RHODES UNIVERSITY

LIFE SCIENCES

RHODES: WHO WE ARE, WHERE WE ARE TODAY AND WHERE WE WANT TO BE

Alive to its context and committed to social justice, academic excellence, academic freedom and public accountability, Rhodes University strives to provide:

- Outstanding undergraduate and postgraduate education to cultivate knowledgeable and skilled graduates who are critical and democratic citizens and ethical leaders;
- Creative scholarships and research to produce knowledge that advances the frontiers of science and human understanding of wisdom;
- Community engagement to promote social and economic development based on respectful and mutually beneficial partnerships with diverse communities.

To achieve the above it means that Rhodes must necessarily intersect and effectively engage with the economic and social challenges of the local, national, African and global contexts – the imperative of economic growth and development; the ability to compete globally; job creation and the reduction of poverty; the effective delivery of social services; the threat of HIV/AIDS; and also the imperatives of equity and redress; social justice; the building of a substantive democracy and a culture of vigorous and critical discourse.

This requires Rhodes to be a powerhouse of knowledge production and knowledge dissemination, and of the formation of new generations of thinkers and actors. All activities, courses and experiences at the University are structured to provide the students with a holistic experience to become ethical leaders able to contribute back to the community.

Vice Chancellor of Rhodes University, Dr Saleem Badat

THE UNIQUE STUDENT EXPERIENCE AT RHODES UNIVERSITY

The involvement of students as part of the Community Engagement (CE) experience is one of the unique experiences being offered at Rhodes University. Although not a philanthropic organisation, we are an academic institution which generates and disseminates knowledge. CE works towards taking knowledge out of the confines of the academy and put it at the service of communities. Partnerships with communities are important as it enriches scholarship, and collectively enable the shaping of a new society.

The main strategic objective of CE is to accelerate the infusion of CE practices within scholarship at Rhodes University and provide support and encouragement to academic department. It also aims to produce graduates who understand their context and are critical and engaged citizens. Its final objective is to strengthen relationships with existing partners and identifying new strategic partners. CE underpins every academic department at Rhodes University and is one of the unique features of student development at this University.

The other Rhodes key characteristics that produce well rounded graduates are the fact that Rhodes is a University strongly committed to pursuing the core purposes of the Institute. It offers principally formative undergraduate degree programmes based on several disciplines and also select undergraduate professional programmes. Its postgraduate, (especially research based) programmes promotes scholarships and research of different kinds.

The purpose of this document therefore is to highlight some of the unique research currently being conducted in Life Sciences and how it addresses the national priorities of our country and the African continent.

THE RHODES UNIVERSITY NEW LIFE SCIENCES COMPLEX

Positioning Rhodes in the global research and development arena

Executive summary

Rhodes University has a strong reputation for undertaking advanced and relevant life science programs, based on an interdisciplinary approach to education that values scholarship, research and development, and service opportunities. Since its inception, the Science Faculty has managed to provide an outstanding educational experience for our students, even as our facilities have aged.

Much of the challenges facing humankind have changed in the last few decades and have impelled us to engage in research that is more relevant and will offer workable, low-cost and effective solutions to the various environmental, health and other issues affecting us as members of the global community. Our research activities are now, in our effort to be one of the world's top knowledge producers, investigations dedicated to responsible and sustainable development.

Currently the Science Faculty houses the first ever DST/Mintek-NIC sensors Innovation centre on the continent as well as 3 other NRF/DST SARChi Chairs. In recent years, our life science departments have attracted increasing numbers of talented young researchers and newer areas of study such as Bioinformatics, especially in applied research and growth of biotechnology at the post- graduate level have been developed. Another exciting and important initiative is the development of an MSc in Forensic Evidence, which is an interfaculty collaboration that builds on the strengths of Entomology, Commerce and Law. However whereas our research expertise has kept up with relevant issues, our existing facilities can no longer support this rate of growth or deliver the level in interdisciplinary scientific interaction that our research programs demand.

It has become necessary to construct a state-of-the-art Life Sciences hub that will provide collaborative interdisciplinary simulations spaces that will help prepare our students to work in an ever more complex research environment, underpinning SA's move towards a more knowledge-based economy. Such a new space will also offer an inter-disciplinary collaborative facility that will provide an ideal environment for students to conduct relevant research, which will increase the country's competitiveness in science and innovation, under the supervision of several A-rated scientists. The complex will also provide for revitalised teaching spaces that will use the latest technology and can support hands-on activities as well as promoting innovation and outreach to serve the wider community.

