



CORE COMPETENCIES REFERENCE MANUAL FOR A LABORATORY SCIENTIST TO PRACTISE IN ZAMBIA.

CORE COMPETENCIES & MINIMUM STANDARDS

Table of Contents

Pages

QUALIFICATIONS AND RESPONSIBILITIES.....	1
1.0 INTRODUCTION.....	2
2.0 EXIT EXAMINATIONS AND AWARD OF THE BSC BIOLOGICAL SCIENCE.....	2
3.0 LICENSURE EXAMINATIONS BY THE HEALTH PROFESSIONS COUNCIL OF ZAMBIA.....	2
4.0 COMPETENCE & OUTCOME GUIDELINES.....	4
5.0 OVERALL COMPETENCIES	4
6.0 CORE COMPETENCIES: LABORATORY SCIENTISTS.....	5
7.0 GUIDE TO PREPARATION OF THE LICENSURE EXAMINATION OF LABORATORY SCIENTISTS.....	10
8.0 BLUEPRINT WEIGHTS BY COMPETENCIES.....	12
9.0 REFERENCES.....	13

QUALIFICATION AND RESPONSIBILITIES

Title of the programme: Bachelor of Science in biological sciences or its equivalent inclusive of:

- 1) Microbiology
- 2) Molecular Biology
- 3) Cellular Biology
- 4) Parasitology and entomology
- 5) Ecology
- 6) Biotechnology
- 7) Genetics
- 8) Virology
- 9) Immunology

Key accountability for the job: Laboratory testing and Analysis of samples

Primary roles and responsibilities:

- 1) Collect samples
- 2) Culture Samples were necessary
- 3) Run appropriate Tests on the samples
- 4) Analyse and interpret observations
- 5) Store and preserve the samples
- 6) Carry out Maintenance and quality control roles

1.0. INTRODUCTION

The Health Professions Council of Zambia (HPCZ) is a statutory body that was established by the Health Professions Act No. 24 of 2009. The Act renames and continues the existence of the Medical Council of Zambia established by the Medical and Allied Professions Act of 1977. The Health Professions Act No. 24 provides for the registration of health practitioners and regulation of their professional conduct; provides for the licensing of health facilities and the accreditation of health care services provided by health facilities; and provides for the recognition and approval of training programmes for health practitioners.

Following the issuance of the guidelines for introduction of licensing examinations for health professionals to be registered with the Health Professions Council of Zambia, this bulletin provides an outline of the core competencies and minimum standards for registrants who have completed the Bachelor of Science in Biological Sciences (BSc) or its equivalent seeking registration as Laboratory Scientists in Zambia.

2.0 EXIT EXAMINATIONS AND AWARD OF THE BSC BIOLOGICAL SCIENCES DEGREE.

Training institutions, private or public (local and foreign), approved by the Health Professions Council of Zambia are mandated to examine and graduate their students under their own seal and authority. The BSc. Biological Science award is designated the primary qualification of the practitioner and it is a pre-requisite requirement for eligibility for a Laboratory Scientist licensing examination. Accordingly, a holder of the BSc. Biological Science award will be required to take and pass the HPCZ licensing examination to qualify for registration with the Council as a Laboratory Scientist.

3.0 LICENSURE EXAMINATIONS BY THE HEALTH PROFESSIONS COUNCIL OF ZAMBIA

A person shall not practise as a health practitioner, unless that person is registered as a health practitioner in accordance with the Health Professions Act No. 24 of 2009. In the exercise of its functions under this Act, the 2nd Council and the 3rd Council of the Health Professions Council of Zambia instituted Licensure Examinations to help maintain standards; given the emergence of multiple private and public training institutions. This “Bulletin of Information on the Core Competencies and Minimum Standards for the Licensing Examinations for Laboratory Scientists to Work in Zambia”, binds all parties regulated under this Act. Examination fees for licensure examinations, as prescribed by the Council, are payable to the Health Professions Council of Zambia as part of the eligibility to sit for licensing examinations.

