

**THE STATUS OF SAFETY MEASURES**

**IN**

**SECONDARY SCHOOL LABORATORIES;  
THIKA DISTRICT**

**A RESEARCH PROJECT**

**BY**

**KINYANJUI, B.C.K.  
BSc (Hons) NAIROBI.**

**EGERTON UNIVERSITY**



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**E34/0287/95**

A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF CURRICULUM  
AND INSTRUCTION IN PARTIAL FULFILMENT OF THE REQUIREMENTS OF THE  
POST - GRADUATE DIPLOMA IN EDUCATION

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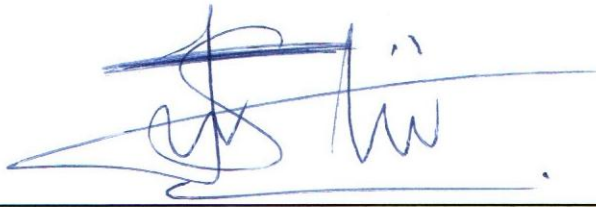
**DECLARATION**

This is my original work and it has not been presented for a diploma or degree in any other university.

NAME: KINYANJUI, B.C.K.

SIGNED:  28<sup>th</sup> / SEPT / 1996.

This Research Project has been submitted for examination with my approval as university Supervisor.



**WACHANGA, S.W.**

## **DEDICATION**

This work is dedicated to my wife Regina Wanjiru; a token of appreciation for patience and encouragement, and the many a night on which she had to do without the comfort of marital bliss during the course of the PGDE programme.

To my parents without whose advice, goodwill and material sacrifice I would not be what I am.

**ACKNOWLEDGEMENT**

My sincere gratitude to all those who made this work possible by assisting in various ways.

I am especially grateful to the school administration, Science Teachers and Laboratory Personnel in the various schools visited during collection of data for their courtesy and patience, and for providing the information which made the project possible.

My thanks are due to colleagues in the PGDE Programme 1995/96 for encouragement, suggestions and countless constructive criticisms of the design and analysis of data.

Special thanks goes to my supervisor Mr. S.W. Wachanga for guidance and duteous perseverance in putting up with the raw draft with its numerous mistakes which he painstakingly corrected.

I am also happy to acknowledge the immense debt I owe to James M. Gichuru, for his compassionate generosity and for patiently typing the script despite the "horrible" handwriting and the many constraints he had to surmount to have it done.

**ABSTRACT**

The research project reviews the status of safety measures in secondary school laboratories in Thika District.

The research involved a sample survey of ten schools. The respondents were the science teachers and the laboratory personnel; a total of ten teachers and ten laboratory assistants formed the survey sample. The respondents were required to respond to questionnaires which were distributed for the purpose of the project. The questionnaires were constructed by the researcher.

In addition the researcher constructed an observation schedule which was used to collect some of the data.

The data collected was organized and analysed using descriptive statistics. The results of the research indicates that there were some areas pertinent to laboratory safety which were neglected and requires attention. In particular it was found that laboratory classes were congested, safety awareness amongst pupils was low and there was a general inadequacy with respect to safety equipment. It was also found that laboratory personnel and science teachers were not adequately trained in basic fire fighting techniques and administration of first aid.

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## CHAPTER 1

### INTRODUCTION

#### 1.1 BACKGROUND INFORMATION.

The introduction of the 8:4:4 school curriculum made it compulsory for all students to take science subjects in their secondary school education. This was meant to equip the students with knowledge and skills that would make them to be self - reliant after leaving school. It was also considered as a necessary pre - requisite for further studies or training in tertiary institutions of learning.

Most science teaching in secondary schools takes place within the specialized environment of the laboratory. Since the work that can be done in a laboratory depends on the use that may be made of the accommodation available, the design of school laboratory and the resources available are meant to cater for a specified number of students per sitting.

This is important so that, each learner has a chance to interact meaningfully with the resources so as to acquire the practical skills required in manipulation of apparatus and responsible use of other resource materials. Existence of well maintained and properly equipped laboratories is therefore, of special significance in secondary schools.

During the 1980s it became increasingly difficult for the government to finance the running of secondary schools. To alleviate this heavy burden on the exchequer, the Kamunge Report (1988) recommended the introduction of cost sharing in secondary schools. This meant that most of the financing for running of school programmes was left to the parents.

Due to social economic problems facing the parents, most schools especially in rural areas found themselves in dire need of finances and it became difficult even to maintain existing facilities for most schools.

Coupled with financial difficulties, the schools have also to accommodate the increasing demand for secondary school education. This demand has increased as a result of a rapidly increasing population which is not proportionately matched by development of new schools.

With their financial burden, existing schools are not in a position to develop new structures to meet this growing need for secondary school places. It has become the trend then, to have congested classes which accommodate over 50 students sharing resources meant for 40 students.

With the schools in financial difficulties, and the increased strain exerted on existing facilities by large student populations, it has become difficult to adequately maintain laboratory structures.

The rate of deterioration of laboratory structures is not matched by the rate of maintenance and replacement and most school laboratories are in varying stages of degradation. This degradation of laboratory structures can be associated with hazardous consequences for both the learners and the teachers, who spend 50 - 75% of their science learning time in the laboratory.

There are many hazards that are likely to be encountered in a school science laboratory. Most of these hazards can be attributed to poorly maintained laboratory structures that can no longer serve their intended purpose. Similarly, lack of adequate body protection and the fact that most schools do not have the financial capability to adequately furnish the laboratory with requisite safety equipment further compounds the issue of safety in secondary school laboratories.

Besides the strain on laboratory structures, the demand for science education in secondary schools has also stretched the available man-power in schools. It is therefore, no longer a problem of teaching science to a selected group of students by properly trained teachers, but that of teaching science to all students by teachers all of whom may not be trained or experienced enough to handle all levels of secondary science curriculum.

This lack of training on the part of the teacher has serious limitation on their laboratory safety awareness. Furthermore, science teachers are not required to undergo training in first aid or fire fighting as part of their teacher training programme. Since the teacher assumes legal responsibility for pupils under him, adequate precautions should be taken to ensure that the 'specialised laboratory environment' of the laboratory remains relatively safe and accommodating for both the teacher and the learners

Laboratory technicians also play a very important role in the conduct of science laboratory classes. In the majority of cases however, schools find it difficult to employ qualified technicians due to financial considerations. Qualified laboratory technicians are also in high demand in institutions of higher learning and research organisations where their services are highly paid for. Most school laboratories are therefore, manned by Form IV or Form VI leavers of the previous 7:4:2:3 education system. These laboratory assistants thus further compromises laboratory safety ,since in the event of an accident they are not trained to cope with emergency situations in the laboratory.

## **1.2 STATEMENT OF THE PROBLEM.**

In view of the hazards that are likely to occur in secondary school laboratories, and the fact that safety is a positive activity which assumes that almost all accidents can be prevented by suitable knowledge, well maintained laboratory structures and adequate planning, there was need to establish the status of safety measures in secondary school laboratories.

The fact that most secondary school laboratories are not manned by qualified laboratory technicians, it becomes the duty of the science teacher to ensure that the school laboratory remains a safe place in which to teach and learn. The study therefore also sought to shed some light on the state of prepared-ness of the science teacher and the laboratory personnel to deal with emergency situations in the secondary school laboratory.

### 1.3 PURPOSE AND OBJECTIVES

The purpose of the study was to establish the status of safety measures in secondary school laboratories with the objective of determining the following;

- (I) The state of secondary school laboratory structures. ✓
- (ii) The adequacy of safety measures in secondary school laboratory.
- (iii) The state of prepare-ness of the science teacher to handle emergency situations.
- (iv) The state of prepared-ness of the laboratory personnel to deal with emergency situations.

### 1.4 RESEARCH QUESTIONS.

In the endeavour to study the status of safety measures in secondary school laboratory, an attempt was made to answer the following questions;

- (I) What is the state of secondary school laboratory structures?
- (ii) How adequate are the safety measures in secondary school laboratory?
- (ii) What is the state of prepared-ness of the science teacher to handle laboratory emergencies?
- (iv) What is the state of prepared-ness of the laboratory personnel to deal with laboratory emergencies?

