THE WESTERN CAPE EDUCATION DEPARTMENT

SCHOOL LABORATORY SAFETY

PROTOCOL AND POLICY

MARCH 2004

Contents

1. INTRODUCTION

School laboratory safety has not received consistent and sufficient attention in South Africa. Chemical waste disposal has been grossly neglected.

The Western Cape Education Department is responsible for ensuring that sound science teaching and learning can be achieved in its schools without compromising its commitment to a clean environment and the safety of its learners, teachers and schools. The Department recognises that school laboratories are potentially dangerous zones and that the storage and use of chemicals need to be tightly controlled. It is also aware that the misuse of chemicals stored in its schools can endanger public safety.

The Department has noted the impact that the new Explosives Bill will have on the storage and use of chemicals in its schools and of the external inspections that are envisaged.

The Department is thus obliged to take the necessary steps to ensure safety and prevent the misuse of chemicals in schools.

2. SAFETY FRAMEWORK

To achieve its goals of safety in school science, the Department:

- requires each school to appoint a safety officer from its staff.
- requires each EMDC to nominate an external safety monitor to monitor safety practices in school science in that EMDC.
- prescribes the functions and responsibilities of the principal, safety officer, safety monitor, school science teachers and learners.
- has provided examples of hazardous chemicals and reactions.
- places restrictions on the use of hazardous chemicals and the creation of hazardous chemical reactions.
- has provided instructions regarding ways in which chemicals should be stored.
- has indicated ways in which chemical waste can be rendered harmless or disposed of.
- will provide training for unqualified and inexperienced teachers in the use of hazardous chemicals.
- will provide schools with a manual containing broad information on safety in school science.

3. APPOINTMENT OF SCIENCE SAFETY OFFICER

The principal of the school will annually appoint in writing the most competent staff member as the responsible science safety officer. The principal will arrange several meetings with staff members and consult experts if necessary to ensure that the best person is appointed.

4. SAFETY IN SCHOOL SCIENCE LABORATORIES

4.1 Functions of the science safety officer

The functions of the science safety officer in a school are to

- develop school policy on safety in science in alignment with the WCED Policy and Protocol on Safety in School Science.
- dispose of certain chemicals in accordance with the procedure prescribed in the WCED Policy and Protocol on Safety in School Science.
- draw up the timetable for the use of the laboratory by teachers and learners.
- issue restricted chemicals and other chemicals to teachers and to keep a record of them.
- ensure that chemicals are used, stored and arranged in ways that ensure safety.
- do on-site training and development of science teachers on matters relating to science safety.
- ensure that the science laboratory is used, managed and kept in a condition that ensures safety and to inspect it daily.
- report immediately to the principal any matters which are hazardous or could lead to a hazard.
- keep an inventory of all restricted chemicals by name and quantity and to update this quarterly.
- ensure that safety signs are displayed in the laboratory and that hazardous chemicals are labelled.
- order the chemicals that are required for science teaching.
- formulate the code of conduct required of science learners and teachers to ensure safety.

4.2 Duties and responsibilities of the teachers using the laboratory and chemicals

In order for the safety officer to execute these functions, the co-operation of the teachers concerned is essential. To achieve this, the duties and responsibilities of teachers are stipulated below. Teachers using the laboratory and chemicals must co-operate with the safety officer to ensure safety.

Such teachers will

- know and apply the School Science Safety Policy.
- ensure that learners using the laboratory follow appropriate codes of conduct that ensure safety.
- ensure that learners are not left in the laboratory on their own or without supervision.
- turn off the gas supply at the end of a lesson.
- lock all chemicals away and ensure that there are no chemicals left lying around the laboratory.
- lock the laboratory door during school breaks and when it is not in use.
- keep hazardous chemicals locked away when they are not in use.
- instruct learners about the dangers involved and the precautions that should be taken before learners handle hazardous chemicals and hazardous chemical reactions.
- not allow learners to perform those reactions which, according to the syllabus, must be demonstrated by the teacher.
- not take chemicals out of the laboratory without the approval of the safety officer.
- use chemicals only for the purposes prescribed in the syllabuses.
- use only those chemicals approved by the safety officer.
- return chemicals after use to their correct storage positions in the storeroom.
- handle hazardous chemicals and hazardous chemical reactions safely.
- report any hazardous or potentially hazardous matters to the safety officer.
- allow learners to smell, taste and touch chemicals only under supervision.

