

Lab+Life

SCIENTIST

A futuristic robot scientist with a white, metallic body and a human-like face. The robot is wearing a white lab coat and is looking through a microscope. The background is dark, and the lighting is focused on the robot and the microscope.

**ROBOT SCIENTIST
ON THE ROAM**

**FROM SEA SPONGE
TO *HOMO SAPIENS***

**A DAILY PILL
FOR PARKINSON'S**

DEC 2020/JAN 2021
VOL.31 NO.5
PP100008671

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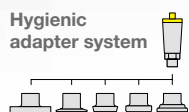
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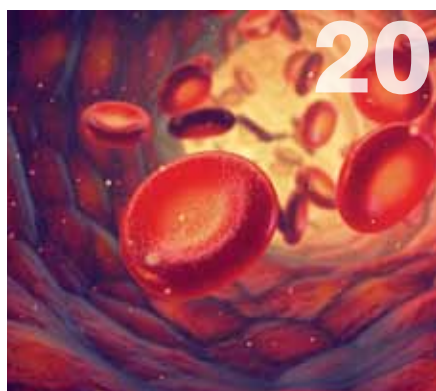
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The end in sight?

I'm writing this comment in early December — some weeks before the launch of this issue's eMag and even longer until the print edition — so I'm even more wary than usual of making grand statements about 'current' events related to COVID-19. In the past few weeks, it seems there have been announcements about particularly promising vaccine candidates every few days, with reports of high efficacy in the candidates from Moderna, Pfizer and BioNTech, Russia's Gamaleya Center and, to a lesser extent, Oxford University and AstraZeneca.

Of the above, the Australian Government has made vaccine purchase agreements with Oxford/AstraZeneca and Pfizer/BioNTech, in addition to Novavax and The University of Queensland/CSL — and may be able to access further vaccines in future through its membership of the COVAX facility. And with both Russia and the UK set to begin vaccination of their respective populations imminently — and the US likely not far behind — it seems that we're set for a climactic finish to a year which has seen some of the fastest vaccine development that the world has ever known. But will the vaccine really work when deployed on a mass scale? Will it ward off COVID-19 entirely, or just lessen the chance of infection and/or transmission? And will it last for life, or just for a year or so? Whatever happens, the world will certainly have an interesting time finding out.

Even with a vaccine, it will take some time before life can get truly back to normal — particularly for those countries that have been harder hit by COVID-19 than Australia. So what

do you do if you want to keep your laboratory running in a time of capped numbers and social distancing? For one lab in the UK, the answer lay in the form of an intelligent mobile robot with the ability to work autonomously for almost 24 hours a day — to learn the story of its creation, see our article on page 18.

There's also plenty of other interesting content this issue to whet your scientific curiosity. So read on to find tips on purchasing the best gas regulator for your specific application (page 6), discover how NASA found water on the sunlit surface of the Moon (page 32) and learn about the genomic mechanism that links humanity with a 700-million-year-old sea sponge (page 25) — as if this year couldn't get any stranger!

So as we say farewell to 2020, and look towards 2021, we can at least take some comfort in the fact that the world appears to be closer to the end of the COVID-19 pandemic than the beginning. Australia in particular has been faring very well lately, with restrictions lifting and borders opening in time for people to safely reunite with their loved ones over the holiday season. The state of Australian STEM sector also looks to be improving, thanks to millions of dollars in extra funding announced back in October's Budget to combat the economic effects of the pandemic. We can only hope that the government remembers how essential the STEM sector was to getting us through these frightening times, and that its workers continue to be supported even once this is all behind us.

I wish you a safe and happy new year.

Regards,
Lauren Davis
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Not all gas regulators are created equal

Choosing the best regulator for your application is critical but can be a mine field. The selection can vary based on your application, gas service, required pressure and purity.

High-purity applications require equipment that will help maintain the purity of the system. Many laboratory applications are sensitive to contamination from elements such as moisture, oxygen, and other gaseous vapours that may be present in ambient air. These contaminants enter the system when the regulator is removed from the cylinder during a cylinder changeout, or they may enter through leaks or faulty seals.

Very often, we select the cheapest regulator that fits the cylinder. Selecting an inferior-quality regulator may compromise the outcomes of your analysis. It is important to understand why a laboratory gas regulator can cost more than an industrial or less reputable brand regulator. The key difference is that they are designed for superior stability and longevity during operation. This can be identified by the body construction and material compatibility, diaphragm and seal material.





It is important to select a regulator made by a manufacturer who guarantees no gas can leak in or out of the regulator over a certain period.

Many industrial regulators are made from forged brass bodies. This process involves pouring casting metal in a mould under pressure. The resulting product has a more porous grain structure and therefore the internal surfaces tend to adsorb contaminants that eventually find their way into the system. A quality laboratory regulator should be formed by bar stock construction. This involves machining out a solid piece of metal, which is a more expensive process but produces a smoother and cleaner internal surface. This method makes it easier to achieve a smaller internal cavity in the regulator body, allowing for easier purging and removal of contaminants like moisture and oxygen.

The body material is also an important consideration. Unlike industrial application, where brass is a suitable material for most inert gases, material compatibility considerations are necessary in high-purity applications. Stainless steel is more suited to avoid chemical reactions between the regulator body and a reactive gas.