The HPCZ Licensing Examination assesses a laboratory scientists' ability to apply knowledge, concepts, and principles, and to demonstrate fundamental research and analytical skills, that are important in medical research and public health. The HPCZ Licensing Examination includes, but is not limited to, theoretical and practical examinations which complement each other as prescribed in the curriculum. No component is a stand-alone in the assessment of readiness for Laboratory Scientists in Zambia.

The candidate will be assessed under three domains, namely:-

- 1) Knowledge
- 2) Skills
- 3) Attitude

The above domains will be assessed by means of a theory exam comprising of multiple choice questions followed by a practical exam.

The subject **areas** (assessed under all three learning domains) for Laboratory scientists are listed in Table 1. The overall expected outcomes of the Laboratory scientist licensure examination is to ensure that the laboratory scientist will meet the minimum standards for the role.

Table 1: List of Subject Areas for BSc. Biological Science or its equivalent.

Subject Areas for Biological Sciences		
<ol style="list-style-type: none"> 1. Cellular Biology 2. Molecular Biology and Genetics 3. Microbiology 	<ol style="list-style-type: none"> 4. Parasitology 5. Biochemistry 6. Virology 7. Ecology and Epidemiology 	<ol style="list-style-type: none"> 8. Immunology/Serology 9. Bacteriology
Subject Areas for Professionalism and Ethical Practice		
<ol style="list-style-type: none"> 1. All practical components of the Courses 2. Professional Development 		

4.0 COMPETENCE OUTCOME GUIDELINES

The curriculum must have identified attributes in each educational domain (knowledge, skills and attitude) and present them to guide student learning and assessment by examiners. HPCZ directs laboratory scientists to be compassionate and empathetic in caring for patients and to be trustworthy and truthful in all their professional dealings. Laboratory scientists have a responsibility to respect and provide care that is up to standard for the lives and health that are entrusted by patients.

5.0 OVERALL COMPETENCIES

A Biological Scientist intending to be registered as a Laboratory Scientist must demonstrate the following key competencies:

Knowledge, Skills and Performance

1. Care of the client is the first concern.
2. Provision of a good standard of practice and care by keeping professional knowledge and skills up to date while recognizing the limits of one's competence.
3. Demonstrate knowledge of the primary disciplines of Biological Sciences.
4. Elucidate the role of Biological Science in medical research and public health.
5. Apply Biological Science disciplines in research and public health.
6. Conduct laboratory experiments effectively by following protocols, methods and procedures.
7. Conduct scientific research and disseminate results.
8. Demonstrate innovation and problem solving skills.

Safety and Quality

1. Prompt action if patient safety, dignity or comfort is compromised.
2. Protect and promote the health of patients and the public.

Communication, Partnership, and Teamwork

1. Uphold the respect of patient's autonomy and dignity.
2. Uphold informed consent and confidentiality.
3. Work with colleagues in ways that best serve the patient's interests.
4. Work with honesty, integrity and fairness.
5. Must be able to work

Maintaining Trust

1. Work with honesty, openness and integrity.
2. Uphold fairness with patients or colleagues.
3. Safeguard the patient's and public's trust in the practitioner and the profession – never abuse the trust.

4. Adhere to professional ethics and conduct, good Laboratory Practice, health and biosafety guidelines.
- 5.

Management

1. Demonstrate awareness and apply administrative, management and finance principles.
2. Take up entrepreneurship challenges to complement public health services in the country.

