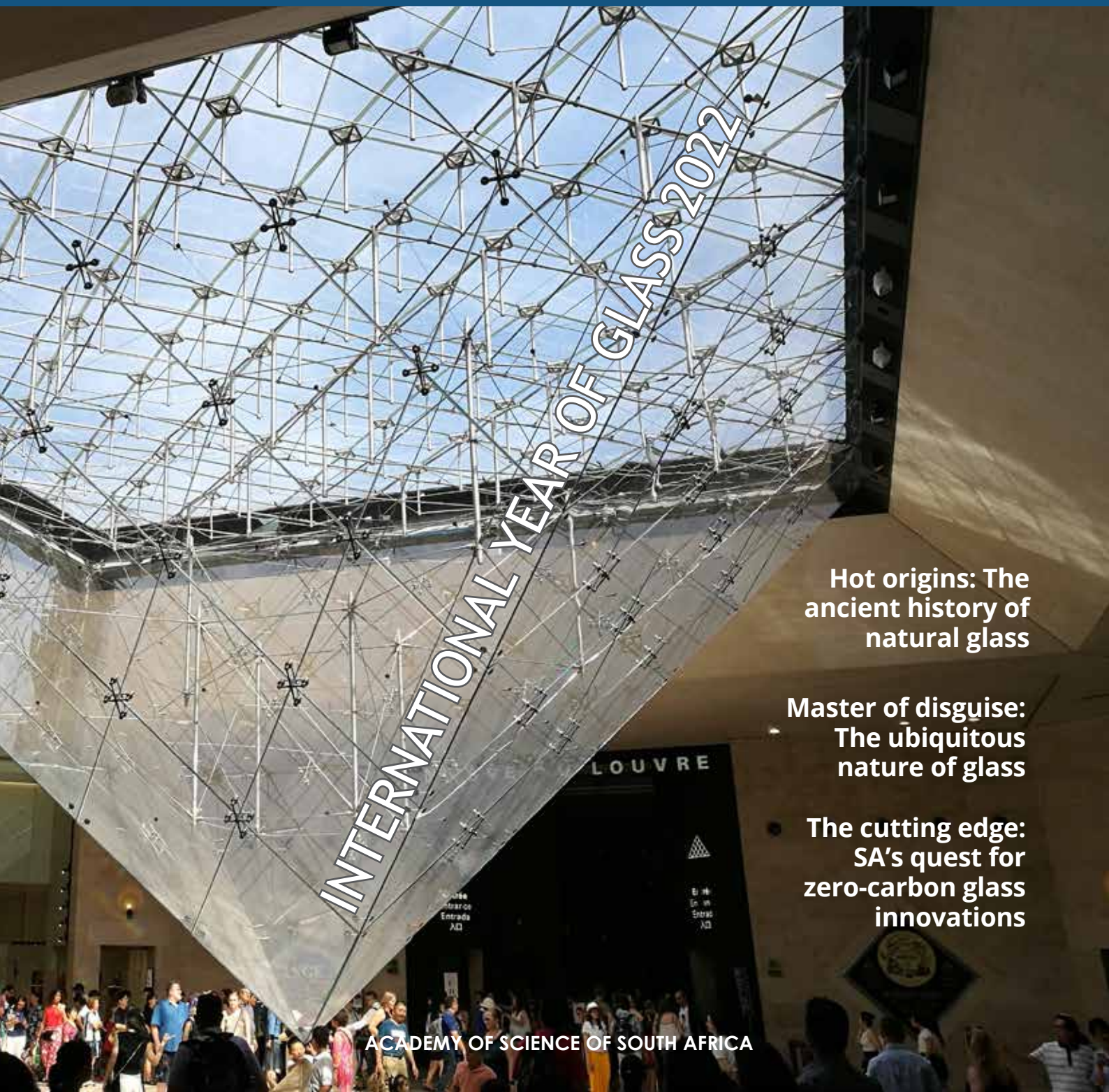
SCIENCE FOR SOUTH AFRICA

Quest

VOLUME 18 | NUMBER 4 | 2022
ISSN 1729 - 830X



INTERNATIONAL YEAR OF GLASS 2022

Hot origins: The ancient history of natural glass

Master of disguise: The ubiquitous nature of glass

The cutting edge: SA's quest for zero-carbon glass innovations

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CONTENTS

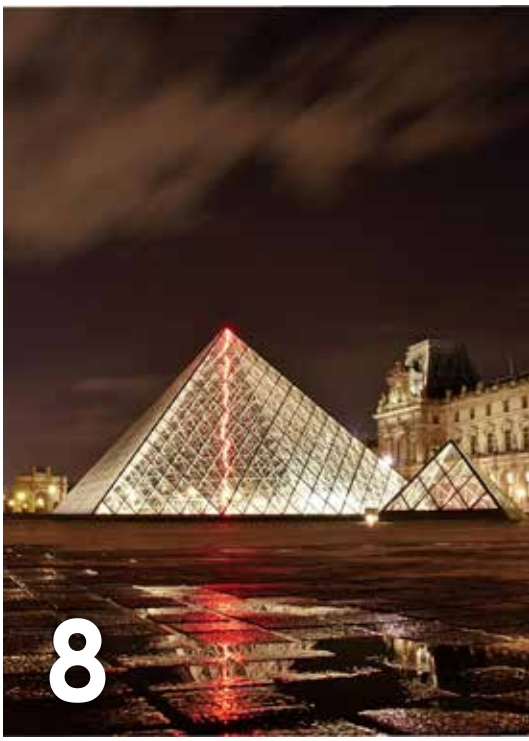
Volume **18** | Number **4** | **2022**

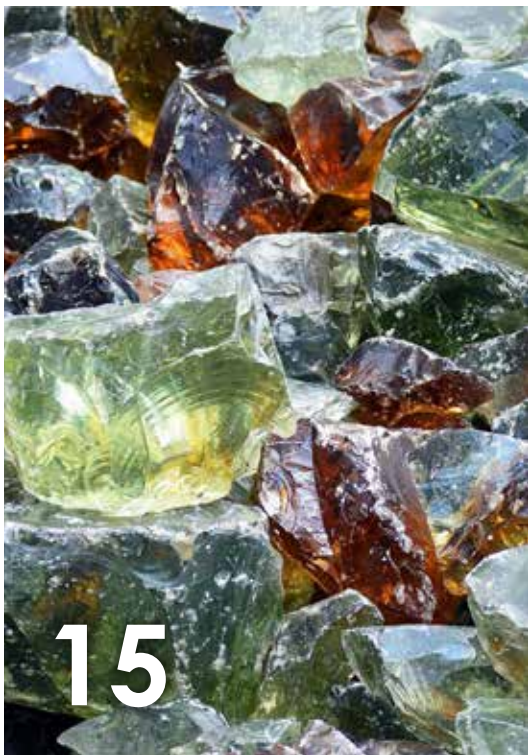
THEME

FEATURES

REGULARS

NEWS





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Published by the
Academy of Science of South Africa (ASSAf)
PO Box 72135, Lynnwood Ridge 0040

Subscription rates
(4 issues and postage)
(for other countries, see subscription form)
Individuals/Institutions - R145.00
Students/schoolgoers - R72.00

Design and layout
Garnett Design Studio

Printing
Seriti Printing Digital

Website and social media
https://questonline.org.za
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Cover image
The Louvre Pyramid in Paris is one of the world's most iconic glass structures.
Photo: Fanie van Rooyen

International Year of Glass 2022

Glass is literally all around us. Just have a look at the screen you are likely reading this on, at the watch that might be on your arm, at the windows all around you or the glass of water you might have on your table. Glass gave us the art of the Louvre, clean, solar energy panels and the optics of the James Webb Space Telescope. It is truly a wondrous material.

On 18th May 2021 the UN General Council approved a joint application by the International Commission on Glass (ICG), the Community of Glass Associations (CGA) and ICOM-Glass that 2022 be declared a United Nations International Year of Glass (IYOG). The year has seen many participating events and institutions celebrating the essential role that glass has in society. In this edition, we carry on with that celebration.

According to the official IYOG website (iyog2022.org) glass, with its unparalleled versatility and technical capabilities, has in its many guises fostered innumerable cultural and scientific advancements, including:

- Glass is the main conduit for information in our knowledge-based society. Glass optical fibres have led to a global communications revolution; they are the backbone of the internet.
- Glassmakers have given us touch-sensitive covers for our mobile phones, revolutionizing the way we communicate.
- Glass is the chemically resistant container material for many of today's life-saving medicines.
- Bioglass compositions have advanced healthcare with their ability to: integrate with human bone; stimulate the human body's natural defense to heal flesh wounds; aid tissue design and regeneration; and resolve hearing and dental issues.
- Glass sheets support solar cells and give clean energy; glass fibres reduce our carbon footprint by strengthening wind turbine blades, by insulating our homes and through carbon capture and sequestration (CCS).
- The evolution of glass optics and optoelectronics means that the James Webb Space Telescope can study the first moments after the big bang and expand understanding of the Universe.
- Glass melting is being de-carbonised and glassy products are being safely recycled.
- Glass artists across the globe have given humankind an awareness of this wonderful material including its remarkable methods of fabrication, inherent beauty, and ability to capture and display nature's full spectrum of colour.

Read on for articles that touch on many of these aspects in fascinating detail.

For an inspirational talk on the role of glass in modern life, watch the "Worldwide presentation of the United Nations International Year of Glass 2022" here: https://www.youtube.com/watch?v=A6ZEaWvlz6k.

And for teachers and learners, a multi-authored book, Welcome to the Glass Age, was designed for IYOG with the aim to whet the interest of an intelligent 18 year old, printed for the IYOG opening ceremony in Geneva. The 13 chapters were written by experts and explain how glassy artefacts are helping the UN achieve its 2030 humanitarian goals. Download a free copy here: https://saco.csic.es/index.php/s/kNgckQJ9ZMLQicR

And of course, the issue has lots more – from the link between our microbiomes and mental health, to water weeds research and smart nanofibres. I hope you enjoy the read.

Fanie (RS) van Rooyen (Editor)

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HOT ORIGINS
The ancient history of natural glass

When you think of glass, you would typically think of a material that was produced in a factory, used to make window panes and jam jars. But, as with many human inventions, nature has been ahead of us: glass has been produced on Earth for billions of years. Moreover, Earth's glass factory is still continuing its production in volcanoes worldwide, forming, for instance, a dark glassy rock called obsidian. But other volcanic rocks, and even meteorite craters, also contain large amounts of natural glass.

Apart from volcanoes, there are other ways in which nature can produce glass. Probably the most dramatic way is by means of a meteorite impact. The glass that is produced here is called tektite, and specific examples of tektites have been given their own names. One example is Libyan desert glass from Northern Africa. Another is the moldavite that can be found in the present-day Czech Republic, which has a beautiful green colour. It was formed from a meteorite impact that happened about 15 million years ago. Most other tektites are far less spectacular bits of black glass, which you wouldn't give a second glance if it weren't for their strange shapes.

Additionally, lightning strikes can also produce material that is sintered together with glass, and this is called 'fulgurite'. In a way, it is fossilised lightning, creating intricate branch-like structures where the lightning bolt hit the ground.

Figure 1: This piece of obsidian from Eastern Africa is the most common example of natural glass, a very quickly chilled silicate liquid.

Bruce Caimcross

Figure 2: Moldavite forms during a meteorite impact; the scalloped edge seen here is formed by natural weathering processes.

Bruce Cairncross

Figure 3: Tektites are also glass pieces that result from meteorite impact, and they get their shape as droplets of melt that fly through the air.

Bruce Cairncross

So, what do volcanic eruptions, meteorite impacts and lightning strikes have in common that they all produce natural glass? One necessary ingredient for producing glass is a high temperature and very quick cooling. In volcanic eruptions, magma (molten rock) which typically has a temperature of more than 900˚C, is brought to the surface of the earth, where the temperature is many hundreds of degrees lower, causing very rapid cooling. The temperature of the air around a lightning bolt is even more extreme, in the order of ten thousand ˚C! High temperatures of more than 2000 ˚C are also attained during a meteorite impact, when the kinetic energy of the meteorite is converted to thermal energy upon impact.

Of course high temperatures by themselves are not enough to produce glass: you also need the correct ingredients. For instance, if lightning hits a tree, you just end up with charcoal, not glass. The main ingredient in glass is silica, which is the term used for the element silicon, bonded to oxygen: silicon dioxide (SiO_2). Most people would be familiar with silica, as it is the sole ingredient for the mineral quartz, which can form very pretty crystals. However, there is a very important difference between a mineral and glass: a mineral is a crystalline material, which means that the atoms are arranged in a regularly repeating pattern in three dimensions. The pretty crystals that we see are a result of this ordering. Glass, however, does not have this kind of order – and will therefore not naturally give the nice shapes that crystals have, although we humans can of course pour it into a mould, or change its shape later.

Figure 4: Pumice is formed during a volcanic eruption, and consists of very thin rims of glass around bubbles of volcanic gas.

Bruce Cairncross

If magma cools down very slowly, for instance when it gets stuck in the earth, rather than coming to the surface in a volcanic eruption, all the elements in the melt organise themselves into different minerals, each with their own crystal shape. That is how we end of up with a rock called granite, consisting of quartz and feldspars. But when the magma cools down really quickly, there is no time for the elements to arrange themselves and form crystals. The microscopic structure of glass is similar to that of a melt: a far more messy affair than the regular structure of a mineral.

So in terms of their ingredients (silica, but also quite some aluminium, sodium and potassium) you cannot tell the difference between granite and obsidian. Their very distinct appearance is only a result of the rate in which the melt cooled. Pumice, on the other hand, looks very different from either granite or obsidian, even though it also has the same chemical composition. For pumice to form, the magma must have contained a lot of gas, which formed bubbles, whereby the glass forms the very thin bubble walls. It's a bit like opening a bottle of soft drink after having given it a good shake – and then immediately freezing the froth that comes out of the bottle.

Glasses associated with lightning strikes or meteorite impacts generally have a composition that is slightly

Figure 5: These pieces of obsidian from Greece were probably used as small cutting tools. As they were found in areas where there is no volcanic activity, they testify to the trade of this material during the Stone Age.

Bruce Cairncross

different from volcanic glass, with more iron and less sodium, and even more silica than obsidian. However, the composition depends on the exact material that was struck by the meteorite or the lightning bolt. Large parts of the earth are covered by silica-rich rocks or sediments (sand, mud, clay…), so there is a good chance that this will be involved. The colour of the glass is related to the chemical composition: the moldavites, with their pretty green colour, have a lower iron content than most other tektites, which are black. Obsidian, on the other hand, looks black because it contains microscopic inclusions; if you look at a very thin piece of obsidian, you can see that the glass itself is actually very light in colour.

Figure 6: Snowflake obsidian forms when the glass starts to devitrify, forming clusters of crystals.