Diaphragm material is one way of identifying if a regulator is built for laboratory applications or for industrial applications. A laboratory regulator uses a stainless steel or Hastelloy diaphragm, whereas an industrial regulator will be using a rubber or EPDM diaphragm. Elastomer materials adsorb and release contaminants. While this material is economical for coarse material applications, it doesn't offer for high-purity applications.

It is important to select a regulator made by a manufacturer who guarantees no gas can leak in or out of the regulator over a certain period. A laboratory regulator has a typical leak tightness of 1×10^{-8} mbar L/s of helium, whereas an industrial regulator only has a typical

leak tightness of 1×10^{-3} mbar L/s of helium. A reputable brand will offer better leak tightness in their regulators. For the safety of the operator, flammable or toxic gas must not be allowed to leak into the environment. A quality regulator with good leak tightness ensures this.

Contrary to most thinking, the misconception is that if there is a small leak in the regulator or anywhere in the pipeline, high-pressure gas from within should leak outwards rather than ambient air leaking inwards. Atmospheric air is a major impurity to ultrahigh-purity gas installations. When there is a constant high-velocity gas flowing through the regulator, atmospheric air can be siphoned into the regulator via venturi effect if the regulator's leak tightness is weak, resulting in the degradation of the gas purity. A 5.0 grade (99.999%) gas containing only 10 ppm (parts per million) of gas impurities can quickly degrade to as low as 3.0 grade (99.9%) if atmospheric air manages to infiltrate into the gas stream through these tiny leaks.

How do I minimise risk of contamination?

A periodic leak check should be performed to make sure no connecting joints have come loose over time due to regular compression/decompression caused by cylinder changeout, or expansion/contraction caused by seasonal change or cylinder changeout. A pressure drop test measures the leak severity by first pressurising the line to a set pressure and timing how long it takes for the line pressure to drop to zero. Hold the pressure for at least an hour to assess whether there is any concern in leaks.

If you identify a leak, we recommend you contact Coregas to arrange a replacement or for

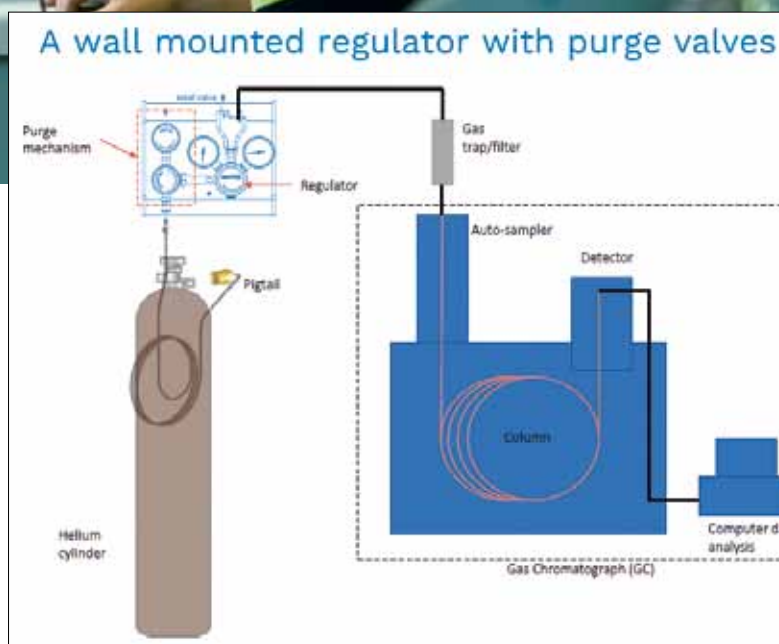


assistance to conduct a detailed leak check to validate the leak tightness of your installation.

What is the recommended practice for gas chromatography?

Some laboratory instruments, the gas chromatograph (GC) being one of them, are sensitive to gas impurities. A cylinder regulator does not have an integrated purge valve. Each time the regulator is disconnected from the cylinder, for example when changing out an empty cylinder, atmospheric air will enter the regulator and the downstream pipeline. When a new cylinder is connected, ultrahigh-purity gas from the cylinder will mix with the atmospheric air inside the regulator, travel down the pipeline and enter the GC. Without a gas trap, the resulting effect is an incorrect reading on the GC. If no purging is done every time a new cylinder is connected, the gas trap's shelf life will dramatically reduce. Over time, the gas trap will become saturated and will no longer trap any more impurities. If a saturated gas trap is not replaced on time, it will become a source of contaminants. Excessive exposure to high oxygen levels can burn out and damage the column inside the GC, resulting in costly repairs.

A wall-mounted regulator, equipped with purge functionality, prevents atmospheric air from entering the regulator. This feature allows the user to use the ultrahigh-purity gas from the new cylinder to purge out any atmospheric air that may have found its way into the pigtail or flexible hose. Purging during cylinder change out will improve the lifespan of gas traps.



The added benefit of a purge valve mitigates the danger associated with disconnecting a pressurised equipment. The purge valve allows the operator to first vent off the gas pressure before disconnecting the line from the old cylinder.

How to prolong the lifespan of your regulator?

