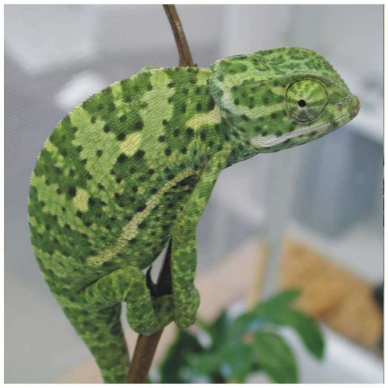
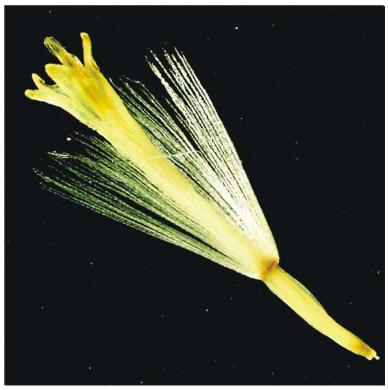
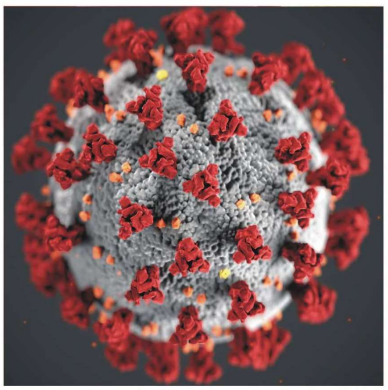
BIOLOGICAL SCIENCES

2021

INFORMATION BOOKLET







WITS
UNIVERSITY

SCIENTIA ET LABORE

Welcome to the Biological Sciences!

CONTENTS

1. GENERAL INFORMATION

List of telephone numbers in the Biological Sciences

CHAIRPERSON	Doctor Pieter De Maayer (Biology Building 242)	717-6322
Administrator		717-6303
Anatomical Sciences	Interim management committee	717-2304
Animal, Plant and Environmental Sciences	Professor N Pillay	717-6403
Molecular & Cell Biology	Professor M Cronje	717-6343
Palaeontology	Professor M Bamford	717-6680
Physiology	Professor W Daniels	717-2560

Almanac for 2021

Activity	Dates	
First teaching block	Mon 8 March	Fri 23 April
Vacation/study/research break	Sat 24 April	Sun 2 May
Second teaching block	Mon 3 May	Thu 17 June
Study Break	Fri 18 June	Sun 20 June
Examinations	Mon 21 June	Fri 9 July
Winter vacation/research break	Sat 10 July	Sun 1 August
Third teaching block	Mon 2 August	Fri 17 September
Study/research break	Sat 18 September	Sun 26 September
Fourth teaching block	Mon 27 September	Mon 8 November
Study Break	Tues 9 November	Sun 14 November
Examinations	Mon 15 November	Fri 10 December
Summer research breaks	Sat 11 December	

Public holidays and days on which the University is closed – 2021

New Year's Day	Friday 1st January
Human Rights Day	Sunday 21st March
Good Friday	Friday 2 April
Family Day	Monday 5 April
Freedom Day	Tuesday 27 April
Worker's Day	Saturday 1st May
Youth Day	Wednesday 16th June
National Women's Day	Monday 9th August
Heritage Day	Friday 24th September
Day of Reconciliation	Thursday 16th December
Christmas Day	Saturday 25th December
Day of Goodwill	Sunday 26th December

2. *ACADEMIC INFORMATION*

Introduction

Subjects taught within the Biological Sciences

Subjects taught within the Biological Sciences are offered by:

- School of Anatomical Sciences
- School of Animal, Plant & Environmental Sciences (Ecology & Conservation, Biodiversity, Organismal Biology)
- School of Molecular & Cell Biology (Applied Bioinformatics, Biochemistry & Cell Biology, Genetics & Developmental Biology and Microbiology & Biotechnology)
- School of Physiology

In addition, most schools offer Honours degree courses in their subjects; for details of these please consult the individual schools.

Biological Sciences –Undergraduate Computer Laboratory

Internet is required for many of the Biological Science courses and it is advisable that all second and third year students register for the Nucleus Computer Laboratory early in the year with Ms Dudu Mditshwa in Gate House, First Floor.

Part-time courses

The Introductory Life Sciences BIOL1000A course equivalent is offered through Wits Plus for part-time students. Part-time students should register for Introductory Molecular and Cell Biology MCBG1001A (which is offered in Semester 1) and Introductory Physiology and Environmental Sciences APES1003A (which is offered in Semester 2).

Curricula

The degree of Bachelor of Science shall extend over not less than three *academic* years of full-time study.

a) a *course* at first year level (level I) is denoted by the Roman numeral I following the descriptor and its code number begins with the Arabic numeral I (e.g. Chemistry I, CHEM1012A);
b) a *course* at second year level (level II) is denoted by the Roman numeral II following the descriptor and its code number begins with the Arabic numeral 2 (e.g. Chemistry II, CHEM2001A); and
c) a *course* at third year level (level III) is denoted by the Roman numeral III following the descriptor and its code number begins with the Arabic numeral 3 (e.g. Chemistry III, CHEM3034A).

A student is deemed to be –

a) in the first year of study if s/he has 0 *credits* or obtained *credit* for, *courses* at level I which do not make up a total of 108 *credits*;
b) in the second year of study until s/he has obtained a minimum of 108 *credits* at level I and 144 *credits* at level II; and
c) in the third year of study until s/he has obtained a minimum of 432 *credits*, at least 144 of which are from level III.

Number of course credits in a current academic year of study

Unless permitted by the *Senate*, a *student* shall include in her/his *programme*:

a) for the first year of study, *courses* for which no more than 144 *credits* at level I are allocated;
b) for the second year of study, *courses* for which no more than 192 *credits* at level II are allocated; and
c) for the third year of study, *courses* for which no more than 192 *credits* at level III are allocated.

In exceptional cases, the *Senate* may permit a *student* in any year of study to register for additional *courses*.

Students are required to have one major in the Faculty of Science to graduate.

Prerequisites and compulsory courses

Prerequisites

Course prerequisites

Many of the courses in the Biological Sciences have prerequisites which you must meet before you will be admitted to them. You will not be admitted to second year unless you have already passed Chemistry I, Auxiliary Mathematics and Introductory Life Sciences or equivalents.

Block course requisites

Some topics have prerequisites that apply even if you are not taking **the whole** of the course to which the block course belongs.

Compulsory and optional courses

Within the major courses for some subjects there are COMPULSORY COURSES and OPTIONAL COURSES. You **must take all** the compulsory courses for any course for which you are registered. You must then select which of the optional courses you wish to take in order to make up the 48 or 72 credits for the course. With the permission of the heads of schools concerned, you may be able to credit an optional course offered in another school.

NOTE:

Details of courses and prerequisites for individual courses are given in the SCHOOL AND SYLLABUS INFORMATION section of this handbook.

Planning a degree curriculum.

*** NOTE these *courses have limitations on student numbers.***

The second and third year Biological Science courses for which you may register are:

Biochemistry & Cell Biology III
Biodiversity II, III
Applied Bioinformatics III
Ecology & Conservation II, III
Genetics & Developmental Biology III
Human Biology III*
Human & Comparative Biology II*
Medical Cell Biology III*
Microbiology & Biotechnology III
Molecular & Cell Biology IIA*
Molecular & Cell Biology IIB*
Molecular & Cell Biology IIC*
Organismal Biology II, III
Physiology II, III*

C***hoosing second-and third-year courses***

The range of courses from which you can choose will be determined to some extent by the courses you have already passed – that is, by the course prerequisites you have met and by restrictions imposed by the timetables. You may only register for either Anatomy or Physiology but **not** both at third year level.

If you are registering for your **second year** of study, you must:

> Check that you have the necessary first-year prerequisites for the courses for which you intend to register.
> Check that you have included in your registration any courses that are compulsory.
> Check that the courses you register for will meet the prerequisites for the courses you eventually intend to register for in your third year of study.
> Check timetable clashes.

If you are registering for your **third year** of study, you must:

> Check that you have the necessary first and second year prerequisites for the courses for which you intend registering.
> Check that the courses for which you intend registering will allow you to complete your degree.
> Check timetable clashes.

Examining of short-courses and courses (first, second and third year)

Separate examinations are held for each short-course. Any short-course that has been completed by the end of block 2 is examined in June during the mid-year examination period with the balance of the short-courses examined at the end of the year in October/November. The mark in a course is the weighted average of the marks for all short-courses taken as part of that course. Students require a mark of 50% to obtain credit for short-courses.

Sub-minima and exemptions

If you fail one or more short-courses in a course but obtain 50% or more for the course as a whole you will be credited with a pass for that course, providing that your mark for each of the short-courses you have failed is not less than the sub-minimum mark of 35%.

A. If you have obtained a mark of 50% or more for a course as a whole but marks below the sub-minimum of 35% for one or more short-courses credited to that course, the following rules will apply:

i. If you have obtained marks below the sub-minimum in one or more short-courses for a course, but in the other short-courses you have accumulated half or more of the total number of credits for the course, you will be required to repeat and obtain at least 50% in the failed short-course the following year in order to receive credit for the course.
ii. If you have obtained marks below the sub-minimum in a short-course or short-course accounting for more than one quarter of the total credit number for the

course, and have failed to accumulate half of the total number of credits for the course, you will be deemed to have failed the course as a whole regardless of your overall mark for the course.

iii. If you complete a short-course successfully for which you had previously obtained a sub-minimum, you will have completed the course.

B. If you obtain less than 50% for a course as a whole then the following rule will apply:

i. If you fail the course but have passed short-courses that comprise half the point value for the course you will be exempted from repeating those short-courses.

ii. A student repeating a course/short-course is required to repeat **both** the theoretical and practical components.

Amendments to registration

Any change in second- and third-year **COURSES** must be made by the end of the first week of the academic year. A course may be cancelled at any time up to the beginning of September of the current year of registration. After that date you will be considered to still be registered for the course and will be marked "failed absent" in the end-of-year examinations if you do not complete the course.

COURSE CHANGES can be made at various times during the year as follows:

1. A course may be cancelled at any time prior to the end of the first week of the block in which the course is offered.
2. An amendment to course registration which involves the addition of a short-course must be made before the end of the first week of the block in which the short-course is offered. This provision is subject to the approval of the heads of the schools concerned. The addition of any short-course is subject to the condition that it does not cause a clash with any existing short-course on the examination timetable.
3. If you have failed a course which is not compulsory, you may, if you wish, register for an additional course in order to replace the one you have failed.

   Course registration amendment forms are obtainable from the Faculty of Science Office, Ground Floor, Mathematical Building, West Campus. These forms must be completed and the change signed by the Head of the School (or nominated representative) for the short-course which you are changing.

Prizes

There are prizes for top students in all disciplines of the Biological Sciences. Please consult the administrator in each school for details.