Bruce Cairncross

It has been known for a long time that glass has special properties, which stem from the fact that it is not a crystalline material: it doesn't have any preferred direction in which it breaks. This characteristic has been exploited by early humans, who used obsidian to make sharp-edged tools such as knives. Obsidian was thus a very valuable material, and there is evidence that it was traded over hundreds of kilometres as early as 20 000 years ago. Interestingly, this material is being used again nowadays for some surgical procedures instead of metal scalpels.

Although glass is very durable if we compare it to other natural materials like wood or cotton, it's actually not a really stable substance: over time, it will start to devitrify, whereby it forms tiny crystals. This will generally give it a dull appearance, although a quite attractive example is the so-called snowflake obsidian, which contains clusters of white crystals. However, devitrification is a rather slow process, and we can still find bits of glass in rocks that are 3.5 billion years old.

So, it is somewhat humbling to realise that with the 'invention' of glass circa 5 000 years ago, humans were simply imitating what nature had been producing for billions of years already.

Article written by Prof. Marlina Elburg, head of the department of geology of the University of Johannesburg. The photos of natural glass specimens were taken by Bruce Cairncross.

Master of disguise: The ubiquitous nature of glass

Glass is one of the most versatile materials ever mastered by humankind. It continuously re-invents itself, to remain a critical component of our everyday lives. Ever since bronze-age craftsmen began melting sand in the presence of hydroxide salts, the production and use of glassy materials has permeated through our society. Rather than being limited to the aesthetic, in the modern world, glass has found a remarkable array of uses, including telecommunications, energy production, construction and healthcare, amongst others. In certain ways it is mystical, and science has been slowly unlocking its secrets for many years. This article will explore some of the most important applications of glass today, and what the future may hold for this wonderful substance.

Connecting our world

High definition video and audio on demand; the ability to see and communicate with people half-way around the world in real-time; studying and working online in a post-COVID society...These have all been enabled by something we never see, and most don't even know exist.

At the bottom of the worlds' oceans are thousands of kilometres of fibre-optic cables that transmit information from one country to another. In fact, subsea fibre-optic cables carry 99% of international internet traffic. Transmitting information using light has been one of the most important developments of the modern age, accelerating the Third- and giving rise to the Fourth Industrial Revolutions. Glass has been central to this technology. A fibre-optic cable is made up of thin strands of glass, each strand much thinner than a human hair. Information is transferred through each strand as a light signal, and scientists have cleverly used the refractive properties of different types of glass to keep the signal inside the cable. These days, scientists have also been able to add nanocrystals to the glass fibres, to further enhance its abilities and uses in communications and laser technologies.

Stronger than steel

Glass fibre materials have been around for a long time. If you have ever been near a marina, chances are you

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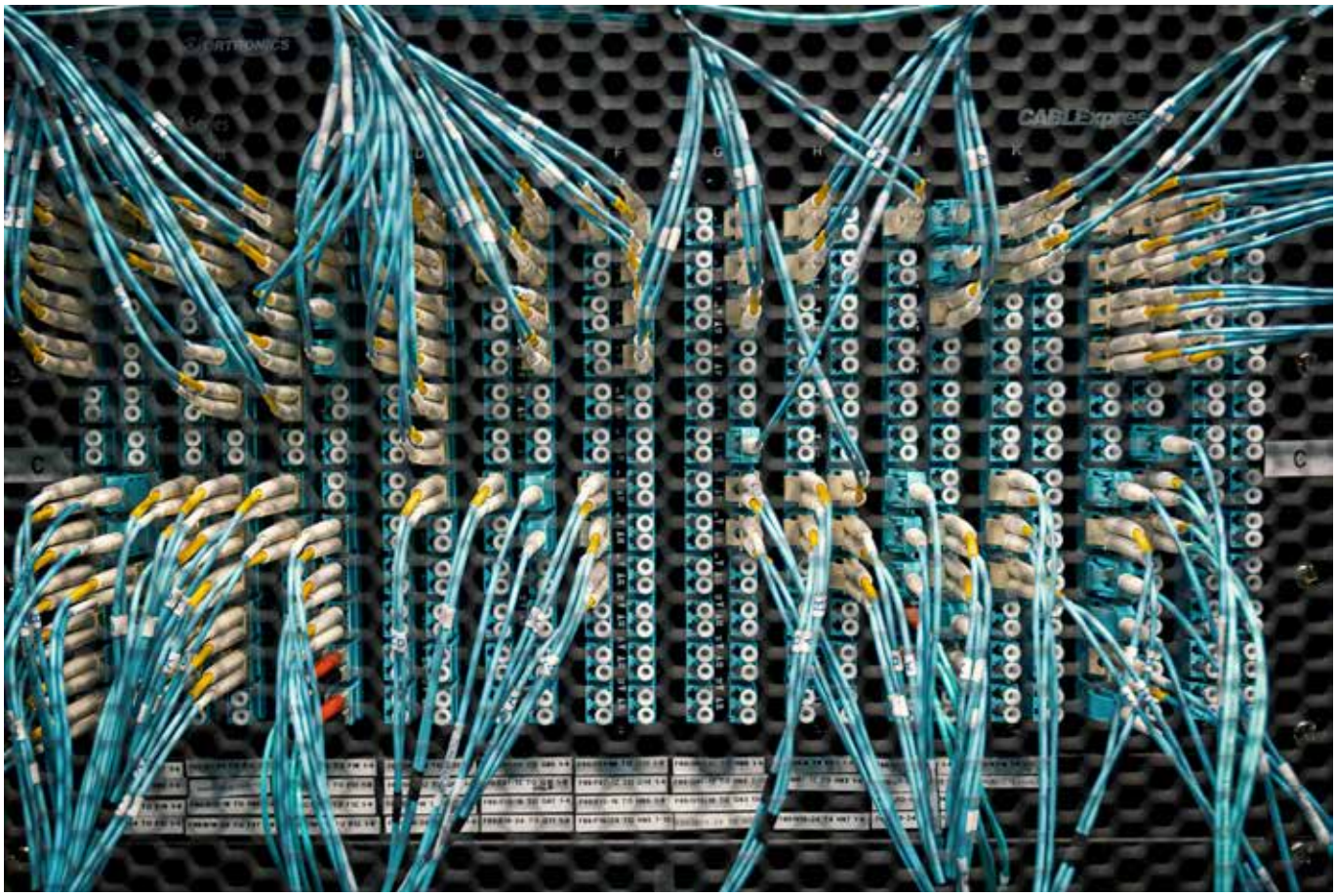
have seen a boat fabricated from fibreglass. Favoured for its strength to weight ratio and durability, this material has been used in numerous other applications, from automobiles and aircraft, to tanks and construction materials. It's not just glass however, typically fibreglass is a marriage of a polymer resin with glass fibres, the latter which gives the composite its characteristic strength. Since glass has very poor thermal properties, glass fibre materials are also very useful as insulation. Many chemical plants around the world use fibreglass insulating materials around their high-temperatures operations, to keep the heat in and protect their workers. Today, a lot of effort is being expended on the development of greener and more sustainable polymer resins, to improve the life-cycle of the fibreglass material and ensure that it has a place in the future of the construction and transportation industries.



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Powering the future

Photovoltaic cells consist of semiconductor materials that are able to convert incident light into electrical energy. These exotic materials are good at harnessing the power in solar radiation, but are not very durable, so they have to be protected when placed out in the open. However, they still need to access the maximum amount of light so can't be placed under an opaque material. Practically no material other than glass can offer high solar radiance transmittance, together with strength and durability. Therefore, in most solar panels, the photovoltaic cells are sandwiched between sheets of tempered glass.

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The incident light is able to pass through with ease, but the cell is protected from the other environmental conditions. As scientists work on developing higher efficiency photovoltaic materials, glass remains a critical supporting act for this renewable energy technology. An interesting development in this area has been solar glass, a new construction material that is able to absorb a portion of the incident light, and allow the rest to pass through. It can be used in the place of windows and glass panels in buildings, directly converting the incident light into electrical energy, without the need for a separate photovoltaic cell. Perhaps one day, the very buildings we occupy will be able to generate all the energy we need.

Medical miracles

The human skeleton provides the framework for one of the most intricate biological machines in nature. However, it is somewhat more than just scaffolding for organs, nerves and skin. It integrates with the organic parts of the body, serves as a storage for calcium and carries an extensive network of blood vessels. Bone regeneration is therefore a very complex and challenging task in medicine.
Amazingly, some fifty years ago, a glass material that could bond to living tissue without rejection by the body's immune system and undergo dissolution in the presence of blood, was developed. It revolutionised orthopaedic surgery, by providing damaged bones with sufficient support and the opportunity to regenerate in a natural way. Bioactive glass has since become an integral part of the orthopaedic field, to treat damaged bones and bone defects.

An even more ubiquitous use of bioactive glass is in toothpaste to treat sensitive teeth. Here the bioactive glass promotes the regrowth of calcium at the base of the tooth, and protects the nerves from exposure to hot and cold foods and drinks.

Glass, climate change and the circular economy

When one thinks about glass, one imagines a clean, clear material that epitomises something natural and sustainable. Glass is indeed made out of relatively abundant, natural materials, and can be recycled and reused many times without significant loss of quality. Nevertheless, it takes a large amount of energy to produce glass products, due to the melting temperature of the glass. This temperature can be lowered by adding salts that are high in sodium and potassium, but only to a certain extent. There is still the need to heat up the glass precursor to almost 1700 °C. To do this, glass manufacturers rely on furnaces powered by both fossil fuels and electricity (the latter also often produced from fossil fuels).

There are efforts underway to develop new furnaces that can run on green hydrogen, produced through electrolysis of water, and to use electricity derived from renewable sources, such as solar, wind and hydro. Engineers are also making the furnaces more energy efficient, to ensure that most of the energy input goes towards maintaining the glass melt. Decarbonization of the glass industry is a significant step towards ensuring the future sustainability of the industry and to mitigate against the current and future effects of climate change.

In South Africa, approximately 44% of glass packaging is recycled (according to The Glass Recycling Company, 2020). This is well below most of the countries in Europe, where the value is on average 78%. Nevertheless, as a manufactured material, glass is amongst the top ten, keeping company with steel, aluminium and paper products. Glass recycling is a critical part of the circular economy concept, reducing waste and improving usage of materials through the complete life-cycle. If you haven't already participated, find out the location of a glass bank in your area, separate out your glass packaging waste, and become part of the glass recycling initiative.

Through the looking-glass

What does the future of glass look like? We can only offer some educated guesses.

Currently, scientists are working on combining glass with new materials to provide convenient properties, e.g. the ability to change colour with changes in temperature, which could improve the storage and supply of beverages and medicines.

Flexible glass products are allowing electronic devices to do amazing things, effectively bending our reality. Advances in photovoltaic technology will perhaps allow such materials to be applied like glass coatings to buildings and infrastructure. Glass may actually form the basis for such infrastructure in the future, as steel and brick did in the 19th and 20th centuries.

Glass has and will continue to be used in space exploration, as integral parts of space-craft and instruments that are charting our past and future. The world's wonder material is playing an increasingly important role in our everyday lives, and as we enter the second half of this century we can expect it to continue to assist in meeting the greatest challenges we face.

Article written by Prof. David Lokhat, president of the South African Institution of Chemical Engineers and head of the Reactor Technology Research Group in the School of Engineering of the University of KwaZulu-Natal.

Ingilazi ingenye yezinto ezingakhiqiza izinto ezahlukahlukene eyaziwa ngabantu abaphila la emhlabeni. Iyaqhubeka nokuziqamba kabusha futhi isiyinxenye yezimpilo zethu ebalulekile. Kulesiskhathi samanje ingilazi ingasetshenziselwa izinto eziningi. Singasho sithi, inemfihlakalo engaqondakali, kodwa ubuchwepheshe buyasiza ukuba siqonde lemfihlakalo kancane kancane.

Translated by Zamantimande Kunene

solar-farm-4683339

Zero-carbon glass? SA upping its circular economy game with glass innovations

Glass manufacturers in South Africa are working to improve the energy efficiency of their products, including by using more energy efficient equipment and furnaces, improving the efficiency of the products through design, and making supply chains more efficient.

The United Nations (UN) General Council has designated this year – 2022 – as the International Year of Glass (IYOG) to celebrate the versatility and usefulness of glass, including as a chemically resistant container especially for medicines and as a conduit for the world's data through fibre-optics, among many other existing and novel uses and applications.

"In a world constrained by a variety of environmental pressures, glass is one of the most recyclable materials; it has a variety of roles in reducing greenhouse-gas emissions such as energy-saving coatings, double or triple glazing and solar cells, is made from widely available materials and is contributing to major improvements in our health," the UN IYOG team, administered by global industry body the International Commission on Glass, states.

These sentiments are echoed by local glass manufacturers Consol Glass and Isanti Glass, as well as industry body the South African Glass and Glaziers Association, which highlight the benefits of glass use to preserve and protect foodstuffs, support reuse behaviour and improve the thermal properties of buildings, while also noting the importance of increasing glass recycling to reduce energy use and emissions in the production of glass, and reducing the costs of final products through greater efficiency.

Cutting emissions with cullet

Cullet, or recycled glass, melts at a lower temperature than the raw materials from which glass is constituted. Therefore, the more cullet Consol Glass is able to use, the less energy is required in the glass-making process. Every 10% of cullet used in production results in an approximate 5% reduction in carbon emissions and energy savings of about 3%. Every kilogram of cullet used also replaces 1.2 kg of virgin raw materials that would otherwise need to be extracted, Consol Glass's executives say.

"The availability of cullet determines how much Consol Glass uses in its production, which is why our relationship with The Glass Recycling Company and glass recyclers is important. The more consumers recycle, the more cullet we can use, without any adverse effect on our products," the company says.

The science journal *Nature*, in a November 2021 editorial article, says that "recycling glass does not degrade it, and

manufacturing it can be carbon free. Heating limestone, sand and soda ash to 1 500 °C to make glass contributes between 75% and 85% of the carbon dioxide (CO_2) emissions and the remaining emissions are a by-product of the chemical reactions between the raw materials.

"When cullet is melted, no CO_2 is released and furnaces do not have to burn so fiercely to melt glass as they need to melt the raw materials, offering further carbon savings. According to the European Container Glass Federation (FEVE), 10% more cullet in a furnace lowers CO_2 emissions by 5%, compared with making glass entirely from raw materials," the journal states.

Further, according to the FEVE, glass bottles are today 30% lighter, require 70% less energy and emit 50% less CO_2 than 20 years ago, Consol Glass highlights.

"Almost all glass packaging placed on the South African market is manufactured locally and not imported. In addition, all glass collected is recycled locally into new glass packaging. Hence, glass contributes significantly to industrialisation in South Africa," says The Glass Recycling Company CEO Shabeer Jhetam.

"Taking into account transportation and processing, for every ton of glass made out of recycled glass, 670 kg of CO_2 emissions are saved. Similarly, recycling one bottle saves enough energy to power a fluorescent light bulb for seven hours," he says.

