UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

WITS RESEARCH REPORT

2019

2019

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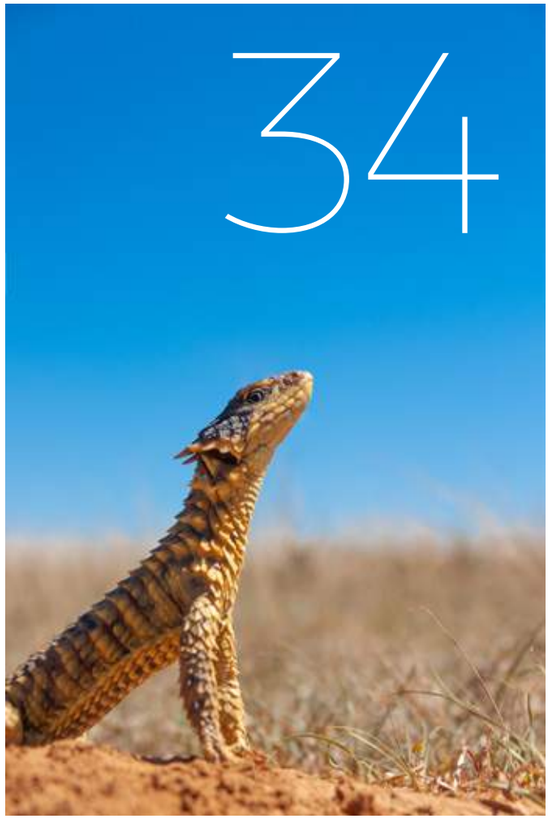
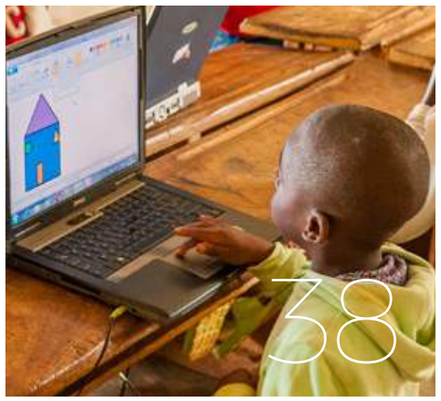




Produced by Wits Communication Services on behalf of the Wits Research Office

MESSAGE FROM PROFESSOR ADAM HABIB,

WITS VICE-CHANCELLOR AND PRINCIPAL

PROFESSOR ADAM HABIB
VICE-CHANCELLOR AND PRINCIPAL

Wits University is approaching its centennial anniversary in 2022, which provides an opportune moment for the institution to reflect on our achievements, to better understand yesterday, to shape today and to build tomorrow. This edition of the research report highlights some of our 2019 achievements – from digging up the fossils of the past to looking at the technologies of the future – all of which in some way advance the public good.

Wits continues to impact on society through its research, teaching and learning programmes, and social leadership endeavours. The year 2019 has been another phenomenal year, with all indicators that matter pointing skyward. Wits remains in the top 1% in the world (from amongst approximately 25 000 universities worldwide), our Humanities and Arts programmes are rated the best in Africa, and we are ranked in the top 100 in the world in clinical medicine, public health, mining engineering, and other disciplines. We have the most number of highly cited researchers in Africa and continue to publish in international, high-quality journals.

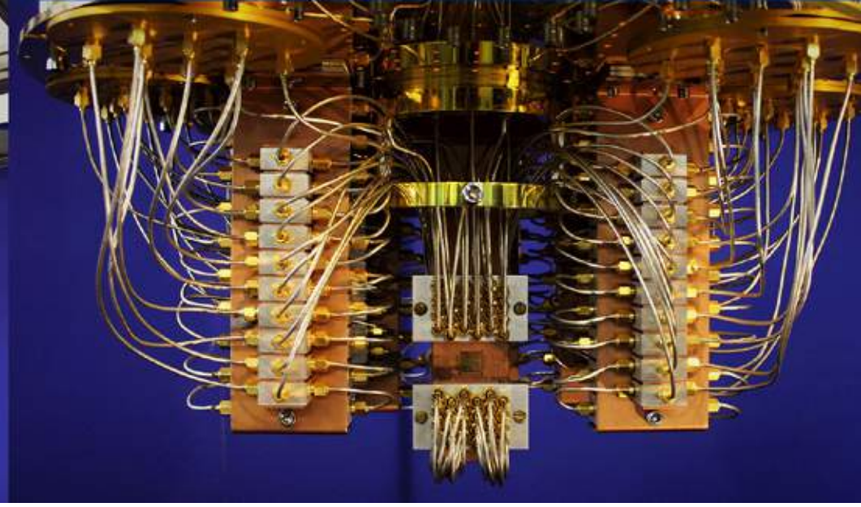
None of these achievements would have been possible without Wits' talented staff, researchers, postdoctoral fellows, postgraduate students, funders, donors and others, and I would like to express my appreciation to all those who continue to conduct globally competitive research, much of which is locally relevant.

Wits is transforming society through producing increasing amounts of research with impact, be it through discovery, applied or innovative research, which the following examples illustrate. This year, our scientists brought us a step closer to finding a cure for HIV; determined why some children die in hospitals; made an ARV breakthrough; and led the first HPV vaccine impact project in Africa.

The first African partner to join the IBM Q Network for quantum computing, Wits scientists are investigating the use of quantum computing and machine learning in the fields of cosmology and molecular biology with a specific

Professor Habib and Professor Vilakazi examining the silicon tracker of the ALICE detector that sits on the surface and is being replaced by a more sophisticated one

Wits delegation with members of the ICPP at CERN



focus on HIV drug discovery. The teams are also jointly studying quantum teleportation. Our academics and students have also connected two computers through the human brain and successfully transmitted words like 'hello' and 'apple', without the user being aware that a message is present.

This year, I also had the pleasure of visiting Wits scientists and students who are conducting world-class research at CERN. Our physicists have also set a record for light-matter interaction and the Optical Society of America has named Wits' fractal light from lasers research as the most influential in optics and photonics in 2019.

Green chemists are turning cashew nut shells into sunscreen and climate scientists are developing the first Earth System Model based in Africa, which will contribute to the fight against the climate catastrophe.

Our students created a new genetic app, developed an off-grid solution to electrify households in Africa, and are saving lives through creating self-sanitising surfaces to prevent infections in hospitals and elsewhere. Neo Hutiri, a Master's student based at the Tshimologong Digital Innovation Precinct, created, one of TIME magazine's Top 100 inventions of the year – the 'Pelebox', which reduces the waiting time for patients to receive medication from three hours to 22 seconds.

Dr Michael Lucas

Other discoveries include a new species of dinosaur; an ancient drop of water that rewrites the Earth's history; dung beetles' wind compass; and an asteroid that contributed to mass extinction and climate change.

We are also doing important work in energy leadership; migration; diversity and inequality studies. The Centre for Applied Legal Studies also appeared in the Constitutional Court and secured a landmark judgment that confirms that a person can be found guilty of rape on the basis of common purpose.

Research output has increased by over 50% in the last five years, with over 96% of research published in internationally-competitive journals. Wits remains home to the most number of highly cited researchers in Africa and hosts the most number of South African Research Chairs in the country.

Wits is consistently conducting more world-class research that impacts on society and our economy, and is set to remain on an upward trajectory as it approaches its centenary in 2022.

Best

Adam

QUICK FACTS

In 2019, the Actuarial Society of South Africa welcomed

52 new Fellow Actuaries into the profession, of whom 17 were Wits graduates, the most from a single university and also the most demographically diverse in South Africa.

Wits placed in the top

200 BAND

and is the highest-ranked university in South Africa (according to the 2019 Academic Ranking of World Universities).

91%

of Wits graduates were employed within 6 months of graduation (Wits Graduate Exit Survey 2018/2019).

Wits hosts the second African IBM Research Laboratory, one of

12

such mega-labs across the world.

OVER **90**

RHODES SCHOLARS

\+

15 MANDELA RHODES SCHOLARS

originated from Wits. Only a limited number of these coveted scholarships are awarded to outstanding students worldwide.

Wits is home to one of the largest fossil collections in the southern hemisphere and is internationally recognised as a leader in the palaeosciences. Wits scientists have been contributing to the palaeosciences record for almost a century.

In 2019, the Minister of Health, Dr Zweli Mkhize, appointed Wits Professor Johnny Mahlangu as Chairperson of the South African Medical Research Council.

ACHIEVEMENTS

The National Research Foundation has bestowed accolades on the School of Mining Engineering by awarding a C2 rating to Professor Rudrajit Mitra.

The Wits Medical School is one of the best on the continent and, through the Wits Donald Gordon Medical Centre, trains more specialists and sub-specialists than any other university in southern Africa.

Africa's first Chair in Digital Business was established at the Wits Business School through an initial five-year funding commitment from Telkom.

PURVIEW OF THE PAST INFORMS RESEARCH **OF THE FUTURE**

PROFESSOR ZEBLON VILAKAZI

DEPUTY VICE-CHANCELLOR: RESEARCH AND POSTGRADUATE AFFAIRS

With the benefit of hindsight, it is clear that 2019 was the quiet before the pandemic storm of 2020. Many believed that the 'Black Death' or the 'Spanish Flu' were disasters of history, unlikely to affect us in the 21st century. We were soon to discover in a very obvious and shocking manner that this was not the case, and indeed that our modern world with its rapid transport systems and online connectedness is not immune to pandemics. It could be said that we are probably now even more prone to the dangers of infection. Research is both an early warning system and a means to identify ways to avoid foreseen disasters.

The research of 2019 was therefore of great importance to our lives and our communities. Some of this research gives us previews of the future and demonstrates what could be and what will be if we ignore public health threats.

The research conducted in 2019 by academics addresses many pending pitfalls facing humankind. Some would include the threats to the Anthropocene, such as climate change, pollution, inequality, unemployment and the shortage of resources for a growing population. It is good quality, peer reviewed research that will help us to identify these threats without the distraction of scaremongering. However, the early warning is not sufficient in itself-we also rely on our research focused scholars to investigate solutions through technical and social innovations.

But research is not only utilitarian – for the theoretical physicists, performing artists, pure mathematicians and others, research also produces beauty, symmetry and aesthetic pleasure for both the authors and their audiences. Knowledge is thus both useful and delightful.

The academy carries a weighty responsibility to inspire young minds and to waken the thirst for knowledge. We bear this great weight on our shoulders because the impact of failure would lead to a world of ignorance where we would stumble from disaster to disaster, never building on the achievements of others. On the other hand, the responsibility also brings joy and a sense of accomplishment. Passing on knowledge and the desire for creating fresh comprehension are self-rewarding activities that provide hope and confidence that our shared world, speeding through the vast and lonely cosmos, will develop into a wonderful space for all its inhabitants.

> It is with these thoughts that I reflect on the increased research productivity and improving quality of the research produced at Wits in 2019. The incredible stories captured in this report are truly inspiring and make me feel privileged to be part of a leading research intensive university in Africa.

I thank all those who contributed to these achievements. To the academics, researchers and supervisors who guided our growing cohort of postgraduate students, I say thank you. To the students who astounded us with their fresh insights as they grappled with existing knowledge and created new knowledge, I say that the future is yours – embrace it. To the professional and administrative staff who contributed to creating a conducive environment for our students to enjoy a swift, secure and stimulating postgraduate experience, I affirm your valuable contribution.

May we all continue to cherish and value knowledge as we collectively wrestle with the world in 2020 and beyond. Let us use our knowledge and wisdom to advance the public good.

RESEARCH BY NUMBERS

DR ROBIN DRENNAN
DIRECTOR: RESEARCH DEVELOPMENT

This section provides a brief overview of the research conducted by Wits in 2019. The report is structured into two parts: an aggregate description of research at the institution and a focus on the authors of this research. It is impossible to adequately and comprehensively describe the research undertaken by Wits in any given year. This report provides only an indication of the contributions made by Wits affiliated authors in 2019 and is by no means a complete report of activities.

QUANTITY

A simple measure of research quantity is the number of accredited units awarded by the Department of Higher Education and Training for research publications. These publication units are calculated using the fractional author counting system, so that an article published in an accredited journal and authored by two people attracts each author half a unit. The system also distinguishes between journal articles, books, chapters in books, and conference proceedings.

Figure 1 below shows the steady growth of Wits publication units by type of publication since 2011. It was pleasing to see that the slight downturn in 2018 was arrested and reversed in 2019 with the submission of 1 997 units.

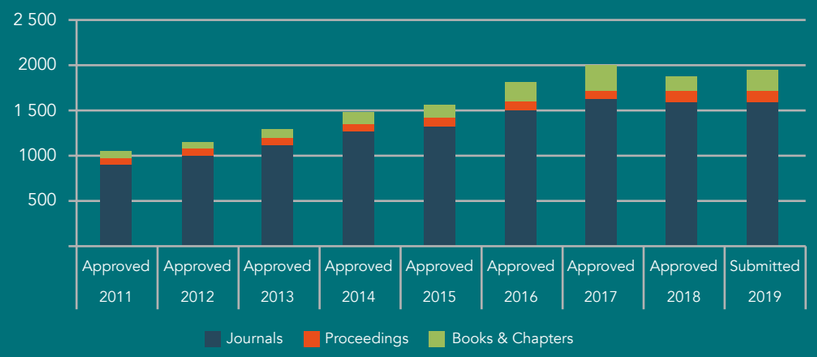


Figure 1: Department of Higher Education and Training (DHET) units for research publications

Another objective way in which to measure the quantity of research output is in the form of peer reviewed publications, which is to report on the number of publications by Wits affiliated authors indexed by various bibliometric data companies, like Elsevier and Clarivate Analytics. Figure 2 below displays the Wits authored publications of all types and specifically peer reviewed journal articles in the Scopus Index (operated by Elsevier). This Index includes some 23 000 peer reviewed journals and therefore reflects a wide range of disciplines. The plot shows a clear growth trend with an average annual growth rate of 8% over the eight years.