6.0 CORE COMPETENCIES

TABLE 2: KNOWLEDGE, SKILLS AND ATTITUDE

KNOWLEDGE DOMAIN		
COMPETENCY	COMPETENCY STATEMENT	SUBCOMPETENCIES
BIOLOGICAL SCIENCE KNOWLEDGE	The graduate should demonstrate knowledge of the primary disciplines of biological sciences. The graduate should be able to apply this knowledge to research and laboratory practice.	<ol style="list-style-type: none"> a) Demonstrate knowledge on the diversity of life on earth and the flow of energy and matter in biological systems. b) Explain the interdependence of living things and the roles of organisms in the ecosystem. c) Elucidate the role of biological sciences in addressing public health issues. d) Demonstrate knowledge of the structure-function relationships from molecules to ecosystems. e) Explain the general knowledge of the organization of the genome with particular emphasis on DNA structure and function. f) Explain the basic knowledge of transcription and translation processes. g) Describe the various classes of mutations, and knowledge of mutation nomenclature. h) Distinguish the types of parasites. i) Explain the knowledge of the cell cycle, chromosome structure and behaviour. j) Explain segregation, and non-disjunction. k) Describe molecular cytogenetic techniques and the types of cytogenetic abnormality. l) Describe the patterns of inheritance.

		<p>m) Describe hormonal analysis and other endocrinological measurements.</p> <p>n) Describe therapeutic drug monitoring.</p>
<h2 style="color: purple;">SKILLS DOMAIN</h2>		
COMPETENCY	COMPETENCY STATEMENT	SUB COMPETENCIES
<p style="color: purple;">PRACTICE-BASED LEARNING & IMPROVEMENT</p>	<p style="color: purple;">Graduates should be able to investigate and evaluate their practices, appraise and assimilate scientific evidences & improve.</p>	<p style="color: purple;">Microbiological Principles and Techniques</p> <p>The graduate should apply microbiology principles by showing competence in:</p> <ol style="list-style-type: none"> a) Routine processing of all clinical samples b) Culturing and isolation of all microbes present in a clinical specimen. c) Carrying out phenotypic-based methods of organism identification. d) Detecting metabolic activity using biochemical analysis. e) Directly measuring antimicrobial activity using conventional susceptibility testing methods such as broth dilution, agar dilution and disk diffusion f) Use of molecular methods such as Polymerase Chain Reaction (PCR) and hybridization to detect resistance profile and species identification. g) Microscopic identification of microbes h) Monitoring and investigation of pathogens and toxin levels in clinical samples, food, water, drugs and other samples. i) Water quality testing and Analysis.

	<p>virology, parasitology and entomology to medical research</p> <p>The graduate shall apply virology and parasitology to medical research by being able to demonstrate the following;</p> <ul style="list-style-type: none"> a) Routine processing of all clinical samples. b) Virus isolation using tissue culture techniques by different cell lines. c) Detection of viral antigens using immunodiagnostic methods. d) Performing enzyme-immunoassays (enzyme linked immunosorbent assay-ELISA). e) Detection of virulence genes using molecular methods such as hybridization and PCR based techniques. f) Detection of Cytopathic effects under the microscope. g) Detection of clinically relevant mutations (resistances) using sequencing methods and probe based assays. h) Quantification of clinical viruses using conventional and real time PCR per standard operating. i) Specify the best specimen for specific parasites and time of collection. j) Perform special staining techniques that will allow for the microscopic identification of parasites. k) Isolate and identify different species of parasites using molecular techniques. <p>Molecular biology, Cell biology, Biotechnology principles and techniques in medical research and forensic science.</p> <p>The graduate should be able to;</p> <ul style="list-style-type: none"> a) Perform standard molecular genetics techniques used in the diagnostic laboratory. b) Process clinical and research samples. c) Conduct extraction of nucleic acids from any type of specimen such as blood samples, serum, plasma, urine, stool, hair, nails and object surfaces.
--	---