4.3 Responsibilities of learners using the science laboratory

In order for the safety officer to execute his or her functions, co-operation from learners is essential. The duties and responsibilities of learners using the science laboratory are given below.

Learners will

- know and adhere to the School Science Safety Policy.
- co-operate with the teacher on duty and with the safety officer to ensure safety at all times.
- conform to the code of conduct laid down by the safety officer.

5. NOMINATION OF EXTERNAL SCIENCE SAFETY MONITOR

The director of an EMDC will annually appoint in writing the most competent staff member as the responsible external science safety monitor. The director will consult experts if necessary to ensure that the best person is appointed.
Should there be no suitable person, the chief curriculum adviser or an appropriate senior curriculum adviser or curriculum adviser will act as external science safety monitor.

6. FUNCTIONS OF THE EXTERNAL SCIENCE SAFETY MONITOR

The external science safety monitor will

- ensure annually that each school offering science in the EMDC is practising safety in accordance with WCED Safety Policy and Protocol before their laboratories can be declared safe.
- report quarterly to the director of the EMDC concerned, via the chief curriculum adviser, on the status of safety in the EMDC's schools.
- train school safety officers on safety matters.

7. RESTRICTED CHEMICALS

A list of hazardous chemicals supplied to WCED schools is summarised in **Appendix A**. The use of these chemicals is restricted to their use as prescribed in the syllabuses. When these chemicals are used, additional precautions should be taken to ensure safety. Unless otherwise stated in the syllabus, learners should not personally handle these chemicals and only teachers should demonstrate them and their reactions to learners. Teachers wanting to use any of these chemicals must inform the safety officer in advance who will issue them. This process should be well planned so that it does not impede teaching and learning.

All hazardous chemicals must have visible labels and appropriate warning symbols.

These chemicals must not be used in primary schools.

8. RESTRICTED CHEMICAL REACTIONS

A list of chemicals which are supplied to schools and which produce hazardous products when heated or when reacting with other substances, is summarised in **Appendix B.** The demonstration of these reactions is restricted to what is prescribed in the syllabus. When these reactions are performed, additional precautions should be taken to ensure safety. Unless otherwise stated in the syllabus, learners should not personally create these reactions and only teachers should demonstrate them to learners. These reactions should not be demonstrated in primary schools.

9. STORAGE OF CHEMICALS

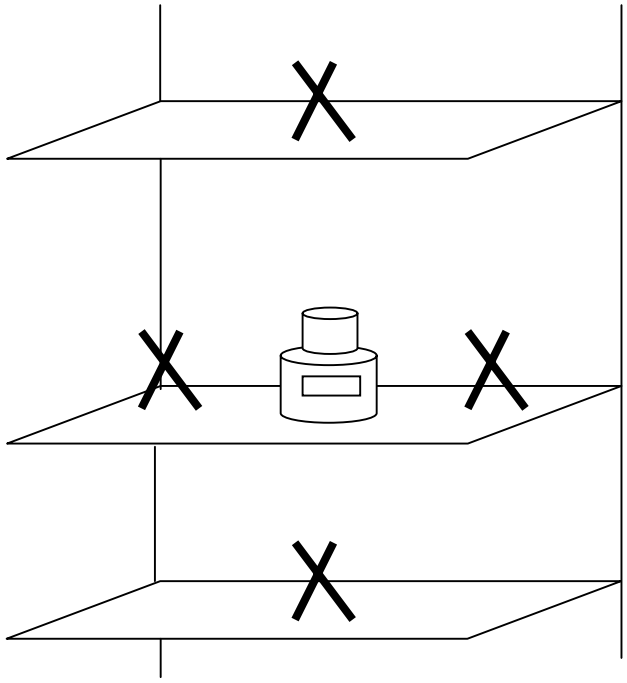
9.1 Chemicals not listed in the syllabus or supplied by WCED to schools

The school science safety officer will make a list of all such chemicals, either in stock or recently purchased, and their intended use. This list must be submitted quarterly to the external science safety monitor. The external science safety monitor will prohibit the

storage and/or use of any chemicals deemed to be inconsistent with the WCED School Science Safety Policy and Protocol.

