using forceps.*

2. put the thin leaf or the epidermal peel on a microscopic slide

3. cover it with a oversleep to keep it flat.

4. *Put a drop of water using a dropper on one side of the slide and an absorbing tissue paper on the other side to allow water to pass under the cover.*

5. *Look at your slide under the microscope, low power objective first, then middle and high power objective*
6. *Describe one of the stomata in detail, and make a labeled drawing of few cells*

Result: *answer the following questions based on your observation*

- *Could you see that the opening of the stoma is bounded by a pair of bean-shaped cells? These are called guard cells.*
- *How could you estimate the number of stomata in a square millimeter of leaf surface?*
- *Most leaves have many more stomata on the low side than on the upper side*

DECLARATION

I, THE UNDERSIGNED THAT THIS THESIS IS MY ORIGINAL WORK AND THAT ALL SOURCED OF MATERIALS USED IN THIS THESIS HAVE BEEN DULY ACKNOWLEDGE.

NAME: **AKLILU YIHUN**

SIGNATURE: _____

DATE: 23/06/10

THIS THESIS HAS BEEN SUBMITTED FOR EXAMINATION WITH MY APPROVAL AS A UNIVERSITY ADVISOR.

NAME: **AKALEWOLD ESHETE (ASS. PROF.)**

SIGNATURE _____

DATE June 28, 2010

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