## **1.5 SIGNIFICANCE OF STUDY.**

The school science laboratory is an important facility in any school. No effort should be spared to equip and maintain the laboratory so as to provide an environment congenial to the learning of science.

It was hoped that, the study would offer a glimpse of the status of safety measures in secondary school laboratories which would provide a framework for policy makers, on which improvements in secondary school laboratory safety measures can be based. It was also hoped that the study would serve as an expose for the science teacher and the laboratory personnel, especially those who are not well versed on the issue of laboratory safety, from which they can glean useful information on safety in school laboratories.

Due to the limitations on the scope of the sample, the study was of limited value as a basis for broad generalisations. It was however hoped that, it would help to focus more attention on the issue of school laboratory safety.

## **1.6 LIMITATION OF STUDY**

Since the time of the study was limited, and due to the nature of the study and lack of adequate finances, it was not possible to use as large a sample as would have been adequate for purpose of broad generalisations or applicability to all situations. The study was therefore restricted to ten sample schools in Thika District, and it was assumed that, the data collected from this sample would be representative of the situation in other schools in the area.

The method of sampling used was a non-probability method for reasons of convenience. Because of the nature of the sampling method, it was expected that the external validity of the results would be affected.

## 1.7 DEFINITION OF TERMS.

For purpose of the study the following terms assumed meaning as follows;

(a) Laboratory Structures

Where used, this phrase refers to the fixed laboratory facilities including fume chamber, floor space, water pipes and taps, drainage system, electrical wiring switches and sockets, gas piping and taps, benches and any other fittings that are an important part of the laboratory infra-structure.

(b) Science Teacher

This term refers to any teacher who teaches any of the basic science subjects; Biology (Biological science), Physics and Chemistry (Physical science).

(c) Laboratory Personnel

This phrase refers to people working in the laboratory; laboratory assistants and laboratory technicians.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 BACKGROUND.

The introduction of the 8:4:4 system of education made it compulsory for all student in Kenyan secondary schools to study science as part of their secondary school curriculum. The purpose of this emphasis on the study of science was to present in a simple form the practical skills required in manipulation of apparatus and responsible use of other equipment. This was meant to make the students self reliant and to prepare them for life after school (Mackay Report, 1981).

The attainment of practical skills as an object of the 8:4:4 system cannot be achieved by theoretical treatment of the science subject content. The learners have to rehearse the skills by practically interacting with the apparatus and equipment in experimentation and application of theoretical principles. For this to be realised, it is not only necessary to have laboratories in secondary schools but well equipped laboratories at that.

It has however, been observed that most secondary schools do not have adequate facilities for proper teaching of science, and in the majority of cases, where laboratories exist, the laboratory shelves are half empty. The problem of laboratory resources has been made worse by ever - increasing class size due to demand for secondary school places as a result of population growth. This increase in demand has not been matched by development of infra-structure necessary to alleviate the situation.

In some schools the class size has reached 45 pupils and above, which is beyond the approved limit (Kamunge Report, 1988). This over-enrolment has led to over-stretching of physical and human resources. This has put a strain on existing laboratory resources which were designed for 35 pupils.

The burden of running secondary schools is shouldered largely by the parents. This is as a result of cost-sharing measures introduced in secondary schools as recommended by the Kamunge Report. The social economic status of parents therefore, imposes limits on the financial ability of the schools.

The limited financial resources and the strain on laboratory structures due to over-enrolment has made effective maintenance of laboratory structures difficult. Inadequate finances have also made it difficult to equip the laboratory with the necessary protective devices to ensure that teachers and learners are safe in the laboratory.

## **2.2 THE ISSUE OF SAFETY**

In the view of the nature of the laboratory environment, working in the laboratory carries its own special hazards. Gases likely to be encountered in school laboratory such as chlorine, bromine, carbon-monoxide, carbon disulphide vapour and others, are poisonous even when present in small quantities (Wachanga, 1991). Such gases should only be prepared in an adequately ventilated fume chamber.

Similarly some experiments performed in school laboratory are highly hazardous; ignition of a hydrogen - air mixture, reactions of sodium or potassium with water in confined space or dilution of concentrated acids. When performing such experiments use of goggles should be made compulsory (Wachanga, 1991). Lack of protective devices and poorly maintained laboratory structures would aggravate such hazards.

Strong emphasis should therefore, be placed upon safety precautions in the laboratory by ensuring that laboratory structures such as the fume chamber are well maintained, that gas mains are regularly checked for leaks and that the necessary protective devices such as goggles and perspex screens are provided to protect the teacher and the pupil so that teaching and learning can take place safely.

It has been noted that such safety measures are necessary requirements in all laboratories. According to the New York State Department of Education (1962) the excellent safety record in the chemical industry is due partly to the fact that all persons are required to wear glasses while in the laboratory. It may be desirable, the Department observes, to require that teachers and pupils wear glasses and visors or similar protective devices when performing demonstrations and experiments. Such devices should be considered basic items of equipment in school laboratory.

### **2.3 PRECAUTION AND ATTITUDE**

In addition to provision of protective devices and maintenance of laboratory structures, the development of the proper attitude towards safety is an important consideration. Most accidents can be prevented if the teachers and pupils make a deliberate effort to develop a conscientious attitude towards laboratory safety. Vital to the development of attitude is knowledge of the hazards which exist in science laboratory and the acquisition of confidence in use of proper laboratory techniques.

All instructions during experiment should therefore, stress safety precautions directed towards avoidance of accidents, and the reduction of the serious consequences which may follow from relatively minor occurrences (Wachanga, 1991). The teacher should also devote several sessions during the course, to the topic of safety. Since the impression created wears off rapidly, these sessions should be spread out rather than occurring all in one part of the course.

### **2.4 THE ROLE OF TEACHER.**

The teacher is responsible for taking every precaution to safe-guard the pupils. All science teachers should therefore know what to do in the event of an accident (Wachanga, 1991). As a matter of policy, the New York State Department of Education (1962) advises that the teacher should be familiar with first aid treatment and be able to administer it satisfactorily. If a pupil under the jurisdiction of a teacher is injured, the teacher is required to administer first aid (New

York State Dept. of Education, 1962). In addition, all laboratories must have a first aid box as required by Law, and its contents should be regularly checked to replace whatever has been used (Wachanga, 1991).

The teacher should also ensure that other safety equipments necessary in the laboratory e.g. fire extinguishers, fire blankets, fire buckets are in working order and that the pupils know how to use them. In addition, the teacher should ensure that emergency charts and regulations are available and that pupils are conversant with the measures to be taken in case of an emergency.

## **2.5 LABORATORY PERSONNEL.**

Every person working in the laboratory should undergo a period of instruction in safety procedures. During training he should learn to actually operate all the safety devices that are found in a science laboratory (New York State Dept. of Education, 1962).

Laboratory personnel should not only be competent in their professional duties but should also be able to cope with emergency situations. Improperly trained laboratory personnel will not have the necessary skills to perform this important aspect of the profession as required. Furthermore, such a worker will compromise his own safety and that of others. It has been pointed out that safety is a cooperative effort which requires active participation by everybody. Experienced laboratory workers refuse to work near a careless or incompetent person since by so doing, they would expose themselves to unnecessary risk. Such people should not be allowed to be in-charge of the laboratory (New York State Dept. of Education, 1962).

## **2.6 FINAL NOTE.**

Laboratory safety can be seriously compromised by lack of protective devices and poorly maintained laboratory structures. In addition, it could further be aggravated by lack of the proper attitude and inadequate knowledge on the hazards likely to be encountered. It is the duty of the teacher to ensure that at all times the pupils pay particular attention to safety and that all safety equipments are in a state of readiness to cope with emergency situations.

Laboratory personnel should also be prepared to deal with any safety eventuality in the laboratory. They must therefore, be properly trained and informed on what is expected of them should the need arise.

In view of the fore-going, the study sought to establish the status of safety measures in secondary school laboratory and whether the science teacher and the laboratory personnel are adequately prepared to deal with emergency situation. The study also focused on the state of laboratory structures.

