

ScienceScope

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BRIGHT MINDS. BOLD FUTURES.



science, technology
& innovation

Department:
Science, Technology and Innovation
REPUBLIC OF SOUTH AFRICA



DON'T MISS THESE VIDEO STORIES!



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Cofimvaba learners log green scores for CSIR-designed science centre

South Africa's first net-zero science centre, designed by **CSIR research architects**, is now an ongoing citizen science experiment in green building practices, and a model for future buildings. Learners from two nearby high schools in Cofimvaba, in the rural Eastern Cape, use tablets to score the building's thermal performance, while its water and energy efficiency is monitored in a digital twin building.



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We grow algae for nature-based municipal water treatment

Wastewater ponds in Mossel Bay use a special algae treatment developed by **CSIR water quality scientists** to improve water quality in a low-energy, low-cost way, while delivering tangible environmental and social benefits. The treatment results in a reduction of up to 90% of nitrates and phosphates and a 10 000-fold reduction in pathogens such as *E. coli*, thereby delivering clean groundwater for nearby agricultural use.



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Cerebral palsy mobility device grows as you grow

CSIR robotics engineers are working on a reconfigurable, low-cost and rugged prototype mobility device that will assist children, adults and caregivers affected by cerebral palsy. The device is intended to help reduce preventable deformities caused by improper seating.



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CSIR upscales growth factor production for local biotechnology firm

Immobazyme, a local biotechnology start-up, approached **CSIR biomanufacturing specialists** with a bacterial strain they had genetically modified to produce a commercial protein called fibroblast growth factor 2 (FGF-2). This protein gives the signal to mammalian cells to multiply and proliferate, so it is essential for the laboratory-grown meat industry. The production process of FGF-2 was successfully upscaled at the CSIR.



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A sliver of brown skin for a world of new medicines

Biomedical researchers at the CSIR and the University of Nairobi in Kenya are turning skin cells from African donors into stem cell lines for global medical research – the goal is that future medicines work better for Africa's unique and diverse genetic profiles. As part of the CSIR-hosted African Cell Initiative™, the skin cells will first be converted into stem cells and then into nearly any type of cell required for early testing of therapies to treat a range of diseases.

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Council for Scientific and
Industrial Research (CSIR)



CSIRNewMedia

South Africa's future prosperity depends on our ability to develop educated, skilled and innovative individuals who can solve complex challenges, create opportunities and contribute meaningfully to their communities and the nation. Science, technology and innovation are critical enablers of this vision, providing the knowledge, capabilities and solutions needed to address unemployment, poverty and inequality, while promoting inclusive economic growth.

At the Council for Scientific and Industrial Research (CSIR), we recognise that building this future begins with investing in people. Developing the next generation of scientists, engineers, technologists and innovators is fundamental to our mandate and to ensuring South Africa remains globally competitive in science, technology and innovation.

Throughout the 2025/26 financial year, we continued to strengthen this talent pipeline through a range of development initiatives. We appointed 24 graduates to our Graduate-in-Training Programme across research and technical fields. We also provided internship opportunities to 160 unemployed South African youth, of whom 75% were women.

Recognising the importance of practical skills development, we hosted and supported numerous Technical and Vocational Education and Training (TVET) apprentices as part of a pilot programme implemented in partnership with Tshwane South TVET College. We also supported the Youth Employment Service Programme, engaging 62 youth participants, seven of whom were appointed to permanent positions at the CSIR.



Our investment extends beyond creating opportunities for entry into the organisation. We are equally committed to nurturing excellence by supporting the academic development of our researchers. CSIR researchers were exposed to learning opportunities with local and international peers and assignments to challenging projects under the guidance of experienced mentors.

These efforts have shaped dynamic professionals who are making an impact in their respective fields.

In this edition of *ScienceScope*, I invite you to learn from this small group, representing a cohort of about 1 500 professionals in our science, engineering and technology base. Whether you are a learner considering your future; a student pursuing a science, technology, engineering and mathematics (STEM) qualification; an educator or simply someone with an interest in science and innovation, I hope these stories inspire you to explore the possibilities that STEM careers can offer. South Africa's future innovators are among us today and perhaps your own journey could be the next story that we tell.

Dr Thulani Dlamini
CSIR Chief Executive Officer

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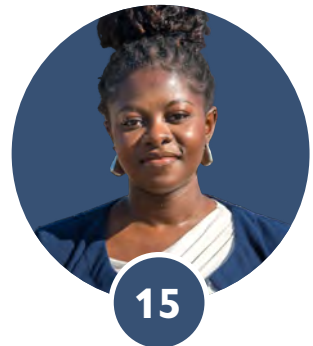
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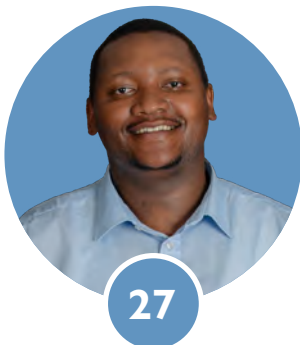
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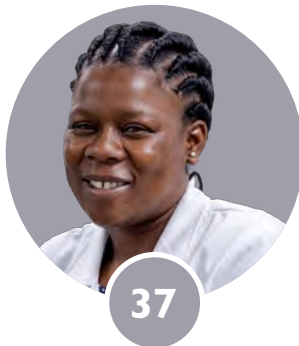


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Elna Niemann

BRIGHT MINDS. BOLD FUTURES



**METALLURGICAL
ENGINEER**
Dr Lerato Raganya



**MECHANICAL
ENGINEER**
Willis de Ronde



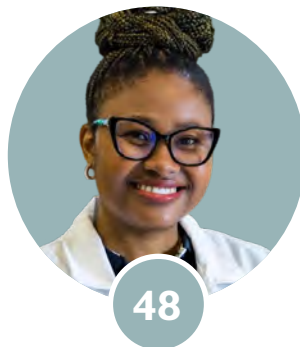
**SOFTWARE
DEVELOPER**
Safiya Turundu



CHEMIST
Dr Asanda Mtibe



**GEOSPATIAL DATA
ANALYST**
Dr Wessel Bonnet



PROCESS ENGINEER
Vuiswa Lucia Motsa



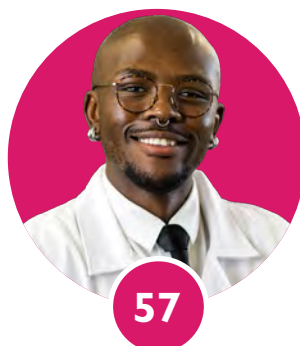
**MOLECULAR
BIOLOGIST**
Dr Sibongile Mtimka



**BIOMANUFACTURING
SPECIALIST**
Dr Veshara Ramdas



BIOENGINEER
Dr Amanda Skepu



**BIOMEDICAL
RESEARCH
TECHNICIAN**
Sizwe Tshabalala

CAREER TYPE: OCEAN MODELLER



RELATED CAREERS

- Oceanographer
- Climate scientist
- Marine data scientist
- Biogeochemical modeller
- Earth systems researcher
- Marine ecosystems researcher
- Environmental data analyst
- Aquatic scientist



ACADEMIC HISTORY

- PhD (Ocean and Atmosphere Science), University of Cape Town
- MSc (Applied Marine Science), University of Cape Town
- BSc Hons (Aquaculture), University of Limpopo
- BSc (Microbiology and Physiology), University of Limpopo



“EVERY EXPERT WAS ONCE A BEGINNER. STUDENTS WILLING TO STEP INTO UNFAMILIAR FIELDS LIKE OCEAN MODELLING SHOULD NOT BE AFRAID OF BEING BEGINNERS OR TRYING THE UNFAMILIAR TOOLS, BECAUSE THAT IS WHERE REAL LEARNING BEGINS.”



| Dr Thulwaneng Mashifane

OCEAN MODELLING AND MACHINE LEARNING FOR CLIMATE SCIENCE

Dr Thulwaneng Mashifane on how climate change is transforming the oceans we depend on

For Dr Thulwaneng Mashifane, the ocean is not just a body of water. It is a living system that shapes the planet's climate, stores carbon and influences the future of life on Earth.

Mashifane is an aquatic scientist turned ocean modeller at the CSIR-hosted Southern Ocean Carbon–Climate Observatory, which is primarily funded by the Department of Science, Technology and Innovation. “My work helps us better understand how the ocean is changing because of

climate change, and what that means for the ecosystems and the communities who depend on it,” he says.

“For the Southern Ocean, I work on improving computer models that simulate how the ocean absorbs carbon dioxide from the atmosphere. This region is very important because it removes a large amount of the carbon dioxide that drives global warming and climate change.”

This involves analysing large ocean datasets and comparing model results with observations collected from ships,



satellites and autonomous ocean instruments. By comparing models with real ocean data, he helps improve our ability to predict how much carbon the ocean will continue to absorb in the future.

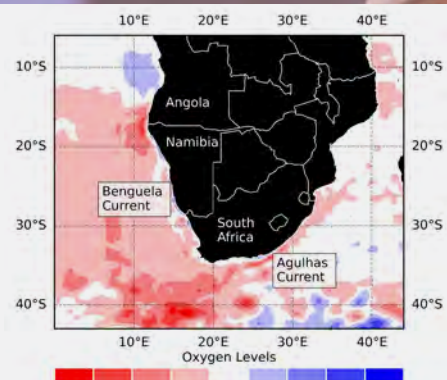
"Another project I'm working on uses machine learning to investigate why oxygen levels are declining in parts of the ocean, including the Benguela and Agulhas regions, and what this means for marine ecosystems and the ocean's role in the Earth system," he says.

"Low oxygen can harm marine life and affect fisheries that people depend on. By identifying patterns early, this work can help improve monitoring and support better planning for ocean resources."

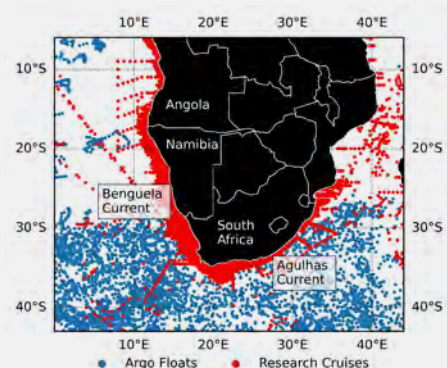
Before joining the CSIR four years ago, Mashifane's work focused mainly on freshwater aquaculture. To gain a deeper understanding of all aquatic systems, he pursued a master's degree in applied marine sciences at



Dr Thulwaneng Mashifane's subject matter: The Southern Ocean. This region is very important because it removes a large amount of the carbon dioxide that drives global warming and climate change.



Ocean oxygen trends off Southern Africa: Red areas show declining oxygen and blue areas show increasing oxygen. Widespread reddening along the Benguela and Agulhas currents points to expanding low-oxygen waters, a trend with major implications for marine life.



Where the data comes from: Blue dots show ocean-drifting Argo floats and red dots show research ship cruises off the Benguela and Agulhas current regions. Measurements like these feed machine-learning models that can help us understand and predict oxygen levels in the ocean.

(continued overleaf)



Dr Thulwaneng Mashifane, an aquatic scientist turned ocean modeller at the CSIR-hosted Southern Ocean Carbon–Climate Observatory.

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the University of Cape Town. “During my studies, I was exposed to ocean modelling for the first time, which opened up a completely new way of understanding how the ocean works and how we can simulate its behaviour.”

The idea that models and data could be used to connect physical, chemical and biological processes in the ocean drew him to the field, especially since the information could be used to solve climate change challenges and better manage marine ecosystems.

“I like working with ocean data and models because it feels like solving a complex puzzle. There are many interconnected processes, and each dataset or model experiment helps reveal a small part of the bigger picture,” he says.

He says huge gaps remain in our understanding of ocean and climate science, especially in regions like the Southern Ocean, where observations are sparse and conditions are harsh. “We’re dealing with a system that is only partially observed, highly variable in space and time, and influenced by processes that operate on very different scales.”

This means fresh talent is desperately needed in the field, and he encourages young people not to be discouraged by the complex technical environment. “A useful starting point is to lean into both curiosity and technical skills at the same time, rather than waiting to fully understand things before engaging with real data or models,” he says.

“Getting hands-on experience with real ocean data early on is especially valuable, as it reveals how complex but interesting the ocean is compared to simplified textbook examples, and builds the skills needed to work with real-world science.”

He suggests pursuing **mathematics, physical science, computer science, geography, life sciences** and learning a **programming** language like Python early on.

ENQUIRIES:

>> **Dr Thulwaneng Mashifane**

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CHEMICAL CLUES IN SOIL AND SEA DECODED

Nafisah Jacobs on laboratory testing for healthier harbours and other water ecosystems

Nafisah Jacobs performs inorganic chemistry tests on freshwater, seawater, industrial effluent, wastewater, marine sediment, soils, biological tissue and plant material. Her work as a laboratory analyst includes preparing and analysing samples for tests that measure nutrients and trace elements in environmental materials, producing accurate, reliable results that support research, industry compliance and a better understanding of the condition of natural systems.



“GOOD LABORATORY WORK
BUILDS THE FOUNDATION OF
IMPACTFUL AND SUSTAINABLE
ENVIRONMENTAL DEVELOPMENT.”

| Nafisah Jacobs

CAREER TYPE: LABORATORY ANALYST – SPECIALISING IN ENVIRONMENTAL INORGANIC CHEMISTRY



RELATED CAREERS

- Environmental chemist
- Water quality analyst
- Marine laboratory analyst
- Environmental monitoring specialist
- Analytical chemist
- Quality assurance analyst
- Laboratory technician



ACADEMIC HISTORY

- BSc (Human Life Sciences), Stellenbosch University

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Nafisah Jacobs' work demands careful handling and dependable methods because the data is often used to understand what is happening in a water system long before damage becomes visible.

"It is not as simple as putting a sample into a machine to get a number," she says. "A lot of extra work goes into producing a test result on a report and it can all be in vain if a test sample is not handled correctly."