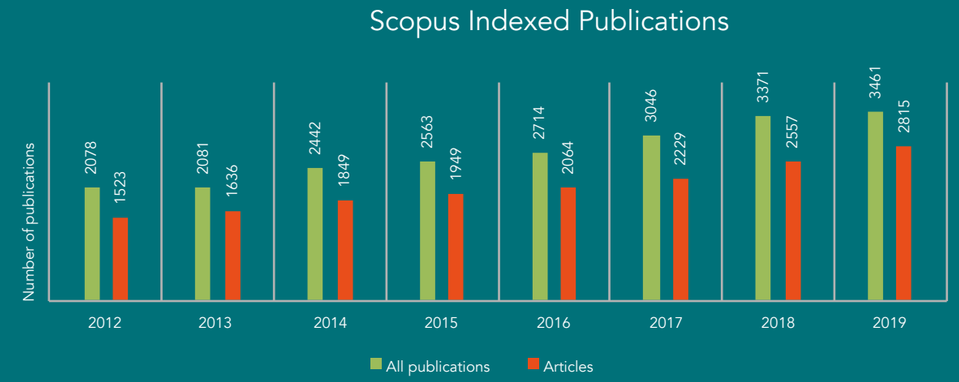


Figure 2: Trend of Wits authored publications indexed by Scopus

Figure 3 below reflects a 12% annual growth rate of journal articles authored by Wits scholars in the Web of Science index (managed by Clarivate Analytics). This smaller index, also known by its historic name the ISI Index, arguably contains on average higher quality journals and is used at Wits as the true benchmark of excellence.

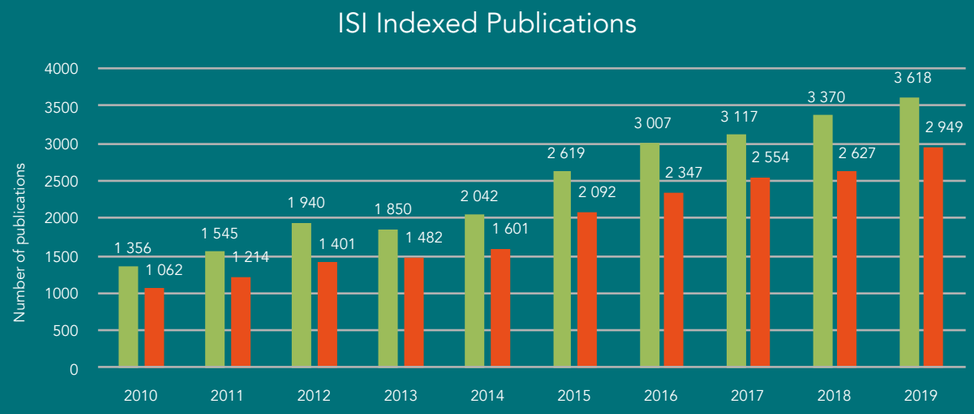


Figure 3: Trend of Wits authored publications indexed by Web of Science (ISI)

PRODUCTIVITY

Given that the number of publishing academic authors (head count) in 2019 was 2 439, the productivity measures can be simply be expressed as follows: 0.8 Department of Higher Education and Training (DHET) units per academic, and 1.2 Scopus or ISI publications per academic.

FIELDS OF RESEARCH

It is interesting to reflect on the fields in which these publications were located. As in previous years, Wits' research is dominated by the broad field of health sciences and clinical medicine. Thereafter, most research is published in the social sciences, life sciences, physics and astronomy, and molecular biology and related areas. The proportion of publications in these fields are reflected in Figure 4 below. Given that the other conglomeration of fields makes up 18% of the research output, after health sciences, Wits has a fairly wide distribution of research interests embracing most areas of knowledge.

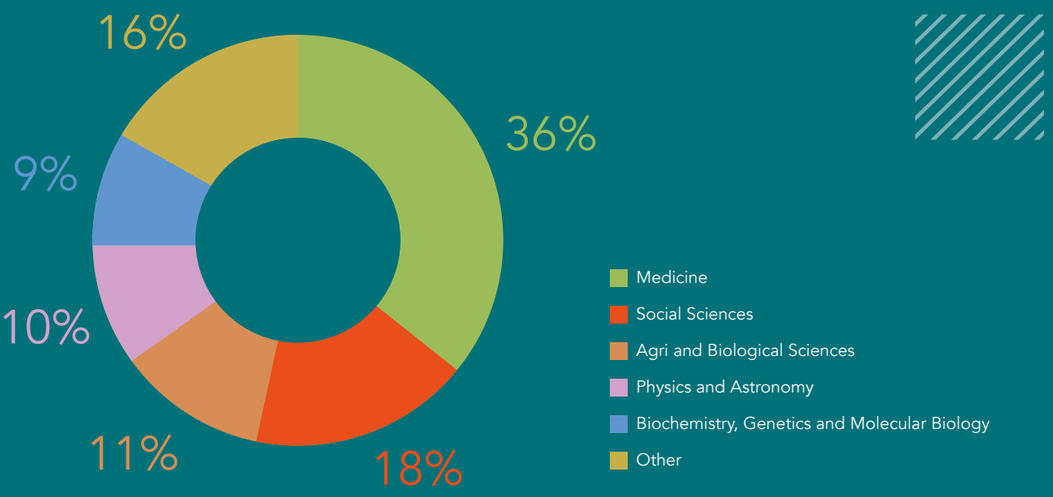


Figure 4: Fields of research extracted from the 2019 Scopus indexed research

The top five journals used by Wits authors to publish their work in 2019 were: PLoS One (85 articles, Impact Factor=3) and the South African Journal of Medicine (45 articles, Impact Factor=1) for the health sciences, and the Journal of High Energy Physics (46 articles, Impact Factor=6), European Journal of Physics (34 articles, Impact Factor =1) and Physics Letters B (34 articles, Impact Factor=4) for the physics and astronomy publications.

Wits authored publications in journals with very high Impact Factors (IF), namely The New England Journal of Medicine (IF=74), Nature (IF=43) and Science (IF=42) journals, are shown in Figure 5 below. With over 20 such publications, 2019 stands out as an excellent year for quality research.

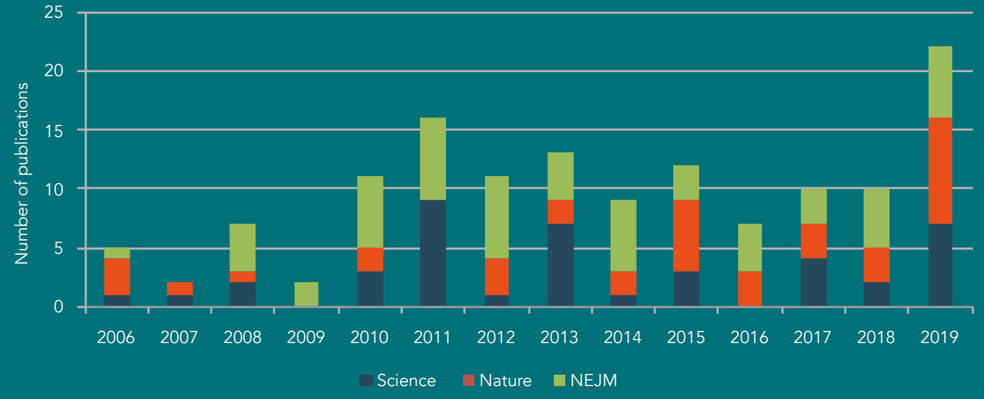


Figure 5: Number of Wits authored journal articles in high Impact Factor journals

QUALITY

No description of research would be complete without an assessment of the quality of the publications. There are multiple ways of assessing quality, all of which have their strengths and weaknesses.

The Nature Index offers one way of assessing the quality of research in the fields of physical and health sciences by comparing the number of articles published by various universities in a set time period and in a preselected list of 68 high quality journals. In the period 1 December 2018 to 30 November 2019, the Wits article count was 112. By way of comparison this is 140% and 160% more than that published by Stellenbosch University and the University of KwaZulu-Natal respectively. The University of Cape Town on the other hand produced 22% more articles than Wits.

Another indicator of quality is shown in Figure 6 below. It shows the number of journal articles published with a Wits address in the period 2015 to 2019 broken down in quartiles of Impact Factors (IF). Besides noting the upward trends for all quartiles, it is pleasing to see that the majority of the journals used by Wits authors are quartile 1 journals. The number of publications in quartile 2 journals are increasing rapidly but still lag by almost 300 items in 2019.

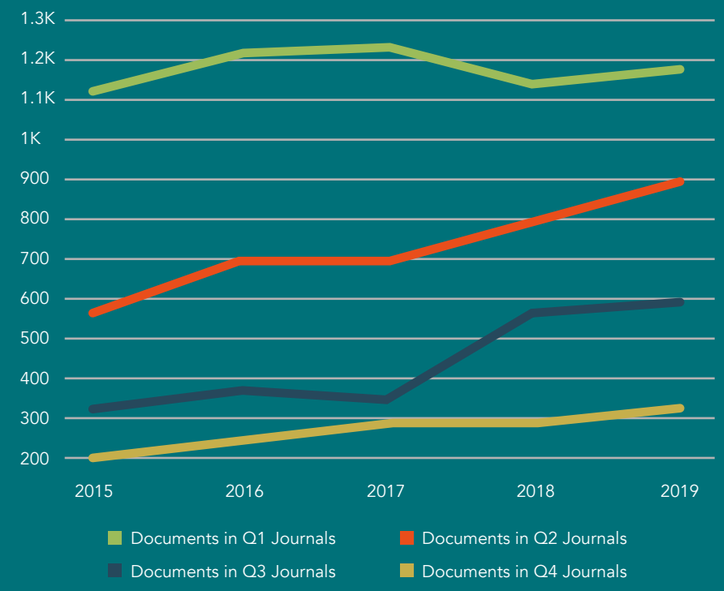


Figure 6: Number of documents published in IF quartiles per year

A further measure of quality is the ISI Category Normalised Citation Impact score. This metric indexes citation counts for disciplinary fields against the global average which is set at a score of one. Wits' performance since 2005 is shown in Figure 7 below. Three features are worth noting in this plot. Firstly, aside from 2007, Wits' research has always been well above the global norm. Secondly, the spike in 2012 is largely due to a single journal article from physics that has been cited nearly one hundred thousand times. Thirdly, the downward trend from 2016 is an artefact of the time lag suffered by the citation process.

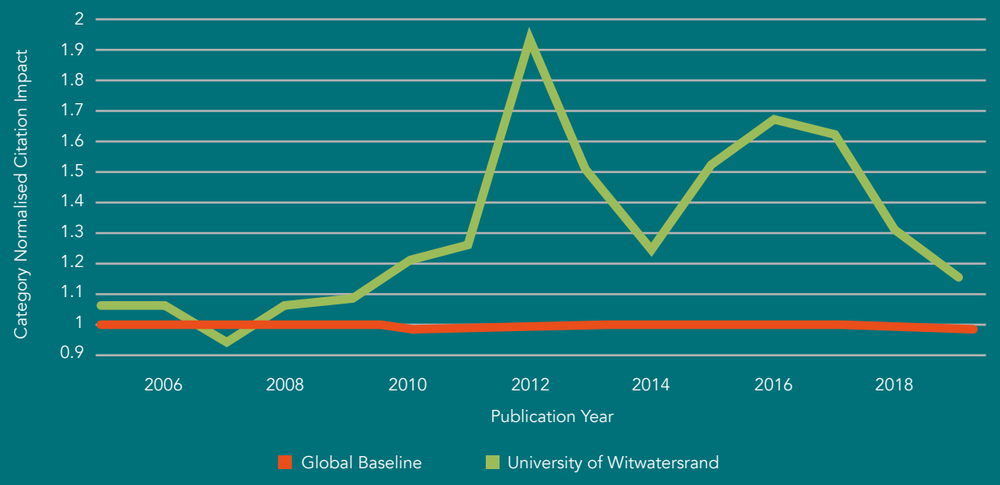


Figure 7: The Category Normalised Citation Impact score for Wits

A final assessment of quality is the number of highly cited and hot papers published by Wits authors in 2019 in ISI indexed journals. Highly cited and hot papers are ranked in the top 1% and 0.1% of all articles by number of citations, respectively. In 2019 Wits published 35 and 7 highly cited and hot papers respectively.

There is a similar indicator of research quality referred to for highly cited authors. These are people whose work is in the top 1% of global citations in their specific field. In 2019, Wits had five such authors – three more than in 2018 and 2017. They are Professors Lee Berger, Lynn Morris, Derick Raal, Marie-Louise Newell and Steven Churchill.