**CHAPTER 3****METHODOLOGY****3.1 RESEARCH DESIGN**

Due to the nature of the project and the type of data required, the study involved a survey of the population through sampling. The sample was selected by a non-probability sampling method.

**3.2 POPULATION AND SAMPLING**

For purpose of the study, the population consisted of all secondary schools in Thika District.

From the population a sample was selected by the purposive (Judgemental) sampling method. This method was used due to its consistency with the time allowed for the study, financial considerations and the diversity of the population, factors which precluded use of other more elaborate and representative sampling methods.

The sample consisted of ten (10) schools. The schools were selected in such a way that collectively they represented the multiplicity of secondary schools in the District in terms of size, proprietor-ship and resource establishment.

Each school had two (2) respondent; the science teacher and the laboratory personnel. Where there were more than one science teacher or laboratory personnel the respondent was selected by convenient sampling. Thus the whole sample consisted of twenty respondents

**3.3 INSTRUMENTATION.**

The instrument used to collect data in the study were of two types; questionnaire and an observation guide.

The questionnaires structure consisted mainly of closed response type items that required the respondent to select one response from a set of alternatives. There were also a few open ended questions and some tables where the respondents had the freedom to express opinions.

The questionnaires were of two types, one for the science teacher and one for the laboratory personnel. Both questionnaire types were validated by colleagues in the PGDE Programme by face validation method.

The observation guide was used to collect data on the state of the laboratory structures. It specified the observations to be made during the visit to the schools. Guided observation helped to minimise bias that would have resulted due to the subjectivity of the respondents. By actually visiting the schools a better understanding of the status of laboratory structures was obtained.

### **3.4 DATA COLLECTION PROCEDURE.**

For purpose of introduction and authority to conduct research in the schools, an introductory note provided by the chairperson in the Department of Curriculum and Instruction Egerton University, was used. This was presented to the school administration by the researcher.

The questionnaires were administered to the respondents by the researcher. During administration of the questionnaires the researcher explained the nature of the study and the requirements of the questionnaire. As the respondents were filling the questionnaire the researcher made guided observations in the laboratory rooms and the preparation and storage areas.

In some cases one or other of the questionnaire was left behind and collected later. Similarly some respondents requested for time to fill the questionnaires in which case it was left behind and collected at the appointed time

### **3.5 DATA ANALYSIS**

The data collected was organised into tables for ease of interpretation. Interpretation of the data was by use of descriptive statistics involving the use of percentages.

**CHAPTER 4****DATA ANALYSIS AND INTERPRETATION****4.1 INTRODUCTION**

The data obtained was analysed in two sections; data collected by use of questionnaire and data collected using the observation schedule.

The data collected using the questionnaires was organized into tables to facilitate analysis and interpretation. The information so organised was analysed to determine the status of laboratory structures and the adequacy of safety measures in the sample schools. The data was also analysed to determine the state of preparedness of the science teacher and the laboratory personnel to handle laboratory emergencies. The analysis of the data was mainly by use of descriptive statistics involving use of percentages.

Data collected using the observation schedule was analysed by means of a description.

**4.2 LABORATORY STRUCTURES**

Table 4.2.1 shows the time spent in the laboratory in the different sample schools. The estimate of the percentage laboratory occupancy is based on the assumption that each class has two - 40 minutes lessons for practicals per subject and that each of the classes i.e forms 1 - 4 take each of the primary sciences Biology/biological science, Physics, Chemistry/Physical Sciences. On this basis a one stream school will have a total of 24, 40 - minutes laboratory lessons per week. According to the secondary school time allocation, each week has 45, 40 - minutes lessons and each laboratory room can therefore accommodate this number (45) of 40 minutes lessons per week.

The table shows that in 90% of cases occupancy of available laboratory time was over 50%; in 30% of the cases there was 75% laboratory time occupancy while in 20% of the cases laboratory occupancy was over 100%.

The table also shows that in 80% of the cases the class size was over 40 pupils.

In view of the large class size and the time spent by the pupils in the laboratory, it appears that in the majority of schools there is a serious strain on laboratory structures. The cumulative effect of this strain over time is to wear down the laboratory structures gradually making the laboratory environment hazardous to the pupils, the teachers and the laboratory personnel.

**TABLE 4.2.1 Laboratory Occupancy and Class Size**

ITEM	SCHOOL *									
	1	2	3	4	5	6	7	8	9	10
(I) Average number of pupils per class	42	40	45	40	45	48	38	45	30	40
(ii) Number of streams in the school	4	1	3	2	5	4	2	2	2	6
(iii) Total number of 40 - minutes laboratory lessons per week	96	24	72	48	120	96	48	48	48	144
(iv) Number of laboratory rooms	2	1	3	2	4	5	2	2	1	4
(v) Number of 40 - minutes lessons per laboratory room per week	48	24	24	24	30	19	24	24	48	36
(vi) Percentage laboratory occupancy time	106	53	53	53	67	42	53	53	106	80

Percentage of schools with;

- (a) over 50% Laboratory Occupancy = 90%
- (b) Over 75% laboratory occupancy = 30%
- (c) Over 100% laboratory occupancy = 20%

\* For list of school see the appendix

Table 4.2.2 was constructed from the science teachers responses on the issue of congestion in the laboratory.

In 80% of the cases the teachers indicated that the number of pupils during a laboratory lesson was too large to be effectively supervised. Similarly the table shows that 70% of the teachers felt that the laboratories were overcrowded in terms of space during the lesson. The table also shows that in all cases (100%), there was no storage facilities for pupil's items such as bags, clothes books, while in 40% of the cases there was no storage space for excess stools.

This shows that in most of the laboratories the lessons are conducted in congested conditions where the teacher cannot effectively supervise the pupils activities. This means that while the teacher is responsible for the pupils safety during the laboratory lessons, his effectiveness to monitor pupils activities is hampered by the large number of pupils under his care.

**Table 4.2.2 Overcrowding and Congestion**

ITEM	SCHOOL									
	1	2	3	4	5	6	7	8	9	10
1) Number of pupils too large to be effectively supervised	✓	✓	✓	✓	X	✓	✓	✓	X	✓
2) Overcrowding in terms of space	✓	✓	✓	✓	X	✓	X	X	✓	✓
3) Storage facilities available for pupil's items	X	X	X	X	X	X	X	X	X	X
4) Storage space for excess stools available	X	✓	✓	✓	✓	X	X	✓	X	✓

Percentage yes in item ; (1) = 80%, (2) = 70%, (3) = 0%, (4) = 60%.

The situation is further complicated by overcrowding which would hinder free movement in circumstances demanding swift action, especially where aisles between the benches are obstructed by excess stools.

Laboratory benches also would be congested with pupils books, bags or clothing. Such items when placed on laboratory working benches pose a risk since they can easily catch fire.

The study also focused on laboratory exits and the results are as shown in tables 4.2.3 and 4.2.4. The exits considered for the study included the main doors, the emergency doors and the windows. As shown in table 4.2.3 in 60% of the cases the laboratories did not have an emergency door. In cases where there were emergency doors 75% of the doors were hang to swing inwards. The table also shows that 50% of the laboratory main doors were hang to swing inwards.

Table 4.2.3 Laboratory Doors

SCHOOL	EMERGENCY DOOR		MAIN DOOR	
	Open Outwards	Open Inwards	Open Outwards	Open Inwards
1	-	✓	✓	-
2	-	-	-	✓
3	-	-	-	✓
4	-	-	✓	-
5	-	-	-	✓
6	-	-	-	✓
7	-	✓	✓	-
8	✓	-	✓	-
9	-	-	✓	-
10	-	✓	-	✓
TOTAL	1	3	5	5

	EMERGENCY DOOR	MAIN DOOR
% Opening Inwards	75%	50%

**Table 4.2.4 Laboratory Windows**

SCHOOL	LABORATORY WINDOWS	
	Burglar-proof grills present	Burglar-proof grills absent
1	✓	X
2	✓	X
3	X	✓
4	X	✓
5	✓	X
6	X	✓
7	✓	X
8	✓	X
9	✓	X
10	✓	X
TOTAL	70%	30%

Table 4.2.4. shows the situation of the laboratory windows. In 70% of the cases the windows were fitted with burglar-proof metal grills, wire mesh or both . The results shows that in the event of an emergency which requires evacuation the scramble for the main door could lead to damage of equipment and massive injuries especially where pupils trample on others in their bid to escape. When crowded at the door it would be impossible for the pupils to escape when the doors open inwards since the press of the bodies on the doors would hinder any attempt to get them open.