3. SCHOOL AND SYLLABUS INFORMATION

A. Interschool courses

The Biological Sciences offers two courses in Biology at the first year level. These courses are run jointly by the School of Animal, Plant and Environmental Sciences (incorporating Ecology & Conservation, Biodiversity, Organismal Biology) and School of Molecular and Cell Biology, (incorporating Biochemistry & Cell Biology, Genetics & Developmental Biology, Microbiology & Biotechnology and Applied Bioinformatics). These courses have been designed to cover the broad spectrum of modern biology and provide students with an opportunity to learn about the diverse fields available, before making more specialised choices at second year level. There is a "core" course called Introductory Life Sciences I that includes material which we feel is essential for all biologists. Complementary Life Sciences I (Diversity of Life) is an optional course that includes more specialised areas of interest. **NB**: It is recommended that students who are interested in a career in biology also register for Complementary Life Sciences (Diversity of Life).

BIOL 1000A INTRODUCTORY LIFE SCIENCES 1 (ILS) (36 credits)(Slot C or D)

Introductory Life Sciences 1 (ILS) (this course is restricted to a total of 600 students), the "core" course that gives entry to all subjects in the Biological Sciences in second year, comprises four topics, 1 topic per teaching block. Introductory Life Sciences I will be offered on two slots to allow for maximum flexibility. To be credited with Introductory Life Sciences I (36 credits) you must complete all four topics.

Introductory Cellular Biology

The underlying theme of the knowledge base will be the relationship between structure and function at the molecular and cellular levels. After attending this topic, students should be able to justify why the cell can be considered the basic unit of life and explain how structure determines function in the cell. To this end, the structure of biomolecules and their roles in the cell will be examined, as well as how cells capture and use energy.

This course zooms in on the biological cell. Different types of cells and the organelles they contain will be studied and their structure and functioning will be considered. Furthermore, the structure of biomolecules such as lipids, sugars and proteins and their roles in the cell will be examined, as well as how cells capture and use energy in the form of ATP. After attending this topic, students should be able to justify why the cell can be considered the basic unit of life and explain how structure determines function in the cell.

Genetics, Growth and Development

This course will start by studying the flow of genetic information in the cell, from DNA to RNA and to proteins via transcription and translation. Then, the cell cycle (including cytokinesis and the reproduction of cells), cell growth, morphogenesis and differentiation in the development of living organisms will be explored. The course also explores chromosome mutations, such as variation in number and arrangements. The cellular events of meiosis will be correlated with genetic phenomena. The Mendelian genetics section involves following a genetic trait/gene from generation to

generation, and then following two traits/genes from generation to generation, and finally mapping those genetic traits to particular chromosomes.

Structure and Function

The objective of this course will be to explain the relationship between structure and function using homeostasis as a common theme linking anatomy, physiology and evolution. Students will become familiar with the relevant vocabulary and important principles involved and will have improved skills in observing structure and interpreting experiments.
NB: Dissection of the rat is a compulsory component of this course. Failure to complete dissections could result in your SP requirement **not** being met.

Ecology and Environmental Management and Sustainability

This course on ecology and environmental management covers ecological theory, knowledge of field practice, knowledge of southern African ecosystems, species interactions and communities, population ecology, climate and biodiversity, environmental impact assessment, causes of environmental degradation, ecosystem function and services, biodiversity and species extinction.

BIOL1006A COMPLEMENTARY LIFE SCIENCES 1 (CLS) – DIVERSITY OF LIFE (36 credits)(Slot B)

Complementary Life Sciences 1 (CLS) introduces you to the Diversity of Life – from the smallest viruses, bacteria, protists, to fungi and multicellular animals and plants, as well as to the genetic basis for all diversity. It is an enriching course that extends knowledge and skills in more specialised areas of interest within Biology. We **strongly recommend** that anyone interested in a career in the Biological, Molecular and/or Environmental Sciences should take this course. To be credited with Complementary Life Sciences 1 (36 credits), you must complete all three components (as listed below).

Life in its Diversity (18 credits)

The aim of this semester-long course is to investigate the patterns of diversity, evolution, relationships and biology of major groups of protists, animals, plants and fungi. This includes how to recognise/identify these organisms, a knowledge of their classification and evolutionary history, the important roles they play in the natural environment and in human well-being, and the need for their conservation.

Molecular and Cellular Biology (9 credits)

This course will centre on identification of major principles recognised in modern molecular and cellular biology and will follow on from the core topics. Emphasis will be on: structure of DNA, the structure of RNA, transcription, translation, structure and function of proteins, regulation of protein functioning including signal transduction, recombinant DNA technology and biotechnology.

Principles and Applications of Microbiology (9 credits)

This course will include microbial diversity; structure, function and importance of bacteria, viruses and fungi; principles of host-microbe interactions; environmental and applied Microbiology & Biotechnology; principles of plant tissue culture; manipulation of micro-organisms in the laboratory.

B. School Courses at 2nd and 3rd year levels

SCHOOL OF ANATOMICAL SCIENCES

The School of Anatomical Sciences offers a diverse array of courses, reflecting the research interests of the staff members. The school is well known for its strengths in biological anthropology (skeletal biology, forensic anthropology, human growth and development, and palaeoanthropology), comparative vertebrate anatomy, developmental biology, neuroanatomy, and medical cell biology. Two separate courses are offered to train scientists in broad but distinct fields of human biology and medical cell biology.

ANAT 2021A HUMAN AND COMPARATIVE BIOLOGY II (48 credits)(Slot E)

***Notes for the guidance of students*:**

1. Entrance to this second year course is restricted and applicants are selected on the basis of merit.
2. The course is recommended for students proceeding to Human Biology III and/or Medical Cell Biology III.

***Admission requirements/prerequisite courses**:*

Human and Comparative Biology II*:* Chemistry I; Mathematics I or Ancillary Mathematics and Statistics I or Auxillary Mathematics or Physics I; Introductory Life Sciences I or equivalent

HUMAN AND COMPARATIVE BIOLOGY II is a full course at the Second Year level of study. The four topics aim to clarify and explain the structure of the human body within a comparative framework of the evolutionary history and development of the vertebrates. The course is a stepping-stone to the Human Biology III (ANAT 3002A) and Medical Cell Biology (ANAT 3011A) courses offered in the Third Year of study. Interactions of organisms with the external environment, combined with evolutionary mechanisms over time have resulted in the development, adaptation, retention and loss of features that have yielded an incredible diversity of form and function among all the vertebrate species, including humans.

Concepts of Evolution, Primary Tissues, and Early Embryology

This is an introduction to the basic principles of evolution, comparative anatomy and embryology as they apply to the study of human biology. Lectures will cover evolutionary theory, adaptation, morphological concepts, and the evolutionary history of the vertebrates. Basic tissue morphology and histology will be covered as an introduction to teaching in blocks 2 and 3. Embryology will be presented as a tool for discerning the unitary origin of life, and as a mechanism for evolutionary change. Topics will include early embryonic development and gametogenesis, comparative embryology, and embryological development of the integumentary system.

Comparative Biological Systems

This topic covers a series of integrated study areas. It is a theoretical and practical topic that introduces students to the basic knowledge of a number of primary tissues and bodily systems placed within an evolutionary developmental framework. These systems include bone and osteogenesis, the lymphatic system, and the male and female reproductive systems.

Vertebrate and Human Neuroanatomy

This topic extends over the entire third block and will cover in detail the neuro-anatomical structures and evolution of the vertebrate brain, focusing on the human brain. This structural knowledge will be related to functional aspects of the brain and how structure and function combine to form the behaviours and neural phenomena of everyday life. Examples such as emotional reactions and the conscious experience will be explored.

The Vertebrate Skeletal System

The vertebrate skeleton is fundamental to comparative anatomy, with the human skeleton specifically forming the basis of biological anthropology. The topic focuses on human and comparative osteology by examining the evolutionary factors underlying morphological differences among vertebrates. Students will acquire the basis for understanding functional anatomy as well as the osteological fundamentals for further study in fields such as Forensic Anthropology and Human Variation.

ANAT 3002A HUMAN BIOLOGY III (72 credits) (Slot D)

***Admission requirements/prerequisite courses**:*

Human Biology III: Human and Comparative Biology II or either Anatomy II or a second year course in Animal, Plant and Environmental Sciences with the approval of the Head of School

Possible fields of employment

Students who wish to pursue a career in the Human Biological Sciences are strongly advised to obtain at least an Honours degree. There is a wealth of research opportunities in South Africa, so students may find employment at academic institutions, although other options are available. Typical career opportunities include:

- Academic – University teaching and research. Higher degrees are essential.
- Museums – Research and public education.
- Technical positions – Laboratory or field work with scientific or medical research institutes.
- Scientific journalism

HUMAN BIOLOGY III is a third year course designed for students with an interest in biology, zoology, palaeontology and biological anthropology. This course consists of four lecture topics and one research topic for a total of 72 credits. It provides an in-depth coverage of issues in human biology and evolution through lecture topics and independent student work. At the same time, this course provides the basic foundations for scientific research and requires that each student design a research proposal under the supervision of a researcher in the School of Anatomical Sciences.

Human Skeletal Biology
An introduction to issues in human skeletal biology, including age and developmental assessment, morphological and metric assessment of sex, morphological and metric assessment of ancestry, stature and body size, unique skeletal markers, trauma, pathology and body modifications.

The Human Legacy
Explores the basic themes underlying human evolutionary biology including our place in the natural world, the shift to bipedality, development of the human brain with its capacity for behavioural complexity, symbolic thinking and language; the expansion out of Africa and the diversity of early human biological adaptations.

Human Biodiversity
Basic concepts and the history of methods for documenting human biodiversity are presented together with new approaches to understanding patterns of human biological variation ranging from the molecular to the population level. Other topics include human environmental adaptation, the role of culture and behaviour in human diversity, and the spectre of race and biological determinism in the 20th century.

Research Methods
A short and intensive course lasting three weeks that focuses on the scientific method and its application, hypothesis construction and quantitative approaches to testing hypotheses. Designed to prepare students for their research proposals.

Research Proposal
The research component is designed to give students the experience of identifying potential gaps in the literature and developing a research project. Working in small groups, students will pursue a research topic under the supervision of a Morphological Anatomy or Biological Anthropology academic staff member. They must formulate a research protocol detailing a specific research question, the relevant literature, the design of the data collection and analysis, and expected outcomes. A literature review and research protocol are presented orally by the group, and a final written report is required for each student.

ANAT3011A MEDICAL CELL BIOLOGY III (72 credits) (Slot B)

MEDICAL CELL BIOLOGY III (ANAT3011A) is a course at level III. The course consists of 6 topics that aim to give students an understanding of the cellular and molecular structure and function of the human body within a biomedical framework, reflecting the current research interests of the School. The course provides coverage of issues related to cell structure and function, developmental biology and applied cell biology through lectures and independent student work. Course content is selected primarily from research articles in order to convey current developments in specific fields, with laboratory sessions aimed at introducing students to commonly used and cutting-edge research and diagnostic techniques. The course thus aims to prepare students for post-graduate studies and employment in the scientific arena.

Teratology and birth defects

Birth defects occur in approximately 3-6% of all newborns. It is now known that environmental-genetic interactions and synergistic interactions of teratogens are some of the causes of birth defects; however, exposure to multiple pharmaceutical, industrial and agricultural chemicals makes it difficult to accurately estimate risk. After Thalidomide (a drug used for morning sickness in the 1960s) induced birth defects it became widely accepted that the developing embryo could be susceptible to agents that have negligible or non-toxic effects on adults. To date, 6 major teratogenic mechanisms have been established: folate antagonism, neural crest disruption, endocrine disruption, oxidative stress, vascular disruption and specific receptor or enzyme-mediated teratogenesis. This topic gives students a basic understanding of the factors leading to abnormalities and defects in physiological development.