Reputable brand regulators should be a laboratory asset for a lifetime. To ensure you maximise the life of this asset, these are the basic steps to follow:

When connecting a regulator to a new cylinder, the operator must not open the cylinder valve quickly and shock the regulator. Supersonic gas travelling inside the regulator can damage the mechanism and cause the regulator to creep. A damaged regulator will have an uncontrollable outlet pressure that constantly creeps upwards no matter how much adjustment is made to the pressure setting. This phenomenon can be easily identified by a constant gas discharge at the regulator's pressure relief valve.

It is recommended to always open the cylinder valve slowly and never allow a regulator to vibrate. If vibration is observed, the operator should quickly close the cylinder valve to stop the vibration and prevent the regulator from further damage. Re-open the cylinder valve slowly until the required line pressure is reached. If the vibration continues, the regulator should be replaced with a larger regulator that can cope with a higher flow rate.

Regulators are essential equipment for a laboratory. However, very often they are an afterthought during the laboratory design process and are left to the very last when a gas cylinder needs to be connected to an instrument. It is imperative to select the right gas equipment that will match the performance of a modern and advanced laboratory instrument to reduce contamination vulnerabilities.

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Simple medical device helps to reverse alcohol intoxication

Researchers from Canada's University Health Network (UHN) have presented a simple method that could serve as a game changer in rescue therapy for severe alcohol intoxication, with a proof of concept that has been described in the journal *Scientific Reports*.

Alcohol affects every part of the human body, from brain function to circulation and even nail growth. When a certain level of blood alcohol concentration is reached, the intoxication can damage organs and lead to death. Three million deaths occur every year as a result of the harmful use of alcohol, according to the World Health Organization (WHO).

Normally, 90% of the alcohol in the human body is cleared exclusively by the liver at a constant rate that can't be increased. Currently there is no other method, short of dialysis, whereby alcohol can be removed from the blood. The only options to treat life-threatening alcohol levels are therefore limited to supportive measures such as giving oxygen, intravenous fluids, breathing assistance and treating any heart issues with drugs.

The UHN team's approach was to recruit the lungs to breathe out the alcohol. The harder the breathing, it was reasoned, the more alcohol is eliminated. The team found that indeed, hyperventilation eliminated the alcohol at least three times faster than through the liver alone.

"But you can't just hyperventilate, because in a minute or two you would become light-headed and pass out," said Dr Joseph Fisher, an anaesthesiologist and senior scientist at the Toronto General Hospital Research Institute. This is because hyperventilation causes the body to eliminate carbon dioxide from the blood along with any alcohol, causing symptoms such as light-headedness, tingling or numbness on hands and feet, and fainting.

Dr Fisher and his team used a device called ClearMate that allows the patient to hyperventilate off the alcohol in their system while returning precisely the amount of carbon dioxide to the body to keep it at normal levels in the blood — regardless of the extent of hyperventilation. The equipment is the size of a small briefcase and uses a valve system, some connecting tubes, a mask and a small tank with compressed carbon dioxide.

"It's a very basic, low-tech device that could be made anywhere in the world: no electronics [...] computers or filters are required," Dr Fisher said. "It's almost inexplicable why we didn't try this decades ago."

The team's study is believed to be the first scientific demonstration that the basic rate of alcohol elimination could be substantially exceeded by using hyperventilation. Their proof of concept was performed in the laboratory with volunteers; the authors recommend following up with further validation studies to understand how the technology could be applied in a clinical setting.



Dr Joseph Fisher demonstrates the use of ClearMate in his lab with the help of Dr Olivia Sobczyk, an associate scientist at UHN. Image credit: UHN.



Gene discovery progresses the fight against sepsis

Melbourne scientists have identified and characterised the gene responsible for immune cell death and inflammation during sepsis — a disease that kills 11 million people worldwide every year.

Sepsis is caused by the immune system going into overdrive in response to infection. Often misdiagnosed as the flu, it leads to extreme inflammation that can cause blood clots and block oxygen from reaching vital organs, resulting in tissue death and multiple organ failure. Some who survive will need to have limbs amputated and be left with lifelong disability.

Now researchers from La Trobe University have revealed that the removal of protein receptor TREML4 in cell-based and in vivo experiments leads to almost absolute protection from sepsis, sepsis-induced pneumonia and blood-born *Candida* infection commonly associated with invasive medical procedures. Their findings have been published in the journal *Nature Immunology*.

As explained by lead researcher Dr Christina Nedeva, sepsis is characterised by two deadly stages.

"The initial inflammatory phase, or septic shock, is followed by a prolonged immunosuppression phase, which commonly leads to pneumonia. While the shock accounts for about 15% of sepsis-related deaths, the immunosuppression phase accounts for 85%," Dr Nedeva said.

"Excitingly, we've discovered the TREML4 gene regulates both of these phases."

Associate Professor Hamsa Puthalakath, lead supervisor of the study, said current therapies aimed at controlling inflammation, such as the use of steroids, help reduce the time that sepsis patients spend in intensive care units but do not reduce the overall deaths.

"Steroids reduce inflammation, but they also wipe out the immune system, preventing our body from fighting both mild and serious infections," Assoc Prof Puthalakath said.