It is envisaged that the new Life Science centre will be an incubator, driving development of new courses, academic programs, research activities and experiences related to science and technology and to teaching and producing learning opportunities for students, addressing national priorities, SA Millennium Development goals and making Science & Technology exciting career fields/choices for

future generations. It will serve as a hub for intellectual and educational activities, and promises to directly affect our community of students, faculty and staff.

The old Biological sciences building cannot accommodate the rapid increase in research priorities of the University

The 2011-2013 Rhodes enrolment plan approved by the Department of Higher Education and Training prioritises growth at the postgraduate level, especially in sciences. To this end the Department has made available R 178.09 million for the construction of a new Life Sciences building. Additional funding is being sought to cover the R20 million still needed to complete the project.

Developing a new generation of scientists

The Minister of Science and Technology, Mr Derek Hanekom recently announced to the Deans of Science from across South Africa's Universities government's commitment to Human Capital Development. The DST's Strategy for Human Capital Development for Research Innovation and Scholarship has been gazetted for public comment. This strategy recognises that innovation and economic growth depend on, among other things, the quality of education outcomes and that investment must be made to enhance South Africa's knowledge-generation capacity in order to produce world-class research papers and turn some advanced findings into innovative products and processes. To this end it is committing itself to develop appropriate Science, technology and Innovation (STI human capital to meet the needs of society; build world-class STI infrastructure to extend the frontiers of knowledge, train the next generation of researchers, and enable technology development and transfer, as well as knowledge interchange; and position South Africa as a strategic international RDI partner and destination through the exchange of knowledge, capacity and resources between South Africa and its regional and other international partners, thereby strengthening the National System of Innovation (NSI).

Rhodes University as a knowledge leader

Despite being the smallest University in the country, Rhodes has a long history of teaching and research excellence in Life Sciences, which encompass the departments of Botany, Ichthyology and Fisheries Science, Microbiology, Biochemistry & Biotechnology, and Zoology and Entomology. In fact the University has directly contributed to history. The first ever specimen of the African Coelacanth was identified by Prof JLB Smith, a Rhodes Professor in December 1938. Today (2013) three Rhodes researchers, along with colleagues, who were part of an international team of researchers, celebrate the successful decoding of the genome of this creature whose evolutionary history is both enigmatic and illuminating. The coelacanth genome sequence has also allowed scientists to answer long-debated questions and demonstrates Rhodes involvement in research that is of also of general interest to the
broader science community.

The African Coelecanth once thought to be extinct. Rhodes scientists have just decoded the genome of this fish.

Rhodes University – Home to world quality research

Each year the National Research Foundation conducts a peer based review process of researchers representing the quality, impact and influence of the recipients research output. A-rated researchers are those who are unequivocally recognised by their peers as leading international scholars in their field. B-rated researchers enjoy considerable international recognition by their peers, and C-ratings represent established researchers with sustained recent records of productivity in the field. The Y category represents younger researchers (40 years or under) who have held their doctorate for less than five years at the time of application.

Of the 71 rated researchers at Rhodes, 2 are A-rated, 18 are B-rated, 39 are C-rated and 11 are Y-rated, a testament to the quality of researchers at this Institution.

Prof. Tebello Nyokong, DST/NRF South African Research Chairs Initiative Professor of Medicinal Chemistry and Nanotechnology; and Director of DST/Mintek Nanotechnology Innovation Centre (NIC) for Sensors is an A-rated scientist.