		<ul style="list-style-type: none"> d) Conduct DNA amplification using different PCR techniques (conventional and real time PCR) e) Conduct genotyping using different assays. f) Perform sequencing using Sanger/Pyro-sequencing/ next generation sequencing. g) Analyse and interpret results using the relevant software. h) Apply recombinant DNA techniques and processes in medical research. i) Conduct antimicrobial resistance studies. <p>Genetics in medicine and research</p> <ul style="list-style-type: none"> a) Apply statistics and/or population genetics as it applies to DNA analysis. b) Conduct cytogenetic testing for diagnosis. c) Categorise and classify genetic diseases. d) Apply pedigree data to interpret the inheritance of various genetic diseases and provide genetic counselling. <p>Immunology, serology and Biochemistry</p> <p>The graduate must be able to perform the following;</p> <ul style="list-style-type: none"> a) Immuno-diffusion techniques. b) Agglutination techniques. c) Immuno-electrophoresis techniques. d) Immunoassays. e) Nephelometry and Immunospectrophotometry techniques. f) Enzyme-linked immunosorbent and enzyme linked immunospot assays. g) Flow cytometry and fluorescence activated cell sorting. h) Multiplex techniques. i) Microarray analysis. j) Complement assays. k) Indirect and direct immunofluorescence techniques. l) Immunocytochemistry. m) Conduct monitoring and investigation of toxin levels.
--	--	--

		<p>Basic Biostatistics to Medical Research</p> <ul style="list-style-type: none"> a) Design studies or experiments to address the research questions. b) Collect and analyse scientific data. c) Conduct statistical analysis of results d) Report results scientifically <p>Ecology</p> <ul style="list-style-type: none"> a) Apply statistics and/or population genetics as it applies to DNA analysis b) Identify species in respect to invertebrates c) Carry out ecological sampling and assessments d) Indirect and direct immunofluorescence techniques e) Immunocytochemistry f) Conduct monitoring and investigation of toxin levels g) Routine processing of all clinical samples h) Virus isolation using tissue culture techniques by different cell lines. i) Detection of viral antigens using immunodiagnostic methods j) Performing enzyme-immunoassays (enzyme linked immunosorbent assay-ELISA) <p>Laboratory Practice and Management</p> <ul style="list-style-type: none"> a) Preparation of laboratory reagents. b) Conduct laboratory tests, following protocols, test methods and procedures. c) Trouble shoot and operate laboratory equipment. d) Keep records effectively. e) Observe safety in the laboratory.
<p>INTERPERSONAL & COMMUNICATION SKILLS</p>	<p>Graduates must demonstrate interpersonal and communication skills that result in effective information exchange & teaming with patients, families & professional associates</p>	<ul style="list-style-type: none"> a) Demonstrate knowledge of the interaction of their practice with other members of the multidisciplinary team. b) Demonstrate knowledge of management principles in health care management

ATTITUDE DOMAIN		
COMPETENCY	COMPETENCY STATEMENT	SUB-COMPETENCIES
PROFESSIONALISM	Graduates must demonstrate a commitment to carrying out professional responsibilities, adherence to ethical principles, & sensitivity to a diverse patient population	<ul style="list-style-type: none"> a) Demonstrate ethically sound practice b) Practice informed decision making c) Respect patients privacy in handling matters d) Practice confidentiality with patient information e) Demonstrate adherence to code of practice Demonstrate sensitivity to diverse patient groups
SYSTEMS-BASED PRACTICE	Graduates must demonstrate an awareness of and responsiveness to the larger context & system of health care & the ability to effectively call on system resources to provide care that is of optimal value	<ul style="list-style-type: none"> a) Demonstrate ethically sound practise b) Practise informed decision making c) Respect patients privacy in handling matters d) Practise confidentiality with patient information e) Demonstrate adherence to code of practise Demonstrate sensitivity to diverse patient groups

6.0 GUIDE TO PREPARATION OF THE LICENSURE EXAMINATION OF LABORATORY SCIENTISTS.

The process of developing the blueprint for competency evaluation involves formulating a set of objectives, reflecting the outcomes and critical areas to be assessed in the licentiate examination. Using George E. Miller’s model of competence (Table 3), there are **four main levels of**

competence that demonstrate professional authenticity (*Miller, 1990*)¹ across the three domains of learning (knowledge, skills and attitudes).