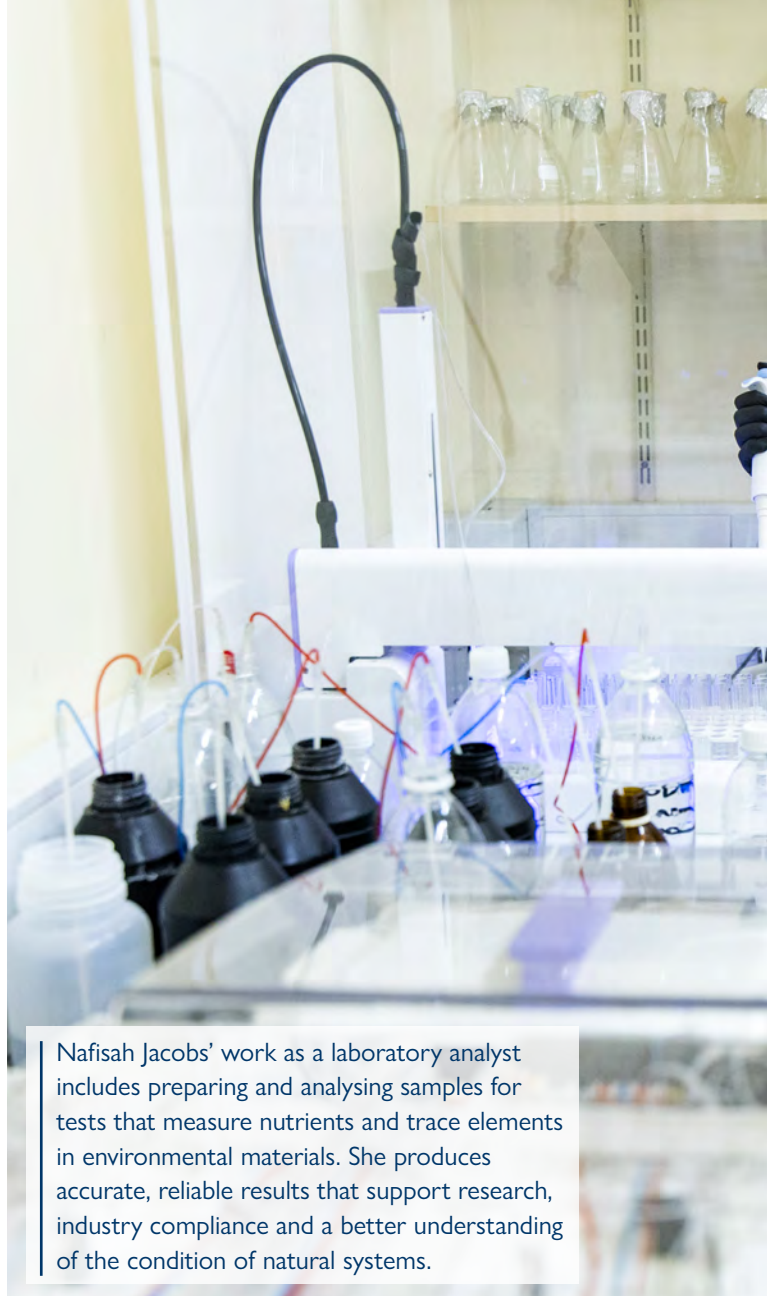
When doing trace nutrient analysis in seawater, for example, she carefully prepares samples for a range of tests using different analytical instruments. Next, she evaluates the results against quality requirements before they can be reported. "It's always exciting to see how the results reveal patterns according to the location of the samples taken," she says. "For example, our beaches, ports and harbours each tend to have particular nutrient profiles due to the surrounding discharge into the seawater. One location would have a high ammonia profile, whereas another would have ammonia and nitrate ranging in similar concentrations."

Jacobs was one of only 16 participants from various countries selected for specialised training in Monaco to improve mercury analysis. Mercury can enter rivers and coastal waters through mining waste, industrial activities or acid mine drainage. Once in the environment, it can accumulate in sediments and living organisms, posing risks to ecosystems and human health. The lab team is working towards contributing to global efforts to standardise mercury testing to protect both environmental and human health.

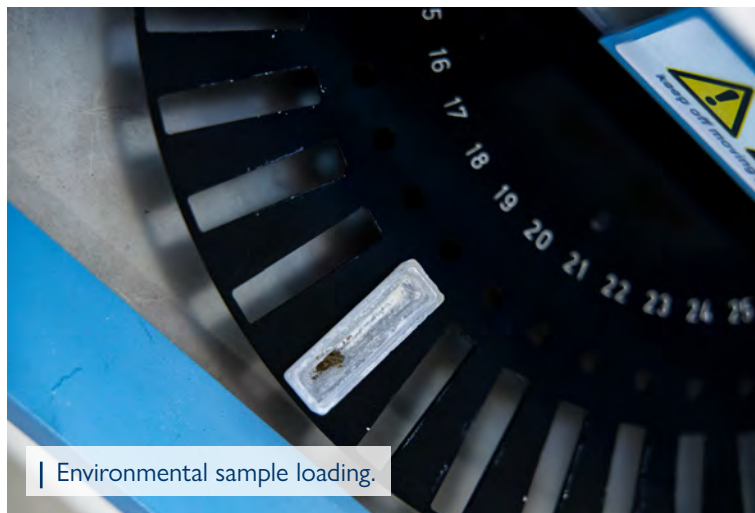
Besides mercury testing, Jacobs' work helps researchers monitor the condition of seas, harbours and other water systems and contributes to sustainable ecosystem rehabilitation.

She says laboratory data can also help businesses remain compliant with environmental safety regulations and standards that affect agriculture and food sectors, and it feeds into decisions about pollution risks, wastewater systems and how to manage sensitive aquatic environments.

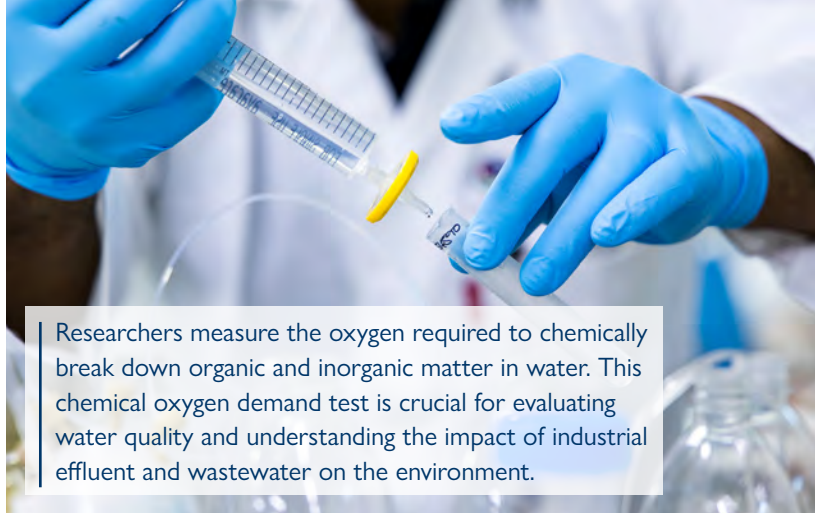
Growing up, Jacobs was always fascinated by the way chemistry explained many ordinary experiences, from



Nafisah Jacobs' work as a laboratory analyst includes preparing and analysing samples for tests that measure nutrients and trace elements in environmental materials. She produces accurate, reliable results that support research, industry compliance and a better understanding of the condition of natural systems.



Environmental sample loading.



Researchers measure the oxygen required to chemically break down organic and inorganic matter in water. This chemical oxygen demand test is crucial for evaluating water quality and understanding the impact of industrial effluent and wastewater on the environment.

the bubbles in a soft drink and rising bread dough to the way medicines help people recover when they are sick. Leadership camps and internships helped her explore where she might find the best fit in science, and her parents made sure she attended as many university open days as possible while she was still at school.

She was awarded early acceptance with a bursary at Stellenbosch University, where she completed a degree in human life sciences. After that, she joined the CSIR's environmental water laboratory in Stellenbosch through an in-service internship from the Department of Science, Technology and Innovation. A year of training led to a permanent position as a laboratory analyst, and in 2023, she expanded her role further by becoming a technical signatory (a person with the authority to sign off on laboratory reports).

She says knowing how a simple chemical test may affect her surroundings and people's daily lives gives her work meaning and perspective, and keeps her motivated. "My work directly and indirectly impacts the environment and wellbeing of others."

For learners interested in a similar career, Jacobs recommends getting as much exposure as possible through internships, voluntary work and conversations with people already in the field. She says laboratory work calls for patience, perseverance and strong problem-solving skills. At school, she recommends focusing on **life sciences, physics and chemistry**.

ENQUIRIES:

>> **Nafisah Jacobs**

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CAREER TYPE: RESEARCH ARCHITECT



RELATED CAREERS

- Architect
- Urban designer
- Built environment researcher
- Spatial planner
- Sustainable settlements specialist



ACADEMIC HISTORY

- PhD (Architecture) *in progress*, University of the Witwatersrand
- MSc (Applied Science in Architecture), University of Pretoria
- BSc Hons (Applied Science in Architecture), University of Pretoria
- BAS (Architectural Studies), University of the Witwatersrand
- Higher Certificate in Accelerated Management Leadership, Wits Business School



“ARCHITECTURE HAS THE POWER TO TURN IDEAS INTO REALITY. THE SPACES WE CREATE INFLUENCE HOW PEOPLE LIVE, WORK, LEARN AND CONNECT, BOTH NOW AND IN THE FUTURE.”



| Tinashe Dube

BEYOND THE DRAWING BOARD: SCIENCE-BASED BUILDING DESIGN

Tinashe Dube on smart architecture for housing, science centres and taxi ranks

As a research architect at the CSIR, Tinashe Dube investigates how buildings, neighbourhoods and public spaces can be improved through practical, science-based interventions in the built environment.

“At any given time, I can be working on a project related to housing, sustainability, public transport or building performance,” she says.

For example, she is currently testing an emergency housing prototype to help people in times of crisis, such as displacement during floods. Previously, she helped

develop design standards for public transport facilities as part of the *Taxi Ranks of the Future* project. The aim was to create taxi ranks that are safer, easier to navigate, more efficient and better connected to modern technology.

“With these projects, we use research to develop practical, sustainable solutions that work for people today, while helping prepare our cities and communities for the future,” she says.

Another highlight is a citizen science project at the Albertina Nontsikelelo Sisulu Science Centre in Cofimvaba, Eastern Cape, where she works with high school learners



Grade 11 and 12 learners from Saint James High School and Cofimvaba Secondary School, both within walking distance of the net-zero Cofimvaba Science Centre in the Eastern Cape (top), use tablets to score the building's thermal comfort levels. The CSIR uses data from this citizen science project to monitor the real-time performance of the building from Pretoria.

to monitor how well the building's green design is working to promote comfort, health, wellbeing and learning.

"The learners come and check the data points, especially around temperature control," she says. "This being a rural area, there's a different sort of knowledge the inhabitants have just from living here. So, they'll be able to bring new learnings, new understandings and new applications of what we can do with building monitoring."

Dube's own journey into architecture began early. "I was first inspired to join the construction field while taking part in a mission trip in Grade 9," she says. Together with a group of university students, she helped build seven structures, including schools and community facilities in rural Mozambique, using an innovative building technology that allowed construction to happen much faster than traditional methods.

"As someone who was both creative and practical, I was fascinated by the process and realised that architecture

would allow me to combine design, problem-solving and real-world impact." She stayed involved in the project for more than 10 years, moving from volunteer to leadership roles and gaining exposure to many design-build projects across southern Africa.

"Interestingly, nearly twenty years later, I now work on projects such as the STI4SHS Roadmap, where I once again engage with innovative construction technologies and sustainable building solutions, bringing my career full circle." STI4SHS is an abbreviation for Science, Technology and Innovation for Sustainable Human Settlements.

Dube studied architecture at the University of the Witwatersrand but felt she did not fit the typical mould of an architect after twice being rejected for postgraduate programmes.

Instead, she pursued an honours degree and later a master's degree in applied science in architecture at the University of Pretoria, where she explored how buildings

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shape everyday life through architecture, research and social science perspectives. Later, a scholarship through a partnership between the University of the Witwatersrand and the Technical University of Berlin, Germany, helped strengthen her writing and research skills and her ability to connect research, policy and design in new ways.

Since joining the CSIR in 2023, Dube has enjoyed working closely with government and industry, seeing the impact of her work beyond a single building or project, directly on decisions at municipal, provincial and even national levels.

For learners considering research architecture as a career, she recommends strong foundational subjects such as **mathematics, physical sciences, geography, accounting and computer studies**, while noting that **technical drawing, engineering graphics and design, art or design** can also be useful.

“Design things and build them whenever you can, whether that’s furniture, small structures or even working on a construction site,” she says. “Don’t wait for university to start experiencing the practical side of the profession.”

ENQUIRIES:

>> **Tinashe Dube**
tdube2@csir.co.za



CSIR senior researcher Tinashe Dube (front row, second from left) visited Panama in March 2026 to learn about the circular economy and addressing the challenges of transformation in urban waste management.



Tinashe Dube is part of a research team that is currently testing an emergency housing prototype such as this one to help people in times of crisis, for example, in times of displacement during floods.

RELIABLE POWER SYSTEMS FOR A CHANGING ENERGY FUTURE

Fiona Oloo on renewable energy, microgrids and clean electricity at scale

For Fiona Oloo, energy sits at the centre of modern economic activity, infrastructure, healthcare and even basic quality of life. That belief shapes her work as an energy systems researcher at the CSIR, where she applies her background in electrical engineering to renewable energy, especially solar photovoltaics (PV) and batteries.

“THE LACK OF ACCESS TO ELECTRICITY IN MANY PARTS OF THE WORLD, PARTICULARLY AFRICA, IS WHAT DRIVES ME TO USE MY SKILLS TO INNOVATE IN THIS SPACE AND FIND SOLUTIONS THAT BENEFIT SOCIETY.”



| Fiona Oloo

CAREER TYPE: ENERGY RESEARCHER



RELATED CAREERS

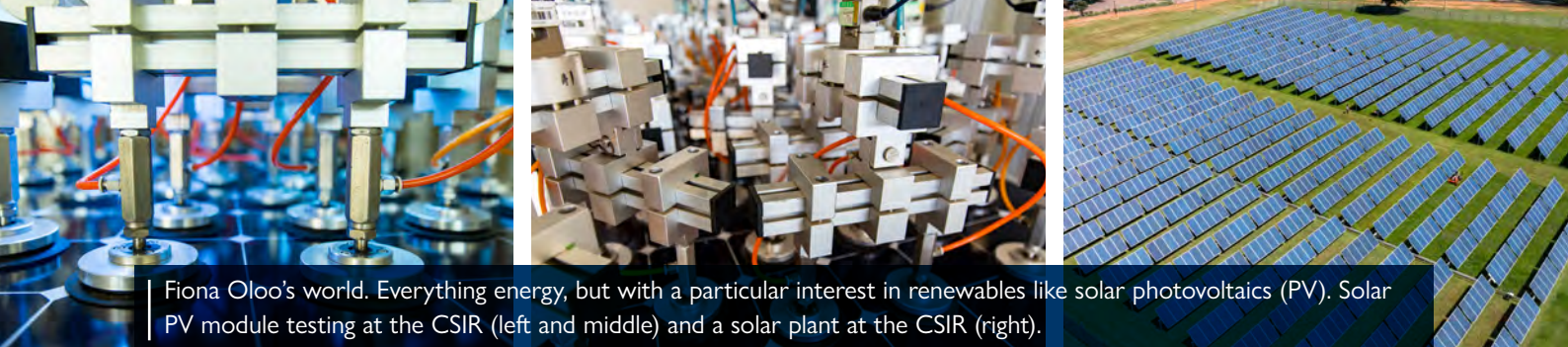
- Electrical engineer
- Power systems engineer
- Renewable energy specialist
- Microgrid engineer
- Energy analyst
- Grid integration specialist
- Energy consultant
- Systems modeller



ACADEMIC HISTORY

- MSc (Engineering Management), University of the Witwatersrand
- BSc Hons (Electrical Engineering), University of the Witwatersrand
- BEngSc (Biomedical Engineering), University of the Witwatersrand

(continued overleaf)



Fiona Oloo's world. Everything energy, but with a particular interest in renewables like solar photovoltaics (PV). Solar PV module testing at the CSIR (left and middle) and a solar plant at the CSIR (right).