Chair in Marine Ecology Professor Christopher McQuaid is an A-rated NRF ***scientist.***

Department of Science and Technology Grand Challenges (Corporate Strategy 2010-2013)

•*Farmer to Pharma: Over the next decade South Africa should develop its bioeconomy to become a world leader in biotechnology and pharmaceuticals, using the nation's indigenous resources and new developments in genomics.*

• *Space S&T: South Africa will become a key contributor and partner to global space S&T through the National Space Agency, a growing satellite industry and a range of innovations in space science, including earth observation, communication, navigation and engineering.*

• *Energy Security: Safe, clean, affordable and reliable energy supplies are in global demand, and South Africa should meet its medium-term energy supply requirements while innovating for the long term in clean coal technologies, nuclear energy, renewable energy and the promise of the hydrogen economy.*

• *Global Change: South Africa should exploit its geographic position, which enables it to play a leading role in climate change science.*

• *Human and Social Dynamics: As a leading voice among developing countries, South Africa should contribute to a greater global understanding of shifting social dynamics, and the role of science in stimulating growth and development.*

One of Rhodes's main purposes as a University is to engage in teaching and learning, research and community engagement that necessarily and effectively engage with the economic and social challenges of the local, national, African and global contexts. Some of the research being conducted in the Faculty of Science is directly related to contributing towards solving the grand challenges as identified by the Department of Science and Technology. Higher education and relevant research is recognised as making a critical contribution to economic and social progress and in line with this, Rhodes University is positioning itself to become a world-class centre for strategic scientific research and development

KEY DEVELOPMENTS IN THE FACULTY OF SCIENCE

The application of science and technology is fundamental to the social and economic transformation of our countries. RU is actively engaging in building up our scientific and technological training capabilities through several exciting and relevant research projects.

IMAGINE…

1. ***A CANCER FREE AFRICA***

The cancer burden is rising in the countries of Africa with about 650,000 people developing cancer annually. Because treatment remains largely unavailable or inaccessible, about 510,000 cancer deaths occur annually, an 80 percent mortality ratio. More than one-third of the cancer deaths in Africa are due to cancers that are easily preventable and/or treatable if detected early (American Cancer Society).

Prof Tebello Nyokong is a professor of Medicinal Chemistry and Nanotechnology and is currently conducting pioneering research into photodynamic therapy which looks at harnessing light for cancer therapy and environmental clean-up. Photodynamic therapy (PDT) uses specially developed dyes to direct deadly light onto cancer cells, and is being researched all over the world as an alternative to chemotherapy. The dye is injected into the bloodstream or applied directly to the skin. PDT is combined with quantum dots (QD), which are nanoparticles that absorb and then re-emit light, thus enabling scientists to target the cancer cells with red light

and allowing for an efficient cancer treatment involving the photosensitization and imaging of these QD to kill the cancer cells.

These dyes have been developed primarily overseas and Prof Nyokong said that more research is needed to establish which dyes are most efficient in the harsh African sunlight. “Any amount of the drug on healthy tissue (such as the skin) is affected by even the smallest amount of sunlight, even indoors,” she said.

Another aspect of Prof Nyokong’s research is pollution control. One of the methods for the purification of water is photochemical destruction of pollutants (such as chlorinate phenols and other pesticides) using ultraviolet light.

2) *UNDERSTANDING AND PREVENTING CLIMATE CHANGE*

Climate change is a significant and lasting change in the statistical distribution of weather patterns over periods ranging from decades to millions of years. It may be a change in average weather conditions, or in the distribution of weather around the average conditions.

Prof Christopher McQuaid is a leading international scholar on marine ecosystems and hosts the University's second NRF/DST SARCHI Research Chair in Marine Ecosystems in the Department of Zoology and Entomology. His current research is focussing on the biological oceanography of the Antarctic and sub-Antarctic realms. He was also recently awarded the prestigious Gilchrist Award by the South African Network for Coastal and Oceanic research for his extensive contributions to research at Rhodes University. His past investigations provide insights into the spatial and temporal patterns in ecosystem dynamics contributing to the advancement of marine science by examining the localised effects of biological invasions to large scales issues of global climate change. In an urgent response to the fast-changing ecological and climatic issues affecting our globe, he is also part of a scientific consortium aimed at tackling questions of climate change and how ecological communities respond to it.

3) ***SOLVING THE GLOBAL WATER CRISIS***

More than 3.4 million people die each year from water, sanitation, and hygiene-related causes. Nearly all deaths, 99 percent, occur in the developing world. In South Africa we face very real water supply concerns that will affect our future survival. Identified as the most precious natural resource the demand for potable water is already exceeding its availability. A central challenge to meeting the Millennium Development Goals for Africa is also the need for a 300% increase in trained and experienced water professionals.