A glass circle

Further, glass is one of the few products that adhere to the principles of the circular economy, as waste glass is used to manufacture the same product, namely new glass packaging. All glass packaging, such as bottles and jars, collected in South Africa goes back to manufacture new packaging and there is no down-cycling of the collected glass, says Jhetam.

"Glass gets cheaper and more readily used once recycling at source improves, which talks to consumer behaviour and recycling practices. Improved separation at source will create improved supply chain and logistical systems, which, in turn, reduce the cost of recycled glass and increase recycled volumes," concurs glass producer Isanti Glass CEO, Pieter du Plessis.

"In support of our customers' carbon footprint targets and our own, we are considering various ways in which to reduce our footprint through improved efficiencies by producing more with the same inputs, or producing the same with less inputs, and also through improvements to our supply chain, including logistics. Those are our two focus areas currently," he says.

Glass composition is a technically complex issue, but excellent quality glass can be produced using recycled glass as an input. This also provides a huge advantage in terms of energy consumption if more recycled glass is used, as recycled glass melts at a lower temperature than the raw material inputs used to produce glass, he says.

Recycling one glass bottle saves enough energy to power a fluorescent light bulb for seven hours

However, there are various challenges to increasing recycling rates, which include the high transport costs to bring cullet back to the manufacturing plants in Gauteng and the Western Cape, and there is no legislation relating to mandatory separation at source, says Jhetam.

"All glass is transported by road and it would be ideal and cheaper if our rail infrastructure can be improved to transport glass to the manufacturing plants. Additionally, municipalities across the country need to implement mandatory separation at source.

"Finally, there remain worryingly high levels of apathy in most households, and education and communication about the importance of recycling is needed, coupled with penalties or disincentives for people who do not recycle, especially when not separating at source," he emphasises.

Low- or no-carbon glass

Isanti is actively looking at diversifying its energy mix to include renewable sources like solar and biomass. However, stable, constant and consistent energy supply is critical in glass manufacturing at full demand requirements, says Du Plessis.

"This is very challenging from a renewable perspective, owing to the nature of renewable energy generation. As a result, it is likely that only a small portion of the energy consumption can be replaced with renewable energy. There remain various opportunities for Eskom to improve its generation mix and thereby impact the whole industry," he says.

Carbon can also be saved by decarbonising the process of melting the chemical mix during manufacturing. A demonstration project called Furnace for the Future, run by the FEVE, makes glass using electricity instead of natural gas to heat recycled glass cullet, the *Nature* journal article says.

"If the electricity source were fully decarbonised, it would mean that the entire process of glass-making would effectively be carbon-free.

"Glass is an essential material. It is possible for its manufacture to become almost carbon- free in a relatively short time. However, legislation is required to ensure that it is properly collected and recycled, and that it doesn't end up in landfill. Communities and companies should be

helped to create infrastructure to collect glass and recycle it," the journal states.

Consol is currently seeing several emergent technologies, approaches and processes that are making glass products stronger, lighter and more energy efficient, including through the use of electric and hybrid-electric furnaces, the company says.

"Glass-making is an ancient industry and yet one that is relentlessly innovating. Some of the emerging approaches include product lightweighting, process automation and smart control systems," the manufacturer adds.

"Through initiatives such as lightweighting, which reduces material used in packaging designs without compromising strength or integrity, and optimisation of processes, we have achieved a substantial reduction in our carbon footprint, both per ton of glass produced and per bottle, over the past 15 years," Consol highlights.

Additionally, stimulated by increasing demand from customers for lower-carbon packaging solutions, the glass-making industry is piloting projects that will test the viability and cost of renewable-powered furnaces.

"Most large glass manufacturers in Europe and the US have typically run their furnaces, which is the production component with the largest energy requirement, on natural gas. They are increasingly looking to augment and then replace natural gas with renewable-energy sources, which means conversion to electricity at the furnace stage. This is possible, and there have been significant advances made towards this goal, such as the FEVE hybrid-electric Furnace for the Future."

The renewable furnace challenge

The possibility of a paradigm shift in the way furnaces run could herald a step-change in the decarbonisation of the industry. A new breed of furnaces designed to run on renewable-energy-derived electricity, biofuels, hydrogen fuel cells or a hybrid of several technologies could usher in a future of zero-carbon glass, says Consol.

"However, electrical furnaces pose significant technical challenges. Consol Glass is among a few glass manufacturers in the world with proven expertise in running electrical furnaces. The traditionally limited availability of natural gas in South Africa has meant that several furnaces have run either wholly or in part on electricity.

"Consol Glass is currently looking at building a test facility that would produce 100% zero-carbon glass within the next two years," the manufacturer highlights.

"The future of zero-carbon glass in South Africa is dependent on the broader renewable-energy discussion in the country, and the appetite from customers to support the effort. Once sufficient renewable energy is available and suitable energy-storage solutions are chosen, zero-carbon glass is a viable model," Consol states.

"Glass is unique in that it can be recycled and reused. Bottles, for example, can be safely refilled many times, and glass is infinitely and completely recyclable.

"Because glass packaging can be fully reused or recycled, a far lower proportion in comparison to other materials ends up in landfill. Further, even glass that does end up as waste does not degrade into harmful components, like microplastics, or produce harmful by-products," say Consol executives.

Glass packaging is made from only natural materials and does not pollute the environment and oceans. Therefore, increased usage will be significantly beneficial to ourselves and future generations, concurs Du Plessis.

"While plastics and metals can be recycled, it is much more complicated and, in many cases, cannot be recycled at or by the actual producers. Glass manufacturers, however, are able to purchase glass from any recycler directly, process or clean it on site and use it in the manufacturing process as raw material.

"Glass remains one of the best, if not the best, packaging material in terms of recycled content, environmental impact and health from consumer perspective," he says.

"The International Year of Glass is an opportunity to celebrate the pivotal role that glass has played and will continue to play in the lives of consumers, brands and retailers around the world, and reflect on how it is driving progress towards UN Sustainable Development Goals," Consol's executives say.

Article written by Schalk Burger for Creamer Media's Engineering News & Mining Weekly. The article was first published on 29 April 2022 on www.engineeringnews.co.za (republished here with permission).

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Translated by Zamantimande Kunene

AT THE CUTTING EDGE OF GLASS MANUFACTURING:

From 'lightweighting' to innovative energy reductions

Thousands of years since it was first discovered, glass remains an integral part of our lives. An ancient material with a rich cultural heritage, glass is more important to modern life than ever before: it is used in technology such as fibre-optic cables, solar panels and telescopes, architecture, art, and, of course, packaging. At the cutting edge of this ancient art, is the current quest to find more energy-efficient and sustainable ways of creating and using glass, including lightweighting – using less glass to create containers without losing too much strength. This is no small feat.

Glass is an incredible packaging material. It is inert, so it doesn't interact with its contents. It is impermeable, so it protects our food, drink and medicines from outside contaminants. And it is 100% recyclable – none of it is lost when it gets turned into another glass product – so it's especially desirable today as we look for ways to make our packaging more sustainable.

Glass is perfectly suited for use in the "circular economy" – in which materials can be infinitely recycled in a closed loop without any loss of quality. But making glass still requires energy. Glass is made inside giant furnaces, where raw materials – sand, soda ash and limestone, alongside "cullet" (recycled glass that has been crushed and sorted) – are melted together at approximately 1 500° C. The stream of molten glass is fed to container-making machines which use compressed air and metal plungers to form the glass into containers.

Finding ways in which to reduce the amount of energy used per glass container is a focus for glassmakers like Ardagh Glass Packaging (AGP). Ardagh Group earlier this year acquired the well-known South African glass brand, Consol, becoming the leading producer of glass packaging on the African continent. AGP's furnaces and facilities across the continent include advanced monitoring, automation and control systems that reduce the amount of energy needed to make high-quality glass. The first generation of renewable-energy-powered furnaces is also being tested, which will lead the way to zero-carbon glass.

But there is another method of reducing energy usage that AGP has been perfecting for more than twenty years. This is "lightweighting" – reducing the amount of material used in a container without compromising its strength.

Lightweighting

It sounds simple, but a lot of science (and some art) goes into making lighter bottles that keep consumers and contents safe. It takes time and effort to develop the skills, people and technology needed to excel in the field, but over the past two decades lightweighting has become one of AGP's core competencies, a key competitive advantage and a point of considerable pride in the company.

Ardagh Glass Packaging – Africa

Glass bottles in a glass manufacturing plant.

The company's lightweighting journey began in the late 1990s when South Africa's markets opened to the rest of the world and industries were pressured to innovate quickly to catch up.

A breakthrough in lightweighting occurred when a new bottle-forming process – the narrow-neck press-blow (NNPB) method – was adopted. NNPB uses a metal plunger to press a cavity directly into the "gob" (a small section of molten glass).

NNPB has considerable advantages when your goal is to use less material while retaining exceptional control over the final product. But this control comes at a price, namely the requirement for astonishingly tight tolerances in the process. To get the desired results the level of molten glass in the vast furnaces that feed the forming machines can't deviate by more than half a millimetre. The temperature of the molten glass supplied to the forming machine, typically around 1 200°C, can't vary by more than a degree.

Moulds running across the glass-forming machine must be meticulously aligned and maintained to precisely match so that each bottle manufactured meets the very tight specification tolerances. And because glassmaking is a non-stop process (once a furnace starts producing molten glass, stopping it is difficult and expensive), these tolerances need to be achieved 24/7, 365 for years on end!

Constant collaboration, coordination

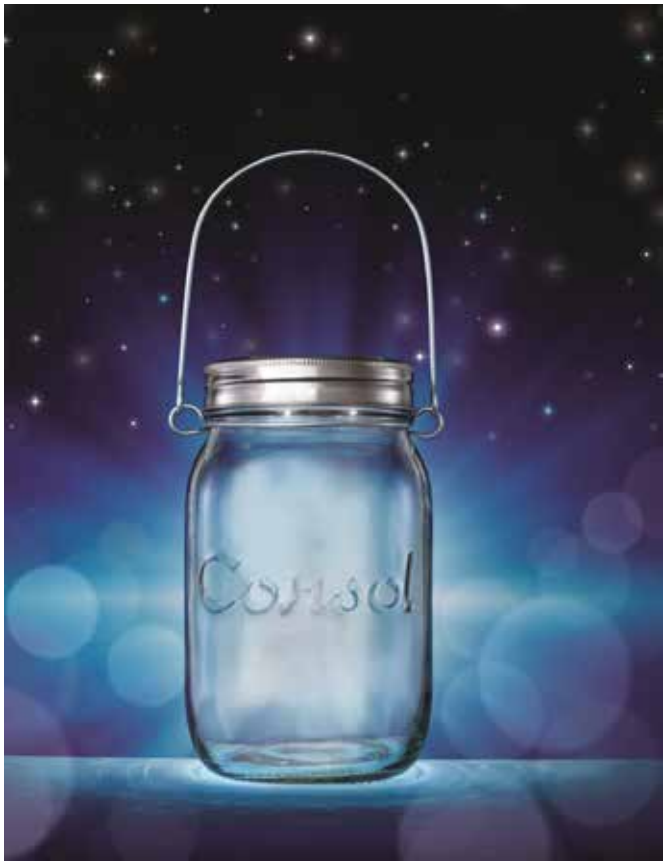
Alongside technical skill and rigorous processes, collaboration is key to a successful lightweighting project. It is a deeply interactive process that might begin with AGP's analysis of market conditions and trends suggesting a new design to a customer, or with a customer coming to AGP with a request to determine what's possible within a certain shape. Designs are drawn up, debated, and sent for stress analyses. Eventually a small trial run of physical samples will be produced, followed by a run of several thousand samples which can be tested for packing and transport.

The testing at every stage is exceptionally rigorous. It must be. There's a lot at stake when designing a lighter bottle. Absolute control over bottle strength and quality must be assured. Most bottles carry products with carbonation, and their safety needs to be guaranteed until they are eventually recycled.

Glass has been a touchpoint of celebration, commerce, culture and science for over two thousand years. The beauty, versatility and endless sustainability of the material inspire continual innovation and creativity.

Lightweighting is just one way in which the technology behind glass manufacturing continues to update the material for a changing world.

Article prepared for Quest by Ardagh Glass Packaging – Africa (formerly Consol Glass), a part of the Ardagh Group.



Ardagh Glass Packaging – Africa

One innovative use of glass was the creation of the Consol Solar Jars, creating a useful solar-powered lamp from a simple glass jar.

State-of-the-ART glass festival wows in Italy

Massimo Pistore

Photo's taken at various exhibits and installations during The Italian Glass Weeks 2022, in Venice and Milan.

In the UN International Year of Glass, the annual Vision Milan Glass Week and The Venice Glass Week united to present The Italian Glass Weeks – Italy's first festival dedicated to industrial and artistic glass in all its forms and processes, which took place in Milan from 10-18 September and in Venice from 17-25 September 2022. Herewith some photos and highlights from the various events.

In September 2022 more than 100 000 visitors participated in 267 events organised as part of the Venetian week of The Italian Glass Weeks, an important festival dedicated to industrial and artistic glass which was born from the temporary fusion of Vision Milan Glass Week and The Venice Glass Week, staged specifically for the 2022 United Nations International Year of Glass.

The festival was held in Milan from 10 to 18 September and in Venice from 17 to 25 September. This special combined edition of the festivals saw visitor numbers in Venice return to pre-Covid levels.

The numbers

The Venetian week of The Italian Glass Weeks took place around Venice, Murano and Mestre, with 267 events and initiatives organised in 148 venues by 174 participants, including foundations, art galleries, museums, cultural institutions, universities, glass factories, furnaces, companies, trade associations, artists and private Italian and foreign collectors.

Specifically, the Venetian week featured more than 130 exhibitions and installations, 42 inaugurations and special events, 27 guided tours, 14 demonstrations and workshops, 24 conferences and seminars, 11 leisure activities and 8 film screenings and concerts, as well as 10 online events designed especially for international audiences.

The two key centres of the Venetian week were the HUBs, each with their own focus. The Italian Glass Weeks – Venice HUB hosted works by 21 Italian and international artists and designers, while The Italian Glass Weeks – Venice HUB Under35 hosted installations by 20 young Italian and international artists and designers.

Another highlight of this year's edition was the programme of online events titled "Conversations on Glass" by Apice: six panel discussions covering various topics relating to the world of glass. Conducted in English in order to involve the international public, the programme was created in collaboration with Apice, a leading company specialising in the transportation and handling of works of art and glass.

Massimo Pistore

Photo's taken at various exhibits and installations during The Italian Glass Weeks 2022, in Venice and Milan.