PROFESSOR LEE BERGER

PROFESSOR LYNN MORRIS

PROFESSOR DERICK RAAL

PROFESSOR MARIE-LOUISE NEWELL

PROFESSOR STEVEN CHURCHILL

ACADEMICS

Research excellence depends strongly on the talent base within the University. It is difficult to find a single indicator of aggregate researcher quality, and so the following indicators provide an indication of quality. It is important to recognise that the research contribution comes from a broad base of researchers – the number of publishing authors in 2019 was 2 439.

Wits hosts 30 South African Research Chairs, 29 National Research Foundation (NRF) A-rated researchers, and 457 NRF-rated researchers. Figure 8 below reflects the number of rated scholars in the country and the proportion of them at Wits. Given an even share of ratings across all 27 universities in South Africa – a 4% share – the table clearly demonstrates that Wits far exceeds its fair share at all levels and particularly at the higher levels (A-rating and B-rating).

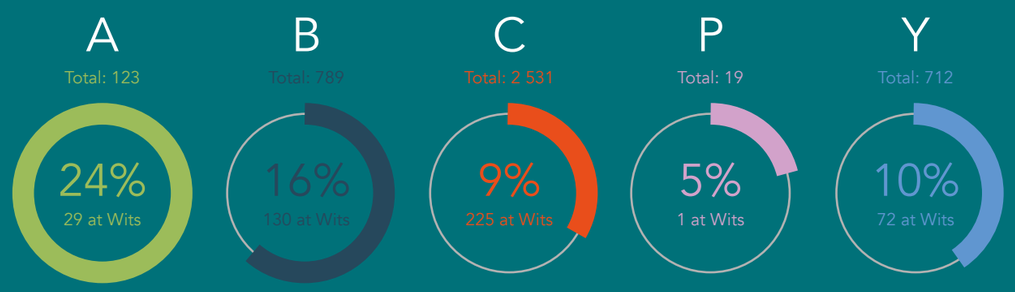


Figure 8: NRF rated researchers at Wits

POSTDOCTORAL FELLOWS AND POSTGRADUATE STUDENTS

At the end of 2019 there were 195 active postdoctoral fellows at Wits, of which 61 were South Africans and 161 were within their first year of a two year fellowship. Seven fellows were in year three or greater. Most of the postdoctoral fellows were hosted in the Faculty of Science (72), with equal numbers in the Faculty of Health Sciences and the Faculty of Humanities (47 each) and the rest were spread between the Faculty of Engineering and the Built Environment and the Faculty of Commerce, Law and Management. Wits postdoctoral fellows published on average 1.5 items each in 2019 and this equates to about 2.5 DHET units of research per postdoctoral fellow.

For postgraduate student completions, one unit is awarded for completion of a Master's degree by research (MR) or a fraction of a unit for a Master's degree by course work and research (MC) depending on the fraction of time spent on research. Three units are awarded for the completion of PhD degrees. Figure 9 below reflects the consistent growth of postgraduate degree completions in all three categories since 2010. The linear regression line for PhD completions shows an expected increase of nearly 50 PhD graduations per year.

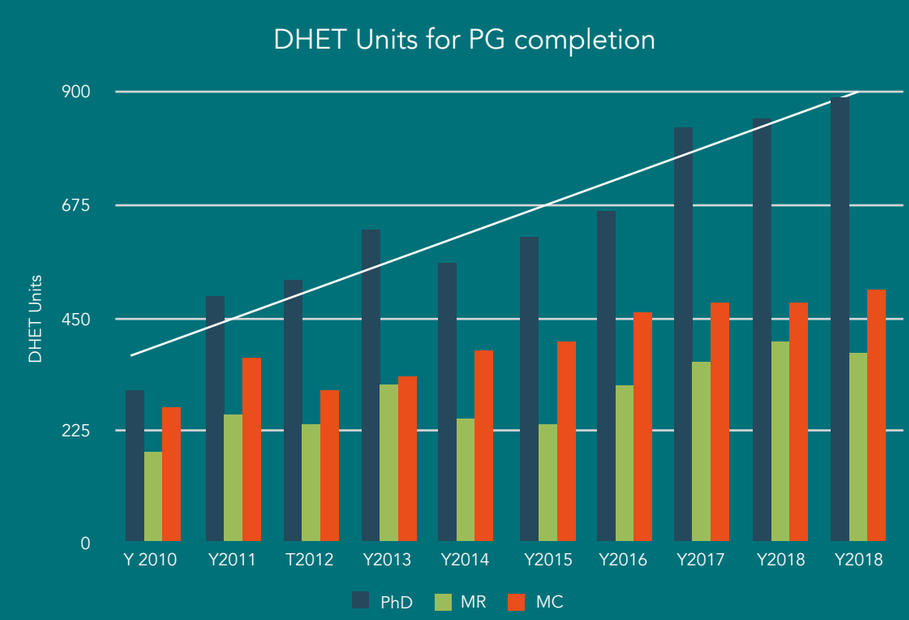


Figure 9: DHET Units for postgraduate degree completions

In summary, the quality and quantity of research at Wits is on an upward trajectory and employees, researchers, postdoctoral fellows and postgraduate students must be appreciated and congratulated for taking Wits to greater heights every year.

FACULTY OF COMMERCE, LAW AND MANAGEMENT

PROFESSOR IMRAAN VALODIA
DEAN: FACULTY OF COMMERCE, LAW AND MANAGEMENT

40
NRF-RATED RESEARCHERS

10
RESEARCH CHAIRS

Situated in the heart of the economic hub of the African continent and connected to the most powerful and influential industrial, commercial and social agents in the country, the Faculty of Commerce, Law and Management (CLM) pursues a vibrant research agenda that moulds the best practices of business, law and economics, and sets public policy.

Research with impact remains a priority for CLM, with a strong focus on the practical value of the Faculty's applied and professional research. Our research entities including the Southern Centre for Inequality Studies, the Centre for Applied Legal Studies, the Mandela Institute and the Centre for Learning on Evaluation and Results continue to provide invaluable services to practitioners and intellectual guidance to policy makers.

The appointment of four CLM staff members to the President's Advisory board in 2019 including Professor Mzukisi Qobo, Professor Liberty Mncube, Dr Kenneth Creamer and myself, reflects the Faculty's strong intellectual leadership.

The Faculty's research is grounded in rigorous academic research and remains internationally visible. We continue to grow reputation and collaborative networks in the areas of economics, finance, business, law, governance and public administration. In 2019, the Faculty has increased its output of journal articles and postgraduates and much effort has been dedicated to building research capacity and productivity at the School level. For 2019, the Faculty research footprint included over 200 journal articles of which 86% were published in internationally accredited journals.

Individual schools continue to make significant progress and seek to cement their positions as knowledge leaders, including the Wits School of Law, which has been ranked by Times Higher Education as one of the top 150 law schools globally.

The Faculty continues to host numerous public lectures and debates on contemporary topics of national and international interest. Our academics edit prestigious international journals in the areas of law, business and finance.

Across the schools, the Faculty boasts over 40 NRF-rated researchers including the National Research Foundation South African Research Chair in Equality, Law and Social Justice and 10 research chairs.

The Faculty has been successful in pursuing its research goals and strengthening its research profile. We continue to draw on our unique combination of expertise, to grapple with and contribute solutions to the economic and social challenges facing South Africa and more broadly the developing world. The impact of research is reflected in how Wits is increasing its African footprint, influencing public policy, informing judgments made by the courts and transferring new knowledge to the Faculty's curricula, thereby ensuring that Wits students are at the leading edge of their professions.

We look forward to continuing these trends in 2020.

CAN MONEY BUY HAPPINESS?

TOWARDS SUBJECTIVE WELLBEING AS AN ECONOMIC POLICY OBJECT

PROFESSOR UMA KOLLAMPARAMBIL

HEAD OF THE SCHOOL OF ECONOMICS AND FINANCE

Professor Uma Kollamparamil postulates that the obsession with economic growth has led to increased economic inequality and social discontent.

Increasingly, economists are acknowledging the need to look for a holistic measure of development that takes into account the quality of life within the context of our natural and social environments. "Subjective wellbeing is considered as one such holistic measure of individual wellbeing that covers various domains like absolute income, relative income, employment status, health, personal relationships, social and natural environments, religion, etc. Subjective wellbeing is a person's cognitive and affective evaluations of his or her life, often measured through general life satisfaction or happiness," she explains.

According to the World Happiness Report 2019, South Africa ranks 106th amongst 159 countries in terms of happiness levels. The average level of general life satisfaction in South Africa still stands low at just over 5, on a scale of 1-10, where 10 is the highest level. There is hence much room for improving the average subjective wellbeing level for the country. The positive is that the average subjective wellbeing of South Africans has increased over recent times, driven primarily by the improved subjective wellbeing of the majority of Black South Africans. This is explained not just by improvements in absolute income levels amongst the poor, but also through non-income factors like increased access to public amenities including electricity, water and sanitation.

The relationship between income and subjective wellbeing is intricate as evidenced by the Easterlin paradox in the developed country context. The paradox negates the fundamental premise of modern day economic policy that equates income with wellbeing. Kollamparambil elaborates: "Our studies in the South African context have revealed that absolute as well as relative income effects are important in determining the subjective wellbeing in the country. We find that even though pro-rich subjective wellbeing concentration exists in South Africa, the subjective wellbeing inequality is decreasing despite rising income inequality. This is on the back of a rising absolute income effect amongst the poor and improved access to public amenities."

The decline in subjective wellbeing inequality in South Africa is due to the reduction of inter-household inequality, although intra household inequality between partners has increased. Therefore, it is clear that relying on policy interventions to improve household level subjective wellbeing drivers like household income and access to public amenities is not sufficient in reducing intra-household subjective wellbeing inequality. "Education based positive assortative mating reduces subjective wellbeing inequality between partners and lends credence to the argument that power dynamics play an important role in determining the subjective wellbeing distribution within the household."

Kollamparambil's research therefore highlights the need to focus on intra-household gender-based power dynamics to reduce the subjective wellbeing gap between partners. Economic empowerment of the non-income earning partner is one way of addressing the issue of growing intra-household subjective wellbeing inequality. There is a need to further study the impact of lockdown circumstances on the intra-household subjective wellbeing dynamics. "A basic income grant that is sufficiently large to empower an individual but at the same time not a perverse incentive to becoming economically active is the policy solution to increased vulnerabilities and inequalities" concludes Kollamparambil.

IN TIMES OF CRISIS, GIVE MORE…

PROFESSOR BHEKI MOYO

DIRECTOR OF THE CENTRE ON AFRICAN PHILANTHROPY AND SOCIAL INVESTMENT

The the Centre on African Philanthropy and Social Investment (CAPSI), based at the Wits Business School. The Centre, the first of its kind in Africa, bridges the gap in the study, research and practice of philanthropy and social investment on the continent.

Under the leadership of Bhekinkosi Moyo, the Centre has grown to bridge the gap in the study, research and practice of philanthropy and social investment in Africa. This is in line with global interest in the field of philanthropy and social investment that has been growing exponentially in Africa and in continents outside of Europe and the United States.

Despite a considerable increase in research related to these topics, the study of these fields is at a nascent stage, with very little formal academic research, teaching and publications available in Africa. In response to this lack of dedicated, formal academic focus, the Wits Business School and the Southern Africa Trust introduced the Chair on African Philanthropy, with Professor Alan Fowler appointed as the first incumbent in 2016, and which was subsequently expanded to the Centre.

WHY AFRICAN PHILANTHROPY AND SOCIAL INVESTMENT?

Philanthropy is an integral element for advancing the development agenda on the continent. African philanthropy, by its very definition, is the foundation upon which transformational development takes place on the continent. African philanthropy – a term that was once foreign in Africa, even though its practice has always been a reality, and one that scholars have grappled with for years to make it contextually relevant. It remains at the heart of Africa's development trajectory.

Development ought to be transformative, sustainable, and essentially based on Africa's own institutions, informed by its own knowledge systems, and supported by its resources. Rigorous and independent academic research and scholarship is required to further develop the conceptual framework of an African-led development, anchored in principles and values enshrined in both pan-Africanism and African philanthropy.

"Our research focuses on increasing knowledge about African Philanthropy and improving the practices of giving, volunteering, fundraising, and other aspects of philanthropic activity. We fill the gap in the knowledge of social investment and philanthropy that African countries are currently experiencing," explain Moyo.

An important vehicle in filling the knowledge gap is the Centre's own journal. The *International Review of Philanthropy and Social Investment* is an interdisciplinary international journal for quality leading-edge primary research on philanthropy and social investment. Aimed at academic and research communities, it explores the emergent and developing field of philanthropy and social investment in Africa and beyond. The journal meets a growing need to develop the international knowledge infrastructure for rapidly expanding interest in this field of human behaviour. An open source publication, the first issue of the Journal is available via this link: https://journals.co.za/content/journal/irpsi_v1_n1

In addition to offering academic programmes and executive courses, CAPSI has commissioned four big research projects across Africa focusing on Covid-19 and its impact on philanthropy and social investment; the Fourth Industrial Revolution and the non-profit sector; High Net Worth Individuals and Philanthropy; and Foundations and Infrastructure Development Organisations in Africa.

The Centre is well placed to guide the way in which business and society interact.