"The removal of TREML4 can be described as the 'Goldilocks' approach, in that it leaves the body with some inflammation, but the immune system remains uncompromised and is healthy enough to fight off infection."

Having already identified the human equivalents of the TREML4 receptor, the researchers now hope to secure new funding for the next stage of their study, which will focus on the development of therapeutic antibodies against the TREML4 receptor.

"There have been more than 100 clinical trials for sepsis-related therapies in the last 25 years, none of which have proved successful," Assoc Prof Puthalakath said.

"La Trobe is on the forefront of potentially life-saving research."



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2. With numerous individually operating facilities, large institutions often lack a system of central oversight. Between rules, regulations and management, they desperately need a way to easily view the financial and operational performance of all core facilities in one place.

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“iLab has done an excellent job to unify our core facilities,” she said. “With over 100 cores, the ability to link resources, provide greater transparency of core operations and drive efficiencies with a single management platform has been extremely helpful. The iLab system allows administrators to easily view the health and performance of an individual core facility, or the institution’s entirety of shared resources. This platform has also benefited our faculty researchers, who now have far greater visibility of essential services offered by cores.”

Built to simplify shared resource operations, iLab acts as a single portal for researchers, staff, and administration alike. Personnel simply log in to the iLab system with their existing university credentials and gain access to integrated capabilities. Once logged in, they can search for and view all available resources the university has to offer. This increases instrument visibility, whether that equipment is inches away or at a different campus. From there, scheduling time on equipment is just

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- The iLab system also takes care of all billing and reporting, providing managers with instant summaries and reports.
- With multiple user levels available, iLab benefits not only lab staff and resource users, but research administrators as well. For those in positions such as Dean or VP of research, a consolidated but comprehensive view of all shared resource operations is critical. With iLab, these administrators have their choice of data across all labs, at the individual instrument or service level, or any grouping of resources.

To know more, please visit <https://www.agilent.com/en/ilab-core>.



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Image credit: Dean Miller/SOI

500 m-tall coral reef discovered in Great Barrier Reef

Australian scientists have discovered what they claim is the first detached reef to be found in more than 120 years, just off Cape York on the Great Barrier Reef — and it's taller than some of the world's most prominent structures.

Measuring more than 500 m in height — in comparison, the Empire State Building is only 443 m to the tip — the reef was discovered by scientists aboard Schmidt Ocean Institute's research vessel *Falkor*, on a 12-month exploration of the ocean surrounding Australia.

Led by Dr Robin Beaman from James Cook University (JCU), the scientists were conducting underwater mapping of the northern Great Barrier Reef seafloor when they came upon the new reef. The team then conducted a dive using Schmidt Ocean Institute's underwater robot, SuBastian, to explore the reef. The dive was live-streamed, with the high-resolution footage broadcast on the institute's website and YouTube channel.

"The base of the blade-like reef is 1.5 km wide, then rises 500 m to its shallowest depth of only 40 m below the sea surface," said Dr Tom Bridge, a Principal Investigator on the expedition who is based at the ARC Centre of Excellence for Coral Reef Studies at JCU. It's one of eight tall detached reefs in the area, the others having been mapped in the late 1800s.

"We are surprised and elated by what we have found," Dr Beaman said. "To not only 3D map the reef in detail, but also visually see this discovery with SuBastian, is incredible. This has only been made possible by the commitment of Schmidt Ocean Institute to grant ship time to Australia's scientists."

"To find a new half-a-kilometre-tall reef in the offshore Cape York area of the well-recognised Great Barrier Reef shows how mysterious the world is just beyond our coastline," added Dr Jyotika Virmani, Executive Director of Schmidt Ocean Institute. "This powerful combination of mapping data and underwater imagery will be used to understand this new reef and its role within the incredible Great Barrier Reef World Heritage Area."

The voyage around the Great Barrier Reef ran until mid-November as part of Schmidt Ocean Institute's broader year-long Australia campaign. The maps created will be available through AusSeabed, a national Australian seabed mapping program, and will also contribute to The Nippon Foundation-GEBSCO Seabed 2030 Project.

Cancer cells traced back to their tumour of origin

Using a small blood sample from 100 gastric cancer patients, researchers from Osaka City University have successfully identified cancer cells circulating in the bloodstream and traced them back to their tumour of origin by detecting an overexpression of fibroblast growth factor receptor (FGFR2) in both the cancer cells and the tumour.

This new diagnostic method, described in the journal *Cancer Science*, may allow for real-time detection of the growth patterns of the cancer, leading to quicker and more accurate preventative action — essentially cutting the cancer's potential metastasizing off at the head.

FGFR2 is a protein that aids in the growth of new cells; for example, it helps repair injuries by aiding in the growth of new tissue cells in the affected area. What FGFR2 does not do, however, is tell cells to stop growing. This means sometimes FGFR2 continues churning out new cells beyond their need, ie, even after the injured area has been repaired, at which point these cells form tumours and turn into cancer.