Introduction to toxicology

Toxicology is the science of chemical hazards, safety and margin of usefulness. Therefore the overall focus of toxicology science is to identify potential harmful effects of chemical compounds to humans, animals and the environment, and to provide for their prevention and treatment. Toxicology is a multidisciplinary science based upon Physiology, Biochemistry, Molecular Biology, Chemistry, Pharmacology, Pathology, Epidemiology and several others. This topic will introduce the student to principles of toxicology, identification and characterization of toxins and determination of their fate in the body, and evaluation of toxicosis.

Reproductive immunology

Maternal immunological tolerance to the implanting semi-allogeneic fetus has long been a puzzle for scientists. During pregnancy the endometrium responds to potential invaders and pathogens, while simultaneously tolerating implantation and development of the fetus, whose genes are 50% paternal in origin. The process of implantation in humans entails extensive invasion of the maternal endometrium by the implanting conceptus, during which the uterine mucosal lining is transformed into a highly specialized tissue. A prominent feature that marks this event, apart from decidualised cells, is the influx of selected lymphocyte subsets. The correct endometrial preparation is central in determining successful implantation. Students will gain a basic understanding of the cells present in the decidua during early pregnancy and their function associated with endometrial preparation for the implanting embryo.

Introduction to cellular and molecular neuroscience

The brain is composed of billions of neurons – the basic functional units of the nervous system – connected to each other and capable of transmitting signals at speeds of 100m.s, allowing organisms to process and respond to any changes in their environments rapidly. This topic will introduce students to the basic principles of cellular and molecular neuroscience which involves the study of neurons at a cellular and ultrastructural level as well as the mechanism by which they express and respond to various signals. This topic will also explore the mechanisms underlying structural plasticity, learning and memory as well as the cellular and molecular basis of several well-known neurological diseases and disorders.

Cellular and molecular mechanisms of cancer

This topic presents cancer as an aberration of normal cellular and molecular processes. Students will be exposed to the epigenetic and genetic contributions to tumour initiation as well as mechanisms of tumour progression in relation to evasion of cell cycle control mechanisms and immunity. Current biomedical treatments (for tumour eradication and palliation) will be discussed in relation to their mechanism of action. The background to which lectures will be set is one of experimental design and an understanding of applications in the field of cancer research.

Research proposal

Students will have an opportunity to compile a research proposal related to a particular topic taught during the year. Project choice is usually based on individual interests, providing the proper distribution among the class is fulfilled. Students will be taught to identify research questions, construct hypotheses, design investigative studies and data collection strategies, conduct analyses of data, and interpret findings. This topic includes basic experimental design, writing, reading and presentation of research reports and sampling techniques.

ACADEMIC STAFF

AUGUSTINE, T	BScHons MSc PhD (Witwatersrand) Senior Lecturer – Interim management committee
BILLINGS, B	BScHons MSc PhD (Witwatersrand) Senior Lecturer
BRITS, D	BScHons MSc (Pretoria) PhD (Witwatersrand) Associate Professor – Interim management committee
HEMINGWAY, J	BScHons MSc PhD (Witwatersrand) Lecturer
HUTCHINSON, E	MedScHons MSc (Pretoria) PhD (Witwatersrand) Senior Lecturer
KRAMER, B	BScHons PhD (Witwatersrand) Professor
MANGER, P	BScHons PhD (Queensland) Professor
MAZENGENYA, P	BSc.Hons MSc (Zimbabwe) PhD (Witwatersrand) Senior Lecturer
MBAJIORGU, E	PhD (University of Limpopo) Associate Professor
MEYER, A	BAHons BScHons MSc (Pretoria) PhD (Witwatersrand) Lecturer
NGWENYA, A	BScHons PhD (Witwatersrand) Lecturer
OLATEJU, O	BScHons Medical Cell Biology (Pretoria) MSc PhD (Witwatersrand) Lecturer
SCHEPARTZ, L A	BA Anthropology (Pennsylvania) MA PhD Anthropology (Michigan) Professor
TSHABALALA, T	BScHons MSc (Witwatersrand) Lecturer

XULU, K BScHons MSc PhD (Witwatersrand)
Lecturer

SCHOOL OF ANIMAL, PLANT AND ENVIRONMENTAL SCIENCES (AP&ES)

The aim of the *School of Animal, Plant and Environmental Sciences* is to provide high quality teaching and research with its theme of *The Biology of a Changing World: Conserving African Biodiversity.*

The staff of the School of Animal, Plant and Environmental Sciences recognise that most students enter university with some idea of the career they want to pursue. This in turn influences their choice of subjects and topics. We have therefore organised our topics into three "Career Lines". However, it is important to remember that it is **NOT** necessary to specialise to any great extent at the undergraduate level as this degree is designed to provide a broad base for future career paths. You will be able to change direction at a later stage should you so wish. We also believe that a degree should give you not only knowledge about the subject but also the skills and attitudes you can use in any career, especially the ability to solve problems.

Possible fields of employment requiring a degree from the School of Animal, Plant & Environmental Sciences:

CAREER OPTIONS

Nature Conservation:	National or conservation agencies, private wildlife enterprises, environmental NGOs, environmental consultancy
Research:	In government and university institutions, e.g. Council for Scientific and Industrial Research (CSIR), Department of Agriculture, Department of Water Affairs and Forestry, Department of Sea Fisheries, Agricultural Research Council (ARC), Veterinary Research Institute, medical and biological departments at universities
Environmental Impact Assessment:	Legislation now requires most developments to have an Environmental Impact Assessment done, which has provided huge career and business opportunities for zoologists, plant scientists and ecologists.
Museums:	Ditsong National Museum of Natural History (formerly Transvaal Museum) is one example, South African National Biodiversity Institute, including the National Herbarium, another. There are many others.
Education:	High school teaching, universities, universities of technology, corporate training
Scientific Journalism:	Newspapers, journals, broadcasting, natural history documentaries.
Commerce:	Private consulting firms, environmental divisions of large corporations, marketing, scientific services, mining and forestry companies
Industry:	Numerous industries are concerned with research and development and supply of biological products and materials.
Law, Commerce & Medicine:	A basic BSc degree forms an excellent first degree for any of these professions.

CAREER LINES

Three broad career lines, each corresponding to a major, are offered in the School:

(i) **Ecology and Conservation**
(ii) **Biodiversity**
(iii) **Organismal Biology**

Students are encouraged to discuss their careers and selection of majors as well as the courses these comprise with staff members.

Notes for guidance of students:

1. Begin by defining your areas of interest. You will then find that the courses fall into natural categories. Furthermore, you will be able to select other appropriate co-majors in the Biological Sciences or other subject areas in the Faculty of Science.
2. Each major comprises a number of courses, to make up 48 credits at second year and 72 credits at third year.
3. Students wishing to specifically pursue a career in biological sciences are strongly advised to proceed to the Honours degree because an Honours degree offers greater opportunities for employment and is required for registration as a Natural Scientist.
4. The exam mark will usually be 50 percent of the final mark for undergraduate courses**.** Any material that is available for scrutiny by the external examiner can contribute to the exam mark.
5. The timetable for 2021 is on page 28 and advice is available in Room B114 or via the Head of School, Professor Neville Pillay (Neville.Pillay@wits.ac.za).

6. ***Admission requirements/prerequisite units***

All APES 2nd year courses	***Chemistry I*** ***Introductory Life Sciences I or equivalent*** ***Ancillary Mathematics I or equivalent***
All APES 3rd year courses	***2nd year APES courses with a minimum 48 credits per major*** ***Basic Statistics for the Natural Sciences II (STAT2013) or equivalent***

Each course is restricted. Students will be selected on the basis of their year of study, performance in their courses in the previous year and the appropriateness of the courses passed.

7. You may add courses from other disciplines in the Faculty of Science to make up 25% of the required number of credits for your major/majors.
8. Recommended first year subjects include Complementary Life Sciences I, Geography I and Geology I.

Composition of the Major

You must make up the required credits by taking courses in 2nd and 3rd year. See the timetable on page 28 to plan your curriculum.

ECOLOGY AND CONSERVATION

Objective

This focus area provides students with insight into the quantitative study and use of ecological, physiological and systematic principles in the context of ecology, conservation and environmental science and its applications in conservation biology and environmental management.

Recommended Courses

Second Year – Total of 48 credits

Fundamentals of Ecology (APES2036) (24 credits)
Aquatic Ecology (APES2034) (24 credits)
Evolution (APES2008) (12 credits)

Third Year – Total of 72 credits

One of the following field trips:

- Applied Freshwater Ecology and Management (APES3064A) (18 credits)
- Field Methods in Terrestrial Ecology (APES3068A) (18 credits)
- People and Conservation Field Course (APES3070A) (18 credits)

or

One of the following laboratory projects:

- Service Learning in Biology (18 credits)
- Laboratory Project (18 credits)

and

offered in 2021:

- Molecular Ecology (APES3069A) (18 credits)
- Spatial Ecology and Conservation (APES3072A) (18 credits)
- Environment & Sustainability III (APES3073A) (18 credits)
- Functional Ecology in Changing Environments (APES3034A) (18 credits)
- Palaeontology III (APES3029A) (18 credits)
- Diversity, Ecology and Economic Importance of Algae (APES3051A) (18 credits)
- Biosystematics and Evolution III (APES3066A) (18 credits)

BIODIVERSITY

Objective

This exciting focus area provides students with the appropriate skills, knowledge and attitudes that would allow them to enter a wide range of zoological, botanical and ecological careers and to provide a foundation for future specialisation.

Recommended Courses

Second Year – Total of 48 credits
Biotic Diversity (24 credits) Evolution (12 credits)
Third Year – Total of 72 credits
One of the following field trips: Applied Freshwater Ecology and Management (18 credits) Experimental Field Biology (18 credits) or One of the following laboratory projects: Microscopy (18 credits) Service Learning in Biology (18 credits) Laboratory Project (18 credits) and Choice from the following courses offered in 2021: Medical & Applied Entomology III (APES3042) (18 credits) Molecular Ecology (APES3069A) (18 credits) Spatial Ecology and Conservation (APES3072A) (18 credits) Functional Ecology in Changing Environments (APES3034A) (18 credits) Palaeontology III (APES3029A) (18 credits) Diversity, Ecology and Economic Importance of Algae (APES3051A) (18 credits) Biosystematics and Evolution III (APES3066A) (18 credits)

ORGANISMAL BIOLOGY

Objective

Animal and plant life are shaped by central processes of evolution, heredity and development. In our School, we focus largely on whole organisms, but cover topics ranging from basic animal or plant biology, including physiology, through to interactions of animals and plants with the biotic and abiotic characteristics of their environments. The syllabus is designed to provide broad competence for careers that involve the biology of animals, plants in relation to their environment, which also include human or veterinary medicine.