Awards

On 24 September 2022, as one of the most significant events of the Venetian week of the festival, an Award Ceremony took place at Palazzo Franchetti, home of the Istituto Veneto di Scienze, Lettere ed Arti, during which three important prizes were awarded. The prestigious Glass in Venice Prize, jointly organised by the Istituto Veneto di Scienze, Lettere ed Arti and the Fondazione Musei Civici di Venezia, was won by the artists Marcela Cernadas and Michele Burato and by the artisan Roberto Donà for the Carlo Donà company. The second edition of the Premio Fondazione di Venezia was awarded to the Gallerie dell'Accademia di Venezia and the artist Ritsue Mishima for the exhibition "Ritsue Mishima – Glass Works".

Finally, the young artist Katerina Krotenko, whose installation "Shaped by Fire" was exhibited within The Italian Glass Weeks – Venice HUB Under35, won the third edition of the Autonoma Residency Prize, which will enable her to undertake an emerging artist's residency at Pilchuck Glass School in Seattle (USA) in 2023.

A bold vision

"The Italian Glass Weeks was the largest event in Italy, and most probably in Europe, dedicated to glass in 2022: two weeks of initiatives designed for all kinds of audiences. Culture and technology were the keywords that ran throughout the programme: not as two separate dimensions, but deeply and inextricably linked, one functional to the development of the other, according to the peculiar characteristics that distinguish them, making them unique," said Dino Necca, President of the VITRUM exhibition which also organised the Italian Glass Weeks.

"With The Italian Glass Weeks we intended to give renewed strength to the positioning of the Italian glass supply chain at an international level, underlining how the Italian proposal is unique and original. Only in Italy, in fact, does glass draw directly on origins that have created and developed a unique history and culture; culture and history that have never stopped, in a continuous flow that has brought them to us via centuries of tradition."

"We are particularly satisfied with this new project," said the Organising Committee of The Venice Glass Week in a media statement, "which could help to provide great momentum for the artistic glass sector, both this year and in the future. The five-year experience of The Venice Glass Week has paved the way for the creation of something bigger and more ambitious, thanks to the great work of all those who have always believed in the project.

"For the island of Murano, which represents the homeland of international artistic glass, and which unfortunately is suffering considerably in this economically difficult period, the new festival was a moment of rebirth, with great international visibility."

Massimo Pistore

Photo's taken at various exhibits and installations during The Italian Glass Weeks 2022, in Venice and Milan.

A history in glass

For the international public, the cities of Venice and Milan are synonymous with Italian tradition and style. Venice, thanks to the 1 000-year-old tradition of glassmaking that has been handed down from generation to generation on the island of Murano, is the city of artistic glass par excellence, as well as a capital of culture and one of the world's most popular tourist destinations.

In Venice, The Venice Glass Week festival has been organised since 2017, taking place across the city centre as well as Murano, surrounding islands and the mainland. Each year the festival has featured over 250 events, involving furnaces and glass companies as well as museums, public and private foundations, universities, art galleries, hotels, restaurants, shops and more.

Milan, which hosted the first edition of Vision Milan Glass Week, is a contemporary city which continues to represent Italy's technological progress, and which is the true capital of the country's economy, design industry and production sector. The city is home to GIMAV, the glass industry trade association belonging to CONFINDUSTRIA which represents the manufacturers and suppliers of machines, accessories, equipment and special products for glass processing. It is also where, for over forty years, glass industrialists have organised VITRUM, the international exhibition of machinery and technologies for glass processing.

Looking ahead

Following the great success of The Italian Glass Weeks, The Venice Glass Week returns in 2023 and the Organising Committee has announced the dates of the seventh edition of The Venice Glass Week, which will be held from 9 to 17 September 2023.

Article compiled from media statements by The Italian Glass Weeks organisers. For more information visit www.theitalianglassweeks.com.

Massimo Pistore

Photo's taken at various exhibits and installations during The Italian Glass Weeks 2022, in Venice and Milan.

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Bio-inspired nanofibres: Weaving biological tissue with nanomedicine to repair brains

By using biologically-inspired nanofibres as an innovative form of 'scaffolding', scientists are learning how to help the brain to repair tissue by itself, hopefully resulting in potentially far less invasive, life-saving treatments for traumatic brain injuries and tumours.

Imagine you get your test results from your healthcare provider after a consultation and you are told that you have a growth in the region of the motor cortex in the frontal lobe of your brain. If left unattended, it will grow and affect your ability to perform fine motor movements (e.g., the ability to move your hands, fingers, and wrists). The good news is that the growth can be removed. The bad news is that removing the growth may also result in exactly the same fate for your fine motor abilities due to possible impairment from surgical injury.

Do you risk the complication of losing motor function? Or do you leave the growth, let it slowly grow, and accept your fate? What do you choose? Are these the only options? These are the dilemmas that healthcare practitioners and patients are routinely confronted with in hospitals daily and globally.

In South Africa, brain trauma is a leading cause of death in children and young adults; furthermore, the incidence of traumatic brain injury (TBI) is 150-170/100 000, a higher value compared to the rest of the world at 106/100 000. There is yet to be a solution to regenerating brain tissue that exhibits consummate results of an effective clinical standard. Critical care resources to manage TBI for optimal outcomes in South Africa are also generally lacking.

Brains are tricky

Fortunately, there is an opportunity to apply pharmaceutical knowledge to design novel interventions in this regard. An aspect of our research work at the Wits Advanced Drug Delivery Platform (WADDP) research unit is concerned with fabricating scaffolds for application as tissue-mimetic implants that provide pro-regenerative platforms to support healing and tissue regrowth in difficult to heal tissues like the brain.

So what do we mean by 'difficult to heal' tissue, such as the brain? To create a solution, we must understand the problem well. There are several factors contributing to the challenge. When something penetrates the brain (e.g. surgical removal of a growth), a cavity forms which disrupts connections and creates a distance between neurons and supporting structures. The second challenge is the hostile environment created at the injury site from the formation of a glial scar, accumulation of inhibitory molecules, and the secretion of free radicals via the blood-brain barrier (BBB) breach resulting in secondary injury. This response is a double-edged sword.

On the one hand, this is a necessary response to injury; the brain forms this glial scar to protect the surrounding healthy tissue from secondary damage. However, this is

at the cost of regenerative capacity because surrounding cells cannot survive the hostile environment nor penetrate the scar tissue to reconnect with neurons on the other side. Reconnection of neural networks is essential to keep the communication flowing so that you can communicate to your brain that your hand is on fire, and your brain can communicate back to your hand to move out of the fire!

Clever scaffold-building

To support the reconnection, we use tissue-mimetic biomaterial scaffolds. A biomaterial is a material that can interact with biological systems and influence cells to behave in a certain way. Hence the name "bio" and "material". These materials can be in the form of synthetic, natural polymers or a combination thereof. An example of a polymer used for biomedical applications is gelatin; as you know, gelatin is also used to make candy and Jelly!

Polymers are selected based on processability into the scaffold designs we want and material closeness to that of the native extracellular matrix (ECM), the home of the cell. A scaffold, just like the scaffolding you would encounter at construction sites, functions as a temporary 3D structure providing support and a 'bridge' at the cavity site created after the healthcare provider removes the growth to help the cells cross and reconnect to communicate for tissue continuity.

A tissue-mimetic biomaterial scaffold should be designed to "mimic" the target tissue-building requirement needs. When we talk about tissue building requirements, we talk about the ECM, the home of the cell. The important thing to note is that the ECM of each tissue has a unique architecture. The brain has been previously described as resembling foam, once described as an "intricate interwoven fibre meshwork of collagen and elastic fibres embedded in a highly hydrated gel-like material of glycosaminoglycans, proteoglycans, and glycoproteins". Examples of tissue-mimetic three-dimensional biomaterials scaffolds synthesised at WADDP include but are not limited to hydrogels, cryogels, nanofibres and the combination thereof (Figure 1).

Let's zone in on nanofibres as examples of biologically inspired scaffolds and ways they can be used as a strategy to weave biological tissue with nanomedicine to solve our dilemma with the growth in the brain.

Nanofibres are defined by their name. The 'fibre' portion refers to the threadlike shape of the fibres (Figure 2). The 'nano' portion refers to the size of the nanofibres. Nano size refers to a size that is 1 billionth of a meter. This means that the nanofibres are so tiny that you will never be able to see one with the naked eye. What you see instead is a 'nanofibre mat', which is simply hundreds and thousands of single intertwining nanofibres overlaid on top of each other (Figure 2b). Compared to everyday objects like the diameter of the thin silk spun from a spider that is already barely visible to the naked eye (approximately 3 500 nm), nanofibres are approximately 300 nm, making them 14 times smaller than a spider's silk thread. Therefore, the actual image of a nanofibre can only be seen using an electron microscope (Figure 2c).

The female *Nephila clavipes* spider (see main photo) has a spider web silk strand of a few micrometers (µm) thickness in this electron micrograph (Figure 2a). Nanofibres are electrospun at the WADDP research unit with Figure 2b being an electrospun nanofibre mat and Figure 2c a scanning electron micrograph of nanofibres, at the same scale bar = 1µm. They are tiny!

Despite their small size, nanofibres have a very big role in society, with a wide range of evolving applications in healthcare, such as gene and drug delivery, cell therapy, cancer therapy, tissue engineering, regenerative medicine and use as biosensors. Figure 3 depicts the conceptual application of nanofibres as brain implantable tissue-

Figure 1: Examples of biomaterial scaffolds fabricated at WADDP

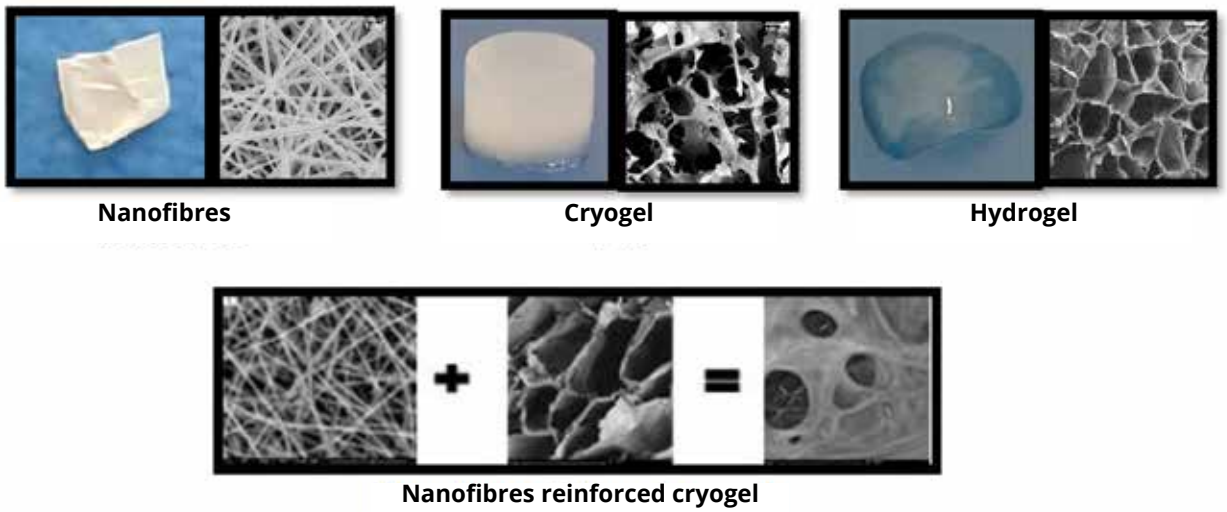
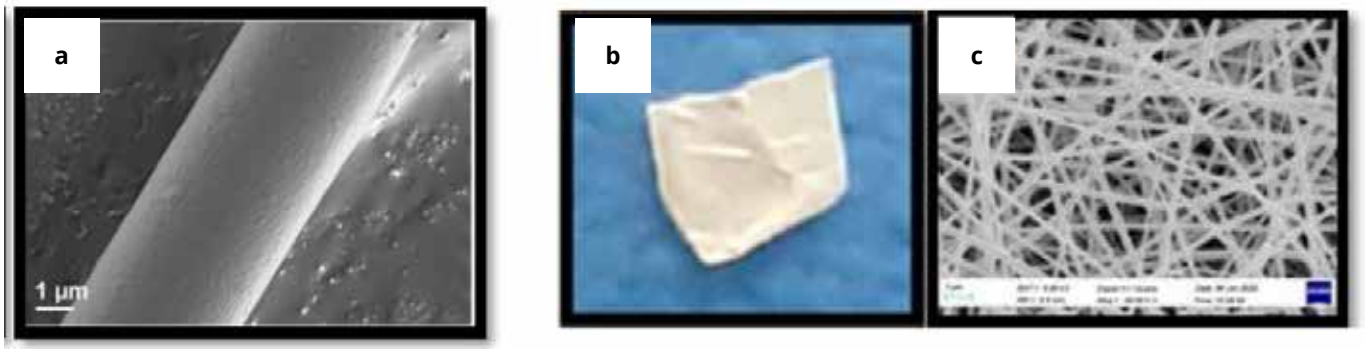


Figure 2: Explaining electrospun nanofibres



mimetic scaffolds able to be loaded with a drug to be delivered to the brain.

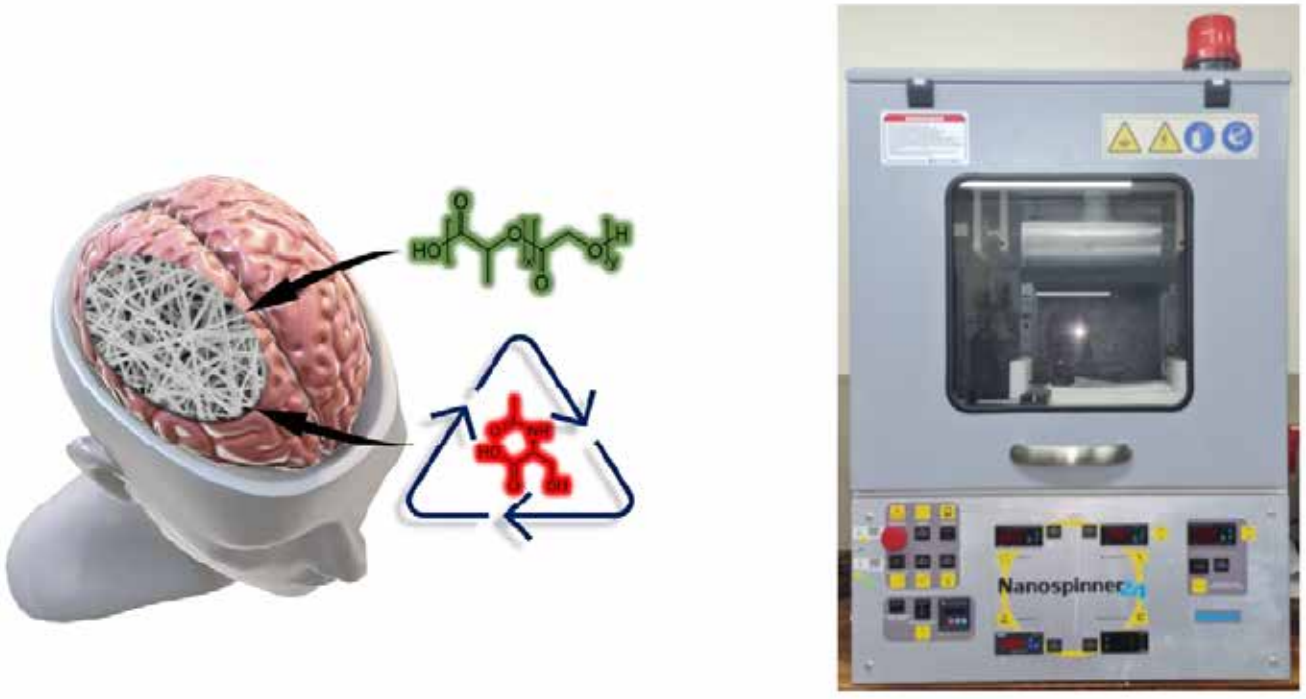
Loading drugs into nanofibres is achievable because of the ease and flexibility of the electrospinning method used to fabricate nanofibres. Moreover, nanofibres present a nanoscale architecture closely resembling the aforementioned native ECM structure of tissues like the brain. They also present with a very large surface area to volume ratio, which allows more space for presenting topographical cues to support the attachment of neural cells, their guided migration and the extension of their processes and axons across the distance of the cavity site to help with the desired tissue reconnection. The ability to guide cell growth is a major advantage of nanofibres' structure to ensure neurons extend towards each other instead of 'circling' around aimlessly.