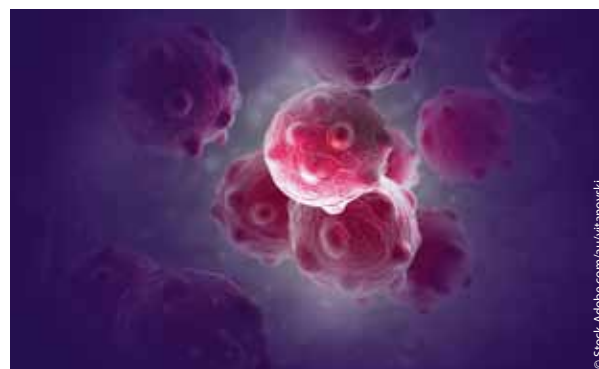
When the tumour saps all the resources from its surroundings, FGFR2 is activated and new cancer cells are sent down the bloodstream to areas with untapped resources. An overexpression of FGFR2 may mean this protein has been activated to make cells to cancerous levels, with FGFR2 overexpression having a reported 3–10% association with gastric cancers. And since cancer may differ in nature between the primary site and the site of recurrence and metastasis, it is difficult to see where the cancer has spread until its fledgling cells have settled into a new area and grown into an obtrusive tumour.

"If circulating cancer cells in the blood can be detected, it will be possible to investigate the characteristics of cancer metastases that are rarely removed, and it will be a useful diagnostic method for selecting molecular-targeted therapeutic agents suitable for the characteristics of each patient's unique form of cancer," said Masakazu Yashiro, lead researcher on the new study.

Yashiro and his team measured the FGFR2 expression level of circulating tumour cells with a FACScan on a 2 mL sample of blood periphery to a tumour they had previously assessed the FGFR2 expression level via immunohistochemistry. They found that FGFR2 overexpression in the blood samples was significantly correlated to the FGFR2 expression level of the tumour.

"The significantly poorer relapse-free survival of patients with these higher correlations suggests that, with this new method of finding FGFR2-positive cancer cells in the bloodstream, scientists can target an existing tumour quicker and with more accurate therapeutic agents," Yashiro said.

"By successfully identifying FGFR2-expressing cancer cells with a small amount of blood, we expect this tool to contribute to appropriate decision-making on the use of anticancer drugs, such as determining when to start FGFR inhibitors."



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Genetic medicine revolution



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The quest to produce the vaccine for COVID-19 has raised concerns about Australia's preparedness for a pandemic, and it has sharply focused attention on the 'new' age vaccines based on mRNA.

say 'new' given the seminal paper¹ that launched this field of nucleic acid vaccines was published in 1990! This was shortly followed by the first demonstrated mRNA-based vaccine to elicit an immune response in an animal² in 1993.

Fast forwarding to 2015, Ulmer, Mansoura and Geall³ suggested that "vaccines on demand" are possible and laid out four attributes of self-amplifying mRNA vaccines summarised as follows:

1. Raw materials that can be stockpiled and production equipment that can be co-located within a single facility.
2. A synthetic and scalable process that is amenable to automation and rapid manufacture of a drug product, in the absence of biological systems.
3. A robust, generic means to manufacture vaccines against many pathogen targets.
4. A small manufacturing footprint with standard, disposable equipment.

In 2020 the world is now finding many novel mRNA vaccine candidates⁴ and the Australian Government is having a gamble on who might be the ones to back, investing millions of dollars to reserve some for Australia. Astutely, they have invested in a massive facility in Victoria.

The new facility will be built in Melbourne's Airport Business Park and is expected to be operational by 2026. It will be funded through a joint venture

between the federal government, which is putting \$1 billion towards the project, and Seqirus — a subsidiary of biotech company CSL — which will contribute \$800 million.⁵

This is great for cultured vaccines — and as Health Minister Greg Hunt stated, "It will provide support for pandemic flu, seasonal flu, antivenoms and Q fever" — but let's not hold our breath as it will be 2026 before it is operational.

Australia invested heavily in reserving COVID-19 vaccines from several companies overseas. Moderna, BioNTech/Pfizer, CureVac, Imperial College London and Arcturus are all working on lipid nanoparticles (LNP) with mRNA. Surely a local facility that has capacity to create medicines for genetic diseases during 'non-pandemic' times and be easily mobilised for vaccine production would be a significant advancement in Australia's preparedness.

The scale of such a facility has been egregiously overstated previously, considering the production of self-amplifying (saRNA) at a commercial scale does not require cell culture, complex purification or novel equipment. The dose concentration of a saRNA is exceptionally low and, in the case of a vaccine, Anna Blakney of Imperial College London stated that 100 mL can result in 1 million doses.⁶

The huge bioreactors used in cell-cultured vaccines arguably can be replaced with a beaker and a stir bar for the cell-free synthesis where RNA is produced from a DNA template using an enzymatic transcription reaction. This method is well defined,

generic, high yield, fast, antigen-independent and can be used for all types of mRNA.

To get a start on this, a small lab which is a cleanroom is all that is needed. The components can be dropped in within a couple of months — and the total cost a fraction of the aforementioned investments. This would allow Australia the opportunity to create such drugs in-country, without spending the multi-millions on a hope we will access the products from big pharma. Perhaps it is time NSW put some skin in the game. When it comes to vaccine production we sadly lag behind Victoria and Queensland. Here's a chance to be novel and build the future powerhouse of genetic medicine for Australia in Sydney. Hopefully, we won't have to wait 30 years again!