Read more at www.capsi.co.za

PROFESSOR IAN JANDRELL

DEAN: FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT

42
NRF-RATED RESEARCHERS

29
PHD STUDENTS

72
MASTERS BY DISSERTATION

271
MASTERS BY COURSEWORK AND RESEARCH

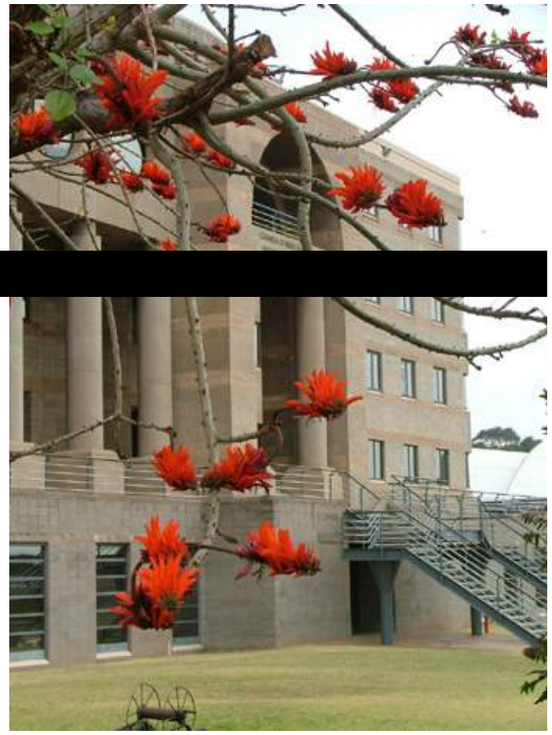
FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT

The Faculty of Engineering and the Built Environment (FEBE) conducts research and teaches a range of critical and scarce skills necessary to advance the South African economy and the continent more broadly.

The seven schools in the Faculty host academics and researchers who are at the centre of training superlative graduates and scholars, and who over the years have been contributing to society and addressing socioeconomic challenges through their work. Wits' graduate engineers and professionals of the built environment are equipped through intense training to overcome the complex challenges and global problems of the millennium.

The Faculty collaborates with the best researchers locally and abroad. For the third year in a row, the Faculty has exceeded its moderate but significant target of 200 research output units. The number of research publications submitted to the Department of Higher Education and Training was 220.46 units in 2019. Faculty staff also authored or edited five books in 2019 including Water Management - Social and Technological Perspectives (Professor Thokozani Majozi and others); Politics and Community Based Research - Perspectives from Yeoville Studio, Johannesburg (Professors Claire Bénit-Gbaffou, Kirsten Dörmann, Sarah Charlton, and Sophie Didier); and Risk Management in Construction Projects (Dr Nthatisi Khatleli and others).

The Faculty encourages strategic partnerships with different sectors and all seven schools actively seek and foster close working relationships with industry partners. They also identify commercial opportunities for growth and income generation. The Faculty hosts two University-recognised institutes and six externally funded centres. It also hosts four South African research chairs and several industry-funded chairs.



The Faculty views the impact and quality of its research as important components of its mandate that is earmarked to benefit society. The range of research specialisations and the breadth of knowledge within the Faculty contribute to making it a truly unique learning environment. Prof. Samuel Azasu, Prof. Geoff Simate and Prof. Kola Akinsomi were appointed as editorial board members of various international journals.

In 2019, the Faculty served as home to 42 NRF-rated researchers. The Faculty is also contributing to the technological performance and innovation activities of the country. Thirty patents were filed or granted in and 2 254 postgraduate students were enrolled, including 29 PhD students, 72 Masters by dissertation, and 271 Masters by coursework and research. Our postgraduate students continue to perform exceptionally well internationally. For example, Tamlyn Naidu from the School of Chemical and Metallurgical Engineering won the prestigious Institute of Materials, Minerals and Mining young persons' lecture award after delivering a lecture in the UK on acid mine drainage. Sean Morrow won a postgraduate student prize for one of the best presentations at the 32nd International Symposium on Shock Waves in Singapore. The productivity of postdoctoral fellows in the Faculty in 2019 was higher than the average productivity of postdoctoral fellows in the University of 0.5 units per postdoctoral fellow and was also higher in terms of actual papers (1.3 papers per postdoctoral fellow).

A German Embassy representative visited Prof. Willie Cronjé's Pico-grid, a highly successful rural electrification smart energy project, which is housed in the School of Electrical and Information Engineering. The School also started a joint postgraduate research degree programme with Tongji University, an event that was initiated through a visit by the Chinese Ambassador. Furthermore, Professor Ling Cheng of the School of Electrical and Information Engineering was awarded the best postgraduate research supervisor in the Faculty in 2019.

> We continue to build on the successes of 2019 in order to remain at the cutting edge of research and innovation on the continent.

NEW TECHNOLOGIES FOR THE ENHANCED EXPLOITATION OF CRITICAL RAW MATERIALS

PROFESSOR SEHLISELO NDLOVU
BIORECOVER PROJECT LEADER

Wits was allocated funding of about €600 000 over four years for the BIORECOVER project which aims to conduct research and to develop new sustainable and safe techniques for the selective processing of a wide range of critical raw materials arising from secondary, primary and other relevant sources. The critical raw materials (CRMs) are important for future technological advancements in various industrial sectors and thus it is vital to safeguard their uninterrupted supply in a sustainable, economically viable and environmentally friendly way.

According to Professor Sehliselo (Selo) Ndlovu, the project leader from the School of Chemical and Metallurgical Engineering, the role of the Wits team in this project is to develop a process for the bioprocessing of platinum group metals (PGMs) raw materials. "This involve the isolation, selection and screening of indigenous microorganisms from mining sites followed by the bio-beneficiation of the feed material, bioprocessing to remove the base metals and, lastly, bioprocessing to extract the PGMs," she says. "In this project, the Wits team is collaborating with the local mining sector who are supplying the PGMs raw materials and also provide the sites for the isolation of indigenous microorganisms. While the bio-extraction of base metals from metal sulphide ores is a well-established process, the bioprocessing of PGMs from ores and concentrates is an unexplored area of study which places the Wits team at the leading edge of research in this field. The Wits team is very excited to be part of this development and we are already exploring future developments and collaborations beyond this project."

The targeted CRMs in the project include: rare earth metals from bauxite residue in Greece, magnesium from magnesium wastes of low grade minerals and calcination by-products in Spain, platinum group metals from South Africa and PGM slags, dusts and press cake from the United Kingdom. The BIORECOVER project is essentially based on a biotechnological approach focusing on the application of microorganisms and their metabolites in order to generate useful products of CRMs arising from various sources.

"Biotechnology has been chosen as the preferred route because it is economically viable and environmentally friendly amongst many other advantages," explains Ndlovu. The project is based on the integration of three main stages in order to achieve the expected CRM recovery rates of 90%, selectivity of 95% and purity of 99%. The three main stages are (1) the removal of major interfering elements present in CRM raw materials so as to access the target metals in the second stage of the process, (2) mobilisation of the metals through specific and improved microorganisms in order to get a leachate enriched with the target CRMs, and (3) the development of non-biotechnology techniques for recovering dissolved metals from leachates with high selectivity and purity that meets the quality requirements for their use.

The BIORECOVER project is part of the European Union funded Horizon 2020 project consortia. Prof. Ndlovu works with Prof. Geoffrey Simate from the School of Chemical and Metallurgical Engineering, Prof. Karl Rumbold from the School of Molecular and Cell Biology and Dr Clarence Yah from the Wits Reproductive Health and HIV Institute as Co-Principal Investigators on the project. Besides the academics, the team also comprises of two Masters students and two postdoctoral fellows. A PhD student is further expected to join the team in 2021.

The project involves a multidisciplinary consortium that encompasses participation from key international collaborators such as CeTEM (Spain), Magnesitas Navarras (Spain), Francisco Albero (Spain), Tecnicas Reunidas (Spain), Mytilineos (Greece), Johnson and Matthey (UK), and several universities including the University of Denmark, the University of Coimbra (Portugal), Linnaeus University (Sweden), Algaenergy (Spain), the Vertech Group (France), LGI Consulting (France) and CeBER (South Africa).

KEEPING MINERS SAFE

To ensure the safety of miners underground, monitoring a miner's location as well as environmental information is essential. For example, knowing the location of a miner enables efficient and effective rescue efforts in the event of cave-ins. There is currently no real time solution that can provide the location of miners and collect data on underground conditions in real time. The Wits School of Mining Engineering has developed a miner's safety solution that leverages existing power line installations and lighting devices as communication channels. This holds the advantage that no new communications infrastructure is required, enabling faster roll out of the solution.

The location of the miner is provided through transmissions of light from LED-based miner's headlamps (figure 1) that have been modified to emit a unique signature monitored by sensors (figure 2) installed at regular distance intervals inside the mine. The system is also being extended to transmit and log data such as atmospheric gas and dust content, temperature, radiation, as well as the vital signs of the wearer, such as his or her heart rate. This data can be used to trigger evacuations if required.

The location solution is ready for piloting at a mine, and discussions are underway with industry partners in the mining sector to run pilots and potentially deploy the solution commercially via Wits Enterprise.

Figure 1: Transmitters installed on miners' headlamps

Figure 2: Receiver installed on mine roof at regular intervals

FACULTY OF HEALTH SCIENCES

PROFESSOR MARTIN VELLER
DEAN: FACULTY OF HEALTH SCIENCES

598.24
DEPARTMENT OF HIGHER EDUCATION AND TRAINING PUBLICATION UNITS

687
POSTGRADUATE STUDENTS COMPLETED QUALIFICATIONS

68
PHD STUDENTS

68
MASTERS BY RESEARCH

318
MASTERS BY COURSEWORK AND RESEARCH REPORT

60
POSTGRADUATE DIPLOMAS

173
BHSC HONS

The Faculty of Health Sciences celebrated 100 years of teaching excellence in 2019. Since their humble beginnings, Faculty clinicians and scientists have excelled at teaching, training, and research, and relied on their inventiveness to find solutions to locally relevant and global health issues. Innovation and a thirst for knowledge continues to inspire our clinicians, researchers and students across all our academic platforms. With the support of the Faculty, the academy continues to advance critical science and to develop cutting-edge research as we nurture a diverse community of leaders committed to alleviating human suffering caused by disease.

> The Faculty of Health Sciences was ranked between 51-75 in Public Health and 51-75 in Clinical Medicine in the 2019 Global Ranking of Academic Subjects (Shanghai ranking).

Our researchers continue to make remarkable progress through outstanding work. In 2019, these ranged from initiating the first gene therapy clinical trials in South Africa for haemophilia, providing evidence to shift patients on first-line HIV antiretroviral treatment to a dolutegravir-containing regimen (the ADVANCE study), showing no substantial difference in HIV risk with three effective contraceptive methods (ECHO study), and presenting a prolonged remission or potential

cure for HIV-1 infection in the London and the Düsseldorf patients (IciStem programme).

Other studies focused on advancing our understanding of the causes of stillbirths and under-5 childhood mortality in LMICs (CHAMPS study), contributing to a Lancet series on gender equality, norms and health, attributing depression in South African teen girls to an even higher risk of HIV-1 infection, and reporting very high rates of unnecessary antibiotic prescribing in South African primary healthcare settings.

The conducting of HPV vaccine catch-up campaigns and establishing a network of surveillance sites to evaluate the impact of one- or two-doses of the HPV vaccine in reducing HPV infection and investigating the use of quantum computing and machine learning prediction models in fields such as molecular biology (for example, in HIV drug discovery, and comprehensive and faster analysis of entire human genomes) diagnostics, predictive and preventative health, was explored. Several of the abovementioned investigations guided public health policies designed to improve our healthcare system.

During 2019, the Faculty housed eight Department of Science and Innovation/National Research Foundation South African Research Chairs, four centres of excellence, six South African Medical Research Council Research Units, and 24 University-recognised research entities. A new entity - Wits Sports and Health (WiSH) was established to enhance the lives of athletes and communities by offering sport and exercise medicine programmes sourced from high calibre, internationally-recognised training programmes, to facilitate peak performance and rehabilitation. A strong collaboration agreement with the Vanderbilt University Medical Centre was formalised in 2019, which will allow us to harness the burgeoning field of biomedical informatics, which reflects the speed with which huge volumes of health data can now be collected, stored and analysed in order to closely study health and disease.

All the above-mentioned research contributed to the Faculty's research productivity, quality and international reputation and ranking. During 2019, researchers increased their number of publication outputs and postgraduate completions. The Faculty contributed 598.24 Department of Higher Education and Training publication units from 1336 publications, a 4.22% increase from the 2018 levels. A total of 687 postgraduate students completed qualifications in 2019, including 68 PhD students, 68 Masters by research, 318 Masters by coursework and research report, 60 postgraduate Diplomas and 173 BHSc Hons, marking an overall increase of 14.12% from 2018.

The research excellence of numerous staff and postgraduate students was acknowledged through various international and national grants, awards and prizes in 2019. For example, Emeritus Professor Beverley Kramer was re-elected as President of the International Federation of Associations of Anatomists for a further five year term; Professor Johnny Mahlangu was appointed as chairperson of the South African Medical Research Council (SAMRC); three scientists in the Faculty won prestigious SAMRC Scientific Merit Awards, including one gold medal (Professor Caroline Tiemessen) and two silver medals (Professors Yahya Choonara and Nazir Ismail). Professor Maureen Coetzee received a new NRF A-rating, bringing to nine the number of NRF A-rated researchers in the Faculty. Professor Shane Norris was the recipient of the Vice Chancellor's Research Award for 2019. Grant funding of approximately R2.7 billion for research and development aid work purposes was secured by Faculty researchers.