Table 3: Miller’s model of competence

Competence level	Outcome and attributes demonstrated by the graduate:
1. ‘Knows’	Cognitive facts gathered in scientific knowledge, skill and attitudes
2. ‘Knows How’	Interpretation and application of cognitive knowledge, skills and attitudes
3. ‘Shows How’	Demonstration of performance, skills and attitudes
4. ‘Does’	Performance integrated into professional practice and behaviour

Therefore, the key areas that guide the formulation of the licensure examination are informed by the levels of competence attainment of the learning objectives for Laboratory Scientists. The objectives set for the licensure examination to competence are as follows:

1. To assess the knowledge of the **primary disciplines of Biological Sciences**.
2. To determine the **application of Biological Science practical techniques** in medicine and research.
3. To assess **laboratory skills and practices** such as developing and following scientific protocols, management and safety.
4. To ascertain adherence to **professional ethics and conduct**, good laboratory practice and biosafety guidelines.

The blueprint developed for theoretical Licensure Examination questions for BSc in Biological Science graduates seeking to practice as Laboratory Scientists in Zambia is spread among the three domains of learning (i.e. scientific knowledge, skills and attitudes) to cover Level 1 and 2 of the competency framework (Table 4).

Considering the great need for graduates to Demonstrate knowledge, apply skills and performance attributes, including practice evidence based-biological sciences, demonstration of knowledge, skills and performance is extremely important hence the knowledge, skills and performance domains are highly weighted and lastly the professionalism and attitudes. The practical Licensure Examination questions for BSc in Biological Sciences are spread to cover the relevant skills, performance, Applied scientific knowledge and attitude domains accordingly.

7.0 BLUEPRINT WEIGHTING

Table 4: Weighting of Competence Areas for Theory and Practical Licensure Examinations for Laboratory Scientist.

Objectives	Examination structure	Percentage (Out of 100)
1. To assess the knowledge of the primary disciplines of Biological Sciences.	Section A: MCQS biological sciences.(all courses examined)	20
	Section B: MCQS Specific field	25
2. To assess laboratory skills and practices such as developing and following scientific protocols, management and safety and to determine the application of Biological Science practical techniques in medicine and research.	Practical examination	25
	Analysis and interpretation of results.	5
3. To ascertain adherence to professional ethics and conduct, good laboratory practice and biosafety guidelines.	Section C: MCQS on Biosafety, Professionalism and ethics.	25
Total		100

NOTE:1) Each candidate writes an exam tailored more to their field

- 2) Laboratory Practicals are in specified fields
- 3) All papers have 3 sections

8.0 REFERENCES.

COURSE	REFERENCE MATERIALS
<p style="text-align: center;">MICROBIOLOGY</p>	<p><i>BSc. Biological Sciences Curriculum</i>, (2017), the University of Zambia, School of Natural Sciences.</p> <p>Greenwood D.et al, (2007) <i>Medical microbiology, A guide to Microbial infections: pathogenesis, Immunity, Laboratory Diagnosis and Control</i> (7th edition).Churchill Livingstone Elsevier.</p> <p>Presot, P.J., et all. <i>Microbiology</i>. 5th ed. McGraw-Hill Higher Education, New York.</p> <p><i>Laboratory Scientists Scope of Practice</i>, (2014), Zambia Association of Biological Scientists (ZABSCI)</p>
<p style="text-align: center;">MOLECULAR BIOLOGY AND GENETICS</p>	<p>Alberts B. Bray D, Lewis J., Raff M., Roberts K, Watson J.D. 2002. <i>Molecular Biology of the Cell</i>. 4th ed. Garland Science, New York.</p> <p><i>BSc. Biological Sciences Curriculum</i>, (2017), The University of Zambia, School of Natural Sciences</p> <p><i>Laboratory Scientists Scope of Practice</i>, (2014), Zambia Association of Biological Scientists (ZABSCI)</p> <p>Russel P.J.,et al (2009) Genetics. <i>A Molecular Approach</i> (3rd edition).Benjamin Cummings.</p>