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For example, the company's Thermo Scientific™ Multidrop™ Pico 8 Digital Dispenser is a non-contact liquid dispenser that enables assay miniaturisation and liquid dispensing down to the picolitre range. The

product precisely delivers fluids with CV values of $\leq 8\%$ for volumes as low as 11 pL into any well of a microplate including 96, 384 and 1536 well plate formats. The non-contact dispense technology removes the risk of contamination of the reagents. Additionally, the dispenser is capable of direct mixing of the dispensed reagents to ensure a homogenous reaction.

The dispenser comes with PicoIT 8 software, which offers a user-friendly interface. The software includes pre-set protocol templates made for qPCR layouts or you can simply create a custom protocol using the PCR function. With the pre-set protocol templates, the software guides you through three easy steps: opening a template, customising the template to your specific assay, and finally running your newly developed protocol with the Multidrop Pico 8 Digital Dispenser. In addition, the software automatically generates associated reports in the appropriate format to be

imported into the Applied Biosystems™ QuantStudio™ Real-Time PCR System. The direct importing of the plate layout with the sample information eliminates the additional steps of recreating the plate set-up in the QuantStudio, allowing you to start the qPCR run instantly.

A study by Thermo Fisher Scientific has demonstrated how the digital dispenser and software allow users to easily set up a miniaturised TaqMan™ qPCR assay plate with successful amplification of the input cDNA. This is significant given that a common hurdle in setting up TaqMan qPCR assays is ensuring pipetting precision at small reaction volumes; in fact, in many cases of qPCR assay development, scientists settle for a larger reaction volume such as 20 μ L because of pipetting errors. Decreasing the qPCR reaction volume while maintaining precision can however improve cost-effectiveness while increasing throughput.



The Multidrop Pico 8 Digital Dispenser and PicoIT 8 software were found to be an ideal solution for preparing a miniaturised qPCR assay. The qPCR assay plate was set up in three steps when using the PicoIT 8 pre-programmed protocol template and PCR function features, and it was possible to miniaturise the TaqMan qPCR assay reaction total volume to 5 μ L without compromising assay results.

The digital dispenser and software can also titrate the reagents needed for a standard curve and eliminate manual pipetting for serial dilution. The titration is beneficial for accelerating the standard curve preparation process in relative quantitative PCR assays, gene expression assays, primer efficiency validations or PCR efficiency validation. Furthermore, each dilution is generated directly in an individual well with non-contact dispensing technology. This feature reduces the risk of contamination and technical errors that are typically introduced in manual pipetting and serial dilution.

Taken together, the Multidrop Pico 8 Digital Dispenser and PicoIT 8 software provide increased productivity in assay development. They facilitate an accelerated and miniaturised qPCR assay with decreased manual pipetting, reduced reagent amounts and precise results.

Homogenisation

Thermo Fisher Scientific also supplies a wide range of homogenisers, such as the Precellys Evolution from Bertin Instruments — a universal tissue homogeniser specially designed for L3 laboratories. An efficient and flexible solution to disrupt samples, it offers optimal robustness and safety and possesses an automatic tube locking system, making it a real push-and-play system. Samples are ready for DNA/RNA analysis via PCR, electrophoresis, liquid chromatography and western blot in about 30 seconds.

Thanks to its different accessories, the device has the capability to process five different sizes of tubes (0.3 mL in well-plate format, plus 0.5, 2, 7 and 15 mL) and up to 24 tubes simultaneously. The optimal efficiency of Precellys Evolution can also be applied to the 96-well plate format thanks to the Precellys Lysing Kit 96WP, an accessory that enables ease of use and better tube positioning. Tubes are individually capped to avoid any cross-contamination risk and the new matrix has better application coverage.

The Precellys Evolution's ability to achieve mechanical cell lysis was recently assessed using the ZymoBIOMICS™ Microbial Community Standard from Zymo Research. DNA of the 12 aliquots (75 μ L each) of the community standard was extracted using the ZymoBIOMICS DNA Miniprep Kit, and cell lysis was performed using a Precellys Evolution set at maximum speed (10,000 rpm). DNA quantification indicated that efficient cell lysis could be achieved by homogenising cells for just 1 min using the Precellys Evolution, instead of 5 min on other systems.

The original tissue homogeniser in the Precellys range, the Precellys 24, continues to be used by thousands of scientists around the world, thanks to its simplicity and efficiency that makes it most suitable for routine and R&D projects. Like the Evolution, it is specially designed for L3 laboratories, can homogenise many different samples in 30 seconds and possesses an automatic tube locking system, making the product easy to handle. It can also process up to 24 tubes simultaneously, with the instrument's 3D motion providing the same high level of energy and homogenisation efficiency to all of the tubes.

Various tests have found that the Precellys 24, the Precellys Evolution and a dedicated Precellys lysing kit can be used to obtain high-quality RNA, which is mandatory to perform RNA sequencing. In experiments conducted at France's Laboratoire de Biologie et

Modélisation de la Cellule (LBMC), researchers used these instruments to achieve very efficient RNA extractions from a half or a whole mouse kidney. Other tests using the Precellys 24 have observed successful RNA extraction from *Escherichia coli* bacteria, *Bacillus globigii* spores and dog skin biopsies.