SOWETO STUDY INFORMS GLOBAL NETWORK ON **TECHNIQUE TO DISCOVER WHY CHILDREN DIE**

A Wits-led pilot study in Soweto has shown that minimally invasive tissue sampling (MITS) can accurately determine causes of stillbirth in South African women and neonatal deaths. The observational pilot study at the Chris Hani Baragwanath Academic Hospital informed the rollout of MITS in low- and middle-income countries (LMIC) globally via the Child Health and Mortality Prevention Surveillance (CHAMPS) Network. To date, the absence of data that reliably characterise specific causes of death in children under-five has severely hampered progress in preventing childhood mortality.

THE SOWETO STILLBIRTHS STUDY: MITS IDENTIFIES LEADING CAUSES OF SOWETO STILLBIRTHS

Despite approximately 2.6 million stillbirths occurring globally each year, 95% in LMICs, data and knowledge on the biological causes of these deaths in LMICs is limited. Professor Shabir Madhi, who is the Director of the Medical Research Council's Respiratory and Meningeal Pathogens Research Unit at Wits, led a pilot study to evaluate the effectiveness of MITS in determining the cause of stillbirths in South African women. The Soweto stillbirths study investigated the utility of the MITS technique, along with examination of the placenta and clinical history, in attributing stillbirth in a South African LMIC setting.

"Minimally invasive tissue sampling can pinpoint pathological causes of infant death, the findings of which can then inform policy, and more effective interventions to mitigate child mortality," says Madhi.

> Sampling of brain, lung, and liver tissue using biopsy needles, blood and cerebrospinal fluid collection, as well as an examination of the placenta revealed a cause of stillbirth for 117 of the 129 cases (90.7%).

The leading underlying causes of stillbirth were maternal hypertensive disorders (high blood pressure), placental separation and haemorrhage, and chorioamnionitis (inflammation of the foetal membranes due to a bacterial infection. The leading immediate causes of foetal death were antepartum hypoxia (abnormally low levels of oxygen in the blood not long before birth) and foetal bacterial infection due to E.coli, enterococcus, and Group B streptococcus.

"In addition to indicating the potential of our approach in ascertaining granular causes of stillbirth in LMIC settings, the findings provide insight into the pathogenies of stillbirths in settings such as ours. This included the potentially under-appreciated dominant role of foetal infection as the cause of stillbirth in 37.2% of cases," says Madhi, who, along with Dr Jayani Pathirana and Dr Vicky Baillie in the Wits Respiratory and Meningeal Pathogens Research Unit (RMPRU) co-authored a related paper unravelling specific causes of neonatal mortality using MITS.

HOSPITAL-ACQUIRED MULTIDRUG-RESISTANT BACTERIAL INFECTIONS CAUSE NEONATAL DEATHS

This prospective, observation pilot study enrolled neonatal deaths at Chris Hani Baragwanath Academic Hospital. MITS included needle core-biopsy sampling for histopathology of brain, lung, and liver tissue. Microbiological culture and/or molecular tests were performed on lung, liver, blood, cerebrospinal fluid, and stool samples. The 'underlying' and 'immediate' causes of death were determined for each by an international panel of 12-15 medical specialists. Infections were the immediate or underlying cause of death in 57.5% of all 153 neonatal deaths in this study. Overall, 74.4% of 90 infection-related deaths were hospital-acquired, mainly due to multidrug-resistant bacteria. GBS was the most common pathogen among deaths with 'infections' as the underlying cause.

"An overwhelming finding from our study was the dominant but under-emphasised role of hospital-acquired infections to in-facility neonatal deaths, especially in late neonatal death (deaths between 7 and 27 days). The observation on the contributions of hospital-acquired infection as a cause of neonatal deaths in this study have underpinned a re-evaluation and introduction of strategies aimed at improving infection control practices at the hospital, the success of which will be evaluated through the ongoing CHAMPS programme here in Soweto," says Madhi.

ILLUMINATING CHILD MORTALITY: DISCOVERING WHY CHILDREN DIE

Following evaluation of the utility of MITS as a diagnostic tool in the Soweto stillbirths pilot study, the multicentre CHAMPS programme was initiated (www.champshealth.org). The programme is funded by the Bill and Melinda Gates Foundation, and aims to generate mortality data in a way that is designed to enable stakeholders at local, national, regional, and global levels to prioritise the most effective strategies and invest in the most needed tools. The current understanding of the causes of under-five childhood deaths in LMICs relies heavily on country-level vital registration data and verbal autopsies. However, these methods do not attribute death from infection-related illnesses (such as pneumonia, sepsis, and diarrhoea) to a specific pathogen. The CHAMPS network aims to systematically describe causes of child death and stillbirth in LMICs using MITS.

> This objective responds to Sustainable Development Goal 3.2: The elimination of all preventable under-five mortality and stillbirths by 2030 and reducing global under-five mortality to a maximum of 25 deaths per 1 000 live births (from its current rate of 44 deaths per 1 000 live births).

A paper on the Soweto study was part of a 13-article CHAMPS supplement published in Clinical Infectious Diseases in October 2019, co-authored by Madhi, Dr Pratima Raghunathan, Director for Science, CHAMPS network, Emory Global Health Institute and Dr Robert Breiman, Executive Director, CHAMPS, and Director, Emory Global Health Institute. The supplement, titled The Child Health and Mortality Prevention Surveillance (CHAMPS) Network: Foundational methods, comprises articles that feature a variety of methods to describe why children under five years die in the parts of the world with high mortality rates.

PROFESSOR SHABIR MADHI

DIRECTOR OF THE WITS RESPIRATORY AND MENINGEAL PATHOGENS RESEARCH UNIT

RESEARCHERS CONTRIBUTE TO GLOBAL INSIGHTS AROUND **GENDER AND HEALTH**

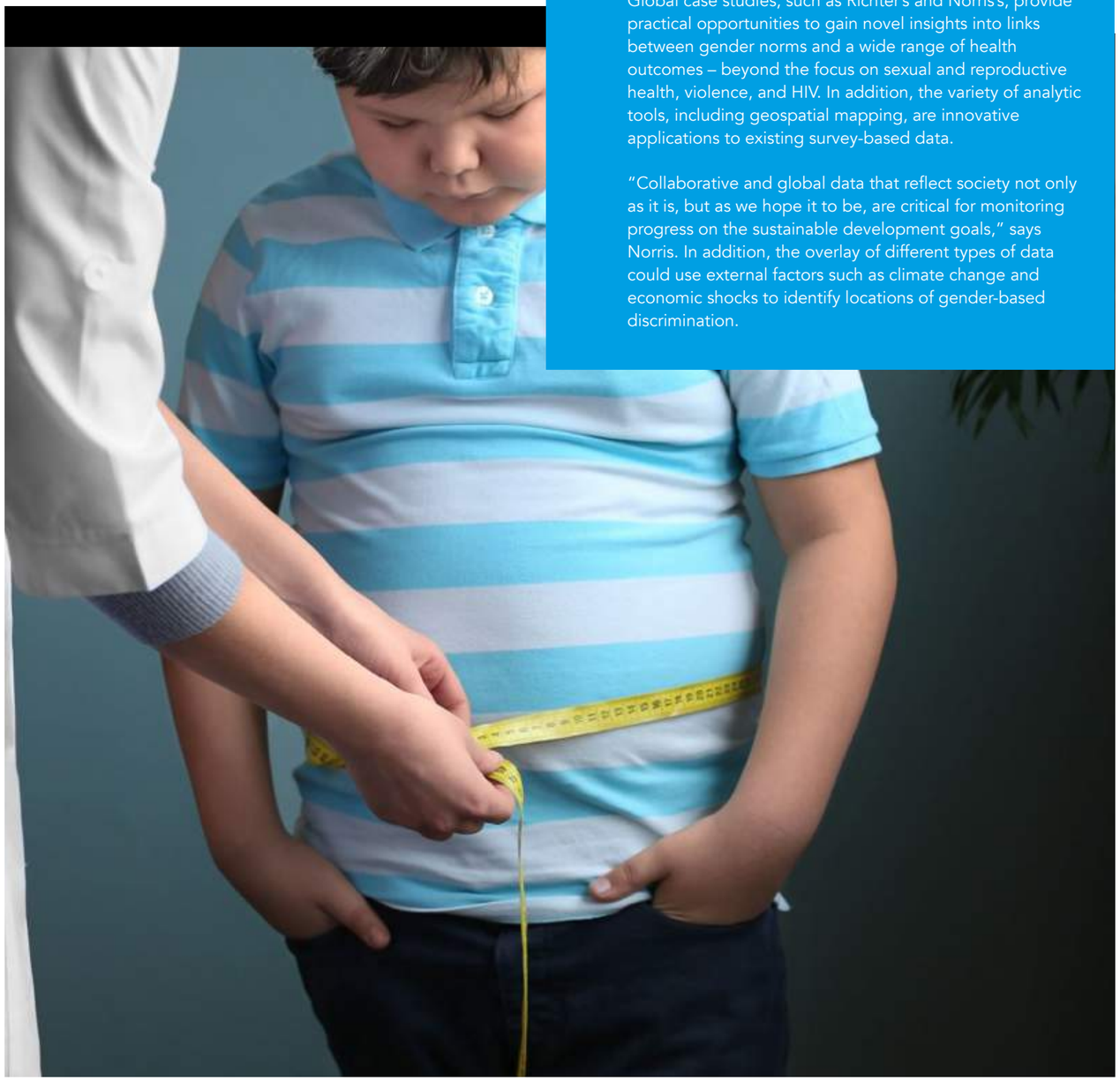
PROFESSOR SHANE NORRIS

DIRECTOR OF THE MRC/WITS DEVELOPMENTAL PATHWAYS FOR HEALTH RESEARCH UNIT

Wits researchers contributed a paper to a historic *Lancet* series on gender equality, norms and health, which was launched on 10 June 2019.

Professor Shane Norris (Director of the DSI/NRF Centre of Excellence in Human Development and the Director of the MRC/ Wits Developmental Pathways for Health Research Unit) and Distinguished Professor Linda Richter in the DSI/NRF Centre of Excellence in Human Development co-authored a paper on gender equality and health insights from global survey data.

Norris and Richter gleaned findings from the seminal Birth to Twenty Plus longitudinal study which showed that the internalisation of gender norms and their influence on health-related behaviours are powerful during adolescence. Specifically, they examined how parental and peer pressure contribute to gendered health beliefs and behaviour, notably around weight and body image.



THE SOUTH AFRICAN CASE STUDY'S CONTRIBUTION

The South African case study is a significant addition on how gender norms impact the health of women and men across life stages, health sectors and world regions. Globally, it is revealed that gender norms are complex and intersect with social factors to impact health over the life course. Early gender-normative influences by parents and peers can have multiple and differing health consequences for boys and girls. Transgressing gender roles or not conforming to gender stereotypes are particularly harmful to health.

Global case studies, such as Richter's and Norris's, provide practical opportunities to gain novel insights into links between gender norms and a wide range of health outcomes – beyond the focus on sexual and reproductive health, violence, and HIV. In addition, the variety of analytic tools, including geospatial mapping, are innovative applications to existing survey-based data.

"Collaborative and global data that reflect society not only as it is, but as we hope it to be, are critical for monitoring progress on the sustainable development goals," says Norris. In addition, the overlay of different types of data could use external factors such as climate change and economic shocks to identify locations of gender-based discrimination.

Richter notes that future research could involve machine learning algorithms and natural language processing could offer novel approaches to eliminating gender-related biases and codes in large existing datasets.

Richter, Norris and their colleagues around the world recommend the designing of public health programmes and policies that are locally relevant and globally active. These would be central to achieving both gender equality and health. Progress can be accelerated through improved qualitative and quantitative data collection, analysis, and interpretation that accounts for the pervasive role of gender norms in shaping human health and wellbeing.

The Lancet series on gender equality, norms and health has been several years in the making. "Rather than seeing the publication as an endpoint, we believe this is when the work of broad dissemination, broader engagement and ownership and impact begins," adds lead researcher Gary Darmstadt. "It is indeed on our collective shoulders to ensure that the work is translated into local, national and global programming with and for those who are most marginalised."

A NEED TO RECOGNISE AND TRANSFORM RESTRICTIVE GENDER NORMS AND GENDER INEQUALITIES

The series is a collection of five papers, led by Darmstadt and colleagues that provides new analysis and insights into the impact of gender inequalities and norms on health, and the opportunities that exist within health systems, programmes, policies, and research to transform gender norms and inequalities.

The need for more action and accountability on gender equality is clear: introduction of the 2030 Agenda for Sustainable Development and the Universal Health Coverage goals demand greater attention to the social determinants of health, including gender, for the purpose of enabling all people to reach their full human potential.

The systemic neglect of gender norms and inequalities in programme design, implementation, monitoring, and evaluation undermines the health of everyone - women and girls, boys and men, and gender minorities. This series aims to inform the global health community of the critical need and effective actions to recognise and transform restrictive gender norms and gender inequalities, and their intersections with other social inequalities, including those related to age, race/ethnicity, religion, and socioeconomic status in all they do.