The Institute for Environmental Biotechnology at Rhodes University (EBRU) is an institute that researches, patents, and develops technology for deployments in South Africa. Since its establishment some 12 years ago, it has developed a number of technologies for the treatment of wasterwater, it's recycle and reuse and, in the process, elaborated products that are used to benefit the process and the community. The opportunities offered by the above research include livestock garminhg, irrigation, endocrine disruptors removal, fertiliser and seed treatment and the development of high-value commodities and chemicals.

A second big water initiative is the A UNESCO Category 1 Institute for Water Education and research in South Africa will be located at Rhodes University in association with Nelson Mandela Metropolitan University and Fort Hare. Such an institute will draw on the best available expertise in South Africa, SADC and more widely across the continent. This new research area will also bring together academics from departments in Humanities, Science, Commerce and Law, various research entities at the University, the South African Institute for Aquatic Biodiversity and the Albany Museum. Such a research institute will provide post-graduates with a holistic understanding of water resources; particularly from a management, science and policy point of view.

UNESCO-IHE
Institute for Water Education

4) **WASTER WATER TREATMENT PLANTS THAT ADDRESS THE GLOBAL WATER CRISIS**

Project Eden is the brainchild of Dr Cliff Jones from the Rhodes Department of Ichthyology and Fisheries Science. It is a first for the South African brewery industry and was initiated at the Port Elizabeth plant. Of the water used in breweries, 75% ends up as effluent and its disposal has financial and environmental implications. Dr Jones and his colleagues have been able to develop a plant that recovers water from brewery effluent using high rate algal ponding (HRAP), built within a greenhouse and a constructed wetland, downstream of the brewery's anaerobic digestion effluent treatment plant. The treated effluent, after being transferred back to the greenhouse, is used to irrigate (hydroponically) lettuce fit for human consumption, as well as sustaining fish-rearing ponds. The implications of this project have far-reaching benefits for our country and the globe. The United Nations FAO states that by 2025, 1.9 billion people will be living in countries or regions with absolute water scarcity, and two-thirds of the world population could be under stress conditions.

5) MANAGING A SUSTAINBLE FISHING INDUSTRY

With the increase in the demand for fish, and the decline of fisheries due to over fishing, the role of sustainable management and aquaculture must increase. The Department of Ichthyology and Fisheries Science (DIFS) is poised to develop an African Centre for Ocean Governance that will enhance and encourage sustainable management and use of coastal and marine goods and services for the long-term security and welfare of associated countries and communities. Amongst the many research projects being undertaken by DIFS, is the Agulhas and Somali Large Marine Ecosystem project.

The objectives of the **UNDP/GEF Agulhas and Somali Current Large Marine Ecosystems (ASCLME) Project** are:

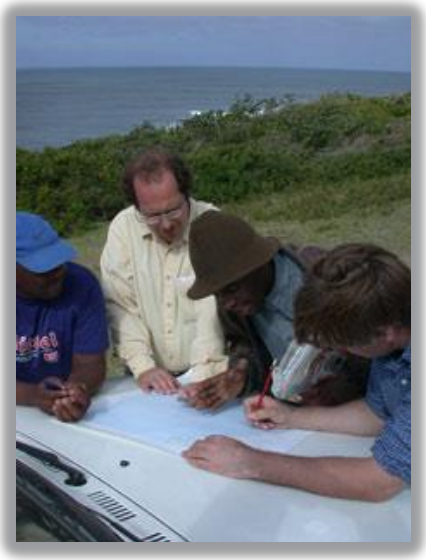
- to gather new and important information about ocean currents and how they interact with and influence the climate, biodiversity and economies of the western Indian Ocean region;
- to document the environmental threats that are faced by the countries of the region in a Trans-boundary Diagnostic Analysis (TDA);
- to develop a Strategic Action Programme (SAP) which sets out a strategy for the countries to collectively deal with trans-boundary threats;
- to strengthen scientific and management expertise, with a view to introducing an ecosystem approach to managing the living marine resources of the western Indian Ocean region.

Other projects include providing input into capacity building and training, producing a regional training plan for the Western Indian Ocean, working in southern Angola, doing research on the assessment of the inshore fishery sectors, aquaculture and fisheries development in Africa, training of senior managers in 8 African countries on monitoring, surveillance and compliance (MCS) of fisheries and assisting with the production of fisheries management plans for Kenya,

Tanzania and the Seychelles, in conjunction with Food and Agricultural Organisation of the United Nations.

