ZIMBABWE

MINISTRY OF PRIMARY AND SECONDARY EDUCATION

CURRICULUM DEVELOPMENT AND TECHNICAL SERVICES

CHEMISTRY

SECONDARY SCHOOL LEVEL

FORM 3 - 6

2015-2022

TEACHER'S GUIDE

Curriculum Development Unit
P.O.BOX MP133
Mount Pleasant
Harare

ACKNOWLEDGEMENTS

The Ministry of Primary and Secondary Education would like to acknowledge the following:

- The Chemistry National Syllabus Learning Area Panel
- United Nations Children's Fund (UNICEF)

TABLE OF CONTENTS

1.0 ORGANISATION OF THE TEACHER'S GUIDE

This document helps you the teacher to implement the Chemistry curriculum effectively.
This teacher's guide is divided into two parts, A and B. Part A focuses on the critical documents you must have as a teacher. Part B deals with curriculum delivery i.e the content, objectives, methodology, instructional materials, class management and assessment.

Part A-Critical Documents

Part B-Curriculum Delivery

2.0 PART A

CRITICAL DOCUMENTS

Introduction

As a teacher it is important for you to have the critical documents and understand them in order to deliver the Chemistry learning area effectively. The critical documents are listed and described for you.

Rationale

Chemistry plays a role in the technological development of any country since it is embedded in our everyday life. The study of Chemistry enables learners to be creative and innovative in industry and society promoting the application of Chemistry in industrial processes for value addition, beneficiation of natural resources and harnessing of available opportunities for entrepreneurship. The Chemistry syllabus enables learners to develop the following skills:

- Problem Solving
- Critical thinking
- Decision making
- Conflict resolution
- Leadership
- Self-management
- Communication
- Technology and innovation
- Enterprise

Objectives

By the end ofpart A which is on critical documents as a teacher you should be able to;

a) Identify critical documents you should have
b) Show understanding of each document

Critical documents you should have

- Curriculum Framework
- Chemistry National Syllabus
- Chemistry School Syllabus
- Scheme cum plan or Schemes of Work and lesson plans
- Learner Profile
- Records
- Register of Attendance
- Assessment Framework

UNIT 1

Curriculum Framework for Zimbabwe Primary and Secondary Education

Introduction

This is a policy document that outlines the underpinning national philosophy, principles, learning areas, the description and expectations of Ministry of Primary and Secondary education (MOPSE) at policy level, serving as a prescription of government expectations.

Objectives

By the end of unit 1 as the teacher you should be able to:

- identify key elements of the new curriculum
- demonstrate understanding of the values that define the new curriculum

Key Elements

The following are the key elements of the curriculum framework:

- Background
- Principles and values guiding the curriculum
- Goals of the Curriculum
- Learning areas
- Teaching and learning methods
- Assessment and learning
- Strategies for effective curriculum implementation
- The future

UNIT 2

SYLLABUS INTEPRETATION

Introduction

Syllabi are key documents for you as a teacher which you should always refer to.

Objectives

By the end of this unit you should be able to interpret the national and school syllabi understanding their components.

TYPES OF SYLLABUS

There are two types of syllabi namely national syllabus and school syllabus

2.1 National Syllabus

The national syllabus is a policy document that articulates the learning objectives, the expected outcomes, the learning content and the recommended teaching and learning approaches. It also includes assessment strategies. As a teacher, you should always have it to guide you in your day to day teaching and learning activities.

Elements

Below are the elements found in the national syllabus:

- Acknowledgements
- Contents
- Preamble
- Presentationof the syllabus.
- Aims
- Syllabus objectives
- Methodology and time allocation
- Topic
- Scope and sequence chart
- Form 3-4 competency matrix/form 5-6 competency matrix
- Assessment

Contents

The contents of the national syllabus are in the respective documents
Chemistry Syllabus Form 3-4 and Form 5-6

2.2 School Syllabus

This is drawn at school level from the national syllabus by reorganising content taking into account local factors.