**The Birth to Twenty Plus study (Bt20+) is the largest and longest running study of children's health and development in Africa, and one of the few large-scale longitudinal studies in the world. Between March and June, following Nelson Mandela's release from prison in 1990, 3 273 were enrolled into a long-term birth cohort study in which it was planned to follow them (and their families) for at least the first decade of their lives. This was extended and continues today, three decades later.*

FACULTY OF HUMANITIES

PROFESSOR GARTH STEVENS
DEAN: FACULTY OF HUMANITIES

76
NRF-RATED RESEARCHERS

463.46
DEPARTMENT OF HIGHER EDUCATION AND TRAINING PUBLICATION UNITS

47
CREATIVE OUTPUTS FOR EXTERNAL ACCREDITATION

As one of the leading intellectual hubs on the African continent, the Faculty of Humanities is not only a formidable producer of new knowledge that harnesses the scholarly lessons of the past and the analytic technologies of the present, but we are also a meaningful social actor in forging and developing the society in which we are globally and local embedded. Renowned for our distinguished academics and scholars, the Faculty offers a cosmopolitan mix of international and local staff working in a number of disciplines that are highly ranked across a range of global higher education measures. It is home to some 76 researchers rated by the South African National Research Foundation as having national and international standing.

Our scholars are innovating at the leading edge of research across a range of fields, answering old questions with new insights and methodologies spanning horizons of knowledge in African art, area studies, cities and housing, human migration, diversity and difference, critical race studies, violence, gender and sexuality, cultural studies, translanguaging, narrative, and labour. Many of these foci are anchored in our prestigious research institutes including the Society, Work and Development Institute; the Wits Institute for Social and Economic Research; the Centre for Researching Education and Labour; the History Workshop; the African Centre for Migration and Society; and the Wits Centre for Diversity Studies. To complement these research Centres, we host eight prestigious research chairs which are developing knowledge and the future research pipeline in globally impactful and locally imperative development areas such as mathematics education, political theory, migration, local history-making, critical diversity scholarship, skills development and labour, and teacher education for diversity and development.

Over the course of 2019, the Faculty's high-impact research through the publication of books and creative research continued to be prioritised alongside the pursuit of growing a strong cohort of postgraduate students. In so doing, the Faculty maintained its widely-recognised leadership in a number of areas of humanities research and research-led pedagogy.

> The Faculty of Humanities was ranked first in Africa in a 2019/2020 global survey of 536 universities, with a special mention for the quality of our research and teaching.

The Faculty's submission of 463.46 Department of Higher Education and Training units during the reporting period represents an 8.2 percent increase in year-on-year output, and the steepest increase in outputs across all the faculties in the University. The submission of 47 creative outputs for external accreditation is also an important research milestone for formal recognition of the important creative research undertaken by our staff. Our proportion of articles published in internationally accredited journals increased across all staff ranks and now comprises over half of all indexed publications. In addition, the Faculty's Category Normalised Citation Impact rose to 57% above the global average.

In keeping with its emphasis on growing the numbers and scholarly contributions of its postgraduate students and postdoctoral fellows, the Faculty graduated the highest number of postgraduate students in its history, representing an increase of 15% over 2018. Postdoctoral publication grew impressively in high-quality outlets.

The Faculty will build on the momentum of its history to contribute to the institutional vision of a future realised through becoming a research-intensive and postgraduate-oriented university, and will continue to enhance enabling conditions for high-impact scholarship and pursue the inclusion of postgraduate students in our research culture. This strategy will powerfully position the Faculty to continue to transform and set the agenda for research in the humanities in Africa and beyond.

DRAMA FOR LIFE
RESEARCH INNOVATION

Drama for Life (DfL), a Department of Applied Arts, Arts Therapies and Arts Research in the Wits School of Arts (WSOA), has grown a deep reach into and across Africa's urban and rural spaces. Its historical interdisciplinary and intersectional focus on arts in activism, education, development and therapies has given rise to a number of research initiatives. Research is responsive to community context, contemporary local, national and global trends, and aligned to the experiential, embodied nature of creative arts somatic education and therapies. DfL's aim is to innovate contemporary arts strategies and contemporary technologies, informed by neuroscience and psychology, digital arts and education, to enhance social and behavioral change. This is enhanced by the innovation of creative research hubs, giving an opportunity for the assembly of a diverse international research community, alongside staff, students and community members, fostering new ideas, practice, and research trends.

A series of creative research projects, driven by Drama for Life's Theatre Research Laboratory – the DfL Theatre Company, focused on gender-based violence, gender identity construction and expression. *Girls and Gals* created a hybrid of physical theatre, storytelling, and an auto-ethnographic folklore to deconstruct gender identity and expression. *Lefa* unearthed the unspoken myths about masculinities, particularly toxic masculinities in South Africa's landscape of culture, sex and parenting. *Drylands* focused on gender, sex and the cruel, violent reality of transphobia. These performance as research projects were further supported by participatory-action research involving applied drama and theatre facilitation interventions guided by change theory.

Drama for Life aligned its field of applied arts with the growth of drama and theatre for child development and education. New research was generated through its 11th international conference and festival. An eight day creative research hub focused on the philosophical and pedagogical questions about what it would mean, and what could be done in and through the performing arts to create a child-centred society. It featured national and international guests, including Unga Klara - Sweden's National Children's Theatre Company and their research team – world leaders in creating performance for early childhood and adolescents. Research collaboration on *My True Selves* involved artist researchers from Sweden and South Africa working together, first through digital platforms and then face to face, on seven versions of *My True Selves* and executing the interventions with Soweto, Johannesburg and Gugulethu, Cape Town school children. Other research included anthropologist, pioneer of Drama Therapy, author, and Drama for Life distinguished scholar, Dr Sue Jennings who shaped the research dialogue about the intersections between dramatic play and neuroscience in early childhood.

Drama for Life continued to foster research into how drama and theatre can effectively enhance deep democracy. This research is enacted through multiple projects. In partnership with the Norway University of Science and Technology, Drama for Life published a call for written and creative research for the project *Building Democracy through Theatre* for an upcoming digital anthology to be launched at the project's conference in 2021. The groundbreaking anthology that combines traditional research forms with cutting-edge technology aims to share research produced by artists, teachers, researchers and postgraduate students.

Other deep democracy research projects included an interactive drama intervention for the *Inyathelo: Institute for Higher Education Conference*. The plenary process served to bring South Africa's student leaders together with all universities and their senior management staff to begin to dialogue in a post- #FeesMustFall era. The Healers, a radical improvisation experiment facilitated three embodied reflective plenary sessions for major international events.

The DfL Theatre Company continued its work across the Southern African region, investigating the efficacy of dialogic community-based applied theatre interventions for social change. For instance, they are the lead players in the Emakhazeni Public Space Arts Festival, My Body My Space, working across the Emakhazeni Region in rural schools, orphan homes, community centres and farms.

DfL hosted a performative research retreat on *African Contemplative Research* inclusive of African, Eastern and Western Spiritual Contemplative thought leaders and Arts Therapists and Healers. The work was framed within the African Social Sciences, including philosophy, the arts, psychology, psychiatry and spirituality. This new research aims to integrate indigenous healing systems and philosophies with contemporary thought and praxis in the Arts Therapies.

THE WITS
MATHS CONNECT-PRIMARY
PROJECT RESEARCH AND DEVELOPMENT TEAM

The Wits Maths Connect-Primary (WMC-P) project, working within the remit of the South African Research Chair in Mathematics Education has over a ten year period made significant impact via its early grades initiatives that have been taken up across provincial education departments and the national Department of Basic Education.

These initiatives have been designed around research questions related to the possibilities for scaling up interventions showing promise in a system where capacity in terms of mathematical content knowledge and mathematics teaching proficiency are severely constrained, and further hampered by limited access to resources.

Interventions have involved a combination of materials and professional development packages, rolled out by members of the WMC-P team. The intervention model links postgraduate and staff research with development activity on the ground, and has been located in schools serving disadvantaged learner populations. Two key projects that have had significant translational impact on policy and practices in early grades mathematics education are described below.

The Multiplicative Reasoning Project has focused on improving learning outcomes for children in disadvantaged schools. Following earlier smaller scale trials within the WMC-P partner schools in Johannesburg and in postgraduate studies, the model was extended to work with all the Foundation Phase mathematics subject advisers in the Gauteng and North-West provinces, which demonstrated pleasing gains in learning. The Department of Basic Education invited the WMC-P team to extend the intervention to two further provinces during 2020 and 2021. Provincial reports on the outcomes and academic research papers both indicate substantial pre- to post-test learning gains for Grade 2 learners in a model where the WMC-P team work with subject advisers to deepen their mathematical content knowledge, and to enhance their capacity for supporting mathematics teaching through working alongside teachers in classrooms.

A second national-level initiative – the Mental Starters project – has been conducted as a collaboration led by the Chairs in Numeracy based at Wits and Rhodes, partnering with national and provincial education departments, research and professional organisations in mathematics education, and non-governmental organisation partners. This project has worked from a research base to design, develop, trial and revise diagnostic mental mathematics assessments and teaching and learning materials for use in Grade 3 as part of national policy. This project has now produced mental starter teaching and learning materials which will be disseminated nationally by the Department of Basic Education in 2021.

The strong body of research produced within the Wits Maths Connect-Primary project over the last ten years has provided insights into primary mathematics teaching and learning on the ground at several levels. Gaps in primary teachers' mathematical knowledge have been highlighted at in-service and pre-service levels. Problems with coherence and connection in instruction have also been studied and theorised for studying change with a view to developing instructional support geared towards the practicalities of the ground. Postgraduate studies have provided important insights into key foci for interventions and possibilities for change.

Alongside this body of work, the WMC-P team has worked together to design, develop, trial and study interventions over and above the two highlighted above. Much of this work began in the locale of ten partner government primary schools, with writing on context, conditions and intervention outcomes published across conference and journal papers as well as policy-focused presentations. Promising outcomes and collaborative partnerships in the education sector have led to scaling up interventions to work at the provincial and national policy levels rather than directly with individual schools. Future plans involve collaboration with the national Department of Basic Education on further multi-province level initiatives to build capacity at the subject adviser level, and translating school-based research findings into curricular content for pre-service teacher education.

FACULTY OF SCIENCE

PROFESSOR NITHAYA CHETTY
DEAN: FACULTY OF SCIENCE

459.12
PUBLICATION UNITS IN SOME 900 PUBLICATIONS

900
PUBLICATIONS

28
NATIONAL RESEARCH FOUNDATION A-RATED SCIENTISTS

160
NRF-RATED SCIENTISTS

49
B-RATED SCIENTISTS

76
C-RATED SCIENTISTS

1
P-RATED SCIENTIST

22
Y-RATED SCIENTISTS

The Faculty of Science has produced 459.12 publication units in just under than 900 publications, a number of book chapters and a few books in 2019. Twenty-eight National Research Foundation (NRF) A-rated scholars are located in the Faculty of Science and another in the Global Change Institute affiliated with the Faculty. The Faculty of Science is also home to another 160 NRF-rated scholars with 49 B-rated scientists, 76 C-rated scientists, one P-rated researcher and 22 Y-rated scholars.

Three Centres of Excellence are housed in the Faculty of Science: the Centre of Excellence in Mathematical and Statistical Sciences, the Centre of Excellence in Palaeosciences and the Centre of Excellence for Integrated Mineral and Energy Resource Analysis. Extensive collaboration within the Faculty and with other Faculties takes place. In particular, a significant number of researchers contribute to the Department of Science and Innovation NRF Centre of Excellence in Strong Materials and the newly formed African Research Universities Alliance (ARUA) Centre of Excellence in Materials Energy and Nanotechnology, which is located in the Faculty of Engineering and the Built Environment.

Numerous researchers published in high profile journals. In 2019, Wits scientists Amélie Beaudet, Ronald Clarke and Dominic Stratford published a paper in the *Journal of Human Evolution* revealing past histories by describing that they were able to virtually extract the inner ear of the 3.67 million-year-old Australopithecus known as "Little Foot" from the Sterkfontein Caves. In addition, some of South Africa's greatest fossil discoveries in modern times were showcased for the first time to a global audience. Wits, the Perot Museum of Nature and Science in the United States and the National Geographic Society took the fossils of two ancient human relatives - Australopithecus sediba and Homo naledi - to the United States.

A PhD student, Kimberley Chapelle, supervised by Professor Jonah Choiniere, discovered a new dinosaur in the University's vaults, after it had been laying misidentified in a collection for 30 years. It was not only a new species of sauropodomorph, but an entirely new genus.

Professor David Lewis-Williams from the Rock Art Research Institute published an essential book on past histories in 2019 titled *Image Makers: The Social Context of a Hunter-Gatherer Ritual.*

Professor Andrew Chen from the School of Physics authored a Nature paper that reported on the detection of very high-energy gamma-ray emission of a gamma-ray burst afterglow with the High Energy Stereoscopic System in Namibia. His colleague, Andrew Forbes published an invited perspective on Super-resolution with quantum light in *Nature Photonics*. His group also published in *Physical Review A* confirmation of a 20 year-old theory using new technologies on the existence of fractals from lasers, which was selected by the Optical Society of America as one of the top 30 optical advances worldwide, and a featured story in Nature Photonics.