The rural fisheries programme based at DIFS is also set to develop an introductory course to fish health and management for veterinary practitioners and managers that will develop expertise and service to sustain and promote the growth of the commercial sector in South Africa as a veterinary service to fish farmers. Currently such a service is not largely available to the farmers.

Aquaculture (fish farming) is the fastest growing animal production sector in the world, yet is a relatively new activity in South Africa. There is a need to develop capacity and understanding of this new sector, both at the provincial and local levels of government. To achieve this goal, DIFS in support with the Department of Agriculture, Forestry and Fisheries (DAFF) are presenting short courses on aquaculture.



6) *EDUCATE, INNOVATE, COMMUNICATE*

There is a strategic national imperative for invention with a new Bio-economy strategy for South Africa currently being drafted by the Department of Science and Technology. This strategy will provide the roadmap for the future of Biotechnology.

Biotechnology at Rhodes University is offered at the postgraduate level including Honours, Masters and PhD. At the undergraduate level Biotechnology modules are taught within the Biochemistry and Microbiology undergraduate programme.

Biotechnology is a broad field of study, encompassing the application and study of living organisms to improve or develop new products and processes. It is a fast developing and multi-disciplinary field which is primarily focused around the application of biochemistry and microbiology but also incorporating other disciplines and fields of study; such as nanotechnology, chemistry, physics, botany, ichthyology, entomology and zoology. Through the newly established School of Biotechnology, research & training in biotechnology at Rhodes University follows an integrated approach, permitting a rich and varied programme of research and training.

Prof Janice Limson who holds a PhD in physical chemistry currently heads the Rhodes University School of Biotechnology. Prof Limson is also the Founder and editor-in-chief, of *Science in Africa*, Africa's first online science magazine, which brings the latest in science from across the Continent, in an understandable and informative manner to the general public.

Prof Limson currently supervises several post-doctoral fellows in addition to several PhD's and other postgraduate students.

7) ***ERADICATING MALARIA***

People living in the poorest countries are the most vulnerable to malaria. In 2010, 90% of all malaria deaths occurred in the African Region, mostly among children under five years of age (WHO, 2013). The Rhodes University Department of Biochemistry, Microbiology and Biotechnology BMB) is conducting research on the protozoan parasites that are transmitted to humans by Anopheles mosquitoes causing malaria. One of their main research priorities is to discover and develop a novel antimalarial compound that will augment the alarmingly limited arsenal of existing drugs.

8) ***AGRICULTURAL PROJECTS THAT WILL LEAD TO SUSTAINABLE RURAL LIVELIHOODS***

The Department of Zoology and Entomology is conducting agricultural entomological research in the control of pests in cabbages, chicory, peppers, olives, macadamias, litchis, potatoes and citrus. More recently the main focus has been on the control of citrus pests using microbes such as fungi and viruses. These projects have focussed not only on commercial farming systems, but also sustainable rural livelihoods. The philosophy of this work is to research problems driven by industry while retaining a commitment to undertaking fundamental science on applied systems and using integrated pest management approaches. This development of Applied Agricultural Entomology as a niche centre of excellence was recognised with the award of a new NRF/DST SARCHi Chair. New research will be strongly focussed of food security, agriculture and nutrition through the reduction in pesticide usage resulting from the long-term, sustainable control of insect pests. Additional research will look at the effects of global climate change on bio control systems.

THE PLANNED NEW LIFE SCIENCES COMPLEX

The new Life Sciences Building (LSB) is a cutting-edge institutional research laboratory designed to be the home of social and environmental scientific research in South Africa, Africa and globally. In an effort to promote interdepartmental and inter-disciplinary research the building will house several life science departments and research centres, which were previously separate.

The new LSB will be completed in two phases. Phase 1 will provide all the space needed for the Departments of Zoology and Entomology as well as undergraduate laboratory spacy for Ichthyology. Phase 2 will house the Botany department and a few offices for Ichthyology. The development promotes a holistic approach and commitment to sustainability, resource efficiency and environmental responsibility. The spaces previously occupied by Zoology and Botany will then be refurbished and renovated to accommodate BMB, the Department of Chemistry and Environmental Science.