Finally, the Minily personal homogeniser is a compact and flexible tissue homogeniser designed to meet particular sample preparation needs for laboratories working with biological samples. Offering optimal grinding, lysing and homogenising efficiency, the product is capable of handling 3x 2 mL/0.5 mL tubes or 1x 7 mL tube to process any type of samples. A manual (but not screw-in) locking system makes the Minily an easy-pick-up laboratory instrument, making it suitable for use in the daily lab workflow. Associated with the appropriate lysing kit, the Minily can grind difficult samples like grains or hairs.

The use of the Minily to homogenise tumour samples has proved efficient compared to manual sample preparation. Tests at Liverpool Clinical Laboratories in the UK showed that the processing time was significantly reduced when using Minily for homogenisation, as well as the post treatment time with Proteinase K (reduced to 1 hour vs overnight for the manual method). The yield of DNA recovery with Minily was higher in 81% of the samples compared to the manual method. Nine out of eleven samples homogenised by the manual method didn't exceed a concentration of 15 ng/ μ L, while the lowest concentration found in samples homogenised by the Minily was 49 ng/ μ L. The average DNA yield recovery with the Minily was also 185.7 ng/ μ L compared to 26.8 ng/ μ L for the manual method; therefore, only one sample needed to be treated.

For more information visit thermofisher.com

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Wireless digital headstage for large animal models

The Cereplex W from Blackrock Microsystems is a small, lightweight, wireless, 96-channel digital headstage for neural recording in freely behaving large animal models. It has been designed to open doors to promising research such as studies of sleep, social behaviour and freely moving primates. Since the set-up and subject are free of cable constraints, innovative research avenues are possible and the set-up is clean.

The product enables novel research paradigms by delivering high-fidelity neural data via wireless transmission. It offers wide input range with onboard impedance measurement, reducing noise while maintaining signal quality. With the Honey Badger ASIC Chip, extracellular spikes and local field potentials have 7x higher resolution compared to competitor solutions, the company claims.

With an ultralong battery life up to 9 h, the Cereplex W is able to charge and record simultaneously with data streaming hardware or wirelessly. The headstage is compatible with various set-ups and provides clean and consistent signals for freely moving animal models.

The product has a full bandwidth with 30 kS/s sampling, 96 channels and long battery life, and enables freely moving recording with multiple animals. Compatible electrodes are the Utah Array and it can be teamed up with the Blackrock Cerebus System.



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Antibody purification technology

Cytiva's Fibro PrismA antibody purification technology has been designed to support the industry's drive for increased speed and flexibility, in order to advance the development of novel therapeutics. The first product based on the company's protein A fibre chromatography technology, it is being used to accelerate research for customers and collaborators.

Fibro chromatography technology enables rapid cycling antibody purification. In research and process development, this means Fibro PrismA can support up to 20 times increased throughput compared with traditional resins, the company claims. In clinical and commercial manufacturing, the technology will enable efficient single-use operations, by using the full unit lifetime in a single batch.

Fibro PrismA enables ultrafast purification in research and process development, allowing researchers to accelerate the drug discovery process. Clinical-scale products are set to follow.

Cytiva

www.cytivalifesciences.com/en/au



Automated cell counters

Cell counting allows the behaviour and viability of cells to be monitored, providing insights into bioprocessing and cell therapy dosing. Many laboratories performing transfection, cell proliferation, viability studies or quantitative PCR use manual cell counting methods like a haemocytometer, which is still considered the gold standard despite being time-consuming, tedious and subjective.

Cells are notoriously challenging to count, even by an experienced analyst. They can exhibit broad size distributions (mesenchymal stem cells), contain debris (PBMCs), be irregularly shaped (primary hepatocytes), be clustered (MCF-7 breast cancer cells) or

contain budding yeast cells. Automated cell counters are designed to offer results in a fraction of the time.

Not all cell counters are created equal, as there are many different instruments. Three systems in the LUNA automated cell counter family are available for demonstration: the LUNA Brightfield (7 s to results), LUNA FL (GFP transfection) and LUNA FX-7.

The LUNA-FX7 is the latest member of the family and is claimed to provide unmatched cell counting accuracy, dual fluorescent and brightfield detection, an advanced de-clustering algorithm, precision autofocus and 21 CFR PART 11 compliance. It has built-in quality control features and precise validation slides for monitoring QC and bioprocesses.

Key benefits include: larger counting volumes, up to 5.1 μ L for high accuracy (1% CV); high throughput using either 8- or 3- channel slides; the convenience of disposable and reusable slides; bioprocess package, CountWire and 21 CFR Part 11 compliance; and intuitive operation.

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www.atascientific.com.au



Educational microscope

Nikon Corporation is pleased to announce the ECLIPSE Ei educational microscope. The product features a streamlined design focused on intuitive operation and, combined with the Online Guide providing quick and easy access to tutorials, removes the learning barrier for first-time users.

Images can be easily shared with fellow classmates, whether it be in person or remotely, when combined with the Digital Sight 1000 microscope camera and operational NIS-Elements L imaging software. These images can be easily shared through videoconferencing platforms for virtual teaching.