Recommended Courses

Second Year - Total of 48 credits
Animal Form and Function (APES2033A) (24 credits) Evolution (APES2008A) (12 credits) Whole Plant Physiology (APES2002A) (12 credits)
Third Year – Total of 72 credits
One of the following field trips: Applied Freshwater Ecology and Management (APES3064A) (18 credits) Experimental Field Biology (APES3067A) (18 credits) or One of the following laboratory projects: Microscopy (18 credits) Service Learning in Biology (18 credits) Laboratory Project (18 credits) and Choice from the following courses offered in 2021: Animal Behaviour III (APES3041) (18 credits) Medical & Applied Entomology III (18 credits) Palaeontology III (APES3029A) (18 credits) Diversity, Ecology and Economic Importance of Algae (APES3051A) (18 credits) Biosystematics and Evolution III (APES3066A) (18 credits)

Information for all prospective biology teachers

Please note that any student who wishes to do a PGCE (Postgraduate Certificate in Education) to teach Life Sciences must have completed three years in any field of biology and have majored in biology. In addition, you must complete a first year unit in each of two learning areas in order to qualify to teach those learning areas to Grade 9 (see School of Education for further details). If you are not sure whether your courses are appropriate, speak to the School of Education.

DETAILS OF COURSES

First Year

BIOL 1000A Introductory Life Sciences I
BIOL 1006A Complementary Life Sciences I (Life in its Diversity)

If your career intentions are in the Biological field we recommend that you take both *Introductory Life Sciences I* and *Complementary Life Sciences I*. The descriptions of the first-year courses are provided in this booklet on pages 7 & 8.

Please note that some of the 2nd and 3rd year courses listed below involve field trips which are compulsory. At the beginning of each semester, it is your responsibility to find out when the field trips take place.

Second Year

Basic statistics for the Natural Sciences (STAT2013A) (12credits) is compulsory.
This course is a prerequisite for all 3rd year APES courses.
Students must apply for individual courses.
A total of 144 credits from all courses must be registered for 2nd year with at least 48 credits per major.

APES2002A Whole Plant Physiology II (12 credits)

This course on physiology is designed to introduce important background concepts in plant metabolism which impact on our understanding of other disciplines in biology, especially ecology, agriculture and biotechnology. This course will cover some details of central / important underlying physiological processes that relate to the 'big picture' of plant function and is NOT intended to be an exhaustive overview of metabolic pathways / physiological responses. This course also covers some key background concepts, including whole plant architecture, cell structure (particularly membrane structure) and the properties of water. Furthermore, some consideration will also be given to certain evolutionary aspects (such as the origin of photosynthesis and aerobic respiration in eukaryotic cells) and adaptations to changing environmental conditions.

APES2008A Evolution II (12 credits)

This course provides a working understanding of evolution that can be applied throughout the rest of the student's biological career. The course introduces Darwinian natural selection and contextualises it in neo-Darwinian population genetics. Macro-evolution, micro-evolution, speciation, evolution of sex, and strategies for improving fitness are topics that will be included in the course. Examples will be drawn across the diversity of life on earth, from organelles to plants, animals and humans.

APES2022A Marine and Coastal Systems Fieldwork II (12 credits)

(This course takes place in January) – WILL NOT RUN IN 2021
This course introduces students to marine and terrestrial environments. The course is a field trip which is run in January on the KwaZulu Natal coast. The course focuses on classification and biodiversity. Students will be introduced to scientific methods and

presentation. This course is strongly recommended for students who have completed the Animal and Plant diversity courses in Complementary Life Sciences I (BIOL1006).

APES2030A Experimental and Sustainable Biology (12 credits)

A broad aim of this topic is to show-case specialised disciplines encountered in biology at the whole organism and environment level. A further important component, which will be threaded throughout the course, is to introduce the students to the applied side of biology. It is the intention of this course to provide students with a broad overview of the types of academic investigation that a modern biologist will encounter, and also to empower them to see how this could be put to good economic use.

APES2033A Animal Form and Function II (24 credits)

This course examines how the anatomy and physiology of living and extinct animals have been shaped through evolutionary processes for functional purposes. Using a set of fundamental principles (e.g., lever mechanics), the course builds integrative knowledge of animal anatomy, functional morphology, and comparative physiology.

APES2034A Aquatic Ecology II (24 credits)

This course provides an integrated introduction to the basic principles of aquatic ecology using freshwater, estuarine and marine systems as examples. The course introduces students to aquatic ecology at the ecosystem scale, physical, biological and chemical processes that regulate aquatic systems, and to the biota that are dependent on these environments. The course will also include discussion on the degradation associated with an ever-increasing human population and the management practices that are in place to ensure the sustainability of freshwater, a valuable yet limited resource in South Africa.

APES2035A Biotic Diversity II (24 credits)

This course introduces students to the major groups of flora and fauna in grassland and savanna (the major biomes that occur in Gauteng Province) in the context of the principles and practices of systematics. The course focuses on the evolutionary trends in morphology, physiology, ecology and/or behaviour, and the biogeographical features that have shaped the complements of organisms occurring in this region. In this way, drivers of biodiversity and the economic/ecological conservation value of this biodiversity will be addressed, and the impact of human transformation on the biota will also be considered. This course lays the foundation for biosystematic, evolutionary and ecological work by familiarizing students with many of the components of and factors affecting biodiversity.
Compulsory Field trip: 1 weekend (dates to be confirmed and advised).

APES2036A Fundamentals of Ecology II (24 credits)

This course is a comprehensive but introductory survey of the main topics in ecology, designed to have an African perspective, and to serve the needs of terrestrial, freshwater and marine ecology. The course covers issues such as the meaning of ecology, autecology, ecoclimatology, ecosystems, populations, communities, niche theory, life histories, competition, facilitation, herbivory, predation, trophic webs, disturbance ecology, ecohydrology, nutrient cycling, energetics, the ecology of biodiversity, natural resource management and conservation, transformed ecosystems

and stability and resilience. The course also has a series of embedded lectures in soil science, given the critical importance of substrates for tropical ecology.
The course includes a field trip.

APES2038A Research Methods in Biological Sciences II (12 credits)

This course provides students with an opportunity to gain experience in research methods. The course consists of a self-study topic in which students engage with particular staff members about a research topic of interest, and learn how to develop the research problem statement, aim and objectives. The student learns how to perform literature reviews, research appropriate methods, conduct the research and write a report. The course will have a strong focus on research methodology and skills development (writing and presenting, data collection and analysis). *THIS COURSE MAY ONLY BE TAKEN UNDER EXCEPTIONAL CIRCUMSTANCES AND WITH THE APPROVAL OF THE HEAD OF SCHOOL.*

Third year

Students must have passed STAT2013A or equivalent to register for third year courses.
Students must apply for individual courses.
A total of 144 credits from all courses must be registered for 3rd year.

It is essential to include topics with integrated assessment in each 3rd year major. This would normally be a Field Trip or Laboratory Project. In exceptional circumstances, other topics that include integrated assessment may be substituted, but only with the approval of the Head of School.

Courses:

APES3023A Self-study topic III (9 credits)

This course is designed to make provision for special interests to suit individual students. *IT MAY ONLY BE TAKEN UNDER EXCEPTIONAL CIRCUMSTANCES AND ONLY WITH THE APPROVAL OF THE HEAD OF SCHOOL.*

APES3026A Special Topic III (9 credits)

Special course given by visiting lecturers – not always offered.

APES3029A Palaeontology III (18 credits)

This course offers an integrated approach to the evolution of plants and animals through time. The course begins with a short introduction to the origin of life and will then focus on higher plant and animal taxa that have evolved. The course covers the major transitions: fish to amphibian to reptile to mammals and hominids to modern humans, mass extinctions, aquatic to land plants, ferns, gymnosperms and angiosperms. The course will provide students with the fundamental concepts of palaeoecology.

APES3034A Functional Ecology in Changing Environments III (18 credits)

This course will examine the interconnectedness of ecosystems within the context of the regional African environments. The course introduces students to the well-documented causes of global change, including change in the composition of the atmosphere, in land use and in water use that impact the way ecosystems function in South Africa. The course also addresses the functioning of soils, plants and animals and will use examples from conservation, water resource management, agriculture and forestry.

APES3041A Animal Behaviour III (18 credits)

This course introduces students to the science of animal behaviour (i.e. ethology). The course is designed to provide the basics of animal behaviour to students who have only a rudimentary knowledge of biology, while at the same time extending the knowledge of advanced students. The course focuses on the underlying (how and why) questions. The course starts with some of the psychological processes underlying animal behaviour, such as stimulus- response, learning, and cultural transmission of information. The course ends with an extensive coverage of the adaptive significance of behaviour, particularly socio- ecological phenomena. The course also covers issues in applied ethology to demonstrate the applicability of animal behaviour.

APES3042A Medical and Applied Entomology III (18 credits)

This course takes an applied look at the problems and opportunities offered by insects in our environment. The course introduces students to the techniques involved in the manipulation of insects considered as pests or biological control agents. The course covers medically important arthropod groups, control methods, vector biology and forensic entomology.

APES3051A Diversity, Ecology and Economic Importance of Algae III (18 credits)

This course explores the importance of algae as primary producers in aquatic and less conventional ecosystems, introduces their long history in economic pursuits such as mariculture, and tackles some intriguing and varied ‘life skills’ that they have employed, including motility, behaviour, symbiosis, toxins, etc. The practical sessions provide a limited exposure to algal diversity and provide some opportunity to undertake independent literature research.

APES3058A Biosystematics and Evolution III (18 credits)

This course will introduce students to the study of biosystematics that examines variability and diversity in organisms. The course will examine the process of evolution and the interpretation of the pattern they produce at the levels of the organism, population and species. Implications for classification (i.e. species concepts and hierarchical organization of organisms), understanding phylogenetic and biogeographic relationship and conservation issues will be discussed. Examples will be drawn from the African flora and fauna. The practical component of the course will involve use of the tools of phenetics and cladistics to examine variation and patterns of the evolution in both plants and animals.

APES3073A Environment & Sustainability III (18 credits)

This course will introduce students to the basic concepts of sustainability, and how human activities and management practices alter biodiversity, ecosystem functioning and ecosystem services. The course also explores the economic and other social science perspectives to estimate the value of aspects such as ecosystem services as well as approaches to the evaluation of options for achieving sustainable ecosystem services and provisioning. The course will cover the value of ecological research in sustainability and environmental management.

APES3069A Molecular Ecology III (18 credits)

This course will show how molecular genetics techniques are used to improve our understanding of ecology and evolution, in a conservation context. The course focuses on the application of molecular genetic techniques to conservation and biodiversity issues while learning skills necessary for future conservation biologists. Through this course, students will gain an understanding of the applications of molecular ecology, its role in professional disciplines, and the use of the scientific method in this field. This course builds on the foundation for biosystematic, evolutionary and ecological work from previous courses by integrating information that can be obtained through molecular resources.

APES3072A Spatial Ecology and Conservation III (18 credits)

This course is designed as an introduction to spatial techniques used in conservation; essentially a peek into the toolbox of tools that are available to conservation practitioners and training in the use of a few of these tools. With easy access to spatial data from various sources, and the reality of conservation planning in the face of biodiversity loss, conservation is becoming an increasingly spatially explicit problem that needs spatially explicit solutions. The course will comprise of theory around spatial ecology, niche modelling, landscape pattern analysis and remote sensing.