THE BUILDING

THE GROUND FLOOR will house undergraduate teaching and research spaces as well as the administrative hub of the building. These include:

- 50 seater Zoology laboratory;
- 50 seater capacity Entomology laboratory;
- 100 seater capacity Zoology lecture room;
- 11 equipment rooms including balance rooms and glass store rooms.

Green Strategies

In line with the environmental challenges facing our globe, the LSB will be built according to international "green building" guidelines that will use a process that is environmentally responsible and resource-efficient throughout the building's life-cycle. The common objective of this building will be to reduce the overall impact of the built environment on the natural environment by:

- Efficiently using energy, water, and other resources;
- Protecting occupant health and improving employee productivity;
- and reducing waste, pollution and environmental degradation;
- Energy and water conservation measures will be employed;
- The building will incorporate Green Living Walls.

CONCLUSION

The Science Faculty is experiencing an unprecedented period of growth and success particularly in postgraduate education and research. The numbers of registered postgraduate students has increased by 61% in 10 years from 2002 to 2012 and the number graduating each year has increased by 109%. In 2003 we graduated 14 PhD students and in 2013 this number reached a record of 35, a 150% increase. Research outputs in the form of accredited papers increased by 86% from 2003 to 2010. The Faculty now has two A rated scientists (acknowledged to be International leaders in their fields) and six DST prestigious Research Chairs. Five of these Research Chairs are established with required space and facilities, and the sixth is still to be established.

The Faculty has recently launched two new Master's degrees in computer security and bioinformatics, and plans at least four more in forensic science, fish health, fisheries management and water resource management. We are working towards the establishment of a biotechnology innovation centre attached to which will be an accredited analytical laboratory to be used for both forensic research and innovation.

Exciting opportunities for growth exist across the Science Faculty, some have been highlighted earlier in this document and a few other examples are given here.

In Botany, in the area of climate change we have recently been donated outdoor chambers that will allow us to examine the effect of elevated levels of CO2 on plants and insects. This will be the first such

facility in Southern Africa.

In agricultural Entomology, an area supported by a Research Chair, there are many new opportunities to build on our history of applied research in the control of pests on agriculturally important plants.

In Chemistry, Distinguished Professor Nyokong has secured research funding which will allow purchase of large pieces of equipment that will significantly increase the range of analytical methods available to our students.

In Biotechnology, we will support the National drive to promote innovation by developing a new centre for biotechnology and innovation that will focus on education, innovation and communication.

In Ichthyology, we will see a growth in fundamental and applied research, and education and training in fish health and aquaculture.

In addition, it is likely that we will respond to the recent call for proposals for the establishment of Centres of Excellence in the area of Marine Ecosystem Functioning, an area already supported by a Research Chair, to cement our place as the leading University in South Africa in this area.

The Science Faculty has a long and proud history of education and research which has laid a firm foundation from which we can continue to grow and excel. However our growth has not been matched by an equivalent growth in facilities which now constrain development in many areas. For the Faculty to seize the opportunities that currently present themselves and to continue to increase the numbers of postgraduate students it is essential that new space is provided. The new Life Science Complex will directly create the space to support many of the new opportunities and will indirectly create space, through the movement of Zoology & Entomology, and Botany into the new building, to support development in the other areas of growth. As we begin a planning process for the next 10 – 15 years, the new Life Science Complex and the additional space that is created elsewhere are central to the realisation of many of our dreams.

Prof Ric Bernard, Dean of the Faculty of Science

DONOR RECOGNITION

Those who make substantial contributions to Rhodes University are recognised appropriately for the significant role they have taken in the future of the University.

In consultation with the University, naming rights of various teaching and laboratory spaces may be discussed where specific capital projects are supported. If you are considering a cornerstone gift to the University, please contact us to discuss how we may acknowledge your exceptional support.

All donations to Rhodes are tax deductible in accordance with Section 18A of the Income Tax Act 58 of 1962 as amended from time to time.

Gift Range Chart		**Recognition**
# Gift	**Gift size**	
1	R 1 Million plus	Donor wall
2	R500 000 plus	Donor wall
4	R250 000 plus	Donor wall
8	R100 000 plus	Donor wall
10	R75 000 plus	Donor wall
15	R50 000 plus	Campaign booklet
20	R25 000 plus	Campaign booklet
25	R10 000 plus	Campaign booklet
30	R5 000 plus	Campaign booklet