9.2 Incompatible chemicals

'Incompatible chemicals' are chemicals that can react with one another and create hazards. Chemicals must be stored in ways that make them easy to find and that do not create hazards. Thus, incompatible chemicals should not be stored as vertical or horizontal neighbours on shelves. A list of these incompatible materials and chemicals are provided in **Appendixes C and D.**



X marks the positions where incompatible chemicals should not be placed.

Chemicals should be kept in a separate room and not in the same room as the Physics apparatus. Large containers containing chemicals should be stored on the floor. There should be no hazardous vapours in either the Physics or Chemistry storeroom.

10. DISPOSAL OF CHEMICAL WASTE

A school's safety in science policy should make provision for procedures to be followed for the disposal of chemical waste. This policy should make provision for the disposal of chemical waste only at sites approved by local government. To dispose of chemical waste, schools should contact their local government's Waste Management division. Their contact details are as follows:

Telephone enquiries: (021) 487 2477
Fax: (021) 487 2476
Web site address: http://www.cmc.gov.za/w&w

Waste Management is a branch of the Directorate: Water and Waste Administrative Services. This Directorate's contact details are as follows:

General telephone enquiries: (021) 487 2669
After-hours emergencies tel. no: (021) 424 7715
Web site address: http://www.cmc.gov.za

11. PROCEDURES FOR EMERGENCIES

12.1 Theft

All cases of theft should be brought to the immediate attention of the school science safety officer who will inform the school principal and the EMDC concerned through its external science safety monitor. The school science safety officer will write a report on the theft and lodge copies of it with the school principal and the external science safety monitor. The school principal will report the matter to the local police authority, open a case and initiate an investigation. If necessary, the external science safety monitor will do an on-site assessment of the theft and report this assessment to the chief curriculum adviser. In all theft cases, the school and the EMDC concerned should file reports and keep the Department informed.

12.2 Injuries and accidents in the laboratory

Injuries should be brought to the immediate attention of the principal through the school science safety officer. Once the cause of the injury is identified, the teacher on duty should render first aid in accordance with the instructions in the Safety in School Science Manual for that injury. In severe cases, the injured person(s) should be taken to hospital.

In the case of serious hazards, such as uncontrollable fires, the laboratory should be evacuated and the local authority concerned alerted to bring the situation under control. The school science safety officer must submit a written report on the incident with the external science safety monitor. Both the school and the EMDC concerned must keep a copy of this report on file.

Each laboratory should be equipped with a first aid kit, fire extinguisher, blanket, spade and bucket in compliance with the requirements in the Safety in School Science Manual.

13. TRAINING

The school's science safety officer will immediately train science teachers in school science safety should this be necessary. The EMDC's external science safety monitor will train newly appointed science safety officers on request. This official will also train science safety officers in schools where science has recently been introduced into the curriculum.

14. SAFETY IN SCHOOL SCIENCE MANUAL

The Department will develop this manual and issue a copy to each of its schools.

15. GENERAL

Whilst the Department is sympathetic to schools that use make-shift apparatuses, it needs to be stressed that schools making and using such apparatuses do so at their own risk. If there are schools storing chemicals other than the minimum required to teach the syllabus, they do so at their own risk and are reminded that the storage and use of these chemicals are not protected by this policy.

APPENDIX A: LIST OF RESTRICTED CHEMICALS

Key:

E = Explosive [tending to explode]
F = Flammable [can be set on fire]
T = Toxic [poisonous]
M = Mutagen [causes mutation in an organism]
O = Oxidant [promotes oxidation or burning]
C = Corrosive [eats away by chemical reaction]
I = Irritant [causes irritation to skin or eyes, etc.]
HC = Human Carcinogen [causes cancer in humans]
PHC = Probable Human Carcinogen [probably causes human cancer]