Field Trips:

Field trips will be organised during the April, July and September study breaks. Small projects will be undertaken usually in groups of 2 – 6 people. Preparation in terms of reading will be required before departure. Results are to be presented orally on the field trip and the full project report has to be submitted within 6 weeks.
Entry will be limited to those students who are registered for an AP&ES major and acceptance may be limited because of space and staffing constraints.

APES3064A Applied Freshwater Ecology and Management III (18 credits)

This field based course will introduce students to research skills in aquatic ecology. Students will use *in situ* physical and chemical parameters, riparian vegetation, macroinvertebrates and fish to determine the health of a river in Mpumalanga Province. The course is designed to equip students with the necessary tools used to determine river health.
This field trip takes place during the September study break

APES3067A Experimental Field Biology III (18 credits)

This field based course is designed to train undergraduate students in basic field techniques, and the application of these, to experimental ecological research. The course consists of a field-based project during which students are introduced to the process of conducting ecological research in the field, and exposes them to a variety of concepts and field techniques. In particular, students will learn skills appropriate to the scientific method, including; hypothesis formulation and experimental design, data collection, data analysis, scientific writing and presentation.
Students can choose to attend this course either during the April, July or September study break.

APES3068A Field Methods in Terrestrial Ecology III (18 credits)

This field based course will give students experience in doing ecological research in a heterogeneous savanna environment. The course will include learning methods for conducting a research project including formulating a research question, planning data collection, field methods for collecting data, how to analyse data in the appropriate manner and how to communicate those results both verbally and in a written report. This course will involve completing a research project in groups.
This field trip will take place during the April study break.

APES3070A People and Conservation Field Course III (18 credits)

This field course is a combination of lectures, tutorials, and fieldwork, in which students will be exposed to concepts, issues and research methodology relating to the relationship between local people and conservation in rural communities. The course is run from the Wits Rural Facility (WRF), in the central Lowveld. The course will introduce students to social research methods, such as structured interviews and participatory rural appraisal focus groups. The course will teach students how to engage with local community members about local environmental issues, dependence on natural resources, environmental attitudes and perceptions, and local resource management.
This field trip will take place during the September study break.

Laboratory Projects:

At the beginning of the year, the times for meeting staff and performing the experimental work will be agreed upon.

APES3044A Laboratory Project III (18 credits)

This course is a laboratory-based project which may only be taken under exceptional circumstances. Entry will be limited to those students who are majoring in one of the AP&ES courses and acceptance may be limited because of staffing constraints. Students may not do both a Field Work Project and a Laboratory Project in the same major. *Students wishing to register for this module should obtain permission from the Head of School and the relevant staff member before registration*.

APES3048A Microscopy III (18 credits)

This course covers the use of microscopy techniques in the field of biological research as tools for solving problems. The course will train students in the practical application of light microscopy, video microscopy, digital photography, scanning and electron microscopy and confocal microscopy for both living and fixed material. The course will include a brief theoretical background to microscopy. This course includes a project on biological material.

APES3071A Service Learning in Biology III (18 credits)

This course introduces students to both the theory behind and the practice of service learning in biology. The course will explore the teaching and learning strategy that integrates meaningful community service with instruction and reflection to enrich the learning experience, teach civic responsibility, and strengthen communities. The course will equip students with event, poster and oral presentation skills, reflective journaling and exhibition planning and time management so that they can participate in the Yebo Gogga Yebo amaBloma event.

HONOURS

The school offers a fourth year of training in a range of subject areas. The Honours degree is the minimum requirement needed to work as a professional scientist. The course is normally a one year, full-time course, but can also be taken as a two-year part-time course.

The Honours course comprises

- Three theory topics.
- One project.
- An enabling skills course, which includes a statistics course.

The following theory topics may be offered:

Animal Ecophysiology & Adaptation Animal Behaviour & Ecology Biocontrol Biogeography Entomology Ethnoecology Evolutionary Ecology	Global change: Impact on Soils, Plants and Animals Histology Management and Conservation of Mammals Medical Entomology Parasitology Plant and Algal Cell Biology Plant Variation & Nomenclature	Plant Population Dynamics & Regeneration Ecology Pollination Biology Resource Ecology & Conservation Range Limitation River and Wetland Ecology

MASTERS AND DOCTORAL DEGREES

The School has staff members with a range of expertise and experience in supervising postgraduate students and has well-equipped and well-run laboratories. MSc and PhD degrees are usually attained by research work and a dissertation or thesis. Alternatively, a student may enrol for one of the MSc degrees by course work and research report. There are three available, namely in Science Education, in Resource Conservation Biology and in Environmental Science.

ACADEMIC STAFF

PILLAY, N	BScHons MSc PhD (Natal) Professor and Head of School
ALEXANDER, G	BScHons MSc (Natal) PhD (Wwrnd) Professor
ARCHIBALD, S	BSc (Wits) BScHons MSc (UCT) PhD (Wwrnd) Professor
BALKWILL, K	BScHons HDipEd(PG) (Wwrnd) PhD (Natal) MPhil Theol. (St Augustine) Professor
BYRNE, M	BScHons (Lond) PhD (Wwrnd) Professor
DUKHAN, S	BSc (Natal) BScHons (Durban-Westville) MSc PhD (Wwrnd) Senior Lecturer
DUNCAN, F	BScHons (Wwrnd) MSc (OFS) PhD (Wwrnd) Professor
FISHER, J	BScHons MSc PhD (Wwrnd) Lecturer
FURNISS, D	BScHons (Wwrnd) MSc (UKZN) PhD (Wwrnd) Lecturer
GLENNON, K	PhD (George Washington University) Senior Lecturer
GOODMAN-CRON,	BScHons MSc PhD HDipEd(PG) (Wwrnd) Associate Professor
HARRISON, J	BSc (Wwrnd) BScHons MSc, PhD (Pretoria) Pr. Nat. Sci. (Zoology) Lecturer and Zoological Curator
HETEM, R	BScHons PhD (Wwrnd) Senior Lecturer
IQBAL, S	BScHons MSc (Wwrnd) Associate Lecturer
MADIKIZA, K	BScHons MSc (University of Fort Hare) PhD (Wwrnd) Lecturer
MARSHAL, JP	BSc (Alaska) MSc (Alberta) PhD (University of Arizona) Associate Professor
MATIMOLANE, M	BSc (Venda) BScHons (Natal) MSc PhD (Wwrnd) HED (Venda) Senior Tutor
MYCOCK, D	BScHons PhD (Natal) Professor and UNESCO Chair in Cryobiology
PARRINI, F	MSc (Florence) PhD (Wwrnd) Associate Professor
REDDY, R	BScHons (KwaZulu-Natal) MSc (Durban Westville) PhD (Wwrnd) Herbarium Manager
REYNOLDS, C	BScHons MSc (Wwrnd) PhD (Cape Town) Senior Lecturer
RISENGA, I	BSc (Limpopo) BScHons MSc (Johannesburg) PhD (Wwrnd) Lecturer

SCHOLES, MC	BScHons PhD (Wwrnd) Professor and SARChi Chair in Systems Analysis
SCHOLES, R	BScHons PhD (Wwrnd) DipDatametrics (Unisa) Professor of Systems Ecology (Distinguished Professor)
SCHWAIBOLD, U	BScHons PhD (Wwrnd) PDM (Wwrand) Senior Lecturer
SITUNGU, S	BScHons (Rhodes) PhD (Rhodes) Lecturer
SNOW, G	BScHons MSc (UPE) PhD (MMNU) Senior Lecturer
SYM, S D	BScHons MSc PhD HDipEd (PG) (Wwrnd) Associate Professor
TWINE, W	BScHons MSc (Wwrnd) PhD (KwaZulu-Natal) Associate Professor and Director (based at Wits Rural Facility)
VOGEL, C	Distinguished Scholar
WILLIAMS, V	BScHons PhD (Wwrnd) Visiting Researcher
WITKOWSKI, E T F	BScHons MSc (Wwrnd) PhD (Cape Town) Professor in Plant Ecology
WOODFORD, D	BScHons MSc (Cape Town), PhD (University of Canterbury - NZ) Senior Lecturer

Honorary members of Staff

FLETCHER, J	BScHons (Hull) PhD (London) Honorary Senior Lecturer
MARKUS, M	BScHons MSc (Pretoria) BAHons (Wwrnd) MSc PhD DIC DLSHTM (London) Honorary Professorial Research Fellow
OWEN-SMITH, RN	BScHons MSc (Natal) PhD (Wisconsin) Research Professor (*NRF* 'A' rated)
WILLIAMS, V	BScHons PhD (Wwrnd) Visiting Researcher

APES 2021 TIMETABLE

2020	BLOCK 1	BLOCK 2	BLOCK 3	BLOCK 4
A	Statistics for the Natural Sciences STAT2013 (*12 credits)*			
C	Animal Form and Function II APES2033 (*24 credits*)		Experimental and Sustainable Biology APES2030 (*12 credits*)	Research Methods in Biological Sciences APES2038A (*12 credits*)
D	Biotic Diversity II APES2035 (*24 credits*)		Evolution II APES2008 (*12 credits*)	Whole Plant Physiology II APES2002 (*12 credits*)
E	Fundamentals of Ecology II APES2036 (*24 credits*)		Aquatic Ecology II APES2034 (*24 credits*)	
A	Medical & Applied Entomology III APES3042 *Marcus Byrne* (*18 credits*)	Spatial Ecology and Conservation III APES3072 *Jolene Fisher* (*18 credits*)	Biosystematics and Evolution III APES3058 *Glynis Goodman* (*18 credits*)	Diversity, Ecology and Economic Importance of Algae III *Stuart Sym* *APES3051* *(18 credits*) Palaeontology III APES3029 (*18 credits*)
B	Molecular Ecology III APES3069 *Kelsey Glennon* (*18 credits*)	Animal Behaviour III APES3041 *Kim Madikiza* (*18 credits*)	Sustainability and Environmental Sciences III APES3073 *Ute Schwaibold* (*18 credits*)	Functional Ecology in Changing Environments III APES3034 *Sally Archibald* (*18 credits*)
3rd year: Compulsory: Field trip (during the April or September breaks) or laboratory project equivalent				
	Courses equivalent to laboratory projects:			
D		Microscopy III APES3048 (*18 credits*)	Microscopy projects	
	Service Learning in Biology III APES3071 (18 credits)	Yebo Gogga		

MOLECULAR AND CELL BIOLOGY (MCB)

A student registered in the School of Molecular and Cell Biology (MCB) will be majoring or intending to major in at least one of the following courses offered at third year level: Applied Bioinformatics III, Biochemistry and Cell Biology III; Genetics and Developmental Biology III; and Microbiology and Biotechnology III.

Students may major in two of the four courses offered in the school of Molecular Cell Biology (see above). This requires that the appropriate courses be completed at both second and third year levels. Alternatively students can major in one course from within the School and one major from outside as specified below.

Second year

- Students need to achieve a total of 144 credits at the second year level.