<p style="text-align: center;">ECOLOGY</p>	<p><i>BSc. Biological Sciences Curriculum</i>, (2017), The University of Zambia, School of Natural Sciences</p> <p><i>Laboratory Scientists Scope of Practice</i>, (2014), Zambia Association of Biological Scientists (ZABSCI)</p>
<p style="text-align: center;">PARASITOLOGY</p>	<p>Cox, F.E.G. (2001). <i>Modern Parasitology: A textbook of Parasitology</i>. 2nd ed. Blackwell Publishing, London.</p> <p><i>BSc. Biological Sciences Curriculum</i>, (2017), the University of Zambia, School of Natural Sciences.</p> <p><i>Laboratory Scientists Scope of Practice</i>, (2014), Zambia Association of Biological Scientists (ZABSCI)</p>
<p style="text-align: center;">VIROLOGY</p>	<p>BSc. Biological Sciences Curriculum, (2017), The University of Zambia, School of Natural Sciences</p> <p>Greenwood D et al,(2007) <i>Medical microbiology, A guide to Microbial infections:Pathogenesis,Immunity,Laboratory Diagnosis and Control</i>(7th edition).Churchill Livingstone Elsevier.</p> <p><i>Laboratory Scientists Scope of Practice</i>, (2014), Zambia Association of Biological Scientists (ZABSCI)</p>
<p style="text-align: center;">SEROLOGY/IMMUNOLOGY</p>	<p><i>BSc. Biological Sciences Curriculum</i>, (2017), The University of Zambia, School of Natural Sciences</p> <p>Kuby (2013), <i>Immunology</i>, 7th edition W.H Freeman and Company, New York.</p>

	<i>Laboratory Scientists Scope of Practice</i> , (2014), Zambia Association of Biological Scientists (ZABSCI)
CELL BIOLOGY	<p><i>BSc. Biological Sciences Curriculum</i>, (2017), The University of Zambia, School of Natural Sciences</p> <p><i>Laboratory Scientists Scope of Practice</i>, (2014), Zambia Association of Biological Scientists (ZABSCI)</p> <p>Taylor, D.J., Green, N.P.O. and Stout. G.W. 1997. <i>Biological Science</i>. Cambridge University Press, London.</p>
BIOCHEMISTRY	<p><i>BSc. Biological Sciences Curriculum</i>, (2017), The University of Zambia, School of Natural Sciences</p> <p><i>Laboratory Scientists Scope of Practice</i>, (2014), Zambia Association of Biological Scientists (ZABSCI)</p> <p>Lehninger, D. (2000), <i>Principals of Biochemistry</i>. 3rd Edition. Worth publishers, New York. ISBN: 1-57259-153-6.</p>
BASIC BIostatISTICS	Betty R., (2003), <i>Medical statistics</i> . Blackwell Science, Victoria. 978-0-86542-871-3.
PROFESSIONALISM	<ol style="list-style-type: none"> 1. HPCZ (2016) <i>Guidelines for good practice in the Healthcare profession – Maintaining Patient Confidentiality</i>. HPCZ Lusaka 2. HPCZ (2016) <i>Guidelines for good practice in the Healthcare profession – Generation and management of patient records</i>. HPCZ Lusaka 3. HPCZ (2014) <i>Professional code of ethics and discipline: Fitness to Practice</i>. HPCZ Lusaka 4. HPCZ (2016) <i>Patients’ rights and responsibilities</i>. HPCZ Bulletin, Lusaka

	<p>1. Banda S.B. <i>Healthcare Ethics and Professionalism Course.</i> https://virtualsityacademy.com/</p>
--	---