Revisiting our case scenario, could nanofibres be a viable intervention in the future to minimise the risk of losing motor function after the tumour is removed? You decide! Cutting-edge breakthrough research, passion and curiosity are key to developing novel actionable solutions to multifaceted healthcare problems.

This requires looking at materials and delivery systems with an openness to their potential for application and problem solving (e.g. application of nanofibres as implants, wound dressings, nanofibrous gels, drug delivery systems and biosensors). This has been a small glimpse into the world of WADDP. If you are curious and need more helpful resources on subjects like nanofibres and other drug delivery systems, get in touch or visit https://www.wits.ac.za/waddp/.

Article written by Gillian Mahumane and Yahya Choonara from the Wits Advanced Drug Delivery Platform (WADDP) research unit of the Department of Pharmacy and Pharmacology in the Faculty of Health Sciences at the University of the Witwatersrand.

Figure 3: A conceptual diagram of nanofibres as brain implantable drug-loaded tissue-mimetic scaffolds (left) and the NanoSpinner24 machine used at the WADDP research unit for electrospinning of nanofibres (right)



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INSPIRING GREATNESS

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A truly global effort to battle PARKINSON'S DISEASE

The battle against Parkinson's disease has in recent years gone truly global, with South African doctors and researchers collaborating with colleagues from all across the world – showing the reach and strength of collaborative science.

Diseases that arise from the death of neurons within the brain are called neurodegenerative disorders. Parkinson's disease (PD) is a complex neurodegenerative disorder that affects dopamine-producing neurons in a region of the brain called the substantia nigra, shown in green (Figure 1). The death of these neurons and subsequent reduction in the hormone dopamine leads to movement problems such as rigidity, tremors, difficulty standing, and overall slow movement. The disorder is also considered degenerative as the symptoms get worse over time requiring more specialized care. There is no cure available for the disease with only so-called non-palliative treatments available, those that treat the symptoms of the disease rather than the cause.

PD is the result of the complex interplay between environmental factors, ageing, and genetic factors (Figure 2). Most PD cases (~ 90%) are sporadic, meaning that there is no family history of the disorder. Therefore, it is difficult to determine the underlying causes of the disease. As a result, researchers often study PD cases with a genetic cause, which relates to a person's specific genes.

When an individual is born, they inherit their genes equally from their parents. We know that some diseases occur more commonly in people that carry certain genetic abnormalities. For example, a child whose parents have

Figure 1: Section of the brain showing the location of the substantia nigra (green)

Type I diabetes is more likely to develop this disease themselves. A similar trend is seen in PD, whereby people with the disorder may have inherited a genetic abnormality from one of their parents that have the disease which made it more likely that they would get the disorder. These individuals can be useful for genetic studies which aim to better understand the causes of PD.

To study individuals with PD, they are recruited along with any of their family members that also have PD. The

DNA of these individuals as well as their affected family members are analyzed to find any genetic abnormalities. This approach has been relatively successful and has identified several genetic abnormalities in genes that are associated with PD, such as *SNCA, LRRK2, PINK1*, and *PRKN*. Analysis of these and the other genes identified has led to a better understanding of several of the cellular pathways underlying the progression of PD, improving our overall knowledge of the disorder.

However, to date, these PD genetic studies were mainly performed on European populations. Due to the early migration of populations out of Africa, each population has their own distinct genetic heritage and single DNA base changes, called single nucleotide polymorphisms (SNPs). Therefore, results from one population are not always relevant to another. This is important as the underlying cause of PD in these populations may be different from European populations and therefore treatments for PD may not be as efficient.

Our research group at Stellenbosch University focuses on studying PD in Sub-Saharan African (SSA) populations. There is a rich genetic diversity in these populations. Indeed, in PD, we and a few other African researchers have shown that known PD genes found in European populations are not often found in SSA populations. Therefore, there is an urgent need to do more genetic research on under-represented populations.

In an effort to do this, large worldwide collaborative groups studying PD have been established. One of these, the Global Parkinson's Genetics Program (GP2) is a collaborative program which aims to better understand the genetics of PD by studying diverse patient groups. The program has acquired cohorts of PD patient data from 56 unique locations around the world (Figure 2). They will be sequencing the DNA of these individuals to find genetic abnormalities. Approximately 160 000 samples are expected, making GP2 one of the largest collaborative efforts examining PD. Our research group and several others across Africa will be sending samples from their local populations to GP2 for sequencing. This should hopefully greatly improve our knowledge of PD in under-represented populations.

Large-scale collaborative science is the future of genetic research, and of research in general. It allows for the sharing of ideas and findings and a greater availability of resources. However, we always have to remember that the most important aspect of PD research is the patients. These collaborations would not be possible without the willingness of PD patients to participate in genetic studies. We are immensely grateful to all the patients that have participated in our studies over the years.

We encourage you to speak to your friends and family members and spread the word on this debilitating disease. Unfortunately, the symptoms of this disease are often confused with normal aging due to people being unaware of PD. By spreading the word and encouraging others to do the same, you might be able to improve the quality of life of people who unknowingly have PD.

If you or any of your family or friends have questions or are interested in finding out more about PD or our research, more information and our contact details are available on our university website: https://www.sun.ac.za/english/faculty/healthsciences/Molecular_Biology_Human_Genetics/parkinsonsdisease.

Article written by Katelyn Cuttler, Kathryn Step and Jessica Burns from the Parkinson's Disease Research Group of the Division of Molecular Biology & Human Genetics at Stellenbosch University.

Figure 2: World map showing the location of all the contributing countries involved in the GP2 initiative

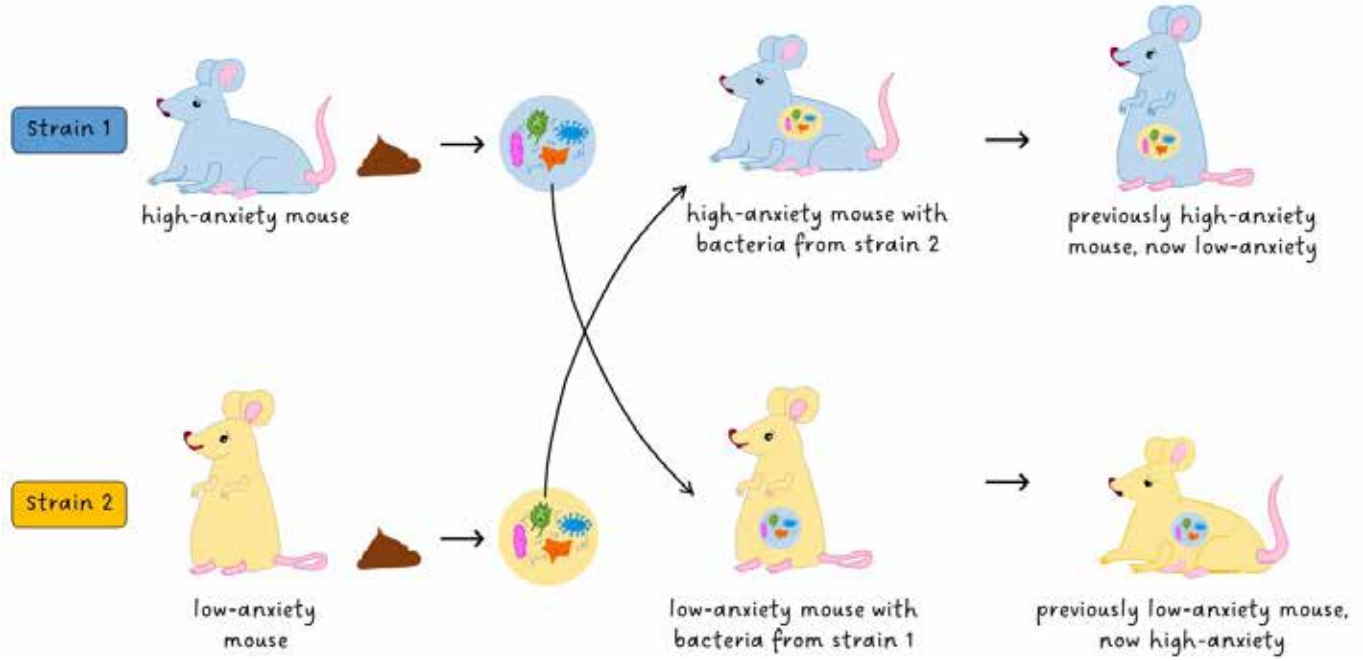
Get the scoop on MENTAL HEALTH and poop!

The trillions of microscopic organisms that live in our gut and make up our microbiome can play a significant role in our mental health, how we perceive and respond to stress and potentially how anxious we are. Altering our gut microbiome may help us treat mental health disorders like anxiety.

It may give us the heebie-jeebies to think about trillions of microscopic organisms squirming around inside and all over us – however, they play a significant role in our physical and mental health, and cannot be ignored. These complex communities of microbes, including bacteria, viruses and fungi, are collectively known as the human microbiota. They can be found on our skin, in our nose and mouth, and especially in our gut (mainly the large intestine). The gut microbiota, together with the DNA of these microbes, is referred to as the gut microbiome.

Most of the gut microbiome consists of bacteria, the number and species-composition of which can drastically change depending on lifestyle factors such as diet, antibiotic use, and stress levels. However, not only do we influence the microbiome, but the composition of the microbiome can significantly influence us, as it can affect our immune system, how we metabolise foods and medicine, and importantly, our mood and behaviour. In fact, these effects are so profound that some researchers have called the gut microbiome the last human organ to be discovered. However, the idea that our gut is associated

Figure 1: Illustration of the effect of 'poop-swapping' in mice on anxiety-like behaviour



with our emotions has been around for thousands of years (just think of the terms "gut feelings" and "gut instincts") – so maybe we've unknowingly acknowledged the gut microbiome for longer than we think!

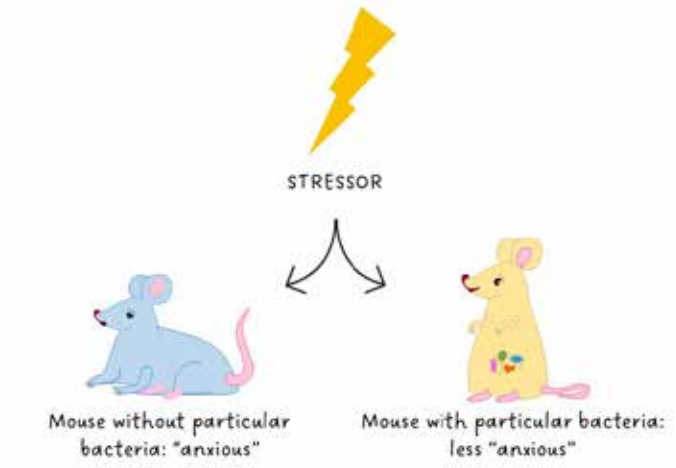
Many studies have been done in animal models to provide evidence that the gut microbiome has a significant impact on behaviour. One such study looked at two strains of mice – one strain exhibits anxiety-like behaviour, and the other a more relaxed behaviour. After microbes from faecal matter were transplanted from one strain to the other (essentially a 'poop-swap'), the previously highly anxious mice showed more relaxed behaviour, and the previously relaxed mice showed more anxious behaviour (Figure 1).

Another study exposed mice to a stressful situation, while recording their anxiety-like behaviour. After this, scientists introduced a certain type of bacterium (a particular *Bifidobacterium* species) into the gut of those mice. When exposed to the same stress, this time with the new bacteria present in their gut, the mice exhibited less anxiety-like behaviour than before. This shows us that something as simple as adding one type of bacteria to the gut microbiome can significantly change behaviour (Figure 2).

But how does this work? Well, the human body is complex, and its working can be compared to that of a busy city with many roads and cars. To address stressful situations that arise in the city, there are response vehicles, such as fire trucks and ambulances. During these situations, some roads may close to allow the emergency vehicles to deal with the situations.

Similarly, the human body has a method of responding to stress. It has its own 'vehicles' that are part of the stress response – these are molecules known as hormones and neurotransmitters, and these can affect how happy, sad or anxious we feel. To control the concentration of these molecules (which molecules and how many of them are present), the body has pathways that work like roads – sometimes some routes need to close, and some vehicles need to be redirected to ensure that the right vehicles reach the right place at the right time.

Figure 2: Illustration of different stress responses in mice before and after the introduction of certain gut bacteria



This is where the gut microbiome comes in – not only can it produce hormones and neurotransmitters, but it can also affect the pathways that regulate these molecules; this is how it affects our mental state.

Although we understand some of the mechanisms of how the gut microbiome affects mental health, there are still a lot of unanswered questions, such as what makes a gut microbiome 'healthy', which microbiota (or combination thereof) are 'good' or 'bad', how exactly does the microbiome communicate with the brain, how does the microbiome interact with environmental and genetic factors to collectively influence mental health, and many more.