- Students wishing to enter the third year of study with two majors in MCB must register for the following -

    - MCB IIA: Scientific Practice MCBG 2036A (36 credits - C slot)
    - MCB IIB: Concepts MCBG 2032A, (48 credits - B slot)
    - MCB IIC: Applications MCBG 2037A (48 credits - E slot) – *is highly recommended*
    - Basic Stats for the Natural Sciences STATS 2013A (12 credits - A slot)

- Students wishing to enter the third year of study with a single major in MCB and a major in another School (e.g. Chemistry, Physiology) must consult the Heads of Schools to check on timetable requirements and ensure there are no timetable clashes. In this instance students must register for the following -

- MCB IIA: Scientific Practice MCBG 2036A (36 credits C slot)
- MCB IIB: Concepts MCBG 2032A, (48 credits - B slot)
- Basic Statistics for the Natural Sciences STAT2013A (12 credits - A slot)
- MAJOR in another School (48 credits)

Third year

- Students need to achieve a total of 144 credits at the third year level.

- Students wishing to obtain two majors in MCB must register for two of the following -

    - Applied Bioinformatics III MCBG 3033A (72 credits - A slot)
    - Biochemistry and Cell Biology III MCBG 3004A (72 credits - D slot)
    - Genetics and Developmental Biology III MCBG 3034A (72 credits - C slot)
    - Microbiology and Biotechnology III MCBG 3035A (72 credits - E slot)

- Obtaining a mark of below 40% in any course in 2nd or 3rd year will result in exclusion from the course examination.
- All queries should be referred to the Senior Administrative Officer or the Head of the School of Molecular and Cell Biology.

See timetable diagram on next page.

SCHOOL OF MOLECULAR AND CELL BIOLOGY 2021

Required and recommended course combinations leading to MAJOR courses offered by the School of Molecular and Cell Biology

1st YEAR (144)

INTRODUCTORY LIFE SCIENCES (ILS) (BIOL1000) [C] [D] (36 CREDITS)

+

CHEMISTRY I (CHEM 1012) [A] [B] [E] (36 CREDITS)

+

MATHEMATICS 1 Auxiliary (MATH 1041) [B] [E] (36) CREDITS

+1 OTHER

PREFERRED UNITS:
- **COMPLEMENTARY LIFE SCIENCES (CLS)** BIOL1006 [B]
- **PHYSICS I Auxiliary** PHYS1001 [A/C]

2nd YEAR (144)

MCB DOUBLE MAJOR STUDENTS MUST TAKE -

MOLECULAR & CELL BIOLOGY IIA - * SCIENTIFIC PRACTICE * (MCBG 2036A) [36 CREDITS]

+

MOLECULAR & CELL BIOLOGY IIB - * CONCEPTS * (MCBG 2032A) [48 CREDITS]

+

MOLECULAR & CELL BIOLOGY IIC - * APPLICATIONS * (MCBG 2037A) [48 CREDITS] ***PREFERRED***

+

STATISTICS FOR NATURAL SCIENCES (STAT2013A) [12 CREDITS]

OR

MCB SINGLE MAJOR WITH ANOTHER MAJOR MUST TAKE -

MOLECULAR & CELL BIOLOGY IIA - * SCIENTIFIC PRACTICE * (MCBG 2036A) [36 CREDITS]

+

MOLECULAR & CELL BIOLOGY IIB - * CONCEPTS * (MCBG 2032A) [48 CREDITS]

+

STATISTICS FOR NATURAL SCIENCES (STAT 2013A) [12 CREDITS]

+

OTHER MAJOR e.g. Chemistry; Physiology [48 CREDITS]

3rd YEAR

2 of these majors (144)

BIOCHEMISTRY & CELL BIOLOGY III (MCBG 3004A) (72 CREDITS)

GENETICS & DEVELOPMENTAL BIOLOGY III (MCBG 3034A) (72 CREDITS)

MICROBIOLOGY & BIOTECHNOLOGY III (MCBG 3035A) (72 CREDITS)

APPLIED BIOINFORMATICS III (MCBG3033A) (72 CREDITS)

1 MCB Major + another Major - see above (72 CREDITS)

For details see Faculty of Science Rule Book and/or Biological Sciences Handbook - ENQUIRIES: Ground floor GATE HOUSE Building Tel: (011) 717-6310

MCBG2036A MOLECULAR AND CELL BIOLOGY IIA: SCIENTIFIC PRACTICE (36 credits) (Slot C) (Blocks 1-3) This is a restricted course

Prerequisites: Introductory Life Sciences I (BIOL 1000A) AND Chemistry I (CHEM 1012A) with 55% minimum mark AND Mathematics I Auxiliary (MATH 1041A) or Statistics I (STAT1013A) AND another 36 credit course

Co-requisite: Molecular and Cell Biology IIB: Concepts (MCBG 2032A) AND Molecular and Cell Biology IIC: Applications (MCBG 2037A) OR one other 48 credit course AND Basic Stats for the Natural Sciences (STATS 2013A) (12 credits)

Description:
This course covers the fundamental aspects of various laboratory methods applied to study molecular genetics, bacteriology, viruses, immunology, fungi, and computational biology. This course is designed to equip the student with scientific reasoning (deductive, inductive and abductive arguments), experimental design, data reporting, scientific report writing (accessing information, citing and plagiarism), and experimental hands-on training. The student will be introduced to the techniques including spectroscopy, chromatography, electrophoresis, centrifugation, cell culture, microscopy, immune-techniques, nucleic acid purification, blotting techniques (Southern, Northern, Western), sequencing, PCR and related applications, genetic engineering techniques, and transgenic plants. The student will be assessed using class tests, practical reports, participation in class activities, and an exam. Since this is a practical oriented course, the attendance is highly recommended.

MCBG2032A MOLECULAR AND CELL BIOLOGY IIB: CONCEPTS (48 credits) (Slot B) (Blocks 1-4) This is a restricted course

Prerequistes: Introductory Life Sciences I (BIOL 1000A) AND Chemistry I (CHEM 1012A) with 55% minimum mark AND Mathematics I Auxiliary (MATHA 1041A) AND another 36 credit course

Co-requisite: Molecular and Cell Biology IIA: Scientific Practice (MCBG 2036A) AND Molecular and Cell Biology IIC: Applications (MCBG 2037A) OR one other 48 credit course AND Basic Stats for the Natural Sciences (STATS 2013A) (12 credits)

Description:
This course introduces the student to key concepts in molecular and cell biology. The course will explore the following fundamental concepts in modern molecular and cell biology by means of lectures and laboratory sessions: universal features of cells and genomes, DNA and chromosomes, cell division, cell cycle, germ cells and fertilization; central dogma, DNA replication, repair, recombination, gene expression

and control. The course also explores the properties of amino acids, the peptide bond, protein structure & enzymology; eukaryotic and prokaryotic phylogeny including microbial taxonomy; cell biology including the study of membrane structure and function, prokaryotic and eukaryotic cell walls, cell junctions, cell adhesion, extracellular matrix and signal transduction; cell metabolism and its control.

STAT 2013A BASIC STATISTICS FOR THE NATURAL SCIENCES II (12 credits) (Slot A) (Blocks 1-2)

Students will work through an elementary coverage of common statistical methods applied in the Natural Sciences. These will include descriptive statistics (graphical as well as numeral summaries), simple random sampling, basic probability concepts, key probability distributions, correlation, simple linear regression, basic inferential statistics - both parametric and non-parametric tests. The above concepts will be reinforced and applied with the use of a statistical software. On completion of this course, the student should be able to identify, and distinguish between, different statistical techniques; select an appropriate statistical test required to analyse data and; analyse data and correctly interpret the result obtained from the analysis.

MCBG2037A MOLECULAR AND CELL BIOLOGY IIC: APPLICATIONS (48 credits) (Slot E) (Blocks 1-4) This is a restricted course

Prerequisites: Introductory Life Sciences I (BIOL 1000A) AND Chemistry I (CHEM 1012A) with 55% minimum mark AND Mathematics I Auxiliary (MATH 1041A) AND another 36 credit course

Co-requisites: Molecular and Cell Biology IIA: Scientific Practice (MCBG2036A) AND Molecular and Cell Biology IIB: Concepts (MCB 2032A) AND Basic Stats for the Natural Sciences STATS 2013A (12 credits)

Description:
This course explores the theory and practical techniques behind the latest research within four broad topic areas. Molecular Basis of Disease investigates the molecular underpinnings and therapeutic approaches of diseases such as cancer and inherited disorders, and focuses on modes of inheritance, epigenetics and gene-environment interactions. Drug Discovery looks at the processes and principles behind identification of drug targets and drug discovery, mechanisms of action and side effects, trials and commercialisation. Current Topics in Microbiology considers the role of viruses, bacteria and fungi in the environment, human health and agricultural biotechnology. Genetic Innovations studies genetics and genomics in forensic science, disease diagnosis, pharmacogenomics and personalised medicine, and considers genetic manipulation for the improvement of human health and the environment. The course consists of four subject areas Genetic Innovations, Molecular Basis of Disease, Drug Discovery, and Current Topics in Microbiology, which focus on the latest developments, research and research methodology with respect to the content in each of the units. Thus each will enrich the co-requisite courses offered at second year level in the school and offer students a firm basis for entering third year.

MCBG3004A BIOCHEMISTRY AND CELL BIOLOGY III (72 credits) (Slot D) This is a restricted course

Biochemistry & Cell Biology is the study of the chemistry of life. It is an experimental science that aims to explore, unravel and understand the structure and function of all living things (micro-organisms, plants, animals, and ourselves!) at the molecular level. It interacts with a wide range of biological and physical disciplines such as chemistry, biophysics, genetics, microbiology, zoology, plant sciences, physiology, etc. Biochemistry & Cell Biology yields important insights and practical applications in medicine, agriculture, nutrition, industry and the environment.

Prerequisites: Molecular and Cell Biology IIA: Scientific Practice (MCBG 2036A) AND Molecular and Cell Biology IIB: Concepts (MCBG 2032A) AND Molecular and Cell Biology IIC: Applications (MCBG 2033A)) OR one other 48 credit course AND Basic Stats for the Natural Sciences (STATS 2013A) (12 credits)

NOTE- When registering for the Biochemistry & Cell Biology major you must use the full year course MCBG3004A not the individual codes.

If you obtain an overall mark of 50% for a course, but have failed more than half the credit value for that course, you will be required to repeat components the following year.

A mark of below 40% for any component will result in exclusion from that examination.

MCBG3005A Protein Biochemistry and Biotechnology III (18 credits)

This course provides the students with an in depth appreciation for protein structure and stability. It focusses on interpretation of data and skills both in the wet lab and in silico. The outline of the course includes: An overview of properties and functions of amino acids, peptide and proteins; molecular forces; Protein primary, secondary, tertiary and quaternary structures. Protein structure determination methods; Protein folding, dynamics and conformational stability. Protein structure-function relationships and motifs. In vitro mutagenesis and protein engineering. Protein Biotechnology, the large-scale production of native and recombinant proteins, and the utilisation of proteins in medicine and industry.

MCBG3010A Advanced Cell Biology III (18 credits)

This course aims to demonstrate how the contemporary field of cell biology has developed through the integration of structural, and biochemical studies that have most recently been revolutionised by the understanding at the molecular level of gene structure and function. The discussion will lead to an understanding of how cells contain highly organised biochemical systems that lead ultimately to the formation of the fundamental molecular components of all living organisms. The course explores the interrelationship of molecules central to the establishment of cellular life and thus provides a detailed understanding of the signals and constraints responsible for the regulation of cell proliferation. Exploring the concepts underlying how cells are continually replaced from undifferentiated self-renewing stem cells will inform an in-

depth interrogation of how differentiated cells maintain their specialised character, and cancer cells proliferate in defiance of normal controls.