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"My job is to study and design how electricity flows through the power grid so that power stays reliable, stable and efficient even as new energy sources are added," says Oloo.

Her day-to-day work involves analysing power systems to understand how the grid behaves as more renewable energy and battery storage are integrated. She builds and runs simulation models, assesses system stability and system performance and translates those results into practical recommendations.

She works across the full project cycle, from feasibility studies and technical design to stakeholder engagement, helping utilities, developers and funders deliver projects that are technically sound and meet system needs.

Oloo currently focuses on microgrids, which are small, self-sufficient electrical networks. "I validate how these systems will perform under real-world conditions, using real-time simulation," she says. "This helps reduce technical risk and improve the reliability and performance of microgrid designs before they are deployed."

Another aspect of her work deals with distribution pricing and network cost signals. Here, she analyses how electricity is used across the network and how increasing embedded generation close to the customer side, like solar PV, can affect the cost and use of distribution infrastructure.

"This informs more efficient and fair pricing structures that reflect the true cost of supplying electricity under changing grid conditions." As the energy system decentralises, this work helps direct infrastructure investment where it is needed while supporting cleaner energy.

Oloo began her career journey by studying biomedical engineering at the University of the Witwatersrand in 2014, fascinated by the human body and how technology can contribute to devices and systems to assist in

healthcare. She later moved into electrical engineering, specialising in heavy current, and completed both degrees within five years. After joining the CSIR in 2019 through its Graduate-in-Training Programme, she rotated through several divisions before finding her place in the CSIR Energy Research Centre.

In 2025, she completed a master's degree in engineering management with distinction at the University of the Witwatersrand. This gave her broader insight into the business world, including engineering economics and strategic management, and helped her relate those areas to her current work.

Oloo says the world is now moving towards smarter, more dependable energy systems. "The future of energy is about creating reliable, intelligent power systems that make clean electricity both possible and dependable at scale."

Her advice to those wishing to enter the field is to stay curious about how other fields connect and to work with other experts. "Always try to approach a problem with the thinking that you are part of a solution, not the whole solution," says Oloo.

"Your skillset is your greatest investment and growing it will always be an asset in your career," she adds. "Attend industry events as much as possible and don't be afraid to be visible often and early in your career."

She recommends **mathematics and physical sciences** at school, with **computer science** becoming increasingly important as the industry moves towards more data-driven and simulated environments.

ENQUIRIES:

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BUSY LITTLE ALGAE SWEEP SEWAGE FROM OUR PONDS

Dr Luyanda Ndlela nurtures microbe “pets” that heal nature and clean water

“WATER IS LIFE AND ANY WORK
IN PRESERVING, TREATING AND
UNDERSTANDING IT LEAVES A
GENERATIONAL INHERITANCE
– A CLEAN AND HEALTHY
ENVIRONMENT ALLOWS FOR
HEALTHY COMMUNITIES.”

Dr Luyanda Ndlela cultivates a special algal mix for wastewater ponds in Mossel Bay. When the algal mix grows, it outcompetes harmful organisms like *E. coli* bacteria and absorbs unwanted nutrients from sewage.

CAREER TYPE: WATER QUALITY SCIENTIST



RELATED CAREERS

- Microbiologist
- Environmental microbiologist
- Aquatic scientist
- Phycologist
- Environmental biotechnologist
- Wastewater treatment specialist
- Limnologist
- Ecotoxicologist
- Bioprocess scientist
- Environmental health scientist



ACADEMIC HISTORY

- PhD (Zoology), Stellenbosch University
- MSc (Microbiology), University of KwaZulu-Natal
- BSc Honours (Microbiology), University of KwaZulu-Natal
- BSc (Microbiology and Plant Pathology), University of KwaZulu-Natal

(continued overleaf)

Dr Luyanda Ndlela works where water, science and everyday life meet. As a senior researcher in the CSIR's Water Research Centre, she tests water quality and develops treatment solutions that help provide clean water to communities while improving environmental health.

"I work in the laboratory testing water samples, growing algae and bacteria, and planning experiments. I also manage research projects and the activities around them," she says.

Much of her current work focuses on water treatment technologies using algae and bacteria, but she is also becoming increasingly interested in understanding where and how people get water when the taps run dry.

Her route into microbiology began with a very personal teenage problem. In Grade 10, suffering from severe acne,

she saw an advert in which a microbiologist explained how a skincare product removed bacteria for "flawless skin". She looked up the word "microbiology" in a dictionary and decided this was her path to clear skin.

"So, pimples got me into this field, but the love of environmental microbiology made me stay," she quips.

Ndlela completed a BSc in microbiology and plant pathology, followed by honours and master's studies focused on sourcing enzymes from herbivore faeces that could be used to break down waste naturally. She later joined the CSIR through the World Wide Fund for Nature South Africa's Environmental Leaders Programme, where she worked on water ecosystems and human health.

She went on to complete a PhD focusing on the biological control of cyanobacteria (blue-green algae) and ecotoxicity, followed by postdoctoral research on antimicrobial resistance and water treatment technologies.

After 13 years at the CSIR, Ndlela has seen that water treatment and scarcity are challenges felt by many communities and industries, and that removing contaminants through cost-saving, environmentally feasible technologies can help address these pressures. She is currently cultivating a special algal mix for wastewater ponds in Mossel Bay. When the algal mix grows, it outcompetes harmful organisms like *E. coli* bacteria and absorbs unwanted nutrients from sewage.

"The algae are naturally occurring biomass, so we are using nature to heal itself," she says.



SCAN TO WATCH



The CSIR's Dr Luyanda Ndlela monitors wastewater treatment ponds in which a special combination of *Chlorella* algae has been introduced to clear contaminants.



CSIR researchers demonstrated pond species diversity to Nelson Mandela University students at the Mossel Bay Wastewater Treatment Works as part of the nature-based solutions project. During the practical, the participants recorded the amount and prevalence of macrofauna in the water, serving as indicators of water quality and ecosystem diversity.

"Because we work with microorganisms, you sometimes literally cannot see them. Quantifying the importance and contribution of the invisible can feel abstract at times, especially when they are living organisms that we spend days and nights tending to. But they are like my little pets, and I get a thrill when my experiments work!"

Her advice to learners is simple: stay curious, go the extra mile and do not lose interest in the basics. **Mathematics and natural science** provide a strong starting point, and, like using natural algae to treat sewage, she says, "the best innovations are sometimes the simplest."

ENQUIRIES:

>> **Dr Luyanda Ndlela**

Indlela@csir.co.za

CAREER TYPE: ECOLOGIST



RELATED CAREERS

- Restoration ecologist
- Biodiversity specialist
- Environmental policy researcher
- Ecosystem services scientist
- Sustainability researcher
- Environmental planner
- Natural resource management specialist



ACADEMIC HISTORY

- PhD (Conservation Ecology), Stellenbosch University
- MSc (Ecology), University of Pretoria
- BSc Hons (Zoology), University of Pretoria
- BSc (Zoology), University of Pretoria

“WE ONLY HAVE ONE PLANET, AND WE NEED TO SAVE IT FROM TOTAL COLLAPSE. ENCOURAGINGLY, THE TIDE MAY BE TURNING, ESPECIALLY WITH THE YOUNGER GENERATION BECOMING MORE ENVIRONMENTALLY CONSCIOUS.”

| Dr Phumza Ntshotsho

FROM TRANSKEI TO THE GLOBAL BIODIVERSITY STAGE

Dr Phumza Ntshotsho on leaving behind a habitable planet

“Planet Earth is in danger, and there is no planet B,” says Dr Phumza Ntshotsho, an ecologist at the CSIR. “My job is to understand the causes of the deteriorating health of the natural environment and to work with decision makers to design and implement solutions to this problem.”

She calls this “action research”, meaning she co-designs environmental interventions based on science alongside communities, government, industry and other role players.

A current initiative she is working on is a multi-institutional collaboration to improve access to safe drinking water for rural households in the Umzimvubu and Thukela catchments in the Eastern Cape and KwaZulu-Natal provinces. The project brings together traditional authorities, municipal officials and relevant government departments to co-develop practical strategies to improve and holistically manage the natural springs on which the communities depend for their daily water needs.

“I’ve always loved nature,” she says. “Growing up in a rural village and developing a personal connection with Mother



Earth made the decision to become an ecologist a no-brainer." She headlines her personal journey as follows: "A 17-year-old rural girl from the Transkei hinterland goes to the capital city of South Africa and ends up on the world stage."

That world stage refers to her prominent contributions to international efforts to prevent biodiversity loss and ecosystem degradation, and to protect ecosystem services. Her work helps governments understand what is happening to nature and why it matters to people.

She is currently preparing for the 17th Conference of the Parties to the United Nations Convention to Combat Desertification, which will focus on restoring rangelands and natural pastures. The conference is considered the top international decision-making body on this topic.

Ntshotsho is also contributing as a South African expert to the Intergovernmental Science-Policy Platform on



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Dr Phumza Ntshotsho is an ecologist and a CSIR senior researcher who believes that it is in the hands of the current generation to leave a habitable planet for future generations.

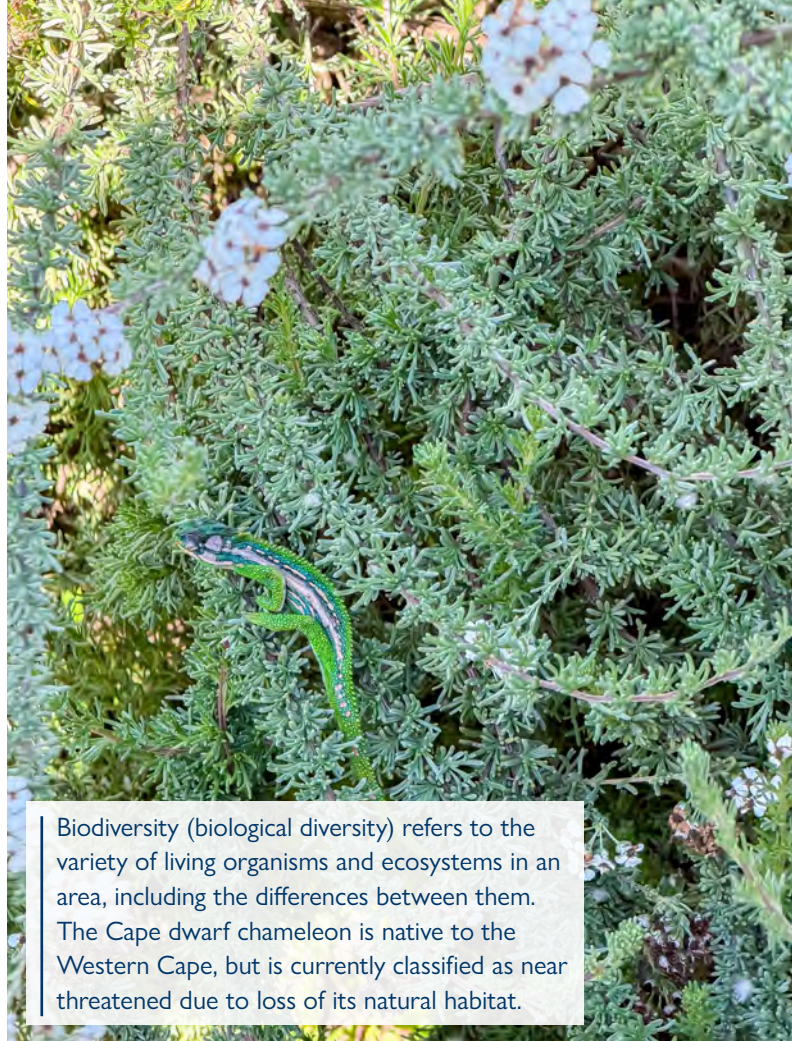
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Biodiversity and Ecosystem Services' second global assessment, in support of the national Department of Forestry, Fisheries and the Environment.

"My day-to-day work involves reading ...a lot... to make a meaningful contribution," she says. "Translating research findings into policy recommendations helps decision-makers implement impactful and evidence-based solutions."

She studied zoology at the University of Pretoria, where she completed her undergraduate, honours and master's degrees, before enrolling for a PhD in conservation ecology at Stellenbosch University through a CSIR studentship. She has been with the CSIR ever since, rising through the ranks from student to senior researcher.

In her role, she enjoys interacting with people who are equally passionate about leaving a habitable planet for future generations. "Fixing the dire state of our planet



Biodiversity (biological diversity) refers to the variety of living organisms and ecosystems in an area, including the differences between them. The Cape dwarf chameleon is native to the Western Cape, but is currently classified as near threatened due to loss of its natural habitat.

requires substantial funding, but sadly," she cautions, "when times become tough and austerity measures are implemented, research on environmental issues is invariably one of the first casualties."

She advises aspiring ecologists to find someone who is a leader in the field. "Work with them, ask questions; I couldn't have gotten to where I am today without the help of experienced and kind leaders. These were people who saw my potential and encouraged me to reach for the stars."

School subjects that were essential to her career, says Ntshotsho, were **English, mathematics, biology, physics and geography.**

ENQUIRIES:

>> **Dr Phumza Ntshotsho**

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HOW TO PREPARE PORTS FOR THE POWER OF THE OCEAN

Rosco Platen on how new infrastructures are modelled and tested to resist mother nature

In the southern hemisphere's largest physical model hydraulic facility, Rosco Platen makes waves for a living. It is his job to make sure a harbour or marine infrastructure model, built to scale at the CSIR's Coastal Engineering and Port Infrastructure (CEPI) model hall in Stellenbosch, mimics the forces and complex behaviour of coastal waters in the real world.

A photograph of Rosco Platen, a man with a tattoo on his right arm, wearing a yellow safety vest and blue work pants. He is kneeling on a large pile of colorful (blue, green, and grey) plastic armour units used in hydraulic modeling. He is holding a small blue and red object in his hands. The background shows a large industrial facility with high ceilings and various equipment.