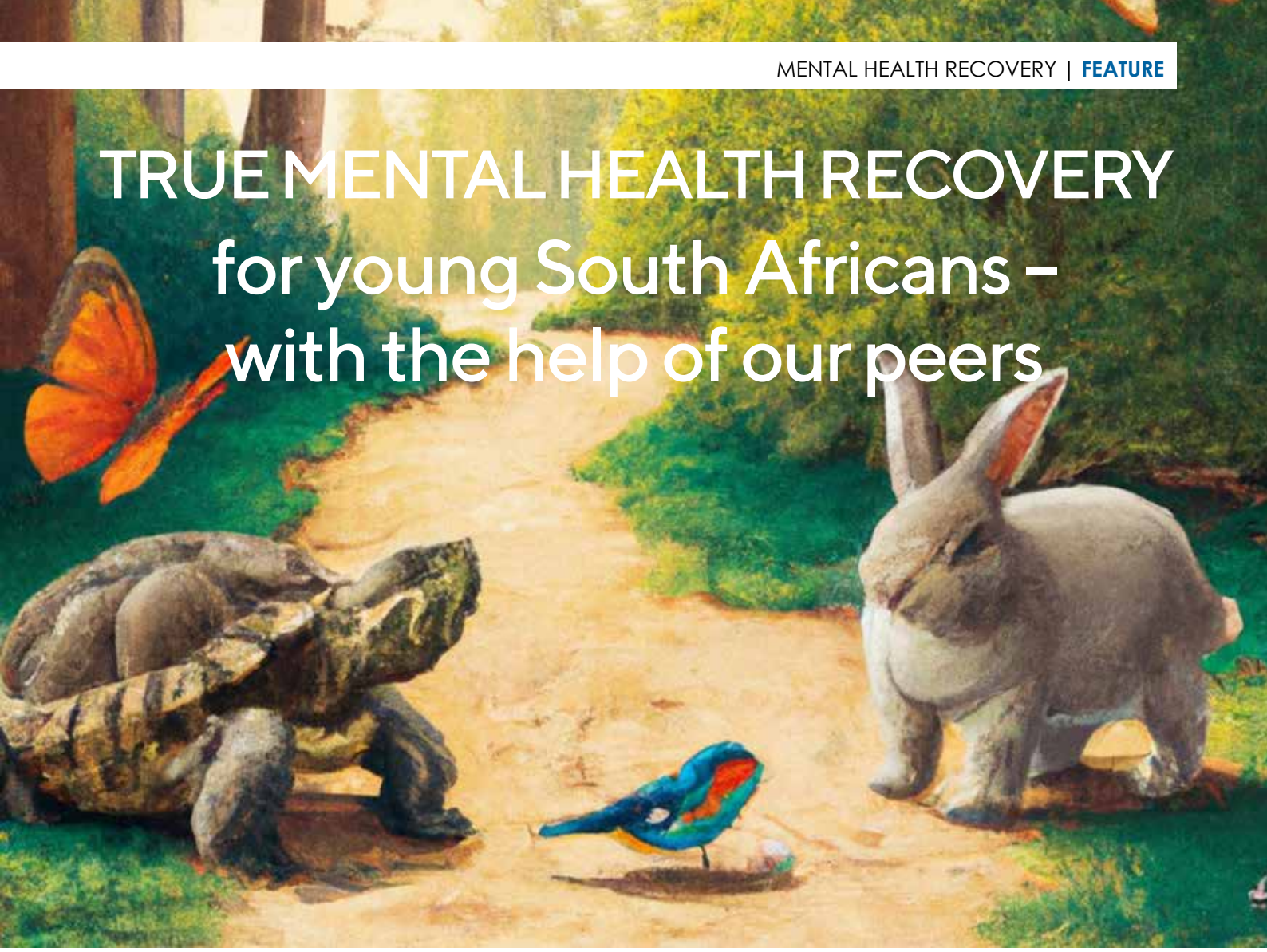
To address some of these questions, researchers at Stellenbosch University are studying what kinds of microorganisms live in our gut and whether they differ based on mental health status. As part of the saNeuroGut Project, participants (> 18 years) volunteer to send of their stool samples to the lab, from which researchers extract and sequence microbial DNA. Sequencing is a method to determine the order of nucleic acids (the building blocks of DNA). The sequence of certain regions of DNA (in the case of bacteria, the 16S rRNA gene) can tell us which types of bacteria are present in our gut microbiome. Once we know which bacteria are present, we can investigate how they interact with human physiological mechanisms. For instance, certain bacteria may produce chemicals that interact with the immune and stress response systems to alter the pathway of molecules that communicate with the brain, possibly resulting in psychiatric disorders, such as anxiety and depression.

This is why studying the gut microbiome is so important: if we can identify the gut microbial composition associated with good mental health, we may be able to use the gut microbiome as a therapeutic target to treat mental disorders.

South Africa has a high prevalence of mental health disorders, but our rich culture and diverse population provides an opportunity to investigate many factors that may alter the gut microbiome and how this relates to mental health. The saNeuroGut Project intends to mark South Africa's contribution to this growing area of research and uses a citizen-scientist approach, thereby creating a space in which to communicate, educate and engage with participants. So, just as you should follow your gut, follow us through this research journey via Facebook page – SA NeuroGut.

Written by Michaela O'Hare, Karlien van Rooyen, Patricia Swart and Sian Hemmings. The authors are part of the saNeuroGut Project which explores the role of the gut microbiome in mental health disorders, specifically depression, anxiety and posttraumatic stress disorder. The saNeuroGut Project is an ongoing study in the Neuropsychiatric Genetics group in the Department of Psychiatry at Stellenbosch University (www.saneurogut.org).

TRUE MENTAL HEALTH RECOVERY for young South Africans – with the help of our peers



In Aesop's fable, The Tortoise and the Hare, each character tries to overcome their personal challenges alone. A recovery approach to mental healthcare can help us face these challenges together and, in the Beatles' famous words, "get by with a little help from our friends."

Mental health is not mental illness

In a developing South Africa, a country rich in culture and in recovery from a painful past, mental health challenges can hamper the healing and upward progression of the youth. Mental health conditions (MHCs) like depression, anxiety and suicide are on the rise globally and affect people of all races, genders, and socioeconomic backgrounds. With the age of onset of most mental health diagnoses being in adolescence and early adulthood, and with nearly half of South Africa's population being under the age of 25, it is pivotal to educate our youth about the warning signs of declining mental health and to connect them to meaningful resources and supports.

Mental health IS health and mental health recovery IS possible. Our mental health affects the way we think and feel from day to day, the way we interact with people we care about, and our ability to do things that are meaningful to us. Signs of poor mental health range from experiences of feeling overwhelmed, prolonged sadness, anger, and irritability, decreased participation and productivity, and strained relationships, to mental illness diagnoses like depression and anxiety disorders, addiction, eating disorders, and psychosis.

The stigma that exists towards people with symptoms of mental illness prevents people from accessing help when their mental health is declining and causes them to suffer in silence. Poor mental health does not necessarily mean mental illness but can result in mental illness without the appropriate support.

Public mental healthcare in South Africa

The COVID-19 pandemic coupled with the strict stay-at-home lockdown in South Africa, resulted in increased levels of stress due to the trauma of loss, financial insecurity, social isolation, and intimate partner violence experienced.

Although South Africans reported struggling with their mental health, over 60% of young people did not seek help for mental health concerns. The pandemic also uncovered deficiencies within the system of mental healthcare in our country. In addition to poor help-seeking for mental health,

Figure 1: Words used by South African public mental health service providers, users, and carers to describe recovery

those who seek help in the public sector are made to rely on medication and hospitals to treat their suffering, with little support and services within communities that facilitate community integration and holistic recovery.

Mental health recovery

In South Africa, and other low-and-middle-income countries (LMICs), traditional approaches for people with mental health challenges are primarily biomedical, focusing on the reduction and remission of symptoms; this is called clinical recovery. Medication, prescribed by doctors and psychiatrists, is used to manage acute mental health symptoms, and management takes place in psychiatric and psychological departments of hospitals and clinics.

The biomedical approach helps clinicians meet demands in the time-pressured South African public mental health system, but clinical recovery has many limitations. Research has shown that for affected persons living with MHCs to lead satisfying and meaningful lives, recovery also needs to take place in the functional, social, and psychological domains.

Well-known researchers in the field have described recovery as:

"... a deeply personal, unique process of changing one's attitudes, values, feelings, goals, skills, and/or roles. It is a way of living a satisfying, hopeful, and contributing life even within the limitations caused by illness. Recovery involves the development of new meaning and purpose in one's life as one grows beyond the catastrophic effects of mental illness" (Anthony, 1993, p. 15) or simply put, "to live well in the presence or absence of one's mental illness." (Deegan, 1988, p. 1).

Functional recovery involves improving the ability to do things for oneself, like being able to concentrate and participate in the classroom and the workplace.

Social recovery focuses on relationships and inclusion in community and involves maintaining and creating friendships and communicating with partners and family.

Psychological recovery is more abstract and includes helping people understand their identity, develop agency, and find purpose, hope, and empowerment.

In South Africa, functional, social, and psychological aspects of recovery are addressed by occupational therapists, social workers, and psychologists in the system. These aspects are treated as complementary to traditional medical approaches and are often neglected due to the large numbers of persons seeking care, scarcity of resources, and lack of willpower of healthcare decision-makers, which results in a lack of funding in mental healthcare.

Recovery should receive a widespread focus and be formally implemented into public mental healthcare policy and service in South Africa. Although the National Mental Health Policy Framework (2013-2020) included mention of recovery, it was, unfortunately, not successfully implemented and lapsed with no other policy document in its place. There needs to be a shift in focus from an emphasis on the biomedical approach to the practice of recovery-oriented care to allow South Africans living with

mental health conditions to resume and build their lives outside of the hospital setting.

The role of peer support work

In other countries around the world, recovery is becoming a standard way of care. The United Kingdom, Australia, Canada, New Zealand, and the United States of America, among others, focus strongly on functional, social, and psychological aspects of recovery and have incorporated these into their care systems. This has resulted in the emergence of a new carer role of peer support workers (PSWs) or peer specialists.

In addition to sharing lived experiences with service users (SUs), known as patients in the biomedical model, PSWs are also part of the communities that SUs live in and this gives them unique insight into the psychological, social, and cultural needs of people with MHCs.

Peer support work thus serves as a significant role within multidisciplinary teams that are more traditionally comprised of licensed psychiatric nurses, occupational therapists, social workers, and psychologists trained in Western approaches to mental health. Although peer support work still faces challenges, such as a lack of understanding of its place, role confusion, and stigma, it has been shown to improve SU self-stigma, involvement, empowerment, and leads to better outcomes overall.

Peer support workers (PSWs) have their own lived experiences with mental health challenges and play a meaningful role in multidisciplinary teams, helping to heal and empower people within their communities. We do not need to run our races alone, the path to recovery is possible with the help of our peers.

What could a recovery approach mean for South Africa?

The benefits of a focus on mental health recovery are numerous. It would mean a more balanced approach to the health of persons living with MHCs, and directly impact SU adherence to treatment, mental health episode relapse, and need for hospitalisation, which, in turn, would mean less costs in public mental healthcare.

A recovery approach should include the training of PSWs to work on multidisciplinary teams. PSW provides much needed job opportunities for service users and relieves the large burden of care that exists in LMICs. SUs are also more likely to trust and build rapport with PSWs, which improves help-seeking and helps address social and cultural barriers to care.

A recovery approach ultimately leaves people with mental health conditions feeling empowered by encouraging collaborative decision-making to achieve meaning, purpose, and hope in life. Recovery is the key to SUs living more satisfied lives, participating more actively in their communities, and, in turn, contributing to society as a whole.

For more information contact the authors at adewet@bu.edu or lisaaug@bu.edu.

Article written by Anneliese de Wet, currently a postdoctoral fellow at the Center for Psychiatric Rehabilitation (CPR) at Boston University in the USA, and Lisa Augustine, a medical doctor from South Africa and visiting fellow at the CPR.

Mental Health Resources for Adolescents and Young Adults

Seek advice:
Mental Health and Young People – SA Federation for Mental Health
https://www.safmh.org/mental-health-and-young-people/

Find support:
South African Depression and Anxiety Group (SADAG)
https://www.sadag.org/index.php?option=com_content&view=article&id=3118&Itemid=193

Get Involved:
Global Mental Health Peer Network
https://www.gmhpn.org/membership.html

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Backing the bugs (to control water weeds)

megamelus_scutellaris_D_Taylor_waainek2

Our 'secret agent' bugs, the water hyacinth hoppers, or *Megamelus scutellaris*, on a water hyacinth leaf.

Water weeds are invading many of our waterways, with hyacinth being the most infamous of all. Through community engagement and community involvement, researchers are nevertheless working hard towards the shared goal of clearing the water systems that are invaded with hyacinth and other water weeds. The most effective method of control has been to use bug 'secret agents' to control these populations.

The Centre for Biological Control (CBC) is a research centre based at Rhodes University although it collaborates with many institutes in South Africa and abroad. The CBC focuses the majority of their research on understanding the ecological dynamics of invasive pests, and the biological control of aquatic and terrestrial weeds in particular.

A large proportion of this work is the development of biological control methods for these invasive plants, which can then be used by implementers and managers. Biological control is a process whereby natural enemies, that are host-specific, are used to control populations of the invasive species. It is a particularly appealing solution because it is not toxic, pathogenic or dangerous to humans. It also does not harm non-target organisms found in the environment and is safe. There are a number of different research programmes within the CBC which focus on various groups of target plant species, and different aspects of biological control.

Weedy waterways and bug agents

South Africa has a particular problem with aquatic weed species which includes water hyacinth, parrot's feather, *Salvinia* spp. and water lettuce. Biological control continues to be the most successful method of control for the aquatic weeds.

We have seen continued success in the control of water hyacinth following a focused mass-rearing and release campaign of the insect known as the water hyacinth hopper, *Megamelus scutellaris*, at a number of invaded sites around the country, including Hartbeespoort, Roodeplaat and Bospoort dams.

This joint venture, whereby community members rear agents (the bugs) or financially support biocontrol on these systems, has been highly successful. There are currently 10 small-scale mass-rearing facilities around dams in the highveld region resulting in huge numbers of the bug

IMG_1742

A CBC researcher, together with a community member, releasing biocontrol agents (bugs) onto a controlled hyacinth population.

agents being released against water hyacinth. In addition, the CBC ran a crowdfunding page earlier this year and managed to raise over R120 000 to support the CBC's efforts to keep sending biocontrol agents from Makhanda's mass rearing facility on a regular basis.