CHEMICAL	Explosiv	Oxidant	Flammabl	Corrosiv	Toxic	Irrltant	Mutagen	Carcinog
Acetic acid				C				
Aluminium chloride				C				
Aluminium powder	E				T			
Ammonia					T	I		
Ammonium dichromate	E			C	T	I	M	
Ammonium nitrate	E							
Ammonium thiocyanate					T			
Barium chloride					T			
Barium hydroxide					T			
Benzene			F		T			HC
Bromine				C		I		
Butanol			F		T			
Carbon (graphite)						I		
Carbon disulfide	E		F					
Carbon tetrachloride					T	I		PHC
Charcoal			F					
Chlorine				C	T	I		
Chloroform					T			PHC
Copper carbonate						I		
Copper carbonate						I		

Copper chloride						I		
Copper nitrate	E				T	I		
Copper oxide						I		
Copper sulphate						I		
Cyclohexane			F			I		
Cyclohexene			F			I		
Decanedioyl dichloride					T			
Ethanoic acid			F			I		
Ethanol			F					
Ether		E	F					
Ether (diethyl ether)			F					
Ethyl ethanoate			F					
Hydrochloric acid				C	T	I		
Hydrogen gas		E	F					
Hydrogen peroxide (30%)				C		I		
Hydrogen sulphide			F		T	I		
Indigo carmine							M	
Iodine vapour				C		I		
Iodine crystals				C		I		
Iron (lll) chloride						I		
Lead (ll) oxide					T			
Lead acetate					T			
Lead bromide					T			
Lead carbonate					T	I		
Lead nitrate					T			
Lead sulphide					T			
Liquid petroleum gas		E	F					
Lithium		E		C				
Lithium chloride				C				
Lithium hydroxide				C				
Magnesium			F					
Mercuric oxide					T			
Mercury					T			
Mercury nitrate					T			
Methanol			F		T			
Methylated spirits			F					

Methanoic acid (formic acid)			F			I		
Methanal (formalin)			F			I		
Naphthalene			F			I		
Nickel								PHC
Nitric acid		O				I		
Oxalic acid				C				
Oxygen gas		O						
Phenolphthalein						I		
Phosphorous (white)				C	T			
Phosphorous pentoxide				C	T			
Phosphorous red			F					
Phosphorous yellow			F	C				
Potassium	E			C				
Potassium carbonate								
Potassium chlorate		O			T	I		
Potassium dichromate				C				HC
Potassium hydroxide				C		I		
Potassium permanganate	E					I	M	
Propanone (acetone)			F		T	I		
Silver nitrate				C			M	
Soda lime				C				
Sodium				C				
Sodium hydroxide				C		I		
Sodium hypochlorite				C		I		
Sodium nitrate							M	
Sodium nitrite	E	O					M	
Sodium peroxide					T			
Sodium sulphide						I		
Sulphur			F					
Sulphuric acid				C				
Turpentine			F			I		

APPENDIX B: RESTRICTED CHEMICAL REACTIONS

CHEMICAL	DESCRIPTION OF THE REACTION AND HAZARD
Acids	Produce heat and hydrogen gas that can explode when they react with metals. Produce heat when water is added. Violent reactions take place when acid is added to water and hot acid is released.
Alkali metals (Group l)and alkaline earth metals (Group ll)	React vigorously with water to release much heat and hydrogen gas, which can explode. Most of these metals burn in oxygen or air.
Ammonium nitrate	Forms hazardous mixtures with acids, chlorates, flammable liquids and finely divided materials.
Ammonium thiocyanate	It can release fumes containing cyanides when heated above 170 ^{o}C.
Bleaching powder	Emits poisonous chlorine gas when it is dissolved in water. Explodes when heated above 100 ^{o}C. Emits toxic and possibly explosive fumes if acid is added to it.
Calcium metal	Fumes emitted from burning calcium are calcium oxide (quicklime)
Calcium carbide	It forms ethyne (acetylene) when it is mixed with water.
Calcium oxide	It produces much heat when it reacts with water, steam, acids or acid fumes.
Carbon (graphite)	If burnt, can explode
Carbon disulphide	Like most flammable gases, it forms an explosive mixture with air.
Ethyne (acetylene)	Forms an explosive reaction when ignited in the presence of oxygen, releasing much heat.
Potassium chlorate	Can explode violently if carbon or organic compounds are added or other impurities, such as dust, are present when it is heated.
Potassium hydroxide	Produces heat when it is added to water.
Silver nitrate	It forms an explosive mixture with magnesium powder.
Sodium hypochlorite	Reacts with acids to form poisonous chlorine gas. It also releases chlorine gas when it is heated.
Sodium hydroxide	Produces heat when it is added to water.
Sodium nitrite	Explodes when heated in the vicinity of 500 ^{o}C. Can form explosive mixtures with ammonium salts and thiosulphates
Sodium peroxide	Reacts violently with water.
Sulphur	Produces toxic sulphur dioxide when it is heated in oxygen. Forms explosive mixtures with zinc and magnesium powder, and with chlorates and other oxidants.
Zinc powder	Is explosive. It forms explosive mixtures with sulphur.