"I MAKE WAVES FOR A LIVING. AND I WATCH THEM. NOT MANY CAN SAY THIS, THAT'S HOW NICHE WE ARE."

| Rosco Platen

| Rosco Platen places armour units prior to a harbour breakwater test.

CAREER TYPE: COASTAL ENGINEERING TECHNICIAN



RELATED CAREERS

- Civil engineering technician
- Laboratory technician
- Hydraulic modelling technician
- Laboratory technologist
- Instrumentation technician
- Engineering operations technician
- Port infrastructure technologist



ACADEMIC HISTORY

- NDip (Building and Civil Studies) *in progress*, College of Cape Town (TVET)
- N1-N5 (Building and Civil Studies), Northlink College (TVET)

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“Our facility allows engineering consultants and contractors to test their existing or new design first before it is constructed or modified in reality,” he says. “The ocean has different water depths and seabed features, wave directions, wave regimes and various natural intricacies that can only be physically modelled. These tests show whether a structure will hold up to mother nature before anything is built at full scale.”

In a recent project, Platen and his co-workers tested concrete armour units designed to reduce the energy of waves entering ports and harbours. They simulated different storm conditions and tracked the movement of the units afterwards to assess possible damage.

“Our national ports are the country’s biggest source of imports and exports. If they are damaged, the economy will feel its effects,” he says. “So, the designs we test mitigate damage and wave energy from entering ports, especially from severe storms.”

Platen’s day-to-day work includes maintaining the facility, guiding the technical team, working from plans and diagrams, and sometimes travelling to field sites around South Africa. He also tests, calibrates and troubleshoots specialised instruments like the renowned wavemakers and various probes used to record different project parameters.

A new project he is working on, for example, involves a newly built wave flume (a long, narrow, enclosed tank of water equipped with a mechanical wavemaker), where Platen’s team will need to use a pressure sensor in a way the team has not tried before. “In my time here, it has not been done,” he says, “so once we learn it, it’s something to add to my skillset.”

This project is important because this newly constructed flume will be used to stress test marine structures, simulate storm events, and study sea-level rises to help the maritime industry and African port authorities adapt to climate change.

“We need to study our oceans and dams. Water is life.”

Platen’s job often takes him out into the field, where he gets to see the impact his work makes on water infrastructure.



Rosco Platen works on a wave probe and control box calibration.



Researchers at the CSIR’s Coastal Engineering and Port Infrastructure model hall in Stellenbosch conduct physical modelling to optimise marine structures.

“I worked a couple of jobs in my early 20s, and I was quite lost in terms of what I wanted to do as a career,” he says. At 27, he enrolled at Northlink College, a technical vocational education and training college in Belhar in the Western Cape, where he studied building and civil engineering. After studying through the disruptions of Covid-19, and working factory and general jobs, he got the call that brought him to the CSIR in 2022.

For young people thinking about pivoting their careers in a similar way, he recommends immersing oneself in instrumentation and electronics. “And practice working with your hands,” he says. “Find a subject that genuinely interests you and be a good problem solver. I feel this is an underrated skill.”

At school, he suggests taking **mathematics, physics, business studies** and **engineering graphics and design** (formerly known as technical drawing) to help with both the technical and administrative sides of the work.

ENQUIRIES:

>> Rosco Platen

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FROM WILDFIRE MAPS TO COASTAL WARNINGS AND FISHING ADVICE

Lufuno Vhengani transforms satellite data into environmental tracking tools

Lufuno Vhengani is a space scientist in the broadest sense. He turns data from satellites orbiting the Earth into useful tools that can pinpoint the location of coastal oil spills or invasive plants, or monitor sea surface temperatures and harmful algal blooms.

“EARTH OBSERVATION SCIENCE IS NOT JUST ABOUT DATA, IT IS ABOUT USING THAT DATA TO MAKE A REAL IMPACT ON CLIMATE CHANGE, DISASTER MANAGEMENT AND SUSTAINABLE USE OF OUR NATURAL RESOURCES.”

| Lufuno Vhengani



CAREER TYPE: EARTH OBSERVATION TECHNOLOGIST



RELATED CAREERS

- Remote sensing specialist
- GIS specialist
- Geospatial software developer
- Earth observation scientist
- Spatial data analyst
- Back-end software developer



ACADEMIC HISTORY

- MSc (Satellite Remote Sensing), Pierre and Marie Curie University, France
- Postgraduate Diploma (Electrical Engineering), Stellenbosch University
- BSc Honours (Physics), University of Venda

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Remote sensing specialists like Lufuno Vhengani use satellite data to create maps such as this one. It informs users, including abalone farmers, about harmful algal blooms in coastal waters.

(continued from page 25)

“Satellites capture images of the Earth and its systems, but it is the scientist who transforms that data into meaningful and useful information,” he says.

“In my work, I automate processes to get the data, process it, analyse it and store it so that users don’t have to; we provide the information products they can use directly to make decisions.”

After graduating with a BSc degree in mathematics, physics and mathematical statistics in the early 2000s, the Soweto-born technician ventured into electronics engineering. He joined the Institute of Satellite and Software Application (ISSA) to study further.

“ISSA was an initiative of the former Department of Communication and they sponsored students from former disadvantaged universities to study further in engineering and information and communication technology,” he says. During a training session as part of a post-graduate diploma at Stellenbosch University, he was among those who raised their hands to change their career trajectories to remote sensing.

In 2007, a few years after completing a specialist diploma in France, Vhengani joined the CSIR. Many colleagues think of him as a developer because he’s a self-taught software developer, but he’s quick to correct the misconception. “What I really am, is a remote sensing specialist who tries to automate things using the Python programming language,” he says.

He also develops the linking software (Application Programming Interfaces or APIs) used to feed useful remote sensing data into easy-to-use applications for decision-makers.

Today, his work supports fisheries and aquaculture. “Fishermen use our information tools to know where to fish, while our aquaculture sector uses them to make sure that their animals are safe from harmful algal blooms,” he says. This work forms part of South Africa’s National Oceans and Coastal Information Management System (OCIMS).

Earlier in his career, Vhengani made a name for himself in the earth observation community by using satellite data to map areas burnt by wildfire. His work eventually fed into the Advanced Fire Information System (AFIS) tool, which is very useful in a region like South Africa, where wildfires have a big impact on forestry and grasslands and can cause major harm to infrastructure, homes, people and animals.

Vhengani says this field is ever-changing with new technologies becoming available to streamline his work, which also creates opportunities for new skills. “The challenges we tackle cannot be solved by a single individual since they require collaboration across multiple disciplines.”

Vhengani says learners and students who are thinking of a career in Earth observation should build a strong foundation in **mathematics, science and technology**. “Skills in areas such as GIS, remote sensing, data analysis and computer programming are essential.”

ENQUIRIES:

>> Lufuno Vhengani

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USING LIGHT TO BUILD SMARTER INDUSTRIES

Dr Lebohang Bell on building laser technologies for medical and manufacturing sectors

“WHAT KEEPS ME MOTIVATED IS KNOWING THAT RESEARCH AND INNOVATION CAN CREATE TECHNOLOGIES THAT IMPROVE INDUSTRIES, DEVELOP SKILLS AND INSPIRE THE NEXT GENERATION OF SCIENTISTS AND ENGINEERS.”

| Dr Lebohang Bell



CAREER TYPE: PHYSICIST



RELATED CAREERS

- Laser physicist
- Applied physicist
- Photonics researcher
- Optical engineer
- Laser systems specialist
- Beam shaping specialist
- Additive manufacturing scientist
- Photonic device developer
- Optics scientist



ACADEMIC HISTORY

- PhD (Physics), University of KwaZulu-Natal
- MSc (Physics), University of KwaZulu-Natal
- BSc Hons (Physics), University of KwaZulu-Natal
- BSc (Computational Physics), University of KwaZulu-Natal

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As a trained physicist, the CSIR's Dr Lebohang Teboho Bell develops laser systems and laser beam shaping technologies for material analysis, diagnostics, 3D metal printing and precision laser processing.

"My job involves designing laser systems, solving technical problems and creating new ideas that can improve manufacturing, measurement systems and optical technologies," he says.

He also writes research papers, patents and technical reports, supervises students and trainees, attends research meetings and collaborates with local and international researchers.

Bell's path into the field started with an undergraduate degree in computational physics at the University of KwaZulu-Natal, where he developed strong skills in mathematics, programming and scientific modelling. He became laser-focused after visiting the CSIR as a vacation work student in 2013, where he was exposed to real-world research in photonics and advanced laser technologies for the first time.

In 2014, he joined the CSIR as a PhD studentship researcher, and that experience jump-started his drive to develop technologies that could benefit South Africans.

He continued specialising in experimental laser physics and photonics during his postgraduate studies. Over the years, he progressed into a senior researcher role, where he now works on laser development, beam shaping technologies and industrial laser applications.

"What I enjoy most is the opportunity to solve complex problems and develop new technologies that can have a real-world impact," he says. He also thrives on mentoring students and seeing research ideas grow into working systems, scientific publications, or real-world industrial solutions.

Bell says laser diagnostics and beam shaping technologies can improve manufacturing quality, efficiency and precision in industries such as aerospace, mining, energy and advanced manufacturing. They can also reduce material

waste, improve production processes and support the development of smarter and more sustainable industrial systems.

But, he says, anyone entering the field should be aware that research and technology development requires a lot of patience, testing and problem-solving behind the scenes. "Experiments can take weeks or months to optimise, and researchers often have to balance technical work, funding applications, project deadlines and scientific publishing."

His advice to young people still at school is to build a strong foundation in **mathematics, computer science and physical sciences**, while developing problem-solving and analytical thinking skills.

He encourages learners to embrace programming and digital technologies, as modern scientific research increasingly relies on computer modelling, simulations, data analysis and automation. "The ability to think critically, solve problems and adapt to new technologies is just as important as academic knowledge," he says.

"Ask questions and take opportunities such as laboratory work, vacation work, internships and research projects seriously. Most importantly, stay patient and persistent, because research and innovation take time, but continuous learning and hard work can open many opportunities locally and internationally."



Dr Lebohang Bell inspects optical components used in laser diagnostics, beam shaping and advanced photonics research.

ENQUIRIES:

>> **Dr Lebohang Teboho Bell**

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MAKING RADARS FOR DRONES TO KEEP WATCH

Dr Ciara Blaauw on sensors for service delivery, security and stewardship



“WE DEVELOP RADAR TECHNOLOGY THAT HELPS PEOPLE MAKE BETTER DECISIONS. OUR SENSORS PROVIDE INFORMATION EVEN IN CHALLENGING CONDITIONS SUCH AS AT NIGHT, WHEN IT IS DARK, THROUGH CLOUD COVER, OR EVEN THROUGH SMOKE.”



| Dr Ciara Blaauw



CAREER TYPE: ELECTRONIC ENGINEER, SPECIALISING IN RADAR



RELATED CAREERS

- Radar systems engineer
- Remote sensing engineer
- Signal processing engineer
- Aerospace systems engineer
- Defence technologist



ACADEMIC HISTORY

- PhD (Electronic Engineering), University of Pretoria
- BEng Honours (Electronic Engineering), University of Pretoria
- BEng (Electronic Engineering), University of Pretoria

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Dr Ciara Blaauw is one of the technical leads in a CSIR team developing airborne synthetic aperture radar (SAR) systems that can create detailed images of Earth's surface for applications as diverse as mining, security and precision agriculture. These advanced sensors can be mounted on aircraft, unmanned aerial vehicles (UAVs) like drones, and even spacecraft.

Unlike optical cameras, radar does not rely on sunlight. It can "see" through obscurants like clouds, smoke and rain, detecting subtle changes in the landscape over time. SAR works by transmitting radio waves towards the Earth and measuring the signals that bounce back.

"Synthetic aperture radar gives us the ability to see when other sensors cannot, day and night and in any weather," she says. This makes SAR a powerful tool for monitoring farms, dams, railways and borders. It can also support search and rescue efforts or help officials assess flood and fire damage when visibility is poor.

Blaauw's work spans the full life cycle of a technology project. "This includes meeting with clients to understand their needs, helping to design and develop solutions, testing systems in the laboratory, planning and conducting flight campaigns to collect SAR data using the radar systems mounted on aircraft, as well as analysing and processing the data," she says.

"I enjoy working with cutting-edge radar systems and helping to develop new technologies and applications that push the boundaries of what is possible. One area that particularly excites me, and that we are starting to pursue, is using artificial intelligence and machine learning to automate data processing to extract useful information more quickly and accurately."

Encouraged early on by her parents, she was drawn to electronic engineering because it combined creativity, science and technology. She says she was always curious about how things worked and enjoyed solving problems.

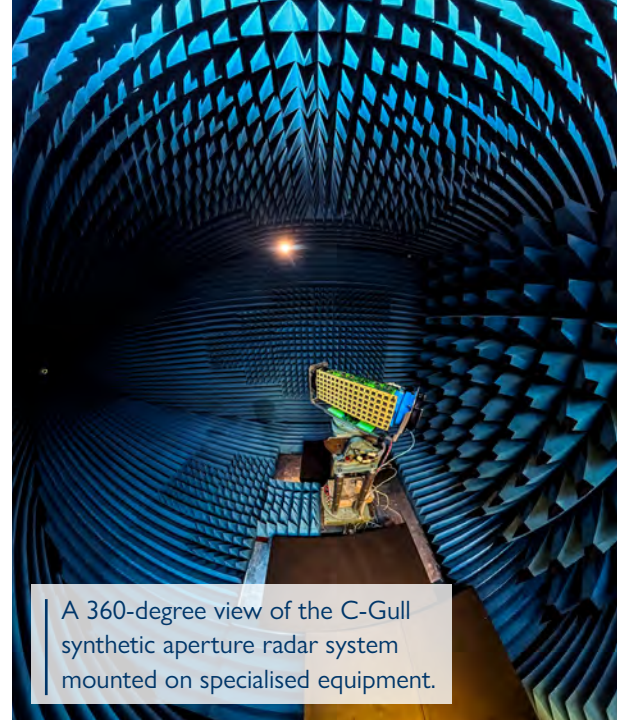
She earned a bursary from the CSIR and studied electronic engineering at the University of Pretoria, gaining practical experience at the CSIR during university



CSIR engineers prepare to mount a compact, synthetic aperture radar system known as C-Gull onto a drone. From left, Dr Ciara Blaauw, CSIR principal engineer, Hebert Tema, CSIR engineer, Katlego Mosito, CSIR senior engineer and Reev Dass, CSIR engineer.



The CSIR-developed C-Gull synthetic aperture radar system.



A 360-degree view of the C-Gull synthetic aperture radar system mounted on specialised equipment.