Similarly laboratory windows when fitted with burglar-proof metal grills or wire mesh would prove to be an impediment, since though pupils would otherwise escape through the windows they cannot when such burglar proof measure are effected.

Data was also collected on storage of gas cylinders and laboratory ventilation. The results are summarised in table 4.2.5.

The table shows that in 89% of the cases the gas cylinders are stored outside the laboratory and that in 80% of the cases the laboratory is well ventilated.

Attention is drawn to school No. 10 where the gas cylinders are stored inside the laboratory and the laboratory was poorly ventilated.

**Table 4.2.5 Gas Storage and Laboratory Ventilation**

SCHOOL	GAS STORAGE		LABORATORY VENTILATION	
	INSIDE	OUTSIDE	ADEQUATE	INADEQUATE
1	X	✓	✓	X
2	-	-	✓	X
3	X	✓	✓	X
4	X	✓	X	✓
5	X	✓	✓	X
6	X	✓	✓	X
7	X	✓	✓	X
8	X	✓	✓	X
9	X	✓	✓	X
10	✓	X	X	✓
% TOTAL	11%	89%	80%	20%

Storage of gas cylinders inside the laboratory has serious safety implications since in the event of fire the cylinders would burst worsening the situation. Similarly laboratory ventilation is necessary to ensure that the concentration of obnoxious gases or inflammable vapour does not rise to hazardous level.

In most school laboratories these dangers are averted by having well ventilated laboratory rooms and storing gas cylinders outside the laboratory.

Table 4.2.6 shows the analysis of the availability and state of the fume chambers.

The table shows that 70% of the laboratories are fitted with fume chambers. In all cases where there is a fume chamber only 29% of these are functional while 71% are non-functional. If "non-functional" is taken to mean "non-availability" then it is only 20% of the laboratories that have fume chambers.

**Table 4.2.6 Fume Chambers**

SCHOOL	AVAILABLE		NOT AVAILABLE
	FUNCTIONAL	NOT FUNCTIONAL	
1	-	-	✓
2	-	-	✓
3	-	-	✓
4	✓	X	X
5	✓	X	X
6	X	✓	X
7	X	✓	X
8	X	✓	X
9	X	✓	X
10	X	✓	X
% Availability	70%		30%
% Functional	29%	71%	-

In most schools the results indicates, the teacher and the pupils are unnecessarily exposed to hazards associated with poisonous gases and vapours such as hydrogen sulphide, carbon monoxide, sulphur dioxide, chlorine, ammonia, which are studied in the school chemistry curriculum. A functional fume chamber is a mandatory requirement of a school laboratory.

### 4.3 SAFETY EQUIPMENTS

Table 4.3.1 shows the analysis of availability of fire fighting facilities. The results indicate that the fire extinguisher was the most popular fire fighting equipment being found in 80% of the cases compared to 70% for the fire buckets and 0% both for the fire blanket and fire hydrant.

**Table 4.3.1 Fire Fighting Facilities**

SCHOOL	FIRE FIGHTING FACILITY			
	Fire Extinguisher	Fire Blanket	Fire (sand) Bucket	Fire Hydrant
1	✓	X	✓	X
2	✓	X	✓	X
3	✓	X	X	X
4	✓	X	X	X
5	✓	X	✓	X
6	✓	X	X	X
7	X	X	✓	X
8	✓	X	✓	X
9	X	X	✓	X
10	✓	X	✓	X
% Availability	80%	0%	70%	0%

Where fire extinguishers were available, Table 4.3.2 shows the quality and number of extinguishers available.

The table shows that 87.5% of the schools had the carbon dioxide type of fire extinguisher, 12.5% had the dry powder type while no school had the soda-acid or foam type of fire extinguisher.

**Table 4.3.2 Quality and number of Extinguishers**

SCHOOL	TYPE OF EXTINGUISHER				TOTAL
	Soda-acid type	Foam Type	Gas Type	Dry Powder	
1	X	X	1	X	1
2	X	X	1	X	1
3	X	X	1	X	1
4	X	X	1	X	1
5	X	X	4	X	4
6	X	X	X	5	5
8	X	X	3	X	3
10	X	X	1	X	1
% Availability	0%	0%	88%	12%	-

Table 4.3.3 shows the adequacy of the fire extinguishers and sand buckets. The adequacy level was estimated on the basis of 1 fire extinguisher and 1 sand bucket per laboratory room.

**Table 4.3.3 Adequacy; Fire Extinguishers Sand Buckets.**

SCHOOL	No. of Lab rooms	Total Number		Adequate	
		Extinguishers	Buckets	Extinguishers	Buckets
1	2	1	2	X	✓
2	1	1	1	✓	✓
3	3	1	-	X	X
4	2	1	-	X	X
5	4	4	4	✓	✓
6	5	5	-	✓	X
7	2	-	1	X	X
8	2	3	2	✓	✓
9	1	-	4	X	✓
10	4	1	4	X	✓
% Adequacy				40%	60%

The table shows that in 60% of the cases the fire extinguishers were not adequate in terms of quantity while in 40% of the cases the fire buckets were not adequate

Attention is drawn to schools 7, 4, and 3 where both the fire extinguishers and the sand buckets were not adequate. This means that in 30% of the cases considered fire fighting facilities were not adequate.

The analysis shows that in most schools the commonest fire fighting equipment are the fire extinguishers and sand buckets. The extinguishers were mainly of the carbon dioxide type. These extinguishers are adequate in terms of quality while dealing with fires likely to occur in school laboratories. In the majority of cases however the fire fighting facilities are not adequate in terms of quantity.

Data was also analysed to determine availability and adequacy of first aid kits. Table 4.3.4 shows the analysis of data on availability of first aid kits. The table shows that in 60% of the cases the laboratories did not have first aid kits. Table 4.3.5 is an analysis showing the adequacy of the contents in cases where first aid kits were available. The table shows that the highest adequacy level was 46%. In view of the fact that only 40% of the laboratories had first aid kits, then the availability and adequacy of the contents of first aid kits in school laboratories paint a pathetic picture. Most schools appear to be ill prepared to deal with medical emergencies in the laboratory, which would require administration of first aid.

**Table 4.3.4 Availability of First Aid Kits**

SCHOOLS	FIRST AID KIT	
	AVAILABLE	NOT AVAILABLE
1.	X	✓
2.	X	✓
3.	X	✓
4.	✓	X
5.	X	✓
6.	X	✓
7.	✓	X
8.	✓	X
9.	X	✓
10.	✓	X
% Availability	40%	60%

**Table 4.3.5 Adequacy of Contents; First Aid Kits.**

CONTENT OF KIT		SCHOOL			
		4	7	8	10
1)	Gauze bandage (1, 2 inches)	✓	✓	✓	X
2)	Gauze dressing (sterile)	X	X	X	X
3)	Absorbent cotton wool	✓	✓	✓	X
4)	Adhesive bandage	✓	✓	✓	X
5)	Applicator (cotton tipped)	X	X	X	X
6)	Tongue depressor	X	X	X	X
7)	Standard antiseptic	✓	✓	X	X
8)	Scissors	✓	✓	✓	X
9)	Petrolatum (petroleum) jelly	X	X	X	X
10)	Sodium bicarbonate	X	X	X	X
11)	Genetian violet (G.V)	X	X	X	X
12)	Emergency charts	X	✓	X	X
13)	Log book for accidents	X	X	✓	X
% Adequacy		39	46	39	0

Data was also collected and analysed on the availability of body protection equipment.

Table 4.3.6 is a summary of the results. The table shows that no school laboratory was provided with safety screens, safety goggles or gas masks. In 50% of the cases the laboratories were provide with protective gloves for use by the laboratory personnel and the science teacher.

In all cases the laboratory personnel had and used protective laboratory coats. It is worth noting that in schools 3, 6 and 8 i.e 30% of the cases the laboratory personnel are not provided with protective laboratory coats but have to cater for themselves.