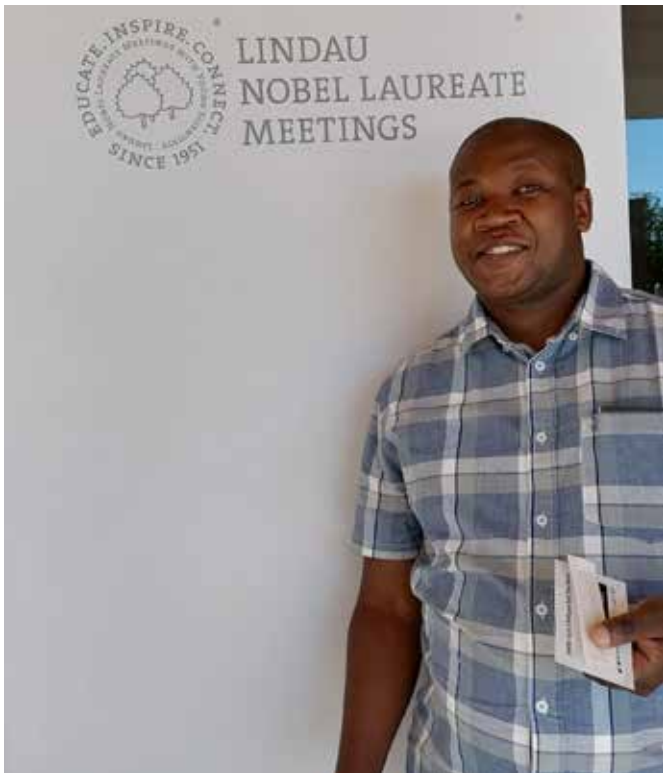
The CBC continues to drive the implementation of their research through engaging with community members who are on the ground. By backing the bugs that we release on your water systems to do this very necessary job, you too can play your part!

Article written by Kim Weaver, community engagement officer of the Centre for Biological Control in the Zoology and Entomology Department at Rhodes University.

https://pixabay.com/photos/water-hyacinth-plant-purple-blossom-989003/

Ukhula lwasemanzini luhlasela amanzi amaningi esiwasebenzisayo, ikakhulukazi i-hyacinth, okuyiyona evelele. Ngokubambisana nemiphakathi, abacwaningi basebenza kanzima ukukhuculula amanzi asehlaselwe i-hyacinth nolunye ukhula olutholakala emanzini. Indlela esebenza ngempumelelo ukukhuculula lolukhula ukusebenzisa I bug "umcuphi oyimfihlo".

Translated by Zamantimande Kunene



Dr Nzondelelo Bingwa

Interview: Accomplished young scientist visits with Nobel Laureate idols in Germany

Dr Nzondelelo Sigqibo Bingwa, (32), a senior lecturer at the University of Johannesburg, was one of a handful of young South African scientists who were chosen to attend the 71st Lindau Nobel Laureate Meeting that was held from the 26 June to 1 July 2022 in Lindau, Germany. We spoke with him about the experience and his journey as a young scientist.

Tell us a little bit about your background?

I was born and raised in the dusty streets of Khayelitsha in the Western Cape. I obtained my junior degrees, B.Sc and B.Sc honours, at Walter Sisulu University (WSU) in Mthatha, Eastern Cape. I then moved to the University of Johannesburg (UJ) in 2013 to pursue a M.Sc degree and completed it with distinction in 2014. After obtaining the M.Sc, I immediately enrolled for a Ph.D at UJ. During my Ph.D studies I spent time at the University of Erlangen-Nuremberg (Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany) where I performed some of my Ph.D experiments.

My research niche is on heterogeneous catalysis – a journey I started during my time as an M.Sc student. Heterogeneous catalysis deals with the design and application of materials (catalysts) that speed up chemical reactions without them getting consumed in the reaction. Among the catalysts I researched, I worked on application nanoparticles as catalysts for degradation of toxic dyes released with industrial wastewater. This research is important because if these toxic dyes, such as 4-nitrophenol and methylene blue, remain in our water streams they might cause adverse health risks to humans.

Currently I am focusing on the design of mixed-metal oxides for catalytic applications in conversion of bioderived molecules to value-added chemicals. This research work looks at possible ways of synthesizing substances that can be used, for example, as fuel-additives from chemicals extracted or produced via renewable processes, making the entire process a green-route to synthesis of important chemicals.

The outcomes of all my research projects are communicated as research articles in accredited international peer-reviewed journals. To date, I have published more than 30 research articles and 1 book chapter. I published the book chapter with a scientist from the Joint Institute for Nuclear Research (JINR) and the University of Dubna, both in the Moscow region of Russia. The book chapter describes processes of making solar-cells for energy generation and the characteristics of the materials used for application in solar-cells.

How did it happen that you were invited to attend the Lindau Nobel Laureates meeting in Germany?

A call for nominations of young scientists across South African universities by the Academy of Science of South Africa (ASSAf) is normally opened few months before each Lindau Nobel Laureate Meeting. I was nominated by a colleague from the Chemical Sciences Department at UJ. The nominations are screened by ASSAf and the second phase involves a strict peer-review process by a scientific review panel of the Council for Lindau Nobel Laureates Meeting in

Germany. It is only after this rigorous screening process that I was offered an opportunity to attend the meeting.

What was the experience like?

We spent 8 days in Lindau attending fascinating talks by Nobel Laureates and interacting with young scientists from other countries. The meeting is one of the best scientific gatherings I have ever attended. The nature of the meeting is designed to enable maximum interaction between young scientists and the Nobel Laureates. It is an amazing environment that not only brings one in close proximity to people with impactful scientific work but also induces the desire to work hard and contribute to your scientific field of choice.

In addition, the meeting provides a platform for networking with other young scientists. A platform that gives a glimpse of diverse research cultures from all corners of the world. This is one of the aspects that make Nobel Laureates Meetings a dream gathering to attend for all aspiring scientists.

What were the highlights for you personally?

During the first few hours of the meeting, it was tense thinking of how to approach some of the Nobel Laureates I'd like to have conversations with. However, after a few icebreakers it became easy to engage and have scientific conversations with Nobel Laureates. The best moment for me came during a tea break when I had a lengthy conversation with Prof. Peter Agre from Johns Hopkins University in the USA. At first, the conversation was centered around the type of research I do at UJ. Later, we spoke about the diversity, inclusiveness, and the future and role of science in solving problems of the 21st century. For me, this was a fascinating conversation because of the way the scientific community had evolved and opened for all diverse groupings worldwide.

Prof. Agre spent many years working in various parts of the African continent and is aware of the challenges we face as scientists in Africa. He shared his experiences of the malaria research wing in Africa and how different regions deal with malaria.

Another highlight is the interaction I had with South African-born Nobel Laureate, Prof. Michael Levitt. What was interesting to note was the fact that Nobel Laureates and communities across Europe and other continents take note of South Africa's scientific research. In our conversation, Prof. Levitt congratulated South African institutions for the big role they played during the COVID-19 pandemic and encouraged young scientists in South Africa to look at the great contribution South Africa made during the pandemic and use that as motivation to keep striving for excellence. This was heartwarming and inspired me to keep working hard.

What did it mean to you to be invited?

The Lindau Nobel Laureate Meeting is a prestigious event. Attending the event is special, a once in a lifetime opportunity. To be invited to such a meeting after a strict and competitive screening process serves as a motivation for me to keep working hard. It also shows that my scientific endeavors are being recognised and there are people encouraged by what I do in the laboratory and by how I conduct myself as a young scientist. I am grateful for the opportunity.

Having taken part in scientific engagements in the Lindau Nobel Laureate Meeting means that I now have the responsibility to inspire other young scientists in our country. Importantly, I must play a role in promoting science among the youth in South Africa and educate and inspire the future scientists of our country. This is a role I hope to play going forward.

What advice would you give to other young scientists or learners who are considering a career in science?

Scientific careers are important to our quest for a safe and habitable planet. Therefore, pursuing a scientific career will always open doors to many opportunities in the world of work. There are always new problems arising such as the emergence of new diseases and global warming and all these require scientific solutions. To achieve scientific solutions, we need people with the correct skills set and those can only be hard working scientists. Therefore, my advice to learners considering careers in science is to try and familiarise themselves with the various scientific fields and choose wisely, choose a field that they are passionate about. There are career expos across the country, and it is important to visit these spaces and engage with the scientists and find out about the different careers and the job opportunities related to each career.

To the emerging scientists, we are now the hope of the world. We need to practice science responsibly and respond with the aim of contributing to the challenges our societies face. We must always strive for research excellence by working hard and by doing research that has a direct impact on the current challenges faced by our country. For example, we are currently facing energy crises and it is us who must devise ways to solve the crises. Lastly, the world is moving at a fast pace, and we need to keep reinventing ourselves by acquiring skills that are relevant in solving modern problems.

Please add anything else you feel is relevant.

I would like to express my sincere appreciation to Prof Philiswa Nomngongo for nominating me and the Council of Lindau Nobel Laureates for inviting me to attend the meeting. The exposure to diversity in science and the networking opportunities during the meeting will go a long way in shaping up my scientific career. Also, I would like to thank ASSAf and DSI for making it possible for me to attend the meeting. The financial support and planning of the trip to Germany would not have been possible without the support from ASSAf staff, Kholani Mbhiza and Dr Melusi Thwala.

The "How to Get Ahead During and After School" Series

Part 3 – Grade 12, a survival kit and life after school

Introduction

This article is the third and final in a series that aims to give learners information on how to make better decisions about their future. The series was in response to an article that was published in *Science Matters* by the National Research Foundation (NRF). The box below gives an excerpt from that article. Here, we provide some guidance and suggestions for you for Grade 12 and for life after school.

The National Senior Certificate (NSC) is the current matriculation (matric) certificate with Grade 12 as the matriculation grade. The NSC, previously known as the Further Education and Training Certificate (FETC) replaced the Senior Certificate in 2008.

Matric is a highly valued grade because you need to pass Matric in order to be awarded a NSC which is a qualification you need to study further after school and sometimes also to find work.

There are many subjects in Matric, however, you need to study seven subjects. There are four compulsory subjects: your Home Language subject; a First Additional Language subject; Life Orientation; and a Mathematical subject (either Mathematics or Mathematical Literacy).

Then, there are three elective subjects that you choose to make up the total seven subjects. These elective subjects might be Economics; Physical Sciences; Life Sciences; Agricultural Sciences; Business Studies; Accounting; History; Geography; and Religious Studies. Some schools may offer different elective subjects and some schools may have restrictions on the combination of elective subjects you can choose. These issues are usually discussed with you in Grade 9 when you make your subject choices for Grade 10.

In Grade 12, it is important to take school seriously from the very first day that the school year starts. The year is a busy one with learning new information, writing practice exams and then writing the final exams. Some subject material from Grade 11 may also form part of what you need to know for your Grade 12 year.

Grade 12 is a year that requires you to work consistently and not leave tasks for the last minute. This can cause

anxiety and stress – two things you should avoid!
Pay careful attention in class to ensure you understand the work. Take your textbook to class every day and open it at the topic of discussion. Try to re-read the topic you did in class at home after school the same day. Complete your homework daily. When you are unsure about a topic, ask your teacher for help. Doing all of these things will help you understand and remember your work.

Grade 12 Survival Kit

- Have a positive outlook and a strong desire to try your best.
- Attend school every day and pay attention to your teachers.
- Have the right textbook and stationery for each subject.
- Plan for the year and how you will stay on top of work. Use a diary or a notebook for your planning.
- Before exams, make a study plan that includes time for revision as well as relaxation and exercise.
- Find past papers and practice by answering them. Ask a teacher for help if you aren't sure of an answer.
- Get enough sleep and eat healthy food. Remember, 'Healthy body, Healthy mind'.

What is active learning?

Active learning means that when you are practicing and studying, you are focused and absorbing the information you are reading and processing in your head. It's the opposite to passive learning when you write notes without really thinking about what you are writing.

Active learning can also be speaking topics out loud to yourself or someone else, or making up songs or rhymes about theories or lists you need to remember.

Is my way of studying working for me? If not, what should I do?

Everyone learns differently. Some people prefer mind maps, others like lists and some people like lots of colour. It is important that you research different ways of studying and find a method that works well for you. You will know it works well for you when you feel confident that you can remember what you have learnt. If someone asks you a question, you can recall what you studied and provide an answer with confidence.

If you are finding that the way you are studying is not helping you remember and understand the material, try a different method as soon as possible to stay ahead in your learning journey.

I am so stressed about school, I can't focus. What should I do?

Finding ways to manage your stress in Matric is very important. Instead of holding the things that are stressing you out in your head, sometimes writing them down or talking to a teacher or friend may help.

Being prepared and making a schedule at the very beginning of the year also helps to show you there is time for you to put in the work and effort to achieve your goals. Five ways to manage stress are:

1. Exercise (even a short walk helps).
2. Being mindful (think about what is worrying you and find ways to help resolve the problems).
3. Talking to someone.
4. Time management.
5. Getting enough sleep.
6. Finding a stress-busting method that works for you.

Sometimes having a study buddy can help but this arrangement needs to be taken seriously, with work done when you meet while also making time to chat about shared worries about Matric.

Life after Grade 12

It might seem like Grade 12 will never end, or it might fly by, but it does end and life after school does begin. Some people know what they want to do after school, such as study and further their education to get the qualification for the job they wish to pursue.

Some people prefer to work after school to save up for university or college. Working after high school also helps you learn soft skills (e.g. how to interact with people in the workplace, be responsible etc.) and hard skills (e.g. core elements of a job) that will be needed in your future career.

Other people take a gap year before committing to studying or working. They might volunteer or work overseas or travel.

As a young adult you may feel free from the routine of school, but it is also a time that comes with responsibilities. You might feel overwhelmed or lost, but

give yourself time to find a new way of being. Talk to your family and friends. There are lots of opportunities waiting for you after school.

My plans for life after school didn't work out. What should I do?

Sometimes things don't go as you planned and what you had hoped to do after school doesn't work out. Don't give up! If you didn't get into the university of your choice, try a different university, a university of technology or a Technical and Vocational Education and Training college. This may take you on a different route but will help get you to where you want to be.

Think about what you enjoy doing and how you can make a career from that. You could ask to volunteer at a place where you would like to work and build your curriculum vitae (CV) with experience in that field. You could then go on to study part-time and slowly build your qualifications. There are many websites that offer free or affordable short courses online that would also help you focus your skills for the career of your choice.