Factors influencing drafting of the school syllabus

The school syllabus is drafted, taking into consideration different factors listed below:

- Level of learner performance (knowledge they already have)- make use of progress reports and evaluation reports
- Relevant facilities and resources(in chemistry one may consider expensive practicals being done in January capitalizing on using left over materials from previous external examination)
- Time allocation in the official syllabus
- Local conditions that affect the choice and sequencing of topics
- Education technology
- Community influences

ELEMENTS

- Topic/content
- Activities
- Time allocation
- Methodology (N.B. learner – centered)
- Instructional or teaching materials
- Assessment

UNIT 3

SCHEME OF WORK

Scheme of work is an interpretation of a specification or syllabus and can be used as a guide throughout the course to monitor progress against the original plan. This is a document that as a teacher you should draw from the national and school syllabus. You should outline the objectives, activities, content and methodologies. You should draw your scheme of work/scheme cum plans at least two weeks ahead of lesson delivery date.

Components
Week ending
Topic/Content
Objectives
Competencies
Source
Methods
Activities
Evaluation

WEEK ENDING	TOPIC/ CONTENT	OBJECTIVES	COMPETENCIES/ SKILLS/ KNOWLEDGE	SOM/MEDIA	FACILITY /EQUIPMENT	METHODS/ ACTIVITIES	EVALUATION
20/01/2017	**Chemical bonding** Covalent and ionic bonding	● describe the formation of ionic bonds between metals and a non-metals ● describe the formation of a covalent bond ● deduce chemical formula of a compound from dot and ● cross diagrams ● Differentiate ionic from covalent compounds. ● describe metallic bonding as ● a lattice of positive ions in a ● 'sea of delocalised electrons' ● relate the physical properties of metals to metallic bonding	predict behaviour of atoms when bonding with other atoms by understanding how atoms are more stable -draw dot and cross diagrams for given compounds -identify metals using paroperties	National Syllabus p8 https://youtu.be/QwpH0Eww-mo o level chemistry (quote relevant textbooks and pages)	Molecular models Science kits Sodium chloride Candle wax Burner Circuit boards Water ICT tools	● Drawing dot and cross diagrams to show ionic and covalent bonding for given compounds ● Constructing models to represent compounds ● Experimenting on: - melting points - boiling points - electrical conductivity - solubility ● Discussing metallic bonding ● Simulations ● Drawing metallic bond model	

WEEK ENDING	TOPIC/ CONTENT	OBJECTIVES	COMPETENCIES/ SKILLS/ KNOWLEDGE	SOM/MEDIA	FACILITY /EQUIPMENT	METHODS/ ACTIVITIES	EVALUATION
20/01/2017	Electrochemistry Lesson 1 ● Redox processes Lesson 2 ● Electrode potentials	-describe redox processes in terms of electron transfer and changes in oxidation state. -Calculate oxidation states -describe the terms standard electrode potential and standard cell potential. -describe the measurement of electrode potentials using the standard hydrogen electrode.	Learners identifying redox reactions Learners calculating oxidation states Learners drawing standard hydrogen cells Learners constructing simple cells Learners measuring electrode potentials	National Syllabus p18 https://youtu.be/QwpH0Ewwmo A level chemistry National Syllabus p18 https://youtu.be/QwpH0Ewwmo A level chemistry (author and page)	Magnesium ribbon, Bunsen burner, copper wire, silver nitrate, iron in copper sulphate Lemon, connecting wires, bulb, beakers, copper electrode, zinc electrode, copper sulphate, zinc sulphate, voltmeter, cotton, distilled water, potassium nitrate, clips	-Discussing reduction and oxidation in terms of electron transfers. -Experimenting on redox reactions. -Calculating oxidation states -Drawing the standard hydrogen electrode. -Calculating standard cell potentials. -Experimenting on constructing simple cells -Experiment on constructing the Daniell's cell	