She says these developments build on years of sustained research and development efforts focused on making advanced SAR technology and capabilities more accessible to civilian users and organisations in developing economies.

Blaauw also played a key role in the performance modelling of the first South African-designed spaceborne SAR system.

“Many people only see the final technology and not the years of research, testing and problem-solving that happen behind the scenes,” she says. “Developing advanced engineering systems requires patience, perseverance and teamwork, and there are often setbacks and failures before a successful solution is achieved.”

While engineering and technology fields can be challenging, she says young people should not underestimate themselves and will reap rewards for their curiosity and creativity. “You can achieve more than you may think; keep learning and say ‘yes’ to new experiences.”

At school level, she recommends focusing on **mathematics and natural science**, as well as **advanced mathematics** for an extra advantage.

vacations. After completing her undergraduate degree, she joined the organisation as a student researcher while continuing with postgraduate studies. In 2018, she completed a PhD in electronic engineering, specialising in electromagnetics, and later became a full-time engineer. Over the last decade at the CSIR, she progressed through technical and leadership roles to become a principal engineer and one of the leaders of the airborne SAR team.

Blaauw and her team are currently preparing for flight campaigns with an advanced airborne SAR system designed for foliage penetration applications, where objects of interest are obscured by the forest canopy (a notoriously challenging remote sensing problem). In parallel, the UAV SAR team is preparing for further flight trials of C-Gull, a prototype UAV SAR system that will enable persistent monitoring of borders, tailings dams, mine walls and other critical infrastructure.

ENQUIRIES:

>> **Dr Ciara Blaauw**

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| Kholofelo Mphahlele

“MINING POWERS TODAY, BUT RESEARCH AND INNOVATION SECURE TOMORROW, TURNING EXTRACTION INTO RESILIENCE, PROGRESS AND SUSTAINABILITY.”

IN LOVE WITH GEOTECHNICAL SCIENCE

Kholofelo Mphahlele on creating safe and sustainable mines

For Kholofelo Mphahlele, a candidate rock engineer at the CSIR, the journey into geotechnical science began long before he entered a mine.

“I was born in the rural mountains, where nature first taught me resilience,” he says. “Moving to the city, I found myself surrounded by mine dumps – a stark reminder of both the cost and the potential of mining.”

That contrast led him to pursue a degree in geology, where, as he puts it, he learned to read the language of the earth.

“Along the way, I met giants in geotechnical engineering who showed me that mining is not just about extraction, but about innovation, safety and shaping futures,” he says. “My path was carved by landscapes, sharpened by mentors and driven by a vision to turn challenges into solutions that protect people, empower industry and respect the environment.”

Today, he studies the challenges mines face and how to solve them sustainably.

He is currently working on an acoustic rock hazard management tool. This digital tool, intended for mobile

CAREER TYPE: ROCK ENGINEER



RELATED CAREERS

- Geotechnical engineer
- Geologist
- Mining researcher
- Ground control specialist
- Mining innovation specialist



ACADEMIC HISTORY

- BSc Hons (Geology), University of Limpopo
- BSc (Geology), University of Limpopo

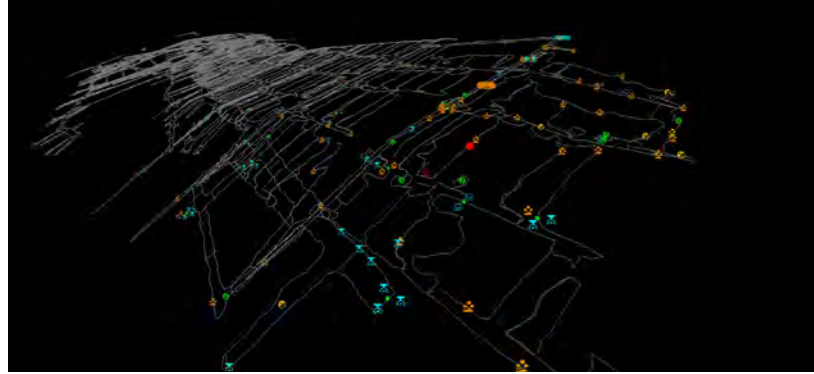
and smart devices, helps determine rock skin condition and collects acoustic data for trend analysis during underground safety protocols known as sounding and barring.

Sounding is when an operator taps the rock surface with a metal bar and listens to the sound it makes. A solid rock usually gives a sharp, firm sound, while loose or cracked rock may sound hollow or dull. This helps them judge whether the rock is safe or unstable. Barring is the process of removing loose or dangerous rock from the roof or sidewalls of an underground excavation. It is done to prevent rocks from falling uncontrollably and injuring people.

Mphahlele is also working on an underground location system for areas where normal GPS signals cannot reach. The system will give exact underground positions using X, Y and Z coordinates, so that geological mapping, sampling, inspections, photographs, equipment and machinery can be georeferenced. This will make it easier to plot information on a mine plan and track tools and machines in real time.

Mphahlele's work moves between project startup, proposal writing, literature reviews, underground data collection, data analysis, report writing, presentations and stakeholder engagements.

"What I love about my work is turning today's challenges into sustainable solutions that safeguard mines, protect people, and shape a safer future for all," he says.



The image presents a detailed mine plan incorporating key safety and geological information. It considers, among others, fall of ground, with record of historical occurrences of ground fall, providing essential data for monitoring and prevention; pillar status indicating the current condition and stability of pillars within an excavation; and rock mass (blue), with details on rock mass quality and structural integrity. Together, these elements provide a comprehensive overview of the mine's condition, integrating both visual evidence and recorded data to support ongoing safety and operational assessments.

After completing his geology studies, he secured an internship in geoscience, where he fell in love with the specialist field of geotechnical science. He joined the CSIR in 2024.

One lesson he has learnt in research is that "a negative finding is also a finding" – a reminder that progress in science does not always come in the form of neat success.

For learners interested in a similar career, he advises building a strong foundation in mining-related fields, seeking mentors early and being open to internships and learnerships because they provide real exposure to the industry and its challenges.

"Fall in love with learning: geotechnical engineering is not just about excavation stability, and mining is not just about extraction; it's about people, safety, innovation and long-lasting solutions," he says.

At school, he recommends taking **mathematics** and **physics**, while **geography** or **engineering** are advantageous.

ENQUIRIES:

>> **Kholofelo Mphahlele**

kmpahlele1@csir.co.za

CAREER TYPE: ELECTRONIC ENGINEER



RELATED CAREERS

- Acoustics engineer
- Sonar systems engineer
- Embedded systems engineer
- Signal processing engineer
- Software engineer
- Electronic design engineer
- Underwater systems engineer
- Systems integration engineer



ACADEMIC HISTORY

- MEng (Electronic Engineering), North-West University
- BEng (Computer and Electronic Engineering), North-West University

“THE IDEA THAT YOU COULD WRITE CODE AND DESIGN CIRCUITS TO MAKE HARDWARE COME TO LIFE AND INTERACT WITH THE PHYSICAL WORLD FELT LIKE A SUPERPOWER. OVER TIME, THIS OPENED THE DOOR FOR ME TO COMBINE MY UNDERSTANDING OF SOUND AND MUSIC WITH ADVANCED DIGITAL PROCESSING.”

| Elna Niemann

TURNING SOUND INTO CONNECTIVITY: ENGINEERING UNDERWATER “WI-FI”

Elna Niemann on unlocking high-speed data transmission from the ocean depths

A love of puzzles, mathematics, science and music put Elna Niemann on the path of becoming an electronic engineer who applies the power of acoustics across different environments, from high-speed underwater data communication to cutting-edge in-air applications.

As a senior researcher at the CSIR, much of her time is spent writing code and developing mathematical algorithms to “build the digital brains” of technologies. She also develops embedded software and firmware, then

moves from the screen into practical testing at the CSIR’s underwater sonar testing tank, and to the field, from Rietvlei Dam and Simon’s Town Harbour to the open sea.

Her team is currently developing an underwater wireless acoustic communication system, or broadband underwater data communication. This, in essence, is underwater “Wi-Fi” using sound, which would allow high-speed, real-time wireless data communication for underwater vessels for the first time.

“This groundbreaking technology could be a game changer for the maritime world, as it would allow surface

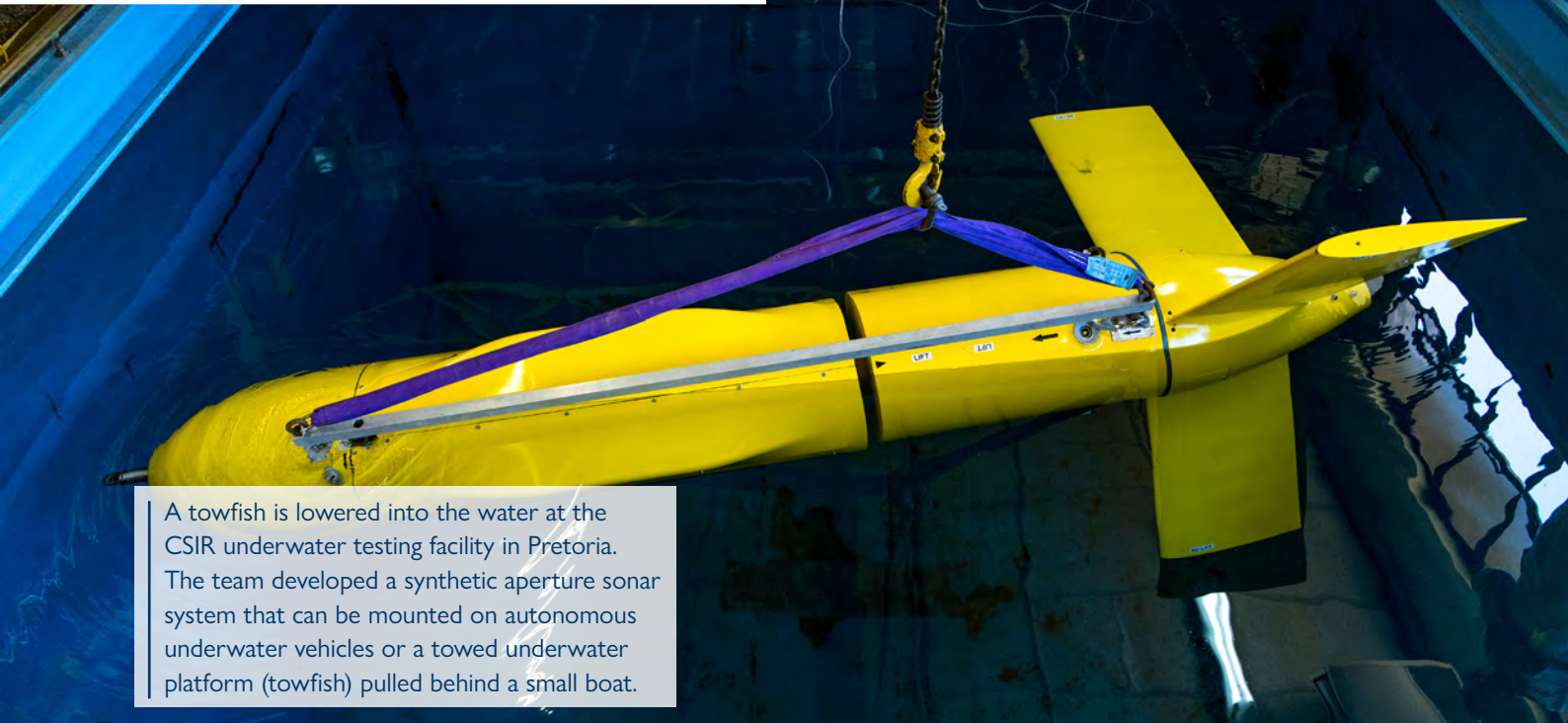


operators to see exactly what an underwater drone is scanning or measuring while it is still on its mission,” she says.

She explains that traditional communication uses radio waves, which, unlike sound waves, do not travel well underwater. “You can’t just submerge a wireless modem underwater and get the same kind of performance you would on land,” Niemann says. “We can offer internet-like speeds compared to current commercial offerings, which is more in line with telegraph speeds.”

She says this technology will help map the ocean floor, secure coastlines and safely guide underwater vessels, all vital for protecting marine life and maritime trade. “In the future, it could also be used for wireless drone swarms, expanded underwater sensor networks, and real-time harbour surveillance.”

Acoustic technology can also be used in the air, she says, to help industries locate hidden faults, reduce noise pollution and create safer work environments.

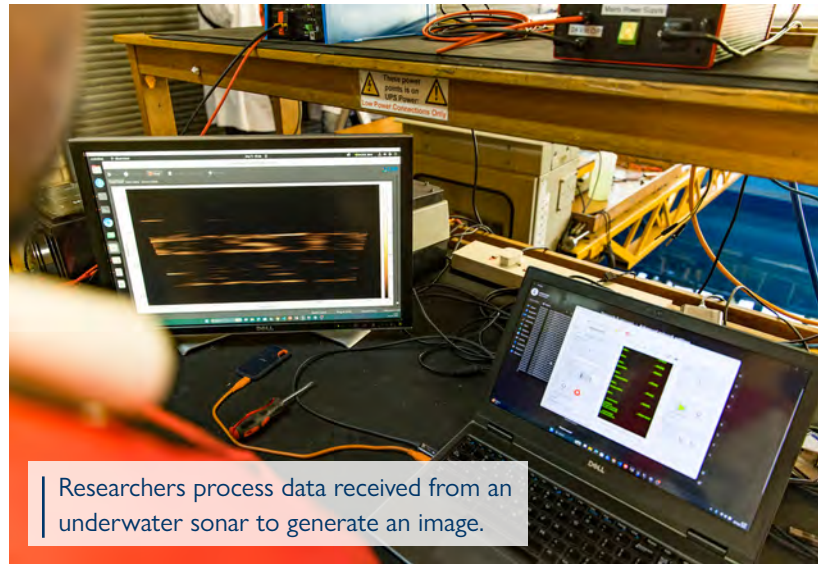


A towfish is lowered into the water at the CSIR underwater testing facility in Pretoria. The team developed a synthetic aperture sonar system that can be mounted on autonomous underwater vehicles or a towed underwater platform (towfish) pulled behind a small boat.

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A towfish before being lowered into the water at the CSIR underwater testing facility.



Researchers process data received from an underwater sonar to generate an image.



CSIR senior engineer Elna Niemann prepares a novel underwater wireless acoustic communication system for testing in the CSIR's indoor, six-metre deep water tank. This technology essentially enables underwater Wi-Fi using sound.

Niemann first joined the CSIR in 2015 as a junior electronic engineer supporting acoustics and sonar research. She had previously completed both a bachelor's and a master's degree in electronic engineering at North-West University.

What she enjoys most about her work is solving complex problems and creating technologies that have not existed before. "You aren't just following a manual; you are designing new technology from scratch," she says.