Websites for more information about Grade 12:

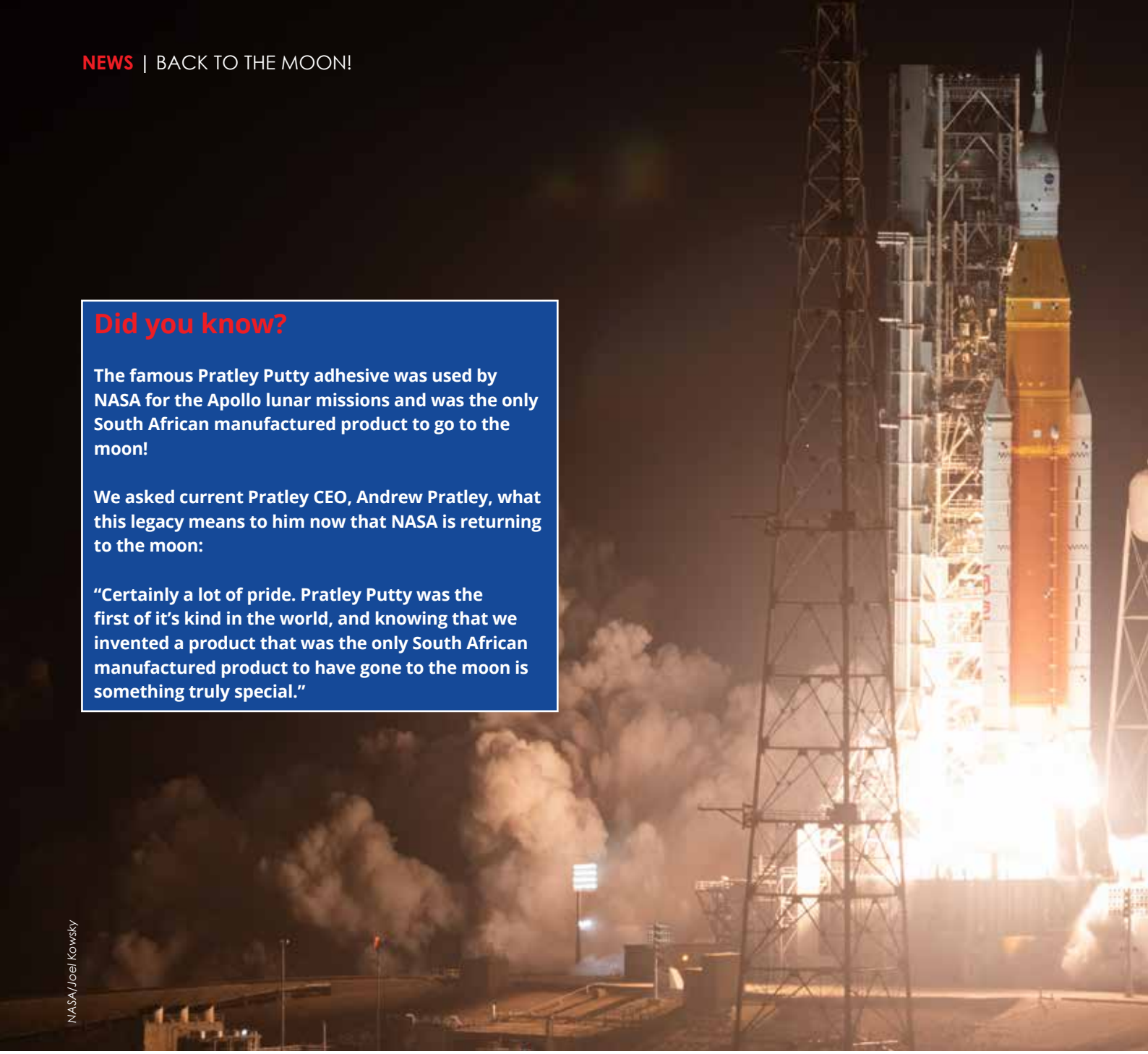
- https://www.matric.co.za/the-meaning-of-matric-in-south-africa/
- https://wcedeportal.co.za/study-tips-for-grade-12
- https://www.westerncape.gov.za/text/2010/4/wced_grade_12_tips_for_success_booklet_1.pdf
- https://www.careersportal.co.za/matric/matric-advice/how-can-i-make-my-matric-year-successful
- https://careerprep.co.za/5-tips-for-surviving-the-matric-exams/

Article (and series) written by Dr Caradee Wright, Chief Specialist Scientist: Environment and Health Research Unit for the South African Medical Research Council (SAMRC).

Indlela yokuzinakekela uma ufunda umatikuletsheni

- Hlala ubuka izinto ngendlela enhle futhi ube nentshisekelo yokuzama ngokusemandleni akho
- Hamba njalo uye esikoleni futhi ulalele othisha bakho
- Phatha njalo incwadi kanye nakho konke okudingwa isifundo ngasinye
- Hlelela unyaka nokuthi uzohlala kanjani wenza umsebenzi wesikolo
- Ngaphambi kwezivivinyo, hlela ukuthi uzofunda kanjani, isikhathi sokubuyekeza, ukuphumula nokuzivocavoca
- Thola amaphepha ezivivinyo amadala uwaphendule. Uma kukhona ongakuqondi kahle, buza uthisha.
- Qinisekisa ukuthi ulala ngokwanele futhi udla ukudla okunempilo. Khumbula umzimba owondlekile usho umqondo owondlekile.

Translated by Zamantimande Kunene



NASA/Joel Kowsky

Did you know?

The famous Pratley Putty adhesive was used by NASA for the Apollo lunar missions and was the only South African manufactured product to go to the moon!

We asked current Pratley CEO, Andrew Pratley, what this legacy means to him now that NASA is returning to the moon:

"Certainly a lot of pride. Pratley Putty was the first of it's kind in the world, and knowing that we invented a product that was the only South African manufactured product to have gone to the moon is something truly special."

NASA's Space Launch System (SLS) rocket carrying the Orion spacecraft launches on the Artemis I flight test, Wednesday, November 16 2022, from Launch Complex 39B at NASA's Kennedy Space Center in Florida. NASA's Artemis I mission is the first integrated flight test of the agency's deep space exploration systems: the Orion spacecraft, the SLS rocket, and ground systems.

BACK TO THE MOON!

Following a successful launch of NASA's Space Launch System (SLS), the most powerful rocket in the world, the agency's Orion spacecraft is on its way to the Moon as part of the Artemis program. Carrying an uncrewed Orion, SLS lifted off for its flight test debut at 1:47 a.m. EST Wednesday from Launch Pad 39B at NASA's Kennedy Space Center in Florida.

The launch is the first leg of a mission in which Orion is planned to travel approximately 40,000 miles beyond the Moon and return to Earth over the course of 25.5 days.

Known as Artemis I, the mission is a critical part of NASA's Moon to Mars exploration approach, in which the agency explores for the benefit of humanity. It's an important test for the agency before flying astronauts on the Artemis II mission.

"What an incredible sight to see NASA's Space Launch System rocket and Orion spacecraft launch together for the first time. This uncrewed flight test will push Orion to the limits in the rigors of deep space, helping us prepare for human exploration on the Moon and, ultimately, Mars," said NASA Administrator Bill Nelson.

Artemis I is supported by thousands of people around the world, from contractors who built Orion and SLS, and the ground infrastructure needed to launch them, to international and university partners, to small businesses supplying subsystems and components.

Through Artemis missions, NASA will land the first woman and the first person of color on the surface of the Moon, paving the way for a long-term lunar presence and serving as a steppingstone for astronauts on the way to Mars. – NASA

NASA/Keegan Barber

Guests at the Banana Creek viewing site watch the launch from NASA's Kennedy Space Center in Florida.

NASA/Bill Ingalls

Guests watch the launch from Operations and Support Building II at NASA's Kennedy Space Center in Florida.

Six South African women scientists receive awards from **L'Oréal and UNESCO for Women in Science**

Photos: Supplied

From left to right: Jessica Thibaud, Dr Farzahna Mohamed, Dr Thilona Arumugam (top), and Boitumelo Mabakachaba, Dr René Booysen and Dr Asanda Mtintsilana (bottom).

The L'Oréal-UNESCO for Women in Science National Awards recognised six outstanding South African women scientists for their contributions to science at a ceremony held in Johannesburg recently.

This year's recipients, Dr Thilona Arumugam, Dr René Booysen, Boitumelo Mabakachaba, Dr Farzahna Mohamed, Dr Asanda Mtintsilana and Jessica Thibaud, join a long list of women scientists honoured by L'Oréal and UNESCO every year. As part of this recognition, each woman received a generous grant in support of their PhD or post-doctoral studies.

L'Oréal South Africa country manager, Serge Sacre says women scientists are leading ground-breaking research across the world, but in spite of their remarkable discoveries, they only represent 33.3% of researchers globally, and their work rarely gains the recognition it deserves. "Less than 4% of Nobel prizes for science have been awarded to women and they hold disproportionately few senior positions in science, worldwide."

Sacre says the programme is underpinned by the understanding that the world needs science and science needs women. "Women have a vital role to play in science, which is why this programme is so significant. It encourages the vocations of girls in high school, supports women in research, and recognises excellence in a field where women are under-represented."

Based on the conviction that science needs women, UNESCO and the L'Oréal Foundation are committed to promoting women in science. In order to make them more visible, make their talent known and inspire vocations in future generations, the L'Oréal-UNESCO For Women in Science programme aims to accelerate the careers of women scientists and to fight against the obstacles they encounter.

Since the creation of the For Women in Science programme in 1998, 122 laureates and more than 3 800 talented young scientists, doctoral and post-doctoral students, have been supported and honoured in more than 115 countries. To date, five of the 122 laureates have gone on to win Nobel prizes.

become more compelling than ever in recent years and to be effective, science must draw on all talents and not leave the contributions of women scientists behind. – IOL.co.za and Unesco.org

Umcimbi we L'Oréal-Unesco, umcimbi wokuklomelisa abacwaningi besifazane abavelele kweze sayensi, uklomelise abesifazane abayisithupha baseningizimu Afrika ngokuzinikela kwabo kulomkhakha, emcimbini ububanjwe egoli. Ngokubamba kwabo iqhaza bathole uxhaso lwemali, kuxhaswa izifundo zabo zobudokotela kanye nocwaningo abazolenza emva kokuthola iziqu zobudokotela kwezobu chwepheshe.

Translated by Zamantimande Kunene

UFS Geography lecturer joins research expedition to Marion Island

Bloemfontein, October 2022. – Marike Stander, a lecturer in the Department of Geography at the University of the Free State (UFS), was granted the opportunity to assist a research group led by Prof Werner Nel (University of Fort Hare) and Prof David Hedding (Unisa) to Marion Island – based on her knowledge and experience in tracer sampling.

According to a media release by UFS, the Prince Edward Islands are the most southerly part of South Africa's official territory and consist of Marion Island and Prince Edward Island. On Marion Island, about 270 km² in size and situated in the sub-Antarctic Indian Ocean, 1 920 km from the South African shore, activities are restricted to research and conservation management.

Back home, Stander is working to complete her doctoral research, investigating the often-overlooked major issue of soil erosion, which impacts the storage of carbon and nutrients, and therefore the production of food, but can also act as a pollutant in water sources.

Stander was approached by the Sub-Antarctic Landscape-Climate Interactions (SANAP-LCI) Research Group, a project funded by the South African National Antarctic Programme-NRF. One of their research objectives is to explore the viability of using geochemical tracers in the substrate on Marion Island, the focus of Stander's doctoral research.

With the support of the UFS Faculty of Natural and Agricultural Sciences and the Department of Geography, she was released to accompany the research group for the first time in her life on their annual relief expedition with the *SA Agulhas II* from Cape Town to Marion Island, where she assisted with fieldwork and data collection. During this three-week field campaign, Stander collected sediment samples for the tracer project, as well as rock and peat samples.

Stander says in a time when the importance of interdisciplinary and multidisciplinary work is being emphasised, it was invaluable to meet and learn from various distinguished scientists. "It changes your perspective and allows your mind to not only think outside the box, but also to think about all the interconnected boxes and how they affect each other."

Very few people get the opportunity to visit Marion Island. Thus, just the chance to visit and experience life on the island is described by many as one of their most memorable events. Always fascinated by volcanic features, Stander was completely captivated by this relatively young volcanic island. "There are so many interesting features, such as the pahoehoe and a'a lava flows, as well as the numerous scoria cones," describes Stander, who cannot believe that she managed to cover the vast distances in gumboots, the only footwear that are effective to cross anything – from razor-sharp rocks to deep waterlogged mires.

She was also overwhelmed by the flora and fauna on the island. "It is so very different from what we are used to and from what I've experienced before. Seeing these animals in a relatively untouched remote location really captivated me," she says.

Watch a video here: https://youtu.be/BhhyzkgwFnU

https://en.wikipedia.org/wiki/Prince_Edward_Islands#/media/File:PrEdwIsl_Map.png

UMarike Stander, ongumfundisi kwezomhlaba e nyuvesi yase Free State (UFS), uthole ithuba lokusiza iqembu labacwaningi abaholwa u Prof Werner Nel (Nyuvesi yase Fort Hare) no Prof David Hedding (Unisa) ukuya endaweni ebandayo futhi ekude ebizwa ngokuthi I Marion Island. Nangu echaza ngakubonile.

Translated by Zamantimande Kunene

YouTube reviews

Here are some of the most interesting, useful and fun YouTube channels we could find about science and the quest for knowledge. Enjoy!

ASAPScience: The team at ASAPScience aims to make science fun – and boy, do they! They often ask (and answer) crazy questions like "Can we forage all our calories from the wild?" or showing how to harvest water out of thin air. Sometimes, Bill Nye the Science Guy even makes an appearance. And the incredibly fun and catchy "Periodic Table Song" has to be seen to be believed: https://www.youtube.com/watch?v=rz4Dd1I_fX0

Kurzgesagt – In a nutshell: These are probably some of the best videos on the internet that explain complex issues simply using entertaining animations. With tons of interesting videos they have proven themselves right in their belief that "nothing is boring if you tell a good story". Two of our favourites are "What happened before history? Human origins" (https://www.youtube.com/watch?v=dGiQaabX3_o&t=3s) and "Genetic engineering will change everything forever": https://www.youtube.com/watch?v=jAhjPd4uNFY&t=293s

Physics Girl: Created by Dianna Cowern, this globe-trotting channel "adventures into the physical sciences with experiments, demonstrations, and cool new discoveries". Most recently, taking a dive on a real nuclear submarine! Dianna also provides entertaining introductory physics classes. You are sure to learn something fascinating following Dianna on her science adventures. Physics Girl has videos for "every atom and eve". See that nuclear submarine video here: https://www.youtube.com/watch?v=JRQSbK4Krg0

Quest

https://questonline.org.za/

Call for articles or special issue proposals

Quest invites proposals for special issues on a topic or theme that fits within the scope of the magazine, which is: a popular science magazine aimed specifically at the youth and the general public who have an interest in the sciences. It aims to present South Africa's foremost scientific work in an accessible form and can be used to support curricula work at various levels and institutions.

Quest is distributed to public high schools, universities, libraries, science centres, government departments, parliamentary committees, embassies, non-government organisations, Technical and Vocational Education and Training Colleges and resource centres. Quest is also available at selected national science events, science Olympiads, events held by the Department of Science and Innovation, and at various community functions.

Quest is full-colour and published on a quarterly basis. Each issue aims to have a theme. For example, an issue may be aligned with the United Nations General Assembly themes: the International Year of Artisanal Fisheries and Aquaculture (IYAFA 2022) and the International Year of Glass (IYOG 2022).

An issue of Quest typically comprises five themed articles (1500 words), five feature articles (1300 words), four news pieces (500 words), and two to three book reviews (400 words). Images, graphics, infographics, etc. are encouraged.

We encourage early career researchers and emerging researchers to take this opportunity, whether to help convene a special issue, or to write an article for Quest. It is an excellent means to illustrate research translation. Your ORCID number is included with your written piece.

For more information or for the application form, please email: quest.editor@assaf.org.za
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