UNIT 4

LESSON PLAN

Definition

This is a detailed daily plan of what you intend to deliver during the lesson. This is to be used in the event of you having drawn a scheme of work rather than a scheme cum plan.
Components of a lesson plan

Date

Time

Learning area

Topic/Content

Subtopic

SOM

Equipment

Number of students

Assumed knowledge

Lesson objectives

Evaluation

DETAILED LESSON PLAN

Date:	17 January 2017
Form:	Form 3
Time:	11:30 -12:40
Learning Area	Chemistry
Topic/Content:	Chemical bonding
Sub-Topic:	Covalent bonding
S.O.M:	National Syllabus page 8
Equipment:	models, TV, flash
Number of students:	45
Assumed Knowledge:	Learners know the electronic configuration and valencies of elements

Lesson Objectives

By the end of the lesson, learners should be able to:

- Build up compounds using models
- Use the models to draw the "dot and cross" diagrams of given compounds
- Define covalent bond

STAGE/TIME	TEACHER ACTIVITIES	LEARNER ACTIVITIES	POINTS TO NOTE
Introduction 10 mins	-to play a short video on structures of molecules -to supervise the learners as they watch the video a	- to watch a short video on structures of molecules -engage in class discussion	Mastering of structure formation
Skill development 20 mins	-to supervise the learners as they build up model molecules	- to collect the required models - to build up model compounds using model elements and bonds in groups	Accuracy in bond formation
Application 20 mins	- to give learners the task to draw the dot and cross diagrams of a variety of compounds	- to draw dot and cross diagrams for the compounds using the models in groups	Accuracy in drawing "dot and cross" diagrams
Summary 10 mins	- organizes Learners to presents their solutions. -Create a platform for class discussion on group presentations	- present their findings per group and entertain questions from the class	Mastery of the concepts under discussion
Conclusion 10mins	- harmonizes the findings from Learners and top up with suitable scientific terms.	- take down questions on power point	

LESSON EVALUATION:

Strength: .....
.....
.....
.....

Areas to be improved: .....
.....
.....
.....

UNIT 5

RECORD - KEEPING

Records are critical documents about the teaching and learning process which you must keep as a teacher

TYPES OF RECORDS

- National syllabuses
- School syllabuses
- Records of staff details
- Records of learner details
- Supervision records
- Files, circulars, handouts, past exam papers
- Minutes of meetings
- Inventory of resource materials
- Stock control registers
- Progress records
- Learners profile
- Assessment framework

Conclusion

It is advisable to have and keep these documents diligently as they are professional documents. They should be ready for supervision so should be kept safely.

3.0 PART B

CURRICULUM DELIVERY

Introduction

This part deals with curriculum development and it is important as a teacher to be well versed with the content, objectives, methodology, learning-teaching materials, evaluation/assessment and class management.

3.1 Objectives

By the end of this unit, you should be able to:

- select appropriate teaching methods for your lessons
- use a variety of learner-centered approaches
- plan and organize study tours
- help pupils carry-out projects or experiments

3.2 CONTENT

The scope of the chemistry syllabus enables learners to understand the technological world in which they live and take an informed interest in science and scientific development. In curriculum delivery it is important to take note of cross cutting issues and how they affect the learner and the immediate environment. In embracing the content it is vital to take into consideration issues such as HIV and AIDS, pollution and climate change. Of paramount importance is the issue of safety precautions which should be diligently observed. Learners gain an understanding of the basic principles of Chemistry through a mix of theoretical and practical studies. The content is designed to produce learners that are scientifically competent, research oriented and has a sense of humanity. As they progress learners understand how Chemistry is studied and practiced and become aware that the results of scientific research can have both good and bad effects on individuals, communities and the environment.