For learners interested in this path, her advice is to focus on **mathematics and physical science** as essential pillars, supplemented by **information technology**, and

to build a strong foundation in physics, analytical thinking and coding.

"Engineering is ultimately about creative problem-solving, the ability to adapt and to communicate ideas clearly," she says. "But you should also cultivate your passions outside of the lab, whether that's music or a unique hobby, because it trains your brain to think differently."

ENQUIRIES:

>> Dr Elna Niemann

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SOUNDWAVES TURN MOLTEN WIRES INTO METAL POWDERS

Dr Lerato Raganya creates titanium and stainless-steel powders for 3D printing



"I MAKE SURE THE METAL POWDER HAS THE RIGHT SIZE AND QUALITY SO THAT 3D PRINTED PARTS ARE STRONG AND RELIABLE."



| Dr Lerato Raganya



CAREER TYPE: METALLURGICAL ENGINEER



RELATED CAREERS

- Materials scientist
- Metallurgical engineer
- Powder production specialist
- Additive manufacturing researcher
- 3D printing materials specialist
- Process engineer
- Advanced materials researcher



ACADEMIC HISTORY

- PhD (Engineering Metallurgy), University of Johannesburg
- MSc (Materials Science and Engineering), TU Bergakademie Freiberg, Germany
- BTech (Engineering Metallurgy), University of Johannesburg
- NDip (Engineering Metallurgy), University of Johannesburg

(continued overleaf)

Working with the CSIR's ultrasonic atomiser machine, Dr Lerato Raganya produces fine metal powders that can be used to 3D print metal parts in a process known as additive manufacturing.

An ultrasonic atomiser uses high-frequency vibrations (sound waves) to turn a thin film of molten metal from wires into a fine, uniform mist, which rapidly cools into spherical powder particles. It is Raganya's responsibility to ensure that titanium, stainless steel and other metal powders have the right properties in terms of particle size, density and the ability to flow smoothly, consistently and without clumping during printing.

"I focus on operating the atomiser system, troubleshooting issues and doing maintenance to keep the equipment running properly," she says. "In this way, we are providing a local alternative to expensive and imported commercial powders."

Raganya has recently returned from Poland, where she received further training on the ultrasonic atomiser to tackle her next big project: recycling atomisation scrap for a greener and more sustainable approach to powder production.

"This new production process will support industry by making it more affordable to 3D print metal parts, and it will reduce waste through a more environmentally friendly production process," she says.

"However, it is not always easy to turn an idea into a clear and workable project plan; it requires careful planning, problem-solving and the ability to adapt when things do not go as expected."

It is this determination to succeed and her natural curiosity that first put her on the path to metallurgical engineering.

"Growing up, I had limited access to science resources and career guidance," she says. "In my area, most people only encouraged careers like nursing, teaching and policing, and engineering was seen as a job for men." She decided to go against the grain and instead pursued a career in science.



| Alloy preparation.

Raganya completed her undergraduate studies at the University of Johannesburg with support from the National Student Financial Aid Scheme and the National Research Foundation (NRF). She later joined the CSIR as an NRF intern, was offered a master's studentship, and then received a Department of Science, Technology and Innovation scholarship to complete her master's degree in Germany. After returning to South Africa, she rejoined the CSIR, submitted her PhD and progressed into the senior research role she holds today.

After eight years with her additive manufacturing colleagues at the CSIR, she still revels in turning ideas into real solutions that help people and industry on the ground. She also enjoys guiding students and young researchers and visiting rural schools to encourage learners to consider careers in science and engineering.

"What keeps me especially motivated is reaching out to female learners and students who have not been fully exposed to STEM, to inspire them to pursue STEM careers." To those learners, she says, "Stay curious and keep learning, even when things are difficult."

She adds that young people need a basic grasp of science and engineering and encourages them to ask questions and not be afraid to make mistakes. At school, she recommends focusing on **mathematics and physical science**.

ENQUIRIES:

>> **Dr Lerato Raganya**

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RELIABLE ROBOTS FOR SPACE AND HEALTH

Willis de Ronde on designing machines that move and help

As a senior engineer at the CSIR, Willis de Ronde spends his days developing robotics and machines that need to move, work and solve real-world problems.

“ONE DAY YOU’RE BUILDING AUTONOMOUS MOBILE ROBOTS, AND THE NEXT YOU’RE DESIGNING MEDICAL EQUIPMENT OR PHARMACY AUTOMATION SYSTEMS.”



SCAN TO WATCH



| Willis de Ronde

CAREER TYPE: MECHANICAL ENGINEER



RELATED CAREERS

- Robotics engineer
- Automation engineer
- Mechatronics engineer
- Design engineer
- Manufacturing engineer



ACADEMIC HISTORY

- MSc (Mechanical Engineering), University of Cape Town
- BEng (Mechanical), North-West University

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He is part of a team that develops bespoke robotics and automation systems for diverse applications across inspection, agriculture, safety and security, space, manufacturing and health at the CSIR Centre for Robotics and Future Production.

"I design the physical hardware and mechanisms for robots and automated systems," he says. This involves calculations, computer-aided design, 3D printing, 3D scanning, manufacturing, assembly, integration and testing.

He is currently exploring robotics for future space applications. "Because the space environment is so unforgiving, we have to throw out our usual design manuals and question every assumption we have about how machines move and operate," he says. "It's the ultimate engineering puzzle, requiring a lot of creative, first-principles thinking."

Previously, during the national Covid-19 emergency response, he also helped develop a local ventilator that saved lives. "This was the biggest impact project I have worked on so far, showing where innovation can have a direct impact on people's lives," he says.

It is this sheer variety of applications that keeps him hooked on robotics. "What I love about my work is that you're never confined to a single industry," he says. "Having the freedom to apply mechanical design to such a wide range of real-world challenges is incredibly rare."

Since childhood, he says, he loved fiddling with everyday items to understand the exact mechanism behind them. "I also enjoyed working with my hands and not just sitting behind a computer all day. Mechanical engineering gives a good balance between the different aspects."

He joined the CSIR as a bursar in his final undergraduate year and has worked there full-time since 2016, growing within the organisation while completing a master's in mechanical engineering through the University of Cape Town.

"People often think engineering is just about solving maths and physics problems on paper, but the biggest unseen challenge is bridging the gap between a digital model and messy physical reality," he says. "In the real world, materials have flaws, manufacturing tolerances vary, and environments are unpredictable."



Dr Sunveer Matadin, who heads up the CSIR Centre for Robotics and Future Production, and Willis de Ronde in the CSIR Learning Centre, which provides a hands-on environment to develop industry-relevant skills – particularly in 4IR technologies.



CSIR robotics engineers are working on a reconfigurable, low-cost and rugged prototype mobility device called Buddy4Life, which will assist children, adults and caregivers affected by cerebral palsy. From left, the CSIR's Willis de Ronde, Dr Sunveer Matadin and Zubair Suddoo in discussion with disability specialist Ruth Stubbs.

His advice to young people interested in robotics and engineering is to build on a foundation of **mathematics, science and information technology**.

"Because robotics is inherently multidisciplinary, success lies in embracing the overlap rather than staying in a silo," he says.

ENQUIRIES:

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AT THE COALFACE OF CODING

Safiya Turundu on building software that helps mines work smarter and safer underground



“WHAT I LOVE ABOUT MY WORK, IS THAT THERE IS NO ROOM FOR BOREDOM. THE TECHNOLOGY SPACE IS AN EVER-CHANGING LANDSCAPE.”



| Safiya Turundu

CAREER TYPE: SOFTWARE DEVELOPER – SPECIALISING IN MINING APPLICATIONS



RELATED CAREERS

- Digital twin developer
- Mining software engineer
- Simulation engineer
- 3D modelling specialist
- Mining technology specialist
- Systems integration engineer
- Data visualisation specialist
- Automation engineer
- Virtual reality developer
- Internet of Things solutions architect

- Data analytics
- Data scientist



ACADEMIC HISTORY

- MSc (Computer Science), University of the Witwatersrand
- BSc Honours (Computer Science), University of the Witwatersrand
- BSc (Computer Science and Mathematics), University of the Witwatersrand

(continued overleaf)

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Safiya Turundu has been a software developer supporting the CSIR's mining research for four years now. She works with a team to innovate and develop dashboards, visualisations and specialised tools for one of South Africa's most demanding industries.

"I code daily, meet with stakeholders to align in terms of requirements, and collaborate with team members as we build code together," she says. She is currently working on an online application meant to be used underground to help rock engineers make better decisions, perform calculations, do audits and store data and research material.

Turundu says the software she works on is designed to be adopted for regular use by the mining industry. "We purposefully engage with stakeholders to understand their needs and offer solutions that will make their work more efficient," she says. Much of the work involves replacing paper-based manual work with automated digital tools that store and interpret data.

Another example is a system being developed for the CSIR's rope testing facility. The facility tests steel winder ropes used to hoist people and materials from underground to make sure they can withstand service loads during operations. Turundu says the new software tool will enable certificates to be generated automatically with the required test data, sent for sign-off and stored in a database for clients to access.

"This will reduce the potential for errors, save time in populating certificates with information, reduce paper handling, and decrease delays," she says.

Her interest in software began early. "My sister was always a gamer, and I remember asking myself, 'How was this game made?' or 'What is inside this computer?'" she says. Although she started out studying geology at the University of the Witwatersrand based on advice from a career counsellor, she soon realised it was not the right path. She switched to computer science, continued to a master's degree level and never looked back.



Her first job was teaching mathematics to first-year students, a role she enjoyed, but she wanted more practical work. "So, I juggled between teaching, research and machine learning work for a while," she says. "My desire was to find an organisation that combined all three elements. This is how I found the role at the CSIR. Of course, when it was offered, I took it."

What she enjoys most is innovation and the chance to keep learning in a fast-changing space. "Joining the CSIR's mining cluster opened up a whole new world that I did not have much exposure to," she says.

People do not always see the planning, architecture, deliberation and coding development that goes into building a secure system that is scalable and well-maintained, she says. Most people focus only on whether an application works, but much of the effort happens behind the scenes.

She encourages young people to learn from others and make use of the resources already available to them if they want to follow in her footsteps. "Nowadays, people can learn to code from home," she says. "Don't wait for university doors to be opened up to you. Get into the industry immediately, because innovation is not waiting for anyone to hop on board."

At school level, she recommends choosing **mathematics, computer science and information technology** as subjects. She also notes that software development supports many industries, so learners should choose subjects they care about. "Your own interests and knowledge will form the foundation of your career," she says.

ENQUIRIES:

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FROM HEMP FIBRES TO BIODEGRADABLE PRODUCTS

Dr Asanda Mtibe on biodegradable materials and practical solutions for industry

"I AM PASSIONATE ABOUT SOLVING PLASTIC WASTE POLLUTION THROUGH DEVELOPING BIODEGRADABLE PRODUCTS."

CSIR researcher Dr Asanda Mtibe tests the properties of non-woven hemp composites and fibres. He can also examine the materials' chemical composition, and test water vapour permeability, abrasion and peeling resistance of the hemp fibre reinforced composites.

CAREER TYPE: CHEMIST



RELATED CAREERS

- Materials researcher
- Polymer scientist
- Product development scientist
- Biodegradation specialist



ACADEMIC HISTORY

- PhD (Textile Science), Nelson Mandela University
- MSc (Chemistry), University of Johannesburg
- BSc Hons (Chemistry), University of Fort Hare
- BSc (Chemistry and Biochemistry), University of Fort Hare

(continued overleaf)

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From biodegradable plastics to hemp fibre products for automotive use, CSIR senior researcher Dr Asanda Mtibe develops sustainable alternatives to fossil-based materials. His research directly supports South Africa's transition to sustainable manufacturing, demonstrating how green chemistry transforms waste streams into valuable products while reducing environmental impact.

Some of the biodegradable products Mtibe has helped develop at the CSIR include diagnostic kits, surgical aprons and agricultural mulch films. Previously, his team also developed biocomposite pellets from recycled polypropylene and sawdust waste, creating biobased bottle caps with reduced carbon footprints.

He is currently working on a project that seeks to replace fibreglass composites used in automotive trims, like boot liners, with hemp fibre composites. "We are developing composites using locally sourced hemp fibres combined with polymers and biopolymers through injection moulding."

"The South African government legalised industrial hemp in 2021, which sparked my interest in the beneficiation of hemp fibres for the development of innovative and sustainable products." He explains that the technical properties of hemp and other plant fibres are highly similar to glass, but they offer the added benefit of being lighter, leading to fuel savings. Hemp is also a renewable resource and sequesters carbon while growing.

Mtibe further supports industry through biodegradation testing in soil, industrial compost and aqueous media. "Our work assists the industry in determining whether their products are suitable for the environment at the end of their life cycle," he says. "For instance, when the client's products are not 100% biodegradable, we advise the client on practical strategies and material modifications that can improve their biodegradability."

He says he has always been a curious person. "My passion for science began in high school when we conducted a static electricity experiment using a ruler and tissue paper." Fascinated by the results, he became determined to understand how science works.



Dr Asanda Mtibe in the Nanomaterials Industrial Development Facility, used in the transition from laboratory research to industrial-scale production.

A teacher recognised his potential and encouraged him to study chemistry, setting him on a path that led to a master's degree and then a CSIR studentship to pursue a PhD.

"Joining the CSIR was a life-changing opportunity that exposed me to the world of research and innovation," he says. For Mtibe, the work remains deeply rewarding because it combines research, problem-solving and hands-on laboratory work.

He believes this field of material science matters because biodegradable plastics and sustainable products made of natural fibres like hemp provide environmentally friendly alternatives, but they often also perform better.

For learners considering a similar path, his advice is straightforward: "Studying science is not easy; one has to work consistently hard and have a never-give-up attitude." He says **physical science, mathematics and biology** are key school subjects for success.

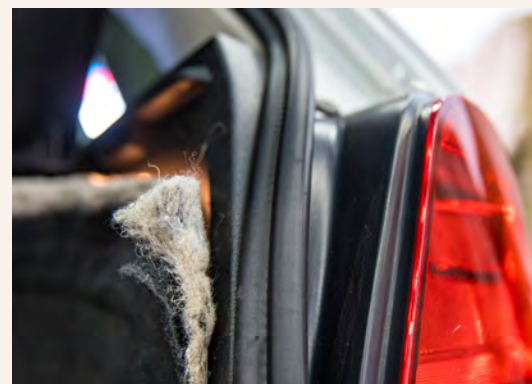
ENQUIRIES:

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SCAN TO WATCH



CSIR senior researcher Dr Asanda Mtibe develops sustainable alternatives to fossil-based materials. He is currently working on a project that seeks to replace fibreglass composites used in automotive trims, like boot liners (right), with hemp fibre composites. Other biodegradable products he helped develop at the CSIR include single-use medical diagnostic kit cassettes (left), a biodegradable mulch film, or soil cover, to protect fruit and vegetable crops (main picture) and a biobased bottle cap made using waste sawdust and recycled plastics (middle).