APPENDIX C: INCOMPATIBLE CHEMICALS [General]

The pairs below are general examples of incompatible materials.

Oxidising agents	**and**	**flammables**
Oxidising agents	**and**	**reducing agents**
Acids	**and**	**bases**
Acids	**and**	**sulphides**
Acids	**and**	**flammables**
Acids	**and**	**chlorine compounds**
Acids	**and**	**alcohols**
Acids	**and**	**elemental metals**
Water	**and**	**Groups I and II elements**
Water or air reactives	**and**	**anything**
Organic peroxides	**and**	**anything**

APPENDIX D: INCOMPATIBLE CHEMICALS [Specific]

Specific examples of incompatible chemicals are given in the table below.

(Adapted from *Safety in Academic Chemistry Laboratories:* American Chemical Society)

CHEMICAL	INCOMPATIBLE WITH
Acetic acid	Nitric acid, hydroxyl compounds, peroxides, permanganates
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Acetone	Concentrated nitric acid and sulphuric acid mixtures
Alkali and alkaline earth metals (Groups l and ll elements] e.g. potassium, lithium, sodium, calcium, magnesium and aluminium powder	Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, halogens
Ammonia (anhydrous)	Mercury, chlorine, calcium hypochlorite, iodine, bromine, anhydrous hydrofluoric acid
Ammonium nitrate	Acids, powdered metals, flammable liquids, chlorates, nitrites, sulphur, finely divided organic combustible materials
Bromine	Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, benzene, metals, turpentine
Calcium oxide	Water
Carbon (activated)	Calcium hypochlorite, all oxidising agents
Carbon tetrachloride	Sodium
Chlorates	Ammonium salts, acids, powdered metals, sulphur, finely divided organic or combustible materials
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, benzene, finely

	divided metals, turpentine
Copper	Acetylene, hydrogen peroxide
Flammable liquids	Ammonium nitrate, hydrogen peroxide, nitric acid, sodium peroxide, halogens
Fluorine	All other chemicals
Hydrocarbons, e.g. butane, propane, benzene	Fluorine, chlorine, bromine, sodium peroxide
Hydrofluoric acid (anhydrous)	Ammonia (aqueous or anhydrous)
Hydrogen peroxide	Copper, iron, most metals or their salts, alcohols, acetone, organic materials, combustible materials
Hydrogen sulphide	Fuming nitric acid, oxidising gases
Hypochlorites	Acids, activated carbon
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen
Mercury	Acetylene, ammonia
Nitrates	Sulphuric acid
Nitric acid (concentrated)	Acetic acid, hydrogen sulphide, flammable liquids and gases, copper, brass, any heavy metals
Nitrites	Acids
Oxalic acid	Silver, mercury
Oxygen	Oils, grease, hydrogen, flammable liquids, solids or gases
Phosphorous (white)	Air, oxygen, alkalis, reducing agents
Potassium	Carbon tetrachloride, carbon dioxide, water
Potassium chlorate	Sulphuric and other acids
Silver	Acetylene, oxalic acid, tartaric acid, ammonium compounds
Sodium	Carbon tetrachloride, carbon dioxide, water
Sodium nitrite	Ammonium nitrate and other ammonium salts
Sodium peroxide	Ethanol or methanol, glacial acetic acid, carbon disulphide, glycerine, methyl or ethyl acetate
Sulphides	Acids
Sulphuric acid	Potassium chlorate, potassium permanganate (similar compounds of light metals, such as sodium, lithium)