The analysis indicates that most schools provide protective gloves and protective laboratory coats for the laboratory personnel. The pupils are not provided with protective gloves and both the pupils and the teachers are not provided with protective laboratory coats. Where the teachers used such coats they had to bring their own.

The teacher, pupils and laboratory personnel are therefore exposed to risk where use of such facilities which are lacking in school laboratories is an essential safety requirement.

**Table 4.3.6 Availability of Safety Equipment.**

SCHOOL	BODY PROTECTION EQUIPMENT				
	Safety Screens	Safety Goggles	Gas Masks	Protective Gloves	Protective Clothes
1.	X	X	X	✓	✓
2.	X	X	X	✓	✓
3.	X	X	X	X	✓
4.	X	X	X	X	✓
5.	X	X	X	✓	✓
6.	X	X	X	X	✓
7.	X	X	X	✓	✓
8.	X	X	X	X	✓
9.	X	X	X	✓	✓
10.	X	X	X	X	✓
% Availability	0%	0%	0%	50%	100%

#### 4.4 SAFETY MEASURES.

Table 4.4.1 is a summary of the safety measures that may be effected to cultivate the proper attitude and safety awareness in school pupils.

The table shows that in all schools the pupils are aware that safety is an integral part of the study of science and are given explicit warnings on possible hazards associated with use of materials, techniques or experiments. In 70% of the cases pupils are provided with copies of laboratory rules and regulations. In all cases however, pupils did not know the position of the main water, gas stop-cocks and electrical controls. Similarly pupils were not given instructions on how to operate these controls, and these controls were not easily accessible to the pupils.

In 60% of the cases the pupils were not drilled on how to act in case of toxic poisoning or accident in the laboratory. In all cases there were no pre-arranged rehearsed evacuation procedures in case of a major fire. The table also shows that the highest percentage safety awareness on the basis of the above considerations was 30%.

The results therefore indicate that pupils awareness of safety measures in school laboratories is largely lacking.

**Table 4.4.1 Safety Awareness**

	ITEM	SCHOOL										% YES	
		1	2	3	4	5	6	7	8	9	10		
1)	Pupils provided with copies of laboratory rules and regulations	X	X	✓	✓	✓	✓	✓	✓	✓	X	✓	70%
2)	Awareness of safety as an integral part of the study of science	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	100%
3)	Pupils given explicit warnings on hazards associated with use of materials and techniques	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	100%
4)	Pupils know the position of main water, gas stop-cocks and main electrical control	X	X	X	X	X	X	X	X	X	X	X	0%
5)	Pupils instructed on how to use controls in (4) above	X	X	X	X	X	X	X	X	X	X	X	0%
6)	Controls in (4) above easily accessible to pupils	X	X	X	X	X	X	X	X	X	X	X	0%
7)	Pupils drilled on how to act in case of toxic poisoning or accident.	X	X	✓	X	✓	✓	X	✓	X	X	X	40%
8)	Pre-arranged, rehearsed evacuation procedures in case of major fire implemented	X	X	X	X	X	X	X	X	X	X	X	0%
	% Awareness	20%	20%	30%	30%	30%	30%	30%	30%	30%	20%	30%	

Table 4.4.2 is a summary of science teachers responses on how often they conduct scheduled lessons on laboratory safety. The table shows that in 20% of the cases teachers conducted scheduled lessons on laboratory safety once per year, 60% once every 4 years while 20% never conducted such lessons. The results thus indicate that, in the majority of cases the science teachers are apathetic on the issue of laboratory safety.

**Table 4.4.2 Conduct of Lessons on Lab Safety.**

SCHOOL	CONDUCTED SCHEDULED LESSON ON LAB. SAFETY					
	3 Times per year	2 Times per year	Once per year	Once per 2 years	Once per 4 years	Never
1	X	X	X	X	X	✓
2	X	X	X	X	✓	X
3	X	X	✓	X	X	X
4	X	X	X	X	✓	X
5	X	X	✓	X	X	X
6	X	X	X	X	✓	X
7	X	X	X	X	✓	X
8	X	X	X	X	✓	X
9	X	X	X	X	X	✓
10	X	X	X	X	✓	X
% Total	0%	0%	20%	0%	60%	20%

#### 4.5 TEACHER PREPAREDNESS

Table 4.5.1. is a summary of science teachers qualifications. The table shows that 46% of the science teachers are in the Dip/S1 category, 44% are trained graduates and 10% are graduate untrained teachers.

The results shows that most science teachers in secondary schools are professionally trained. They are thus in a position to make proper judgement and decisions on safety issues in the laboratory.

Table 4.5.2 shows a summary of some aspects of teachers preparedness to handle emergency situations in the laboratory. The analysis shows that in all schools teachers were not cautioned on pupils abnormal susceptibilities e.g. allergies to chemical/biological materials, respiratory problems, epilepsy etc. The table also shows that only 11% of the teachers in the schools sampled attended basic training in fire fighting techniques and administration of first aid. This represents the group that attended the defunct pre-university National Youth Service Program.

**Table 4.5.1 Teacher Qualification.**

SCHOOL	TEACHER QUALIFICATIONS				
	Untrained 'A' Level	Dip/S1	Graduate Untrained	Graduate Trained	TOTAL
1	X	4	1	3	8
2	X	4	X	1	5
3	X	1	1	4	6
4	X	3	2	X	5
5	X	4	X	9	13
6	X	4	X	3	7
7	X	4	X	2	6
8	X	2	X	3	5
9	X	2	1	2	5
10	X	5	2	5	12
TOTAL	0	33	7	32	72
%	0%	46%	10%	44%	100%

**Table 4.5.2 Teachers Preparedness**

ITEM	SCHOOL											
	1	2	3	4	5	6	7	8	9	10	Total %*	
1) Cautioned on pupils abnormal susceptibilities e.g allergies to chemical/biological materials etc.	X	X	X	X	X	X	X	X	X	X	0	0%
2) Attended pre-service/In service training in basic fire fighting	0	0	5	0	0	0	0	3	0	0	8	11%
3) Attended pre-service/In-service training in Administration of first aid	0	0	5	0	0	0	0	3	0	0	8	11%

\* % expressed out of total of 72 teachers

From the two tables it can be seen that although the majority of science teachers are professionally trained they are not adequately prepared to deal with emergency situations in the laboratory.

#### 4.6 LABORATORY PERSONNEL.

Table 4.6.1 and 4.6.2 show a summary of laboratory personnel qualifications, their state of preparedness to deal with emergencies and their feelings on the current status of safety in school laboratories.

The summary on the table 4.6.1 shows that 44% are untrained form fours and 6% are untrained form six leavers both from the previous 7:4:2:3 system of education. 38% are trained Junior Laboratory Technicians while 12% are diploma holders in Laboratory Technology.

Table 4.6.2 shows that 30% of the laboratory personnel have undergone pre-service training in basic fire fighting techniques and administration of first aid. 60% of the laboratory personnel intimated that they felt unsafe working in the laboratory at present.

**Table 4.6.1 Laboratory Personnel Qualification.**

SCHOOL	LABORATORY PERSONNEL QUALIFICATION				TOTAL
	Untrained From 4	Untrained Form 6	JLT	DIPLOMA	
1	X	X	1	X	1
2	1	X	X	X	1
3	2	X	1	X	3
4	1	X	X	X	1
5	1	X	1	X	2
6	1	X	1	1	3
7	X	X	X	1	1
8	X	X	1	X	1
9	X	X	1	X	1
10	1	1	X	X	2
TOTAL	7	1	6	2	16
%	44%	6%	38%	12%	100%

**Table 4.6.2 Laboratory Personnel Preparedness.**

ITEM	SCHOOL										% YES
	1	2	3	4	5	6	7	8	9	10	
1) Attended pre-service/In-service in basic fire fighting	✓	X	✓	X	X	X	X	X	✓	X	30%
2) Attended pre-service/In-service training in administration of first aid	✓	X	✓	X	X	X	X	X	✓	X	30%
3) Do you feel safe working in the laboratory at present?	X	✓	X	✓	✓	X	X	✓	x	x	40%

The results indicate that some school laboratories are manned by untrained personnel. In the majority of case the laboratory personnel are not trained in basic fire fighting or administration of first aid. It also appears that most laboratory assistants felt unsafe working in the laboratory.