CAREER TYPE: GEOSPATIAL DATA ANALYST



RELATED CAREERS

- Agronomist
- Full stack software developer
- Data scientist
- Modelling and machine learning specialist
- Remote sensing specialist
- Precision agriculture specialist
- Geospatial analyst
- GIS specialist
- Earth observation scientist
- Agricultural data scientist
- Satellite image analyst
- Soil scientist
- Crop monitoring specialist
- Environmental monitoring specialist
- Agri-tech researcher



ACADEMIC HISTORY

- PhD (Plant Science), University of Pretoria
- MSc (e-Science), University of the Witwatersrand
- BSc Hons (Advanced Mathematics of Finance), University of the Witwatersrand
- BSc (Financial Mathematics), University of Johannesburg



FROM FINANCE TO FIELDS

Dr Wessel Bonnet on drones and satellites for data-driven farming

When Dr Wessel Bonnet looks at a farm from behind his desk, he doesn't see crops and soil; he sees data waiting to be unlocked. As a CSIR researcher in precision agriculture, Bonnet uses satellite and drone imagery to help South African farmers monitor and manage their fields more effectively, without ever setting foot on the land.

"What I love about my work is its dynamic nature, moving between statistical modelling, physics, coding and

geographic information systems," says Bonnet, who has been with the CSIR for four years.

His journey into precision agriculture was anything but conventional. After completing a BSc Honours in advanced mathematics of finance, Bonnet's first job was in consulting for banks, helping customers transition from branch to digital transactions. He later moved into private equity consulting, conducting due diligence studies and profit forecasts for potential acquisitions.

But his love of all things green and machine learning pulled him in an entirely new direction.

"AGRICULTURE WILL BECOME A MORE DATA-DRIVEN, HIGH-TECH INDUSTRY, MAKING IT MUCH MORE APPEALING TO YOUNG, TECHNOLOGY-DRIVEN GENERATIONS."



"I have a passion for plants, machine learning and statistical analysis, and digital agriculture is naturally the field where these skills can be combined most effectively," he explains.

Shifting away from finance, Bonnet went on to complete an MSc in e-Science, where he applied machine learning to satellite imagery in his dissertation. He then joined the CSIR while he completed his PhD in plant science at the University of Pretoria. The PhD focused on using remote sensing techniques together with soil and plant radiative transfer models to analyse crop and soil characteristics.

Today, his work involves implementing, calibrating and updating the digital offerings of the CSIR's precision agriculture group. This includes large-scale data analysis, coding and building data pipelines from satellite feeds to agricultural applications.

One of the projects he is most excited about involves a CSIR drone that collects very detailed information about crops and land. "This advanced drone platform is a highly specialised capability of the CSIR. The drone, or unmanned aerial vehicle, was acquired from Headwall and boasts a hyperspectral camera, a light detection and ranging scanner (LiDAR), and a high-precision global positioning system and inertial measurement unit."

It uses advanced imaging to capture many more colours than the human eye can see, and it uses laser scanning to measure the shape and height of the land and plants.

"I am honoured to process this rich data into usable agricultural and topography insights," says Bonnet.

"Highlights for me include the georeferencing, colour corrections for clouds and shadows, and creating 3D canopy height diagrams."

The impact of this research extends far beyond the laboratory. The group's Precision Agriculture Information System gives South African farmers access to near-real-time crop and soil monitoring without requiring expensive laboratory tests or physical plant inspections.

For those interested in following a similar path, Bonnet offers candid advice: "Careers in remote sensing require a very diverse skill set, with new technologies, platforms and applications regularly appearing with technological advances. Therefore, there is a steep learning curve which continues deep into your career, requiring broad expertise as well as good adaptability."

He recommends that learners focus on **mathematics, physics and biology** at school to build the foundation needed for this exciting and evolving field.

ENQUIRIES:

>> **Dr Wessel Bonnet**

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CAREER TYPE: PROCESS ENGINEER



RELATED CAREERS

- Chemical engineer
- Process engineer
- Bioprocess engineer
- Agro-processing engineer
- Bioresource engineer
- Sustainable manufacturing specialist
- Food process engineer
- Circular bioeconomy researcher



ACADEMIC HISTORY

- PhD (Chemical Engineering) *in progress*, University of Johannesburg
- Certificate (Agile Project Management), University of Cape Town
- MTech (Chemical Engineering), University of South Africa
- BTech (Chemical Engineering), University of Johannesburg
- National Diploma (Chemical Engineering), University of Johannesburg



“IT IS REWARDING TO HELP SMALL BUSINESSES TRANSFORM A SIMPLE, KITCHEN-BASED RECIPE INTO A SAFE, SCIENTIFICALLY VALIDATED AND MARKET-READY PRODUCT.”



| Vuiswa Lucia Motsa

HOW TO TURN PLANTS AND PLANT WASTE INTO PROFIT

Vuiswa Lucia Motsa on engineering value from indigenous knowledge

On a mission to improve lives, create jobs and reduce waste, Vuiswa Lucia Motsa turns indigenous plants and other bioresources into products.

“I am a senior process engineer who works to turn plants such as cannabis, aloe, African ginger and moringa, as well as other bioresources, into useful products such as medicines, oils and sustainable materials,” she says. “Ultimately, my role is to use science and engineering to protect the environment and empower people to turn what they grow into valuable, real-world solutions.”

Her work is highly interdisciplinary and spans technical design, laboratory research, fieldwork and project leadership. She uses engineering and data analysis tools to model and simulate processes before implementation. She designs process flows, analyses experimental data and develops technologies that convert plant materials and industrial waste into valuable products such as proteins, oils, food products and bioenergy.

In the laboratory, she performs hands-on experiments to test and optimise these processes, using advanced equipment like ultrafiltration systems, continuous-flow microwave systems, aseptic filling machines, large-scale



| Aseptically produced puree.

spray dryers and pilot-scale bioreactors. She also trains young engineers and students, providing practical, hands-on experience to build their confidence and technical skills while gaining real-world experience in bioprocessing and pilot plant operations.

She is currently working on a dairy waste valorisation project, for which she is a patent co-inventor. The project aims to reduce South Africa's imported high-purity whey proteins, leading to several novel whey high-protein food products. Whey is a high-quality protein found naturally in cow's milk. She is also localising a food process technology to help farmers convert perishable crops into high-value products.

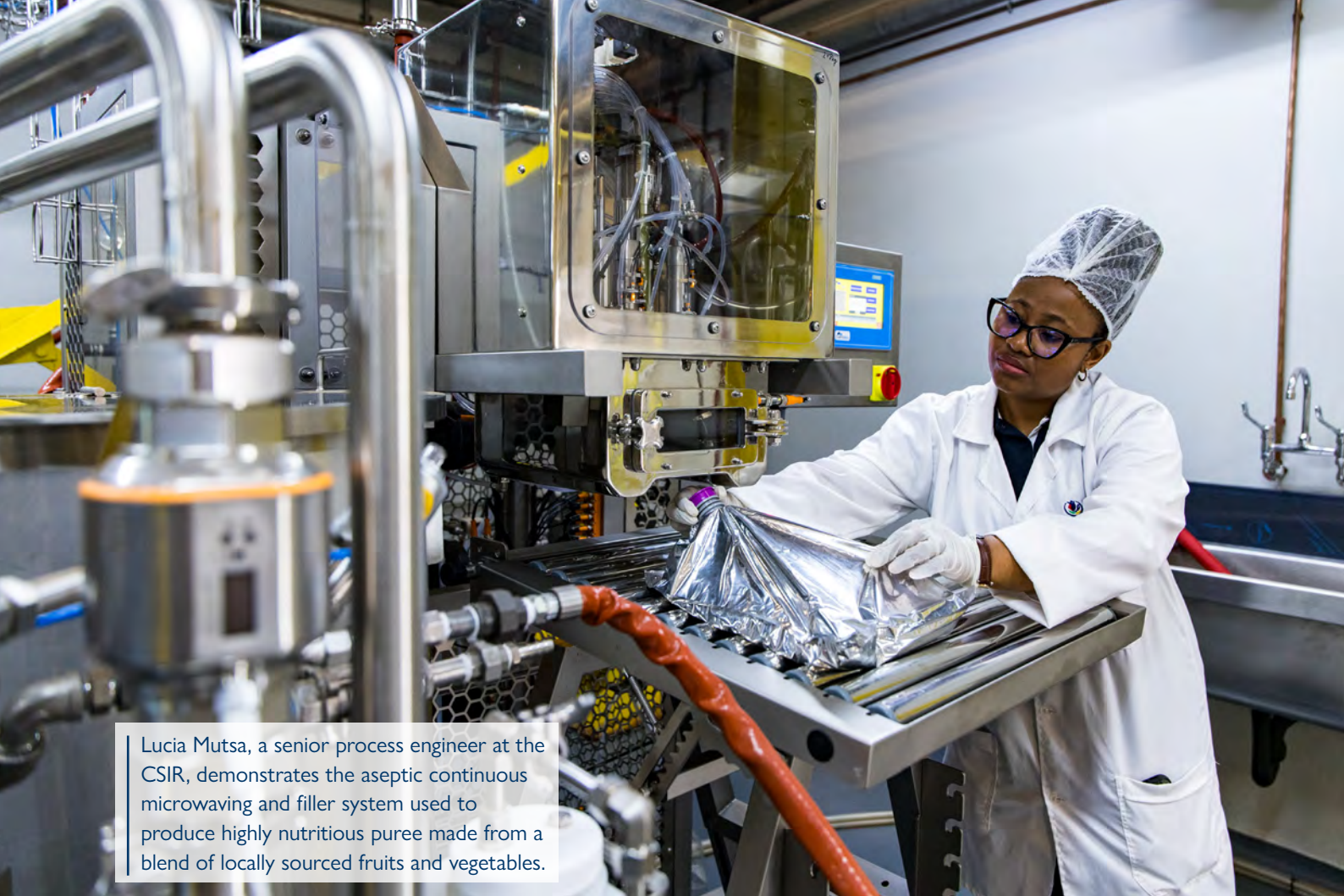
Motsa fell in love with **chemistry** in high school, and says **mathematics and science** are key subjects to a career in process engineering.

After school, she completed a national diploma and a BTech degree in chemical engineering. Next, she enrolled for a research-based master's degree focused



| Lucia Motsa sets the parameters for the microwave system prior to aseptic processing and filling.

(continued overleaf)



Lucia Mutsa, a senior process engineer at the CSIR, demonstrates the aseptic continuous microwaving and filler system used to produce highly nutritious puree made from a blend of locally sourced fruits and vegetables.

(continued from page 49)

on renewable energy from biodegradable waste at the University of South Africa. “That experience,” she says, “sparked and solidified my passion for waste-to-value research and sustainable technologies.”

She joined the CSIR through an internship six years ago. She is currently completing a PhD on a zero-waste system that converts hemp and cannabis residues into renewable energy and bio-based products.

Mutsa has also contributed to the engineering design, process development and implementation strategy for a hemp and cannabis processing facility in Bergville, KwaZulu-Natal and towards a rural community-based project focused on *Aloe ferox* processing in the Eastern Cape.

“I’m most passionate about working on community-based projects, where I support farmers and agribusinesses in

transforming their indigenous resources into thriving, sustainable businesses,” she says. “There is nothing quite like taking a complex scientific idea from the laboratory and watching it translate into something that can genuinely change someone’s life,” she says.

For Mutsa, engineering must always stay grounded in people’s realities. “It is one thing to perfect a chemical process in a small beaker, but it is far more complex to design large-scale systems that can be easily and affordably operated and maintained by local communities or small businesses,” she says. Her advice to young people is first to ask, “Does this help people? Does it make sense for a small business? Is it good for the environment?”

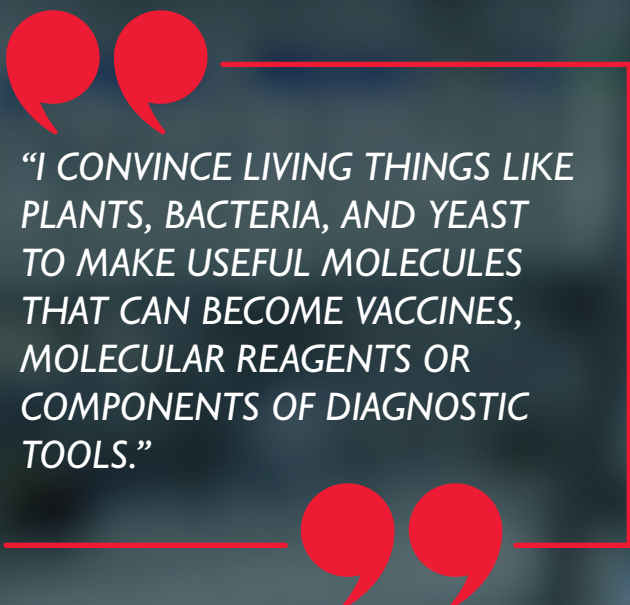
ENQUIRIES:

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MEDICAL MOLECULES FROM MICROBES AND PLANTS

Dr Sibongile Mtimka on home-grown vaccines, diagnostics and biologics



| Dr Sibongile Mtimka



CAREER TYPE: MOLECULAR BIOLOGIST



RELATED CAREERS

- Biochemist
- Biomanufacturing researcher
- Bioprocess scientist
- Vaccine development researcher
- Biotechnology researcher
- Protein scientist
- Microbial discovery scientist



ACADEMIC HISTORY

- PhD (Biochemistry), University of KwaZulu-Natal
- MSc (Life Sciences), University of South Africa
- BSc (Medical Biosciences), University of the Western Cape

(continued overleaf)

(continued from page 51)

By building South Africa's capacity to produce its own vaccines and biologics, Dr Sibongile Mtimka hopes local patients will be able to rely less on imported medicines, as well as pay less for medical products.

"I help people by working on projects that make biotherapeutics affordable and accessible – something Africa has needed for too long," she says.

Mtimka is part of a CSIR research group tasked with demonstrating new biomanufacturing technologies. "We solve problems with science, and the capability to locally produce biotherapeutics and reagent proteins will enable us to improve the economy and people's lives."

She believes the future of biomanufacturing lies in learnings from nature, whether that means using virus-based proteins to fight infections that no longer respond to antibiotics, or growing specialised antibodies in plants to help address major global health problems.

In the laboratory, she spends her days growing cells and plants that express useful proteins and then purifying these proteins. "Think of it as giving a cell a recipe and asking it to bake something for you." She also explores environmental samples such as soil and water to discover novel molecules using a technique called metagenomics.