MCBG3008A Enzymology III (18 credits)

This course focusses on the study of enzymes and will provide the student with an introduction to enzymology. This is achieved by means of lectures and computer-based enzymology laboratory sessions (using alkaline phosphatase as a model enzyme). The course is designed to equip the student with a fundamental understanding of enzymology in the following areas: enzyme techniques; chemical kinetics; mechanisms of enzyme catalysis; enzyme regulation and application of enzymes in biotechnology**.**

MCBG3009A Information Pathways and Bioinformatics III (18 credits

This course is designed to equip the student with an in-depth understanding of the structure and function of genes. The course consists of the study of the structure and topology of nucleic acids and provides the student with comprehensive information on how genetic information is stored, duplicated during cell division and transmitted to direct cellular function. Furthermore, the course will explore the regulation of gene expression and DNA repair mechanisms with relation to oncogenesis. Finally, bioinformatics analysis of nucleic acid and gene regulation will be introduced.

MCBG3034A GENETICS AND DEVELOPMENTAL BIOLOGY III (72 credits) (Slot C) This is a restricted course

Genetics is the science of heredity and variation. It includes the study of whole organisms and the molecular sequence of genes and whole genomes. Genetics provides the understanding of how traits are passed from one generation to the next and has elucidated the evolutionary origins of and modifications to animals, plants and microbes. Developmental biology of animals and plants is the study of how genes determine the growth and differentiation of multicellular organisms. Genetics and developmental biology have given us fundamental insights and useful applications in the fields of agriculture and the health sciences.

Prerequisite: Molecular and Cell Biology IIA: Scientific Practice (MCBG 2036A) AND Molecular and Cell Biology IIB: Concepts (MCBG 2032A) AND Molecular and Cell Biology IIC: Applications (MCBG 2037A) OR one other 48 credit course AND Basic Stats for the Natural Sciences (STATS 2013A) (12 credits)

NOTE- When registering for the Genetics & Developmental Biology major you must use the full year course MCBG3034A not the individual codes.

If you obtain an overall mark of 50% for a course, but have failed more than half the credit value for that course, you will be required to repeat components the following year. **A mark of below 40% for any component will result in exclusion from that examination.**

MCBG3012A Gene Regulation in Eukaryotes III (18 credits)

This course focuses on the mechanisms that contribute to regulating gene expression in eukaryotes. The material covered starts at the level of DNA structure, which includes looking at the contribution of epigenetic modifications. This is followed by transcription initiation with an examination of the components responsible for modifying gene expression, such as DNA promoter elements and transcription factors. Then, the mechanisms involved in RNA processing are discussed with a focus on their influence on protein expression. Finally, the signalling cascade of events that modify gene regulation and expression will be placed into context using examples from various cellular processes, such as those in development and disease.

MCBG 3029A Population Genetics III (18 credits)

This course will be a general introduction to the field of population genetics, which has become an integral component of genomics, medical genetics, forensics, conservation biology and bioinformatics. Particular topics to be dealt with in detail include processes that affect frequencies of alleles, haplotypes and genotypes in populations over time, and departures from Hardy Weinberg equilibrium. Quantitative genetic variation and genetics of complex traits, heritability, selection and evolutionary genetics will be discussed. We will explore advanced and current molecular genetic techniques to detect different kinds of genetic variation for use in population genetics applications.

MCBG3014A Chromosomes and Gene Maps III (18 credits)

This course will provide an overview of the sequences and consequences of cell division and focusses on chromosome organisation, structure and function. The course also explores chromosome mutations, such as variation in number and arrangements. Cellular events especially those of the chromosome will be correlated with genetic phenomena. Various approaches to the construction of genetic maps in humans and the identification of genes for disease will be discussed. The practical component will include the visualisation of human chromosomes and linkage mapping in a model organism, *Drosophila melanogaster* (the fruit fly).

MCBG 3030A Advanced Developmental Biology III (18 credit)

In this course students are introduced to the exciting field of modern Developmental Biology. The course encompasses exploration of the morphological, molecular and genetic processes that are responsible for vertebrate embryogenesis, as well as how these processes are altered during evolution or in congenital disease. Formation of several vertebrate anatomical structures (e.g. limbs, reproductive system) is discussed in depth. Additionally, students are provided with an overview of the exciting fields of aging and regenerative medicine.

MCBG 3035A MICROBIOLOGY AND BIOTECHNOLOGY III (72 credits) (Slot E)
This is a restricted course

The courses in Microbiology & Biotechnology aim to provide a good basic knowledge of the various groups of microorganisms, their morphology, metabolism, genetics and taxonomy. A considerable amount of time is spent on specialised techniques. The courses pay particular attention to the part Microbiology & Biotechnology is playing in modern industry, ecology, medicine and agriculture. The topics are given in the form of lectures, seminars and practical classes.

***Prerequisite*:** Molecular and Cell Biology IIA: Scientific Practice (MCBG 2036A) AND Molecular and Cell Biology IIB: Concepts (MCBG 2032A) AND Molecular and Cell Biology IIC: Applications (MCBG 2037A)) OR one other 48 credit course AND Basic Stats for the Natural Sciences (STATS 2013A) (12 credits)

NOTE- When registering for the Microbiology & Biotechnology major you must use the full year course MCBG3035A not the individual codes.

If you obtain an overall mark of 50% for a course, but have failed more than half the credit value for that course, you will be required to repeat components the following year. **A mark of below 40% for any component will result in exclusion from that examination.**

MCBG3018A Advanced Virology III (9 credits)
This topic will cover principles of virus-host interactions and pathobiology with respect to human and animal viruses, with specific emphasis on the host immune response. Included in this will be the strategies employed by the different viruses to subvert the host immune response. We will also address virus evolution in some detail, and in that context, try and understand the emergence of new viral diseases such as HIV/AIDS and SARS.

MCBG3024A Advanced Bacteriology III (9 credits)
This course is designed to provide students with an overview of the unique characteristics of bacteria and their interactions with other organisms in the environment. The course reviews bacterial metabolism and growth, bacterial attachment to surfaces and the formation and characteristics of bacterial biofilms. The course also explores bacterial infections of mammalian hosts, pathogenesis and virulence factors. Key concepts relating to interbacterial communication and coordinated population responses are reviewed.

MCBG3027A Plant and Invertebrate Pathology III (18 credits)
Plant pathogens and pests cause considerable crop losses world-wide. The course introduces students to the key group of insect and plant pathogens. In addition to reviewing insect defences to pathogens, the methods of infection, disease development and transmission of the different groups of insect pathogens are studied. The course will also cover the principles of insect biocontrol. Plant pathology topics include disease identification (as part of practicals) and the molecular basis of susceptibility and resistance of plant hosts. The outcomes are an understanding of plant and insect pathogens and their interactions with their hosts.

MCBG3032A Bioengineering & Biotechnology III (18 credits)

This course introduces the student to the key concepts underlying selected topics in Bioengineeering and Biotechnology. The course involves the critical analysis of the design, development, operation and optimization of bioprocesses for the production of various high value 'bioproducts'. In this course the use of algae, yeasts, fungi and bacteria for the production of high valued products such as biomethane, bioethanol, biohydrogen, biodiesel, bioplastics, antibiotics, insecticides, biofertilizers, pharmaceuticals and fine chemicals will be discussed. In addition, the use of bacteria in bioleaching (application of bacterial to extract minerals), bioremediation (acid mine drainage and organic chemical pollution) and crop pest control (the entomopathogenic nematode-bacterial-host complex) will be investigated. Also in this course the applications of various bioprocess and bioreactor technologies such as continuous stirred tank bioreactors, fluidized bed bioreactors, air lift bioreactors and photobioreactors will be described. The course will be comprised of lectures, laboratory based practicals and computer lab

MCBG3021A Microbial Food Safety III (9 credits)

Modern concepts in food preservation and food safety and quality management will be reviewed. The concept of hurdle technology and its application in food preservation will be illustrated. Modern approaches to achieving food safety and stability by applying hygiene management and the Hazard Analysis Critical Control Point (HACCP) system will be explained and illustrated. The concept of quantitative microbial risk assessment and its application to international food trade will be reviewed and explained.

MCBG3022A Biotechnology of Fungi III (9 credits)

This course provides an overview of the use of fungi in the biotechnology of the food industry; the production of biochemicals; in medical biotechnology; agricultural biotechnology; environmental biotechnology; and bioremediation. Detailed aspects cover the use of yeasts and fungal cell wall-degrading enzymes in the food industry; the use of white-rot fungi in the pulp and paper industry; fungi and the biodegradation of industrial and mining wastes.

MCBG 3033A APPLIED BIOINFORMATICS III (72 credits) (Slot A) This is a restricted course

***Prerequisite*:** Molecular and Cell Biology IIA: Scientific Practice (MCBG 2036A) AND Molecular and Cell Biology IIB: Concepts (MCBG 2032A) AND Molecular and Cell Biology IIC: Applications (MCBG 2037A)) OR one other 48 credit course AND Basic Stats for the Natural Sciences (STATS 2013A) (12 credits)

***Compulsory*:** Introduction to Bioinformatics III (36 credits) -Blocks 3 & 4, Slot A; and any two Molecular and Cell Biology III 18 credits courses **NOT** included in the other MCB major. **NB**: These courses must fit into available slots in the student's timetable,

which is especially important to note if the other major is not within MCB.

If you obtain an overall mark of 50% for a course, but have failed more than half the credit value for that course, you will be required to repeat components the following year. **A mark of below 40% for any component will result in exclusion from that examination.**

MCBG 3031A Introduction to Bioinformatics III (36 credits) (Slot A) <u>Plus</u> another 36 credits from MCBG (e.g. 2x18 credits)

The overall aim of the course is for students to understand the utility of bioinformatics in the scientific field. Students will learn to select, describe and use basic bioinformatics tools and how to interpret computational results. Students will also develop an appreciation of the breadth and shortcomings of available computational approaches. More specifically the course will include the history and application of bioinformatics; the major bioinformatics databases and portals; searching, local and global alignment; BLAST; multiple sequence alignment techniques and tools; an introduction and overview of phylogenetics techniques; visualisation techniques; pattern matching techniques and applications; gene expression: Microarray data analysis, protein analysis and proteomics, functional genomics and genome analysis. Students should develop the ability to identify the appropriate bioinformatics tool for the task at hand; explain the underlying theory behind these tools; demonstrate the utility of different computational approaches; compare and contrast databases and portals; assess the limitations of algorithms and tools; evaluate results of bioinformatics experiments.

Possible fields of employment with a degree from the School of Molecular and Cell Biology:

Academic: Teaching and/or research at universities

Research: Animal and plant breeding at institutions such as the Onderstepoort, the South African National Biodiversity Institute, Agriculture Research Council.
Medical research can be carried out at the Council for Scientific and Industrial Research (CSIR), the National Health Laboratory Services (NHLS), National Institute for Communicable Diseases (NICD), amongst others. A degree can be used as a foundation for moving into other medically related fields such as genetic counselling and opportunities at the Departments of Health.