3.3 Methodology

As a teacher it is important for you to use problem-solving and learner-centered approaches. You are the facilitator and the learner is the doer. Select appropriate teaching methods for your lessons. You should use a variety of learner-centered approaches, plan and help learners carry-out projects or experiments. Given below are the methodologies you can embrace during curriculum delivery. However the list is not exhaustive.

- Question and answer
- Lecture
- Demonstration
- Observation
- Simulation
- Role play
- Experimentation
- Project
- Field trips

Choice of method is influenced by:

- Your personality
- learner`s level of development (cognitive, affective and psychomotor)

- Content to be covered
- Competencies to be developed

Cross- Cutting Themes

The Chemistry learning area encompasses the cross cutting themes listed below:

- Inclusivity
- Environmental issues
- Indigenous knowledge system
- Enterprise Education
- Life skills
- Team work
- Food security
- Safety and health issues
- Disaster risk management
- HIV/ AIDS

3.4 Teaching and learning materials

There are a variety of teaching and learning materials that can be employed in the chemistry curriculum delivery. You are encouraged to be resourceful and improvise wherever possible. Given below are examples of materials you can use:

- test tubes
- burettes
- magnesium ribbon
- Bunsen burner
- water bath
- electronic balance
- pH meter
- nitric acid
- sodium hydroxide
- copper sulphate
- projector
- model kits

3.5 Assessment and Evaluation

There is need to measure your success in terms of teaching and learner performance. Evaluation is aimed at giving you feedback on the acquisition of knowledge, competencies and attitude of learners.

Evaluation/assessment can be in form of exercises, tests, projects, or group tasks. There are two main types of evaluation:

- Formative evaluation (ongoing/continuous)
- Summative evaluation(coming at the end of the course)

Methods of assessment

- Tests and exercises
- Assignments
- Research

- Examinations
- Projects
- Practical

3.6 Class Management

Is the process of planning, organizing, leading and controlling class activities to facilitate effective teaching and learning. Classroom management can be categorized into organizational, physical, emotional, grouping, control, motivation and supervision.

- **ORGANISATIONAL SKILLS FOR EFFECTIVE CHEMISTRY LEARNING**

Laboratory organization which covers:

- physical environment
- emotional environment
- grouping the learners
- class control and discipline
- supervision

- **PHYSICAL ENVIRONMENT**

- Laboratory to be clean, tidy and well ventilated
- Safety considerations when arranging furniture/equipment
- Teaching aids to be visible to learners

- **EMOTIONAL ENVIRONMENT**

- Be firm, warm and pleasant
- Set the right tone
- Tell learners what behavior you expect

- **GROUPING**

- Learners may be grouped according to needs, abilities, problems but not sex
- Promote sharing of ideas among learners

- **CLASS CONTROL AND DISCIPLINE**

- Know the schools policy on discipline
- Be firm and fair
- Punishment should be corrective
- Acknowledge good behavior
- Make use of prefects and class monitors
- Create an atmosphere of trust and honesty
- Aim for intrinsic discipline

- **MOTIVATION**

- Make learners feel important
- Recognize and reward excellence
- Be a role model in terms of your demeanor

- **SUPERVISION**

- Check learners` work in order to guide and correct them
- Areas that require supervision include practical work, written work, discussions, group work and field trips

UNIT 6

SCOPE OF THE GUIDE

Topics to be covered (form 3-4 and form 5-6)