She says she relishes "playing" in the lab with everything from pipettes, agar and bacteria to protein purification systems and DNA tools, all in service of solving challenges faced by South Africa and the continent.

She recalls being fascinated by harmful bacteria as a child, and imagining how they might be killed. "I didn't know it then, but that was my first hypothesis."

Later came a fascination with cooking, then forensic television shows. "They planted a deeper seed in me. Science is for curious minds that can't leave a mystery alone."

She applied for a BSc in medical bioscience in 2009, expecting to end up in pathology, but detoured to recombinant protein production and biomanufacturing instead.



Dr Sibongile Mtimka collects soil samples at the Kogelberg Biosphere Reserve in the Western Cape. The reserve is known for its high plant biodiversity, which researchers believe could translate to microbial diversity in its soil.

She first joined the CSIR in April 2014 through a National Research Foundation and Department of Science, Technology and Innovation internship programme, during which she was encouraged by mentors to continue her studies. After completing her PhD in 2024, she continued at the CSIR as a postdoctoral researcher. "I completed all my studies while I was at the CSIR, so I am proof of the CSIR supporting young people's careers and developing the a pipeline of future researchers."

Now, as a senior researcher, she is equally committed to training the next generation of African scientists. "Knowledge dies unless you hand it to someone younger," she says. "The future of biomanufacturing in Africa depends on us scientists, and on us teaching and passing on the skills, motivating people to give science a chance."

At school, she says learners should take **mathematics, life sciences and physical sciences**, adding that job shadowing, finding a mentor and combining theory with hands-on experience are important for aspiring scientists.

"We need more people in this field, and science isn't as scary as people make it out to be," she says. "Stay curious, read widely and do not be afraid to admit when you do not know something."

ENQUIRIES:

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MICROORGANISMS FOR GREENER PRODUCTS

Dr Veshara Ramdas on biotechnology and biomanufacturing



“BIOMANUFACTURING IS NOT JUST INNOVATION; IT IS A NECESSITY. IT IS HOW WE WILL PRODUCE SMARTER, SAFER AND MORE SUSTAINABLE PRODUCTS FOR FUTURE GENERATIONS.”



Dr Veshara Ramdas examines microorganisms under a microscope.

CAREER TYPE:

BIOMANUFACTURING SPECIALIST



RELATED CAREERS

- Bioprocess specialist
- Microbiologist
- Biotechnologist
- Bioprocess development scientist
- Industrial biotechnologist
- Fermentation scientist



ACADEMIC HISTORY

- PhD (Microbiology), University of KwaZulu-Natal
- MSc (Medical Laboratory Science), Durban University of Technology
- BTech (Biomedical Technology), Nelson Mandela Metropolitan University
- National Diploma (Biomedical Technology), Nelson Mandela Metropolitan University
- Programme in Project Management (PPM 1&2), University of Pretoria

As a senior researcher in the CSIR's bioprocessing team, Dr Veshara Ramdas uses microorganisms to design and grow sustainable products at scale. She says biotechnology and biomanufacturing help industries make safer, greener and more efficient materials.

After completing her master's in medical laboratory science, she joined a bioprocessing team through an internship. "This experience introduced me to an entirely new dimension of microbiology," she says. Having previously worked mainly with pathogenic microorganisms, she found it inspiring to shift towards using non-pathogenic, beneficial microbes to develop products that positively impact industry and the environment. "That

transition was transformative and ultimately shaped my passion for biomanufacturing and biotechnology."

One of the projects she's most passionate about tackles plastic pollution. Her team wants to develop a bioprocess to produce safer, marine biodegradable plastics using microorganisms. "While this problem is global and complex, I feel motivated knowing that my work

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contributes, even in a small way, to a more sustainable environment,” she says.

At the CSIR, she leads research projects like these as a principal investigator, designing experiments, overseeing and conducting research, analysing data and compiling technical reports. She is also responsible for writing research proposals to secure funding and support new projects. In addition, she handles administrative responsibilities, serves as a safety, health and environment representative to ensure safe lab practices and is increasingly involved in maintaining and improving quality management systems.

Over the past three years, Ramdas has also been part of a train-the-trainer biomanufacturing programme. Together, the team has been involved in training more than 200 individuals from across Africa, including industry professionals and early-career scientists.

In addition, she works with small, medium and micro enterprises on project-based collaborations, technology transfer, as well as national and international partnerships, helping to translate research into real-world applications.

A recent example of this work in action is a collaboration with South African biotechnology start-up Immobazyme, which approached the CSIR to help scale up production of a growth factor used in food and agricultural applications. Ramdas and her colleagues developed a cost-effective production process in state-of-the-art CSIR bioreactors.

“For the first time in South Africa, we were able to demonstrate a process for this growth factor at a 50-litre bioreactor scale,” she says.

But the journey to this point has not been easy. During her master’s studies, she recalls a period when money was so tight that she sometimes had to choose between bus fare and food, but she stayed committed to finishing her education. When she later moved to Pretoria, she says she felt like a small fish in a huge ocean and had to rebuild herself from the ground up.

Along the way, mentors recognised her potential and encouraged her to pursue a PhD, helping her grow into the senior role she holds today.

“I remember one mentor telling me, ‘From now on, only expect negative feedback’. At the time, I was shocked and didn’t understand. It felt harsh. But over the years, I realised they meant that constructive criticism is what pushes you to improve and grow.”

For this reason, she encourages learners to seek mentors and to stay open to feedback, even when it is difficult to hear. She says young people should build a strong foundation in **mathematics, science and biology**, and be willing to step outside their comfort zone to grow. “I hold onto the last words my father shared with me: ‘You are my pride; keep going.’ In moments of challenge, I remember that, and it gives me the strength to continue my journey.”

In 2021, after completing her PhD, Ramdas received the L’Oréal-UNESCO Women in Science Award in the Southern Africa postdoctoral category. She also completed a project management diploma and extensive training in places such as the United States of America, Scotland and Italy.

At 40, she says she is still learning and is currently continuing her development with quality management systems auditing training. “For me, continuous learning is essential and I believe growth never stops.”



SCAN TO WATCH



ENQUIRIES:

>> Dr Veshara Ramdas

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OUTBREAK: DISEASE DETECTIVES ON THE CASE

Dr Amanda Skepu on diagnostics to catch HIV, Mpox and Covid-19 early



“WE DEVELOP TOOLS THAT HELP HEALTHCARE WORKERS FIND THE CLUES LEFT BEHIND BY VIRUSES AND OTHER DISEASE-CAUSING ORGANISMS.”



| Dr Amanda Skepu

CAREER TYPE: BIOENGINEER



RELATED CAREERS

- Biochemist
- Medical microbiologist
- Diagnostics researcher
- Biomedical scientist
- Molecular diagnostics specialist
- Molecular biologist



ACADEMIC HISTORY

- PhD (Biochemistry), University of the Western Cape
- MSc (Biotechnology), University of the Western Cape
- BSc Hons (Biochemistry), University of the Western Cape
- BSc (Biochemistry and Medical Microbiology), University of the Western Cape

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As programme manager for human diagnostics at the CSIR, Dr Amanda Skepu leads teams of scientists, whom she describes as “disease detectives”, in developing new ways to identify sick patients quickly and accurately.

Part of her time is spent in the laboratory designing and testing new detection methods, and part is spent working alongside other researchers, healthcare professionals, universities, government departments and industry partners to develop new medical devices.

On a typical day, she might review laboratory results, discuss experiments with researchers, help solve technical challenges, plan project activities, write reports, meet with partners and funders or mentor young scientists.

She is particularly excited about a current project to develop simple, rapid and affordable diagnostic technologies for emerging diseases and infectious diseases that can cause outbreaks.

“We are developing simple diagnostic tests that can help healthcare workers detect diseases such as Covid-19, HIV and Mpox quickly, using just a finger-prick drop of blood, saliva or urine,” she says. “The aim is to make testing easier and faster, especially in clinics and communities that do not have access to large laboratory facilities.”

Skepu explains that some of these tests resemble a home pregnancy test. A small sample is placed onto a test strip and, as the liquid moves along the strip, a visible colour change or coloured line appears if the disease is detected.

“The results can be read with the naked eye, without the need for specialised laboratory equipment or highly trained personnel,” she says. “In many cases, results are available within 15 minutes, allowing testing to be performed almost anywhere, from rural clinics and community health centres to border posts and outbreak response sites.”

During a disease outbreak, she explains, early detection is critical for timeous treatment and to prevent the disease from spreading. “It is exciting to know that the work we do today could help communities respond faster to future health emergencies and ultimately save lives.”

Dr Amanda Skepu with a new diagnostic test. A small sample is placed onto a test strip and, as the liquid moves along the strip, a visible colour change or coloured line appears if the disease is detected.



Growing up, Skepu was always curious about the human body and how doctors could tell what was making people sick. “The more I learned about diseases and health, the more I realised that science could be used to help people and improve lives,” she says. “What really inspired me was seeing how diseases affect communities and family members. I wanted to be part of finding solutions.”

She studied biochemistry and medical microbiology, continuing all the way to a PhD in biochemistry. She then worked as a researcher, first as a postdoctoral fellow and then as a senior scientist at the South African Medical Research Council, where her research focused on diabetes.

She says success in science is not about knowing all the answers, but about being willing to learn, explore and keep going when things do not work out the first time. She encourages young people not to let their background, circumstances or self-doubt limit what they believe is possible and to take **mathematics, life sciences** and **physics** at school. “Your journey may not always be straightforward, but if you stay curious, work hard, and believe in your potential, you can achieve more than you think.”

ENQUIRIES:

>> Dr Amanda Skepu

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CELL MODELS TO IMPROVE MEDICINE FOR AFRICAN POPULATIONS

Sizwe Tshabalala on turning donated skin cells into stem cell lines for research

“A TREATMENT THAT WORKS WELL FOR ONE POPULATION MAY BE LESS EFFECTIVE FOR ANOTHER. BY GENERATING CELLULAR TOOLS THAT REPRESENT AFRICAN GENETIC DIVERSITY, WE CAN TEST MEDICINES AGAINST MODELS THAT BETTER REFLECT THE PATIENTS WHO ARE ULTIMATELY MEANT TO RECEIVE THEM.”

| Sizwe Tshabalala



CAREER TYPE: BIOMEDICAL RESEARCH TECHNICIAN



RELATED CAREERS

- Stem cell researcher
- Cell culture specialist
- Biomedical scientist
- Molecular biologist
- Pharmacogenomics researcher
- Laboratory technologist
- Biochemist



ACADEMIC HISTORY

- MSc (Biochemistry), University of Pretoria
- BSc Hons (Biochemistry), University of Pretoria
- BSc (Biochemistry and Genetics), University of Pretoria

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Sizwe Tshabalala spends most of his time in the laboratory monitoring human cells under a microscope, bathing them in the correct nutrient mix and making sure they are healthy. He is part of a CSIR team that collects skin cells from consenting African donors, converts the skin cells into stem cells, and then converts those stem cells into nearly any other type of cell that scientists can use for biomedical research.

“My work aims to improve how medicines are developed and prescribed for African populations,” he says. “There is quite a lot of evidence that shows that genetic differences can affect how people respond to certain drugs.” This

means that new medications should be tested against cell lines that represent African genetic diversity; an ideal that Tshabalala and his colleagues are turning into a reality through the CSIR’s African Cell Initiative.

Before joining the team in 2025, Tshabalala had completed a bachelor’s degree in biochemistry, followed by an honours degree and a master’s at the University of Pretoria, focusing on malaria research. His first job was at the same university, where he screened novel compounds against malaria parasites.

“None of these were carefully planned out career moves,” he says. “Instead, I followed opportunities that aligned with my interests at the time, and this allowed me to keep learning. This eventually led me to a field I had not even imagined working in: stem cell research.”



Sizwe Tshabalala is part of a CSIR team that collects skin cells from consenting African donors, converts the skin cells into stem cells, and then converts those stem cells into nearly any other type of cell that scientists can use for biomedical research.

He now applies a range of molecular biology techniques he learnt at university to investigate how cells function under different conditions, while planning experiments, reading scientific literature, analysing data and keeping detailed records.

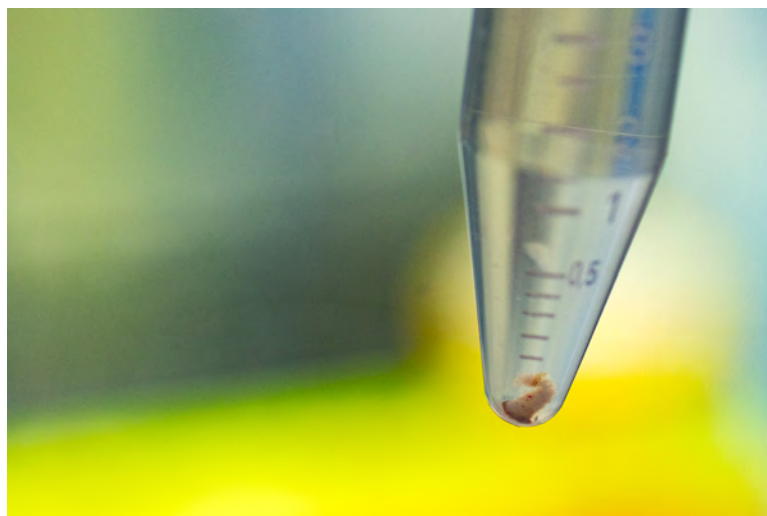
Each day brings new challenges and learnings, he says. “Experiments do not always work, and quite often, months of work can produce a result that raises even more questions or provides answers that were not anticipated.” Learning how to deal with that disappointment, he says, is part of the nature of scientific research.

Although he feels he is still in the early phases of his career, he hopes his experiments will one day lead to a very real medical benefit for people of African descent.

“In five or 10 years, we hope to see fewer patients returning to the hospital because of treatment failure,” he says. “An example here would be tamoxifen, a breast cancer medication. It is the first-line breast cancer medication used for most populations. However, we have seen that there is a genotype-drug response relationship with African women.”

In other words, if cancer drugs are tested against the cell lines Tshabalala and the team are generating from African women's skin cell donations, these patients could expect treatment outcomes to improve in future.

“This field of research is important as we move forward,” he says. “Biomedical research will need to better reflect human genetic diversity, such that life-saving treatments can be effective across diverse populations.”



Tshabalala says his journey in science has been a series of serendipities, ultimately turning his curiosity into a career by making small decisions to say “yes” to opportunities. “Opportunities often present themselves unexpectedly, and some of the most rewarding parts of my career have come from opportunities I did not plan for,” he says.

For learners interested in following a similar path, he recommends building a strong foundation in **mathematics, physical science and life sciences.**

ENQUIRIES:

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