A paper published in the *Proceedings of the National Academy of Sciences* titled *Multimodal cue integration in the dung beetle compass* by Professor Marcus Byrne from the School of Animal, Plant and Environmental Sciences also received tremendous media attention, resulting in an altmetric score of 153. The paper highlighted how dung beetles can switch between the most reliable orientation cue at any given moment, the sky or the wind, and the same part of the brain appears to handle both sets of information. Byrne also wrote a book titled *Dance of the Dung Beetles*, which considers the role of dung beetles in the development of science, from Kephri the Egyptian god of resurrection, through to modern evolutionary biology and evidence for speciation. The book received numerous favourable reviews, including one from *Nature* and won the 2020 Humanities and Social Sciences Award for the best non-fiction monograph awarded by the National Institute for the Humanities and Social Sciences.

From the School of Chemistry, a paper published by Professor Charles de Koning in T*he European Journal of Organic Chemistry* on the use of cashew nut shells to make UV absorbers resulted in significant media attention with an altmetric score of 150, and was covered by many news outlets around the world.

Professor Allan Wilson from the School of Geosciences authored a paper in *Nature* titled *Deep hydrous mantle reservoir provides evidence for crustal recycling before 3.3 billion years ago*". Colleagues Rais Latypov and Sofya Chistyakova published a paper on evidence for igneous differentiation in Sudbury igneous complex and impact-driven evolution of terrestrial planet proto-crusts in *Nature Communications.*

The examples above provide a snapshot of the excellent research conducted in the Faculty in 2019, which will without a doubt continue in 2020.

USING SOCIAL MEDIA AND MACHINE LEARNING TO STOP **ILLEGAL REPTILE LAUNDERING**

In 2017, a man who had travelled to South Africa from Japan was caught by the Malmesbury police with 48 lizards that he had poached from the wild and that he had intended to smuggle out of the country. His sentence was 13 years imprisonment or a R1 million fine. A month later, another Japanese man was caught for the same offence, and a few months after that, two German men.

Shivan Parusnath, a PhD candidate in the School of Animal, Plant and Environmental Sciences at Wits, plans to clamp down on the rampant illegal reptile trade, starting on social media. His research on a threatened reptile species has already led to changes in the South African legislature. His postdoctoral studies will focus on the sale of South African reptiles on online forums, social media, and at international reptile fairs. His initial research reveals how crucial this study will be.

Parusnath's documentary on sungazers, *Saving Dragons*, recently won the Simon Mabhunu Sabela Award for the Best Environmental Conservation film from the KwaZulu-Natal Film Commission.

"Without much difficulty, I found several reptile trade groups selling South African reptiles on social media. I've even done some searches on the dark web, which came up empty-handed. Chances are that social media already provide such an easy means to conduct illegal trade that using the dark web isn't even necessary," he says. The dark web, often used for illegal trade, refers to websites that exist on encrypted networks and cannot be found through traditional search engines.

Although some platforms have banned the sale of live animals, the rules are not always enforced. "There are many loopholes, such as creating secret groups on Facebook, or pretending to 'rehome' animals – those in the market will know that it's code for a sale, and will contact the person privately," explains Parusnath.

Getting a better idea of the species being sold in this manner, and in what quantities, will help inform legislature and scientific authorities to better protect species threatened by trade.

Besides manual searches and visiting international trade shows, Parusnath also employs machine learning for his research. After feeding an algorithm with training data (images of reptile species to be searched for), the software will be able to access data on which species are being sold online, where they are sold, and at what price, and even identify false keywords or guises used to cover up sales.

Parusnath has so far concentrated most of his research on sungazer lizards (Smaug giganteus), named for their upward-arching stance when basking in the sun. Over the past decade, several of these vulnerable lizards were shipped or smuggled from South African shores into the hands of exotic reptile collectors, fetching thousands of dollars each. The biggest markets are in Europe, Japan and the USA.

In his PhD, Parusnath focused on investigating the genetic structure of the species by DNA barcoding almost 200 sungazers in 13 different colonies in Mpumalanga and the Free State – their only natural habitat. This was done using microsatellites, special genetic markers that he developed especially for the sungazer.

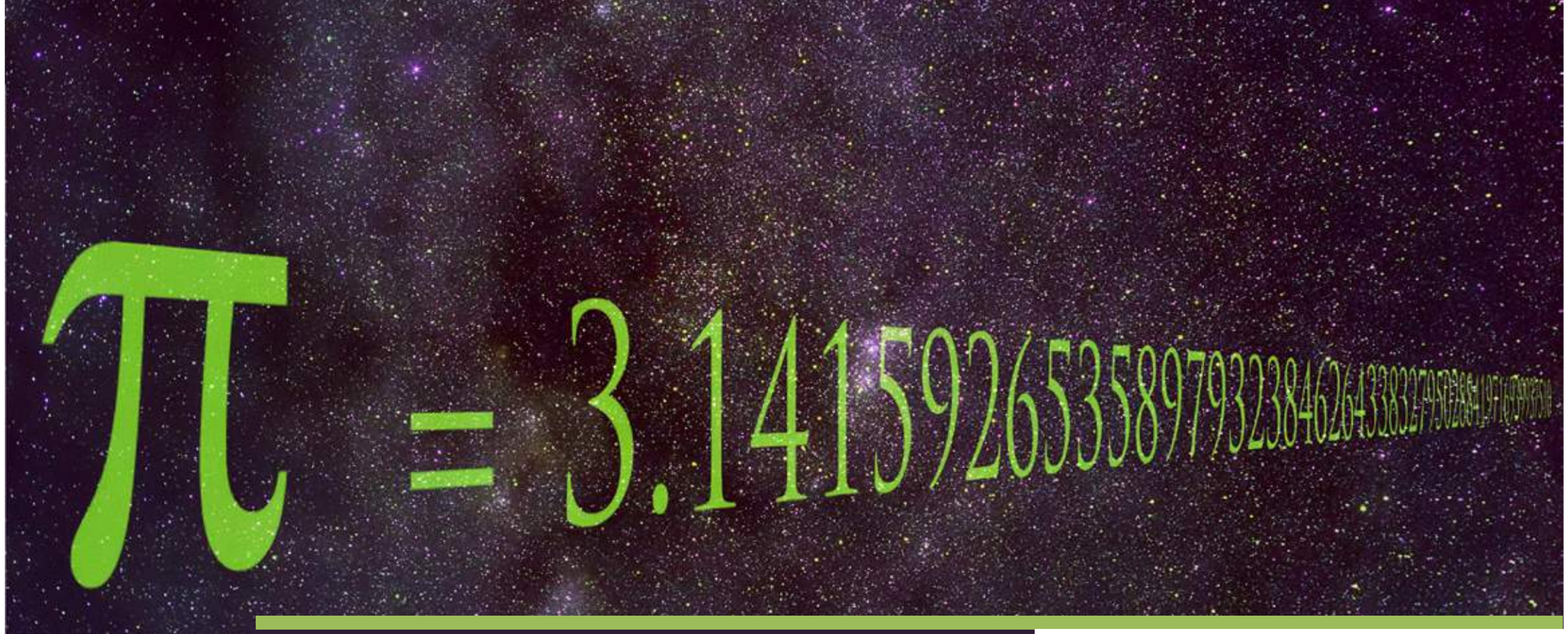
"Microsatellites allow one to understand more about the population and social structure of a species in the wild. You can, for example, determine if a baby belongs to a certain parent, if two animals are first cousins, or if they are not related at all. You can then use this information to learn more about their social behaviour, for example if babies and parents live together in a burrow or not," says Parusnath.

Secondly, the information can be used in regulating trade in the species. Sungazers are listed on CITES Appendix II, a multilateral treaty to protect endangered plants and animals, and species on this list may only be traded if bred in captivity. Microsatellites can help clarify whether animals were indeed bred in captivity when a trader applies for a permit.

The technology is so effective that it's been used to identify poaching hot spots for elephants. When a detailed enough network of DNA barcodes is collected from across a species' distribution, it can be used to determine where an animal came from. Parusnath's network is already big enough to determine if a confiscated sungazer came from the East or West Free State, for example.

For his Master's research, Parusnath reassessed the conservation status of the species, which was last done in 1978. Sungazer populations had declined 30% since the last assessment, and they're at the same level as rhinos on the National Environmental Management: Biodiversity Act list of Threatened or Protected Species.

His research led to the finding by the South African scientific authority that trade in wild-caught sungazers would be detrimental to the species. A legislative change followed, and trading in sungazers now requires proof of captive breeding before a permit is issued, effectively stopping what is known as reptile laundering, where wild-caught animals are sold under the guise of captive breeding.



THE LINGUA FRANCA OF MATHEMATICS

Speaking to visitors from outer space would one day require a common language and one not found in a dictionary.

One day, when extra-terrestrial aliens finally make contact with us Earthlings, we'll need to communicate. Such an historic occasion will demand that we make a good impression, and that might mean leaving the introductions to a mathematician or a physicist.

"The natural place to start conversing with aliens would be to use mathematics because it is universal," says Professor Vishnu Jejjala from the Wits School of Physics. "Aliens might not have the same biology as we do. We are carbon based, they could, for instance, be silicon based. Who knows? But whatever their physiology is, the mathematics that we have is exactly the same as the mathematics that aliens have."

THE PERSISTENCE OF PI

DEFINING Pi: Pi (π) describes the ratio between a circle's circumference and its diameter. Pi's decimal representation (3.14…) never ends and never settles into a permanently repeating pattern. The Guinness World Record for a person to memorise the value of Pi is 70 000 digits.

Across the universe, the same numbers keep cropping up in unexpected places, much like an invisible code that appears to unite unrelated principles. The famed mathematical constant, Pi (or π), which describes the ratio of a circle's circumference to its diameter (with a value of 3.14…) is one example.

Another example is the so-called 'Golden Ratio' – also known as the Divine Proportion – which is expressed not only in the geometric shapes of nature (such as in the shape of the Whirlpool Galaxy, Nautilus shells and hurricanes) but also in many human creations. The Pyramids of Giza were allegedly built using the Golden Ratio, and artist Leonard Da Vinci apparently used its eye-pleasing proportions to paint the iconic Mona Lisa.

Wits Emeritus Professor Francis Thackeray and the late Professor Jan Boeyens suggest that there's a strong case that the Golden Ratio (1.61803...) can be related to not only aspects of mathematics, but also to physics, chemistry, and biology. The Golden Ratio could even be identified in the topology of space-time, Boeyens claimed.

UNIVERSAL LANGUAGE

Jejjala explains that numbers such as Pi and the Golden Ratio recur because the language we use to analyse physical phenomena – mathematics – is in itself a universal language.

"As a physicist, I work on various problems and the same sort of numbers appear in various places. It is not just the same numbers appearing, it is also the same equations that are appearing; the same phenomena that manifest in vastly different situations." Pi, for instance, appear everywhere because circular forms appear in various places in nature, says Jejjala. "Pi is just a reflection in phenomena in which these things happen."

Other examples of where numbers appear across a variety of disciplines appear in periodic phenomena.

"The infection rate for disease might be one example. Such periodic behaviour is characterised by trigonometric functions, like sine or cosine. The period for such a function is 2Pi, which relates back to the circle [the circumference of a circle is 2PiR]."

Various other phenomena are exponential. The half-life of radioactive isotopes, the inflationary phase of the cosmos, the population growth of various organisms are all described as "e" raised to the power of something.

"The number 'e' – or Euler's Number, which is approximately 2.71828, pops up everywhere, like in calculations of compounding interest and probability theory, while other numbers, such as the Euler-Mascheroni constant, the zeta function evaluated at special points and the Golden Ratio that all appear in different contexts."

So, because mathematics is universal, it would be the natural lingua franca for a conversation with Martians. But what form would such a conversation take? How would we say hello?

"The conversation might start with teaching each other prime numbers," says Jejjala. "The distribution of prime numbers is described by Riemann's zeta function. The famous Riemann conjecture states that all of the non-trivial zeroes of the zeta function have real part equal to 1/2. No one has been able to prove this statement. We could, for instance, describe the function in terms of the prime numbers and ask the aliens for help."

Mathematics has been described as "unreasonably effective at describing the natural world". The fact that everything in nature works so well (through mathematics) has had philosophers, mathematicians and physicists puzzled for years, but, up until now, there are only partial answers.

"In the end, it seems that every bit of mathematics has some utility in physics," says Jejalla. "The second thing to note is that there are only certain equations we can solve. So we are bullying whatever we thought into one of the equations we can solve." And while progress is slow in deciphering newly discovered equations that could advance our understanding of the world, Jejalla believes we are on the right track.

"One of the key insights in science is that the same patterns appear in many places and the methodologies for describing those patterns is largely the same irrespective of the subject. This is how we translate developments in one area to other areas."

Wits Enterprise
The Innovation Edge

WITS COMMERICAL ENTERPRISE

Wits Commercial Enterprise is mandated by Wits to provide the University with innovation, research and consulting support. Our mission is to help Wits make its knowledge matter and to translate ideas to reshape the world.

Over the course of 2019, Wits Commercial Enterprise managed over 116 contract research and consulting projects across faculties. This represented R 84.2 million in external revenue for Wits in 2019. Of this external funding, the private industry funded research, consulting and analytical service projects are valued at R 10.5 million.