Form 3-4	Form 5-6
Physical Chemistry: ● Laboratory techniques ● Matter ● Atoms, Elements and Compounds ● Chemical bonding ● The Mole concept ● Stoichiometry ● Acids, Bases and Salts ● Electrochemistry ● Chemical energetic Equilibria ● Reaction kinetics **Inorganic Chemistry:** ● Periodic table ● Metals ● Non metals **Organic Chemistry:** ● Fuels ● Classification and naming of organic compounds ● Hydrocarbons ● Alcohols and carboxylic acids ● Polymers **Environmental Chemistry** ● Waste management ● Pollution ● Water purification ● herbs	**Physical Chemistry** ● Atoms, Molecules and Stoichiometry ● Atomic structure ● Chemical bonding ● States of matter ● Chemical energetic ● Electrochemistry ● Equilibria ● Reaction kinetics **Inorganic Chemistry:** ● Chemical Periodicity of period 3 ● Chemistry of Group II elements ● Chemistry of Group IV elements ● Chemistry of Group VII elements ● Chemistry of Nitrogen and Sulphur **Organic Chemistry:** ● Hydrocarbons ● Halogen derivatives ● Hydroxyl compounds ● Carbonyl compounds ● Carboxylic acids and derivatives ● Nitrogen compounds ● Polymerisation **Applied Chemistry** ● Transition Elements ● Phase Equilibria ● Environmental Chemistry ● Nano Chemistry

TOPIC (POLLUTION)

Teachable units

- Sources of pollutants
- Effects of pollutants
- Methods of controlling

pollution

E.g.**Sources of pollutants** (teachable unit)

Content

- industrial waste
- exhaust fumes
- domestic waste

Activities

- Learners take a tour in groups around the school campus identifying sources of pollution
- Record their findings
- Discuss their findings and write notes

Methodology (learner-centred)

- Group work
- Discovery
- Experimentation
- Field trip
- Research
- Question and answer

Teaching and Learning Materials
ICT tools
Litter
Water from different sources
pH meter
beakers
catalytic convertor
printed materials(textbooks, modules and handouts)
chalkboard
video clips showing pollution

You are encouraged to breakdown all the topics into teachable units as demonstrated above.

CONCLUSION

It is the assumption of the Ministry of Education in conjunction with the compilers of this guide that this document will be helpful to the teacher to appreciate and embrace the new curriculum. The guide is not is not an exhaustive prescription for effective teaching and learning therefore the teacher is encouraged to be creative, initiative and, innovative for effective implementation of the new curriculum.

Annexure 1

SCOPE AND SEQUENCE CHART

FORM 3 AND FORM 4

TOPIC	FORM 3	FORM 4
PHYSICAL CHEMISTRY:		
Laboratory techniques	• Measuring Instruments • Separation techniques - Filtration, - Distillation - Crystallisation	• Volumetric Analysis • Separation Techniques - Fractional distillation - Chromatography • Qualitative analysis
Matter	• Matter	• Heating and cooling curves
Atoms, Elements and Compounds	• Atomic structure • Elements • Compounds • Metallic Bonding	
The Mole concept	• Mole Concept	• Percentage Composition • Molar gas volume
Stoichiometry	• Chemical equations	• Percentage yield and purity
Acids, Bases and Salts	• Properties of Acids and Bases • Preparation of salts	
Electrochemistry	• Redox reactions • Cells and batteries • Electrolysis of water	• Redox equations • Electrolytic purification of copper
Chemical energetics	• Endothermic and Exothermic reactions • Energy profile diagrams	• Enthalpy changes - Neutralisation - Combustion - Solution
Equilibrium	• Reversible reactions • Dynamic equilibrium • Haber process • Contact process • Ostwald process	• Production of fertilisers
Reaction kinetics	• Rates of reactions • Factors affecting rate of reactions	• Industrial applications

INORGANIC CHEMISTRY

Periodic table	• Periodic trends • Group trends	• Transition elements - Properties and uses
Metals and Non - Metals	• Properties of metals and non-metals • Reactivity series	• Composition of mineral ores • Extraction of metals
Non metals	• Lime in agriculture and construction	• Processing of diamond and coal • Liquefaction and distillation of air

ORGANIC CHEMISTRY:

Fuels	• Types of fuels • Production of fuels	• Fuel efficiency
Classification and nomenclature of organic Compounds	• Homologous series - Hydro carbons - Alcohols - Carboxylic acids	• Isomerism
Hydrocarbons		• Alkanes and Alkenes
Alcohols		• Fermentation • Properties of ethanol
Carboxylic Acids		• Carboxylic acids
Polymers		• Synthetic polymers • Natural Polymers