#### 4.7 OBSERVATIONS

Some observations were made in conjunction with the questionnaires. Table 4.7.1 shows questionnaire responses on some aspects of safety management.

**Table 4.7.1 Safety Management.**

ITEM	SCHOOL										% avail-able
	1	2	3	4	5	6	7	8	9	10	
1) Stock-book giving exact location of materials and equipment	✓	✓	✓	✓	✓	✓	x	✓	✓	✓	90%
2) Labelling giving the likely hazards associated with use of substance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	100%
3) Manual on laboratory safety	x	✓	✓	✓	✓	x	✓	✓	x	✓	70%
4) Manual on storage and safe disposal of hazardous chemicals	x	✓	✓	✓	✓	x	x	✓	x	✓	60%
5) Safe collection facilities for different kinds of waste	✓	x	✓	✓	✓	x	x	✓	x	x	50%

The table shows that 90% of the schools have stock books giving exact location of materials and equipment. Though in all these cases stock books were available the researcher did not see any evidence of stock books giving the exact location of materials or equipment.

Similarly although 100% of the respondents indicated that the labelling gave likely hazards associated with use of substances, it is only where the containers had manufacturers label with such details where the researcher could see evidence of such labelling. The commonest mode

of labelling was where labels gave the name, chemical formula and the concentration of substance. In 70% of the cases laboratory manuals on safety were found, however, although 60% of the respondents indicated that there were manuals on storage and disposal of hazardous waste, the researcher did not see evidence of such manuals.

50% of the respondents indicated that the laboratories were provided with safe collection facilities for different kinds of wastes. There was however no evidence of such arrangements and in all cases only one dust bin was provided.

Observations were also made on some aspects of the condition of laboratory structures. The areas to be observed were categorised as follows;

- (1) Water system
- (2) Drainage system
- (3) Electrical system
- (4) Gas system
- (5) Storage facilities
- (6) Laboratory benches and floor

In all cases the water system was satisfactory except in school (9) where the laboratory had no piped water.

The drainage system in all schools was satisfactory with no broken sinks or leaking drains and the drainage canals were carefully covered with concrete slabs.

The electrical system was of a permanent nature in all schools. The system was well maintained and there were no broken switches / sockets or exposed wires. Schools 3, 5, and 8 had step down transformers which supplied low voltage D.C. - A.C. current to the laboratory.

Gas system was permanent and well maintained with no leaking taps. The gas storage was outside except in school (10) where the gas was stored inside the laboratory.

Storage space was adequate with enough space in the preparation room and store room. Some schools e.g 5 and 6 had wall cupboards and in almost all schools there were under-bench storage lockers. In all cases except for minor cracks the floors were entire and made of cement finishing. Benches were well maintained, made of wood, formica topped wood or cement / terrazzo.

**CHAPTER 5****CONCLUSION AND RECOMMENDATIONS****5.1 CONCLUSION:****5.1.1 LABORATORY STRUCTURES:**

The findings of the study indicate that secondary school laboratories are over utilised in terms of laboratory occupancy. The number of pupils per class is also quite high, 80% of the schools had classes with over 40 pupils.

The teachers felt that the laboratories are congested in terms of space and that the classes can not be effectively supervised during practicals.

It was also found that school laboratories did not have storage facilities for pupils items such as bags books or clothing, similarly school laboratories do not have storage space for excess laboratory stools and chairs.

The study also revealed that 70% of the school laboratories are fitted with fume chambers. Most of these fume chambers are however not functional either because the glass windows are broken, the exhaust fan not working or a combination of the two.

Gas cylinders are stored outside the laboratory in most schools and laboratories are well ventilated with wide windows.

The windows in most schools are however fitted with burglar proof wire mesh or metal grills. Most schools have no emergency doors and even where such doors are found they are hang to swing inwards. This also applies to the main doors.

Laboratory services were well installed and adequately maintained. The water system in most schools was well installed and there were no leaking taps or broken sinks. Similarly the drainage canals were clear and neatly covered with concrete slabs.

Gas service was piped in from cylinders located outside. The system was well maintained with no leaks and the piping was permanent and well installed.

The laboratories had adequate storage facilities with enough space in the preparation and store rooms. Additionally there were wall cupboards and lockers below the working benches in most schools. The benches were well maintained. A variety of bench tops material was noted ranging from heavy mahogany, concrete / terrazo in the older laboratories to Formica topped wooden benches in the recently constructed laboratories.

#### 5.1.2 SAFETY MEASURES AND EQUIPMENT.

##### (a) SAFETY MEASURES.

The study showed that pupils were provided with copies of laboratory rules and regulations. They were also sensitised that safety is an integral part of the study of science. They were also given explicit warnings on hazards associated with use of materials and alerted on the risk involved in experiments and techniques which they were required to use.

The pupils were however not shown the position of the main water, gas stock cocks or that of the main electrical switch. These controls were also not easily accessible. Pupils were not instructed on how to act in case of toxic poisoning or accidents in the laboratory. School laboratory also did not have pre-arranged rehearsed evacuation procedures in case of a major fire or other situation requiring such evacuation.

In general the highest percentage awareness of laboratory safety was 30%. This can be seen in view of the fact that teachers conducted scheduled lessons on laboratory safety once every four years. This reflects lack of safety awareness in secondary school laboratories.

#### (b) SAFETY EQUIPMENT

The study showed that school laboratories were provided with fire fighting equipment; fire extinguishers, fire buckets. The fire extinguishers were adequate in terms of quality being mainly of the carbon dioxide gas type. 88% of the laboratories were equipped with the gas type fire extinguishers while 12% were equipped with the dry powder type. The fire extinguishers were however not adequate in terms of numbers although the fire buckets were found to be adequate. No school laboratory was equipped with fire hydrants or supplied with a fire blanket.

The study also revealed that most school laboratories were not equipped with a first aid kit. Even where a first aid kit was supplied the contents were not adequate. The highest adequacy level was 46%.

The study also focused on the availability of safety goggles, safety screens, gas masks protective gloves and protective clothing. In all cases, the study revealed that school laboratories were not supplied with safety goggles, safety screens, or gas masks for use by pupils, teachers or laboratory personnel. Protective gloves were however available for use by the teacher and the laboratory personnel. It was also found that only the laboratory personnel were provided with protective laboratory coats. The teachers either brought their own or did not use them at all. The study established that the pupils in all schools were not required to have laboratory coats let alone use them.

### (c) SAFETY MANAGEMENT.

Other areas studied related to safety measures were availability of stock books, laboratory manuals and facilities for safe collection of waste. The study also focussed on labelling of chemicals.

In all cases stock books were available but they did not give an indication of the exact location e.g cupboard numbers of the materials or equipment. Similarly although the laboratories were supplied with manuals on laboratory safety, there were no manuals on the safe disposal of hazardous waste. The laboratories were also not equipped with facilities for the safe collection of different kinds of waste.

The laboratories had different forms of arrangement of materials in the stores. The materials were also labelled but except where there were manufacturers labels, the labels did not give the likely hazards associated with the use of the materials. The concentration, name of the substance and chemical formula were however given.

#### 5.1.3 TEACHER PREPAREDNESS.

From the results most secondary school science teachers are trained professionals. 90% of the teachers were either trained university graduates or diploma / S1 teachers. The study showed that the teachers were not conversant with basic fire fighting technique or administration of first aid. Most of the teachers had no pre- service / in- service training in basic fire fighting techniques or administration of first aid.

In addition it was found out that the teachers were not given warning on pupils abnormal susceptibilities e.g allergies to chemical / biological materials, respiratory problems, epilepsy or other medical conditions.

#### 5.1.4 LABORATORY PERSONNEL:

Laboratory personnel in school laboratories were a mixed group of trained and untrained assistants. 50% of the laboratory personnel were either diploma or certificate technicians. The others were either form four or form six leavers of the previous 7:4:2:3 system of education.