The Faculty of Humanities and the School of Education dominated in terms of externally funded revenue generated through research and training projects, totalling over R40 million, with more than half of this funding sourced from various SETAs.

The ICT integration in education portfolio led by Dr Reuben Dlamini, secured R 35 million from research and training projects funded by the ETDP SETA, the Limpopo Department of Education, the Matthew Goniwe School of Leadership and Governance, Anglo American and the MICT SETA. The Centre for Research in Education and Labour led by Presha Ramsarup, raised over R 5 million in research funding from the BankSETA, ServSETA and MerSETA.

Wits Commercial Enterprise has been involved in a portfolio of consulting projects for the Construction SETA. An unemployment construction workers research project worth R4 million and a sector skills plan project worth R 11.6 million were completed in 2019, with contributions from faculties across Wits.

Two new European Union funded Horizon 2020 projects, where Wits researchers will play a prominent role, were secured in 2019. These are the Making Africa Urban project which will focus on factors of urban development on the African continent and BioRECOVER which is focused on the development of an innovative sustainable strategy for selective biorecovery of critical raw materials from primary and secondary sources.

In addition, Wits Commercial Enterprise raised over R2.5 million in seed funding primarily from the Technology Innovation Agency, to advance Wits' innovations to the next stage of research and development towards commercialisation.

DUNCAN RAFTESATH
CEO: WITS COMMERCIAL ENTERPRISE

ICT INTEGRATION IN EDUCATION

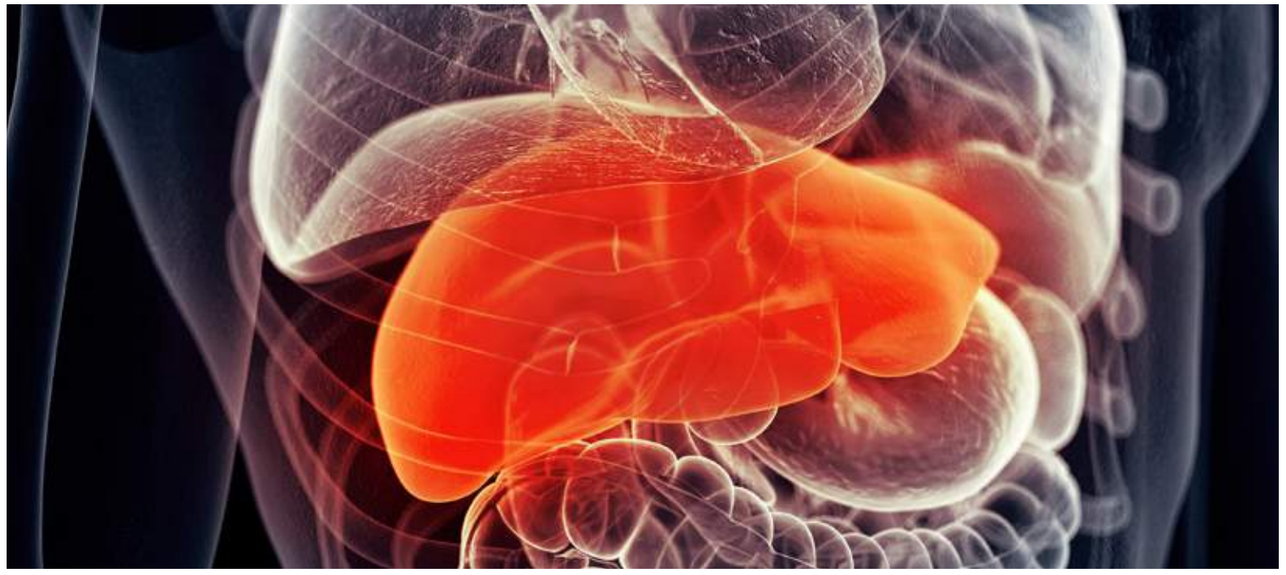
An Information Communication Technology (ICT) skills development programme, rolled out by the Department of Educational Information and Engineering Technology within the School of Education and Wits Commercial Enterprise has touched the lives of thousands of South African educators, with the goal of equipping them for the 21st Century. The Wits initiative enables an intersection between ICT skills, digital pedagogies, and research to inspire disruptive innovations in the classroom.

Funded by the provincial Departments of Education and the EDTP SETA, the programmes provide training in ICT, financial literacy and business acumen for teachers, focusing primarily on rural areas where skills gaps are most prevalent. The goal is to bridge the digital divide in order to prevent the digital skills gap from widening and causing more digital inequalities in schools. Between 2017 and 2019, the initiative reached 2 106 educators in Limpopo, 550 in Mpumalanga, 175 in the North West Province and 300 in Gauteng.

Research drives the initiatives to understand the complexities on the ground and to avoid a one-size-fits-all model that is disconnected from the reality. Monitoring, evaluation, and research activities inform and enable the Wits team to develop a systematic approach to ICT adoption, appropriation and integration in education. Although a formal impact assessment is yet to be conducted to gauge the programme's overall impact, the success is evident in the number of educators who are generating reports online, capturing attendance, and accessing online resources made available by the Department of Basic Education. Educators are now more empowered to use social media and WhatsApp groups to share knowledge and facilitate communication. Unfortunately, the disparate distribution of ICT infrastructure in public schools remains a challenge. However, the empowering of educators with ICT skills will go a long way towards driving professional learning communities in the sector.

WITS DONALD GORDON MEDICAL CENTRE

DR JUNE FABIAN
RESEARCH DIRECTOR:
WITS DONALD GORDON
MEDICAL CENTRE



Since the inception of the Wits Donald Gordon Medical Centre's (WDGMC) onsite support for investigator-initiated, undergraduate and postgraduate research in 2014, the WDGMC has increasingly contributed to the research output of the Faculty of Health Sciences.

To date, we have supported 116 research projects and of these, 48 were postgraduate degrees. We are also proud of our publication record in that we achieved 25 peer-reviewed publications in 2019.

Our team from left to right: Harriet Etheredge, Soneni Maphosa, Prudence Mashegoana, Heather Maher, June Fabian (front), Portia Xakoshe, Lincoln Nhlapo and Masupha Adoro. An additional member of the team, Carolyn Bouter, was a full-time research intern in 2019.

THE FIRST AFRICAN LIVER TISSUE BIOREPOSITORY (ALTBio)

A highlight from 2019 includes the inception of the ALTBio collaboration between the Transplant Unit of the Wits Donald Gordon Medical Centre (WDGMC) Unit and the Wits Sydney Brenner Institute for Molecular Bioscience.

While Africa and its people have the greatest diversity known to humankind, the paucity of genomic research continues to impact on our understanding of susceptibility to disease and drug response, preventing the development of effective vaccines and therapeutic treatments. Our primary focus with ALTBio is therefore to create the first liver tissue biorepository in sub-Saharan Africa, and to lead pharmacogenomic and therapeutic drug development research for African populations.

Liver tissue samples are sourced from consenting living liver transplant donors at the WDGMC, and are bio-banked and genotyped by the SBIMB team. In the context of liver transplantation, we know that many African organ recipients require much higher doses of certain immunosuppressive drugs to reach therapeutic levels (compared to Caucasian counterparts), thus increasing the risk for organ rejection and side-effects. While this is a single example, ALTBio will create the infrastructure to capacitate scientists on the continent to perform drug metabolism and pharmacogenomic testing for future drug development, and facilitate access to testing for pharmaceutical industry research and development that will represent African populations.

STUDYING COLORECTAL CANCER IN SOUTH AFRICANS

Another highlight has been the completion and refunding of the Colorectal Cancer in South Africa study. Professor Paul Ruff and Dr Brendan Bebington have created the first longitudinal cohort of patients diagnosed with colorectal cancer from the Gauteng region. Their study was funded by the South African Medical Research Council and the project has received further funding to explore genetic markers that may determine responsiveness to chemotherapy, ultimately paving the way for a personalised medicine approach that will improve care at the bedside.

Visit the research page on the WDGMC website for more research case studies: www.dgmc.co.za/clinical-research-main

WITS HEALTH CONSORTIUM

The Wits Health Consortium (WHC) (Pty) Ltd is wholly owned by Wits and was established to serve as a legal entity through which the University, and primarily the Faculty of Health Sciences, can conduct contract or sponsored research, entrepreneurial or commercial activities, and philanthropic funding activities and services including clinical services. The Consortium has over 70 divisions undertaking world-class research, vaccine trials, and supporting the national and provincial departments of health with health systems strengthening activities funded by international donors. The WHC managed in excess of R2,7 billion in 2019 and has grown into a globally recognised and respected organisation with efficient systems, excellent governance, and outstanding performance. We have over 4 000 academic, professional and support staff working on grants funded by over 30 international donors.

The primary role of the Consortium is to provide the governance, legal framework, human resources, financial and grant management services for the research Divisions linked to the academic departments within the Faculty.

Health related research is an invaluable tool for building critical knowledge in the field of science and medicine. Improving health outcomes and addressing health challenges through education, advocacy, innovation and science is the mantra of our research divisions. Steered by local and internationally acclaimed clinicians and scientists, research efforts in 2019 yielded prolific results.

ADVANCE-ing HIV TREATMENT

In 2019 Ezintsha, linked to the Wits School of Clinical Medicine at the University of the Witwatersrand, finalised the primary 48-week analysis of its ADVANCE study. In July 2019 the 48-week outcome results were presented at the international AIDS conference held in Mexico City, and at the same time was published in the prestigious New England Journal of Medicine (NEJM). One of the findings that received the most attention during the conference was that the newer antiretrovirals DTG and TAF, especially when used in combination, cause weight gain, especially among African women. The principal investigator of the study, Professor Francois Venter, was awarded the most prestigious PhD award of the Faculty of Health Sciences, University of the Witwatersrand, for his work on treatment optimisation.

ALF FARRELL
CEO: WITS HEALTH CONSORTIUM

TRANSGENDER CLINICS IN PRIMARY HEALTHCARE SETTINGS

During the first year of the five-year USAID Award for advancing the South Africa's HIV Response for key populations, sex workers, and transgender individuals, the Wits Reproductive Health and HIV Institute's Key Populations Programme intensified services at four existing sex worker sites and opened four new transgender sites. The latter provide the first USAID-funded services for the trans community in Africa. The integration of gender-affirming hormone therapy and psychosocial support within a primary healthcare setting and HIV prevention and treatment package serves to increase the uptake of services and retention in care. The transgender programme launch was held in Cape Town in December 2019 and was attended by dignitaries including the US Consul General.

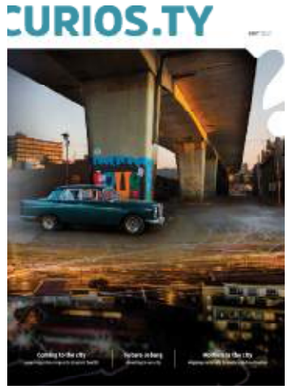
TOWARDS EXPANDED HIV SUPPRESSION

The Perinatal HIV Research Unit (PHRU), part of the Department of Paediatrics and Child Health at Wits, has expanded its clinical research footprint to be able to conduct studies in five provinces in South Africa. A key success factor of any academic is the number of scientific articles published in internationally peer reviewed journals. In 2019, researchers at the PHRU were listed authors on the mastheads of 75 such articles. One of these articles described a young child in Soweto who remains in virally suppressed remission after several years without antiretroviral treatment.

TACKLING DRUG-RESISTANT TUBERCULOSIS

A world-first programme aimed at fighting drug-resistant tuberculosis was launched in Port Elizabeth by the Clinical HIV Research Unit (CHRU) and is expected to cut treatment time frames, making treatment far easier and with fewer side-effects. Dr Francesca Conradie, a Principal Investigator at the Unit explained that treatment was provided to participants or patients with drug-resistant tuberculosis that involved a combination of the new and repurposed medications used together for six months.

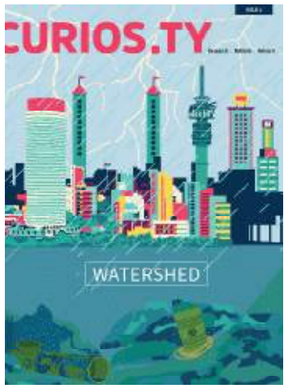
CURIOS.TY



CITIES

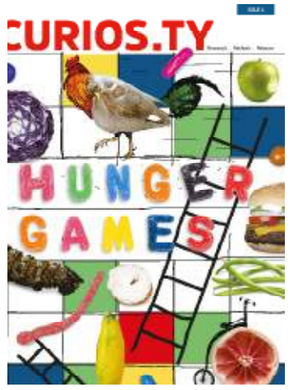
iHUMAN

CAPITAL



WATERSHED

MANDELA100



HUNGER GAMES

EKHAYA [HOME]

CODE

Curios.ty is a print and digital magazine that aims to make the research at Wits University accessible to multiple publics. It tells the stories of pioneering research at Wits through the voices of talented researchers, students and academics. First published in April 2017, *Curios.ty* is published three times per year.

Each issue is thematic and explores research across faculties and disciplines at the University that relate to the theme. Since its inception, research themes have included: Cities, iHuman, Capital, Watershed, Mandela100, Hunger Games, Ekhaya [Home], Code, Climate Emergency, Mood, and Viral.

www.wits.ac.za/curiosity/

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