ENVIRONMENTAL CHEMISTRY

Waste management	• Classification of waste • Effects of waste on the environment	• Waste disposal methods
Pollution	• Sources of pollutants	
Water purification	• Composition of water from different sources	• Water purification
Herbs		• Herbs

SCOPE AND SEQUENCE CHART

FORM 5 AND FORM 6

TOPIC	FORM 5	FORM 6
7.1 PHYSICAL CHEMISTRY:		
Atoms, Molecules and Stoichiometry	• Relative masses of atoms and molecules • Mass spectra • The mole and Avogadro constant • Empirical and molecular formulae • Stoichiometric calculations	• Stoichiometric reaction ratios • Titration • Percentage yield and percentage purity
Atomic structure	• Sub-atomic particles • Electronic configurations • Ionisation energy	
Chemical bonding	• Ionic bonding • Covalent bonding • Bond reactivity • Dative bonding • Shapes of molecules • Metallic bonding	
States of matter	• Intermolecular forces • Gaseous state • Liquid state • Solid state	
Chemical energetics	• Enthalpy changes • Hess' Law and Born-Haber cycles • Charge density	
Electrochemistry	• Redox processes • Electrode potentials • Electrolysis of acidified water • Electrolytic purification of copper/nickel • Extraction of aluminium • Production of chlorine from brine	• Redox titration • Fuel cells • Quantitative electrolysis

Equilibria	• Chemical equilibria • Equilibrium constants • Factors affecting equilibrium • Ionic equilibria • Bronsted-Lowry theory of acids and bases • pH and pOH • Acid and base dissociation constants • Choice of indicators • Titration curves	• Buffer solutions • Solubility products
Reaction kinetics	• Rate equations • Mechanism of reactions • Factors affecting rates of reactions	• Catalysis

7.2 INORGANIC CHEMISTRY

Chemical Periodicity of period 3	• Variation in Physical properties • Variation in Chemical properties	
Chemistry of Group II elements	• Trends in Physical properties • Trends in Chemical properties • Properties and uses of Group II compounds	
Chemistry of Group IV elements	• Trends in Physical properties • Trends in Chemical properties • Properties and uses of Group IV elements and compounds	
Chemistry of Group VII elements	• Trends in Physical properties • Trends in Chemical properties • Properties and uses of Group VII elements and compounds	
Chemistry of Nitrogen and Sulphur	• Chemical properties of Nitrogen • Chemical properties of Sulphur	

	• Haber Process • Contact Process • Environmental impacts of Nitrogen and Sulphur compounds	

7.3 ORGANIC CHEMISTRY:

Hydrocarbons		• Nomenclature • Isomerism • Preparation and occurrence • Physical properties • Chemical properties • Reaction mechanisms
Halogen derivatives		• Nomenclature • Isomerism • Preparation • Physical properties • Chemical properties • Reaction mechanisms
Hydroxy compounds		• Nomenclature • Isomerism • Manufacture • Preparation and occurrence • Physical properties • Chemical properties • Reaction mechanisms
Carbonyl compounds		• Nomenclature • Isomerism • Preparation • Physical properties • Chemical properties
Carboxylic acids and derivatives		• Nomenclature • Preparation and occurrence • Physical properties • Chemical properties • Reaction mechanisms
Nitrogen compounds		• Preparation and occurrence • Chemical properties
Polymerisation		• Types of Polymerisation - addition - condensation • Uses of polymers

7.4 APPLIED CHEMISTRY

Transition Elements		• Characteristic properties • Occurrence and extraction • Chemical properties and uses
Phase Equilibria		• Steam Distillation • Distribution between phases • Chromatography and electrophoresis
Environmental Chemistry		• Pollution • Waste management
Nano Chemistry		• Properties of nanomaterials • Applications of nanomaterials