The study indicated that most of the laboratory personnel even though professionally trained had not attended pre- service/in- service training in basic fire fighting techniques or administration of first aid.

The study also revealed that most of the laboratory personnel (60%) felt unsafe while working in the laboratory.

#### 5.2 RECOMMENDATIONS:

In view of the significance of the laboratory facilities in the school science education and the hazards likely to occur in the laboratory, and also in view of the findings of the study, the following recommendations are suggested so as to improve the level of safety in secondary school laboratories.

- (a) It is recommended that the government and school management should make concerted efforts to ensure that safety equipment e.g safety goggles, safety screens and other protective devices are available in secondary school laboratories for use by all persons working in the laboratory.
- (b) The school management and the government should also make efforts to expand existing schools to accommodate the large demand for secondary school places. In this connection the government in concert with local communities neighbouring the secondary schools could also build new schools. This would ease the strain which large class size impose on the existing laboratory structure.

- (c) The design of the laboratory rooms should be such that the laboratories are provided with facilities for storage of pupils' items and excess laboratory stools. This would give room for free movement of the teacher and learners and create clear aisles that can be used in case of an emergency.

The design should also be such that the main gas, water and electrical controls are easily accessible to all persons working in the laboratory.

- (d) The laboratory structures/services should be well maintained so that existing structures and services which are vital to laboratory operation such as water, gas and electrical systems are not allowed to deteriorate.

Special attention should be focused on the maintenance of the fume chamber since a functional fume chamber is an important aspect of safety in the laboratory.

- (e) The laboratory should be equipped with a sufficient number of fire fighting equipment. Every laboratory room should have at least one fire extinguisher. There should also be pre-arranged and rehearsed emergency evacuation procedures in case of any eventuality requiring such evacuation.

The laboratories should also be supplied with an adequately stocked first aid kit. The teacher should ensure that the kit is re-stock when certain items become depleted. The first aid kit should also be placed in an easily accessible place

- (f) The teachers should endeavour to improve the level of safety awareness. This can be done for example by conducting more scheduled lessons on laboratory safety. The pupils should also be instructed on how to operate the main laboratory gas, water stop-cocks and electrical controls.

Pupils should be instructed on how to act in case of toxic poisoning or other accidents in the laboratory.

- (g) It is important that as a safety policy it be made compulsory for all the pupils working in the laboratory to use protective clothing.

A safety screen and safety goggles should be used whenever there is risk of explosion, splashes of corrosive liquids or when working with glass under pressure. It should also be made a requirement that gas masks be used especially when dealing with poisonous volatile liquids.

- (h) The laboratory stock book in addition to giving quantities of materials and equipment, should also give the exact location in the laboratory of all reagents and equipment.

Manuals on safe disposal of hazardous materials should be supplied and safe collection facilities for different types of waste should be provided.

Labels of materials and reagents should carry the name, chemical formula, concentration and hazards likely to be associated with the use of the substances

- (i) Science teachers and laboratory personnel during their pre-service training, should be given instructions on how to use fire fighting equipments, basic fire fighting techniques and administration of first aid. Such training should include acquisition of actual practical skills.

Those already in the field should be given in-service training on the same. Seminars and refresher courses should also be occasionally organised to acquaint science teachers and laboratory personnel with new techniques or give them an opportunity to practice these skills.

- (j) Laboratories should be provided with emergency exits, which should be wide and be hang to swing outwards. Where possible laboratory windows should not be fitted with burglar proof wire mesh or metal grills. Employment of an additional watchman may be more desirable.
  
- (k) The Government should pass legislation requiring certain minimum standards of safety in secondary school laboratories. Such legislation should have provision for the contractual obligation of science teachers, laboratory personnel and the school administration on the issue of laboratory safety.

It should also spell out the training requirements of science teachers and laboratory personnel in relation to laboratory safety.

- (l) More research should be carried out on the working environment in secondary school laboratories with a view to establish why the laboratory personnel feel unsafe when working in the laboratory.

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**APPENDIX****1.0 LIST OF SCHOOLS;**

<u>SCHOOL NO.</u>	<u>NAME OF SCHOOL</u>
1.	MUHOHO HIGH SCHOOL
2.	JUJA SECONDARY SCHOOL
3.	MANGU HIGH SCHOOL
4.	TRIKHA GIRLS SEC. SCHOOL
5.	CHANIA HIGH SCHOOL
6.	THIKA HIGH SCHOOL
7.	RUIRU SECONDARY SCHOOL
8.	ST. FRANCIS GIRLS HIGH SCHOOL
9.	MURERA SECONDARY SCHOOL
10.	RUIRU HIGH SCHOOL

NB. The school numbers are as used in chapter 4 on data analysis and interpretation.

**CONFIDENTIAL****1.1 QUESTIONNAIRE FOR LABORATORY ASSISTANTS**

The purpose of this questionnaire is to help establish the status of safety measures in school laboratories.

Kindly provide the information requested. The information will be treated as confidential and will only be used for the purpose of this research.

NAME OF SCHOOL \_\_\_\_\_

**1.1 CURRENT STATUS OF SCHOOL**

(a) Management Private  
Public

(tick (✓) as appropriate)

(b) Number of streams \_\_\_\_\_

(c) Number of Science rooms (Labs) \_\_\_\_\_

**1.2 INFORMATION ON LABORATORY ASSISTANTS**

Key to qualification

F4 - Untrained Form 4

F6 - Untrained Form 6

JLT - Junior Lab Technician/Certificate

DIP - Diploma

Use the key above to fill the table below:-

QUALIFICATIONS	NO. OF LAB ASSISTANTS	EXPERIENCE
F4		
F6		
JLT		
DIP		

2. Is the laboratory provided with laboratory manuals on:-

(a) Laboratory safety?

YES

NO

(b) Storage and Disposal of hazardous chemicals?

YES

NO

(c) Have you displayed charts on laboratory rules and regulations in the laboratory?

YES

NO

3. (a) Are all the adults using the laboratory aware of the position of gas, water stop-cocks and main electrical switch?

YES

NO

(b) Are these controls readily accessible?

YES

NO

(c) Do all the people working in the laboratory know how to operate these controls?

YES

NO

4. (a) Is the laboratory provided with fire fighting equipment?

YES

NO

(b) The table below lists types of fire safety equipment. Fill the table to indicate availability and quantity of the apparatus.

---

A V A I L A B L E

EQUIPMENT	YES	NO	QUANTITY
Fire Extinguishers			
Fire (sand) buckets			
Fire Hydrants			
Fire Blankets			

(c) In the table below is a list of types of fire extinguishers. Fill the table to indicate availability and condition of the equipment.

## A V A I L A B L E

TYPE OF EXTINGUISHER	NO. WORKING	NO. NOT WORKING	NOT AVAILABLE
Soda Acid			
Foam Type			
Carbon Dioxide			
Dry Powder			
Others - Specify			

(d) Do you have stand-by, rehearsed evacuation procedures in case of a major fire?

YES

NO

(e) Are all the people working in the laboratory versed in the use of the fire equipment?

YES

NO

5. (i) How many Laboratory Assistants have received Pre-service/In service training in basic fire fighting techniques?

\_\_\_\_\_

(ii) Who organised for the training?

\_\_\_\_\_

(iii) How often do the laboratory assistants attend such training?

\_\_\_\_\_

6. (a) Is the Laboratory provided with a first aid kit?

YES

NO

(b) Is it easily accessible and prominently displayed?

YES

NO

(c) The table below shows basic items in a first-aid kit. Fill the table using "YES" or "NO" to indicate contents of kit.

I T E M	A V A I L A B L E
(i) Gauze Bandage (1 inch, 2 inch)	
(ii) Gauze Dressing (Sterile)	
(iii) Absorbent Cotton Wool	
(iv) Adhesive	
(v) Applicator (Cotton Tipped)	
(vi) Tongue Depressors	
(vii) Standard Antiseptic	
(viii) Scissors	
(ix) Petrolatum (Petroleum Jelly)	
(x) Package of Sodium Bicarbonate	
(xi) Genetian Violet (GV)	

(c) In your opinion do you think your first aid kit is adequately stocked?

YES

NO

(d) Laboratory emergency charts indicate recommended first aid procedures for different types of emergencies.