Private enterprise: Many private companies such as seed producers, breweries and agricultural companies, the dairy and food industries, water purification, pharmaceutical and chemical companies require graduates with majors in the fields of Molecular and Cell Biology.

HONOURS IN MOLECULAR AND CELL BIOLOGY

This is a restricted course

Honours is a fourth year of training and is the minimum requirement needed to work as a professional scientist. Honours in the School of Molecular and Cell Biology will allow you to specialize in one of four disciplines, namely Applied Bioinformatics, Biochemistry and Cell Biology, Genetics and Developmental Biology or Microbiology and Biotechnology

Duration
One academic year of full-time study.

Honours in Biochemistry and Cell Biology (120 Credits)

The candidate must complete the following compulsory courses to qualify for a BSc Honours in the field of Biochemistry and Cell Biology.

Course code	Description	Credit Breakdown
Compulsory courses		
MCBG 4029A	Research Project in Biochemistry and Cell Biology	60
MCBG 4027A	Current Topics in Molecular and Cell Biology	24
MCBG 4028A	Laboratory Techniques in Molecular and Cell Biology	36

Honours in Genetics and Developmental Biology (120 Credits)
The candidate must complete the following compulsory courses to qualify for a BSc Honours in the field Genetics and Developmental Biology.

Course code	Description	Credit Breakdown
Compulsory courses		
MCBG4031A	Research Project in Genetics and Developmental Biology	60
MCBG 4027A	Current Topics in Molecular and Cell Biology	24
MCBG 4028A	Laboratory Techniques in Molecular and Cell Biology	36

Honours in Microbiology and Biotechnology (120 Credits)
The candidate must complete the following compulsory courses to qualify for a BSc Honours in the field of Microbiology and Biotechnology.

Course code	Description	Credit Breakdown
Compulsory courses		
MCBG 4032A	Research Project in Microbiology and Biotechnology	60
MCBG 4027A	Current Topics in Molecular and Cell Biology	24

MCBG 4028A	Laboratory Techniques in Molecular and Cell Biology	36

Honours in Applied Bioinformatics (120 Credits)

The candidate must complete the following compulsory courses to qualify for a BSc Honours in the field of Applied Bioinformatics

Course code	Description	Credit Breakdown
Compulsory courses		
MCBG 4030A	Research Project in Applied Bioinformatics	60
MCBG 4027A	Current Topics in Molecular and Cell Biology	24
MCBG 4028A	Laboratory Techniques in Molecular and Cell Biology	36

NOTE: Students must obtain a pass in all three compulsory courses in order to pass overall.

List of proposed Current Topics in Molecular and Cell Biology 2021 from which the candidate will choose three.

Hot Topics in Infectious and non infectious diseases and aging
Cell Signalling in Cancer
Protein Biotechnology
Personalised Medicine
Plant and Insect Pathology
Microbiology in the age of microbiomes
Principles of Macromolecular Crystallography
Synthetic Biology

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SCHOOL OF PHYSIOLOGY

PHSL2000A PHYSIOLOGY II (48 credits) (Slot D)

This is a full year course which each examines mammalian physiological systems with an emphasis on human physiology.

Prerequisites for PHSL 2000A are:
- Introductory Life Sciences I (BIOL 1000A) and Chemistry I (CHEM1012A)

And one of the following:
- Physics I (Auxiliary) (PHYS1001A)
- Mathematics (Ancillary) (MATH1041A)
- Ancillary Mathematics and Statistics I (MATH1010A)

The course will include the physiology of blood and other body fluids; excitable tissue and neuromuscular physiology; the cardiovascular and respiratory systems and renal function; physiology of the central and sensory nervous system; the gastrointestinal tract and nutrition; endocrines; exercise; energetics and temperature regulation.

***The content of the courses will be*:**

Blood and Body fluids:	Basic fluid physiology, dynamics, haematology and fluid compartments.
Excitable tissues:	Neuromuscular Physiology, synapse physiology and the functioning of the autonomic nervous system.
Cardiovascular system:	The basic principles of cardiac function and the circulation of blood and other body fluids.
Respiration:	The basic mechanisms of ventilation, gas exchange, gas transport, regulation of respiratory, and principles of acid-base balance.
Renal:	The filtration, reabsorption and secretory function of kidneys, renal regulation of sodium and water balance, responses to acidosis and alkalosis.
Central nervous system:	A detailed examination of the sensory nervous system, various special senses and the control and initiation of movement. Higher functions of the central nervous system such as memory are also discussed.
Gastrointestinal tract and nutrition:	An overview of the transport, digestion, absorption, excretion and use of nutrients.
Endocrines:	An overview of the major endocrine glands, their function, their hormones, releasing and inhibitory factors and feedback control mechanisms.
Energetics and Exercise and Temperature regulation:	Intermediary metabolism, the source of energy and its measurement, and the physiology of exercise and thermoregulation (concepts of body temperature, mechanisms of heat loss and heat gains).

PHSL3002A APPLIED AND EXPERIMENTAL PHYSIOLOGY III (72 credits) (Slot A) (this course is currently in abeyance)

The course assumes Physiology II knowledge and follows a set curriculum consisting of the following topics and a research assignment. The topics are as follows:

Principles of experimental physiology:
The aim of this topic is to introduce students to aspects of experimental design, the ethics of animal and human experimentation, and statistical analysis methods for analysing data.

Cardiovascular physiology:
The topic examines the physiological basis of altered cardiovascular function. Electrocardiographs: physiological approach to understanding abnormal ECG's. Cardiac failure: precipitating factors, pathophysiology, physiological basis of the signs and symptoms. Hypertension: classification, causes and complications. Shock: basic haemodynamics, classification, effects, compensatory mechanisms and metabolic changes.

Respiratory physiology:
The topic examines hypoxic conditions: causes and effects of anaemic, histotoxic, stagnant and hypoxic hypoxia assessment of hypoxic hypoxia. Consequences of defects of ventilation and perfusion and respiratory failure. Hypoxia associated with high altitude and breath-hold diving.

Acid-base balance:
The topic examines principles of body acid-base balance, effects and diagnosis of acid-base disturbances, and physiological basis of restoration of acid-base balance.

Body fluid balance:
The topic examines disturbances to body fluid homeostasis: dehydration and overhydration, capillary membrane abnormalities, diarrhoea and vomiting, kidney disease, assessment of kidney function, acute and chronic renal failure, physiological basis of fluid therapy.

Higher functions of the nervous system:
The topic examines the physiology of autonomic (ANS) and central nervous system (CNS) function, and of altered states of consciousness (SoC). ANS: adrenergic pathways; effects of ANS dysfunction on other body systems. CNS: physiological basis of localizing signs. SoC: the electroencephalogram; sleep; loss of consciousness and coma.

Gastrointestinal physiology and nutrition disorders:
The topic examines disturbances to the gastrointestinal system in the context of macro and micronutrient components of a balanced diet, appetite regulation, weight control, digestion, malnutrition, absorption and metabolic processes. Assessment of nutritional status: anthropometry, blood variables, signs and symptoms of nutritional and metabolic deficiencies.

Molecular physiology:
This topic will introduce physiology students to some of the basic techniques of molecular technology. It will also include DNA replication, transcription and translation as the basis of molecular technology, how genetic mutations affect physiological function, cloning and recombinant expression of genes, antibody-based analysis of proteins and the *in vivo* analysis of gene function – transgenic animals.

Temperature regulation:
The topic examines physiological responses to thermal stress: the techniques used to measure core body temperature, and the physiological mechanisms which control

body heat gains and heat losses during change in the environment as well as during a fever.

Exercise physiology:

This topic applies the physiology of exercise to integrate the functions of the cardiovascular system, the respiratory system, temperature regulation, nutrition, muscle function and the environment. The effects of training on various physiological systems are dealt with and the application of exercise physiology in special populations is explored.

Research project:

All students will be required to undertake a seven-week research project in one of the fields of interest of members of the School of Physiology.

PHSL3006A HUMAN PHYSIOLOGY III (72 credits) (Slot A)

The course assumes Physiology II knowledge and follows a set curriculum consisting of the following topics and a research assignment. The topics are as follows:

Principles of experimental physiology:

An introduction to aspects of experimental design, the ethics of animal and human experimentation, and methods for analysing data.

Cardiovascular physiology:

The topic examines the physiological basis of altered cardiovascular function. Electrocardiographs: physiological approach to understanding abnormal ECG's. Cardiac failure: precipitating factors, pathophysiology, physiological basis of the signs and symptoms. Hypertension: classification, causes and complications. Shock: basic haemodynamics, classification, effects, compensatory mechanisms and metabolic changes.

Respiratory physiology:

The topic examines hypoxic conditions: causes and effects of anaemic, histotoxic, stagnant and hypoxic hypoxia assessment of hypoxic hypoxia. Consequences of defects of ventilation and perfusion and respiratory failure. Hypoxia associated with high altitude and breath-hold diving.

Acid-base balance:

The topic examines principles of body acid-base balance, effects and diagnosis of acid-base disturbances, and physiological basis of restoration of acid-base balance.

Body fluid balance:

The topic examines disturbances to body fluid homeostasis: dehydration and overhydration, capillary membrane abnormalities, diarrhoea and vomiting, kidney disease, assessment of kidney function, acute and chronic renal failure, physiological basis of fluid therapy.

Exercise physiology:

This topic applies the physiology of exercise to integrate the functions of the cardiovascular system, the respiratory system, temperature regulation, nutrition, muscle function and the environment. The effects of training on various physiological systems are dealt with and the application of exercise physiology in special populations is explored.

Gastrointestinal physiology and nutrition disorders: Nutrition, malnutrition and failure to grow. Assessment of nutritional status: anthropometry, blood variables, signs and symptoms of nutritional deficiencies. Nutrition during infancy; nutrient requirements. Malnutrition: physiological basis of obesity and protein energy malnutrition.

Molecular physiology:
This topic will introduce physiology students to some of the basic techniques of molecular technology. It will also include an understanding DNA replication, transcription and translation as the basis of molecular technology, how genetic mutations affect physiological function, cloning and recombinant expression of genes, antibody-based analysis of proteins and the *in vivo* analysis of gene function – transgenic animals.

Higher functions of the nervous system:
The topic examines the physiology of autonomic (ANS) and central nervous system (CNS) function, and of altered states of consciousness (SoC). ANS: adrenergic pathways; effects of ANS dysfunction on other body systems. CNS: physiological basis of localizing signs. SoC: the electroencephalogram; sleep; loss of consciousness and coma.

Temperature regulation:
The topic examines physiological responses to thermal stress: the techniques used to measure core body temperature, and the physiological mechanisms which control body heat gains and heat losses during change in the environment as well as during a fever.

Pregnancy and neonates:
This additional topic in the PHSL 3006 course examines the physiology of reproduction and of the failure to reproduce. Sex determination and differentiation; regulation of synthesis and the effects of the sex steroid hormones; sex hormone cycles in gametogenesis and pregnancy. Physiology during the first 28 days of life.

Research Assignment:
A three-week assignment involving the analysis of experimental data and the writing of a research report (paper) based on the analysis.

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