Do you have such charts displayed in the laboratory?

YES

NO

(e) (i) How many laboratory assistants have received pre-service/In service training in administration of first aid?

(ii) Who organised the training?

\_\_\_\_\_

(iii) How often do they attend such courses?

\_\_\_\_\_

7. (a) Do you have a stock-book giving exact location (shelf, cupboard number) for all materials and equipment?

YES

NO

(b) Are all the containers fully labelled e.g. giving name of substance, its concentration and likely hazards associated with its use?

YES

NO

(c) If NO what is the mode of labelling?

(d) Is the laboratory provided with safe collection facilities for different types of solid wastes?

YES

NO

(e) If NO how do you dispose of solid waste?

8. (a) For reasons of security are the laboratory windows provided with burglar proof wire-mesh or metal grills?

YES

NO

(b) In your opinion is the laboratory well ventilated?

YES

NO

(c) Are/is the gas cylinder storage chamber(s) inside or outside the laboratory?

(d) Are/is the gas cylinder storage chamber(s) well ventilated?

YES

NO

9. (a) Are you provided with the following safety devices? (indicate "YES" or "NO" against each).

- (i) Safety goggles
- (ii) Protective clothing
- (iii) Protective gloves
- (iv) Gas mask
- (v) Safety screen

(b) In your opinion do you feel safe working in the laboratory as it is at present?

YES

NO

10. (a) Do you have a log-book for reporting accidents in the laboratory?

YES

NO

(b) Suggest ways of improving laboratory safety.

(i) \_\_\_\_\_

\_\_\_\_\_

(ii) \_\_\_\_\_

\_\_\_\_\_

(iii) \_\_\_\_\_

\_\_\_\_\_

**THANKS FOR YOUR CO-OPERATION**

**CONFIDENTIAL****1.2 QUESTIONNAIRE FOR SCIENCE TEACHER (HOD)**

The purpose of this questionnaire is to help establish the status of safety measures in school laboratory.

Kindly provide the information requested. The information will be treated as confidential and will only be used for the purpose of this research.

NAME OF SCHOOL \_\_\_\_\_

**1.1 CURRENT STATUS OF SCHOOL**

(a) Management Private

Public

(tick (✓) as appropriate)

(b) Number of streams \_\_\_\_\_

© Number of students per class \_\_\_\_\_

(d) Number of science rooms (labs) \_\_\_\_\_

**1.2 INFORMATION ON SCIENCE TEACHERS (BIOLOGY, CHEMISTRY, PHYSICS)**

Key to qualification

- A - Form 6 Untrained Teacher
- DIP - Diploma/S1
- GU - Graduate Untrained
- GT - Graduate Trained

Use the key above to fill the table below:-

QUALIFICATION	NO. OF TEACHERS	EXPERIENCE (YEARS)
A		
DIP		
GU		
GT		

2. What is the average number of class experiment lessons conducted per week in the laboratory?
- (a) Forms 1 & 2
- (b) Forms 3 & 4
3. Are the classes too large (in terms of number of pupils) to be effectively supervised during the class experiment lessons?
- YES
- NO
4. In your opinion is there overcrowding (in terms of space) in the laboratory during class experiment lessons?
- YES
- NO
5. Is the laboratory provided with:-
- (a) Storage facilities for pupils items such as clothes, bags, jackets?
- YES
- NO

(b) Area for storage of excess laboratory stools?

YES

NO

6. (a) Are the pupils provided with copies of laboratory rules and regulations?

YES

NO

(b) Have it been made clear to the pupils that safety is an integral part of the study of science?

YES

NO

(c) Are pupils given explicit warning of any hazards associated with particular experiments, materials or techniques?

YES

NO

(d) How often do you conduct scheduled lessons on laboratory safety?

(i) Thrice a year

(ii) Twice a year

(iii) Once a year

(iv) Once every two years

(v) Once every four years

(vi) Never

7. (a) Are the mains - gas, water, electricity - controls situated in an easily accessible place?

YES

NO

(b) Have the pupils been shown their location and instructed on how to operate them?

YES

NO

(c) Have the pupils been drilled on how to act in case of:-

(i) Fire in the laboratory?

YES

NO

(ii) Toxic poisoning in the laboratory?

YES

NO

(iii) Any accident in the laboratory?

YES

NO

8. (a) Is the Laboratory provided with a first aid kit?

YES

NO

(b) In your opinion do you think the contents are adequate to deal with hazards that are likely to occur in the laboratory?

YES

NO

- (c) Are the teachers cautioned on pupils abnormal susceptibilities e.g. allergies to chemical and biological materials, respiratory problems etc.

YES

NO

- (d) Comment on the proficiency of teachers in administration of first aid.

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9. (a) Is the laboratory provided with fire fighting equipments?

YES

NO

- (b) In your opinion would the equipment be adequate to deal with likely fire hazard in terms of:-

- (i) quantity

YES

NO

- (ii) quality

YES

NO

(c) Comment on:-

(i) Proficiency of teachers to use equipment

(ii) Proficiency of pupils to use equipment

10. In some experiment there is risk of explosion e.g. burning hydrogen-air mixture or reactions involving alkali metals.

(a) When conducting such experiments do you provide the pupils with safety goggles?

YES

NO

(b) When conducting demonstrations on such experiments do you use a safety screen to protect yourself and the pupils?

YES

NO

(c) Do you have a functional fume chamber in the laboratory?

YES

NO

(d) Do you use the fume chamber when preparing poisonous gases such as chlorine, ammonia, hydrogen sulphide?

YES

NO

If no where do you prepare these gases?

11. (a) Have you ever been asked to release your class to teachers on teaching practice?

YES

NO

- (b) If YES do you make it your responsibility to ensure that His/Her laboratory lessons are conducted safely?

YES

NO

- 12. (a) How many science teachers have received pre-service/In service training in basic fire fighting techniques?

\_\_\_\_\_

- (b) Who organised the training?

\_\_\_\_\_

- (c) How often do the teachers attend such programmes?

- 13. (a) How many science teachers have received pre-service/In service training in administration of first aid?

\_\_\_\_\_

- (b) Who organised the course?

\_\_\_\_\_

- (c) How often do the teachers attend such courses?

\_\_\_\_\_

- 14. Suggest ways in which safety in laboratories can be improved.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**THANK YOU FOR YOUR CO-OPERATION**

### 1.3 OBSERVATION SCHEDULE

NAME OF SCHOOL

NUMBER OF LABORATORY ROOMS

#### OBSERVATION CHECKLIST

- 1) Condition of water system
  - (i) Lay - out
  - (ii) Condition
  
- 2) Condition of gas system
  - (i) Lay - out
  - (ii) Condition
  
- 3) Condition of Electrical system
  - (i) Lay - out
  - (ii) Sockets/Switches
  - (iii) Exposed wiring
  
- 4) Fume Chamber
  - (i) Exhaust fan
  - (ii) Doors
  
- 5) Condition of Sink/drainage system
  - (i) Sinks
  - (ii) Drainage pipes
  - (iii) Drainage canals
  
- 6) Storage Facilities
  - (i) Adequacy
  - (ii) Availability
  
- 7) Condition of Benches

- (i) Top
  - (ii) State of Maintenance
- 8) Exit Doors
- (i) Emergency doors
  - (ii) Direction of opening (Main & Emergency)
- 9) Floor
- (i) Finishing
  - (ii) Cracks

EGERTON

UNIVERSITY



P.O. Box 408  
Phone: 0381-20531\3  
KISII

KISII COLLEGE CAMPUS

24th October, 1995

To  
The School Head,

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Dear Sir/Madam,

RE: REQUEST FOR ASSISTANCE TO OUR P.G.D.E. STUDENTS

Our Post Graduate Diploma Students are required to carry out a Research Project as part of their course work and your school has been identified as an appropriate source of information.

Any assistance given to the student(s) concerned will be highly appreciated.

Yours faithfully,

DR. HELLEN SAMBILI  
CHAIRLADY CURRICULUM & INSTRUCTION DEPARTMENT  
For: VICE CHANCELLOR



c.c. Principal  
Kisii College Campus

HS/cng