The ECLIPSE Ei features an ergonomic design which encourages natural posture when using the microscope and minimises fatigue. Operating components are strategically colour-coded and labelled with easy-to-understand illustrations for a seamless, intuitive operating experience.

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Robot chemist discovers a new catalyst

Researchers at the University of Liverpool have built an intelligent mobile robot scientist that is claimed to be the first of its kind, with the ability to work almost 24 hours a day and to carry out experiments by itself.

Robots have been used before in chemistry research, but they are typically hardwired to a specific experiment. In contrast, the 1.75 m-tall robot developed by the Liverpool team is mobile and can roam around the laboratory, performing a wide range of different tasks. It can also work with equipment designed for human operation thanks to its human-like dimensions and physical reach, relying on an articulating arm to interact with lab equipment and a special gripper that allows it to pick things up and operate machinery.

“What we’ve done, unusually, is to use a mobile system,” said Professor Andrew Cooper, who led the project. “That has advantages because you can really drop it into an existing lab and, without much modification, use equipment which is already there. To some extent, if a human can use the equipment, the robot can use the equipment.”

Unlike a human, however, the 400 kg robot has infinite patience, can think in 10 dimensions and works for 21.5 hours each day, pausing only to recharge its battery. In place of a vision system it uses lasers to map its 3D environment (lidar), coupled with a touch feedback system for positioning.



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“The robot taps a cube which is located in a fixed space, and that then provides a six-position reference point,” Prof Cooper explained. So the robot is programmed with the coordinates of the equipment and instruments that it needs to use, and each of these stations is marked with its own cube.

“The biggest challenge was to make the system robust,” said PhD student Dr Benjamin Burger, who built and programmed the robot. “To work autonomously over multiple days, making thousands of delicate manipulations, the failure rate for each task needs to be very low. But once this is done, the robot makes far fewer mistakes than a human operator.”

The robot was designed to help the team in their work developing photocatalysts, which are materials that help produce hydrogen from water using light. Writing in the journal *Nature*, the researchers recounted how the robot conducted 688 experiments over eight days, working for 172 out of 192 hours.

“The robot weighs out the solid catalyst; it dispenses the liquids; it shines the light onto the

samples; it measures the output, which is the hydrogen; and based on this output, the hydrogen emission from the experiment, it then makes a decision about what to do next,” Prof Cooper said.

The robot’s brain used a search algorithm to navigate a 10-dimensional space of more than 98 million candidate experiments, deciding on the best experiment to do next based on the outcomes of the previous ones. By doing this, it autonomously discovered a catalyst that is six times more active, with no additional guidance from the research team.

“If you explore too much then you end up doing 98 million experiments, and that’s just not possible,” Prof Cooper said. “But if you exploit too much, if you optimise too greedily or too quickly, you don’t necessarily find the best solution.

“So the robot uses an optimisation algorithm, using a method called Bayesian optimisation, to navigate that chemical space.”

While the robot won’t be replacing human jobs any time soon, as it still needs scientists to devise the experiments, the researchers say their

technology could be used to tackle problems of a scale and complexity that are currently beyond our grasp. For example, autonomous robots could find materials for clean energy production or new drug formulations by searching vast, unexplored chemical spaces.

“Our strategy here was to automate the researcher, rather than the instruments,” Prof Cooper said. “This creates a level of flexibility that will change both the way we work and the problems we can tackle. This is not just another machine in the lab: it’s a new superpowered team member, and it frees up time for the human researchers to think creatively.”

The researchers have also received a lot of interest from laboratories that are looking to recommence operation while still maintaining a level of social distancing. Prof Cooper noted, “If you have a technology where you can load the system up, and then that takes three hours and then it works for eight days or two weeks by itself, then you can see possibilities there. So I’d be delighted if we can find some way to contribute to that.”

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Rapid diagnostic could save people from dying of blood loss

Researchers from Monash University and BioPRIA (Bioresource Processing Institute of Australia), in collaboration with medical device manufacturer Haemokinesis, have developed a diagnostic using a glass slide, Teflon film and a piece of paper that can test for levels of fibrinogen concentration in blood in less than four minutes.

Described in the journal *ACS Sensors*, the fast, portable and cheap diagnostic could help deliver urgent treatment to the more than 2 million people at risk of dying from rapid blood loss every year.

Fibrinogen is a protein found in blood that is needed for clotting. When a patient experiences traumatic injury (such as a serious car accident), major surgery or childbirth complications, fibrinogen is required in their blood to prevent major haemorrhaging and death from blood loss. But hypofibrinogenemia (insufficient fibrinogen to enable effective clotting) in critical bleeding is common, and is experienced by more than 20% of major trauma patients. Heavily bleeding patients must therefore be transported to a hospital or emergency centre to undergo diagnostic tests before being treated — tests which require expensive equipment, specialised/personnel and can take up to half an hour.

“When a patient is bleeding heavily and has received several blood transfusions, their levels of fibrinogen drop,” said BioPRIA Director and study co-author Professor Gil Garnier. “Even after dozens of

transfusions, patients keep bleeding. What they need is an injection of fibrinogen. However, if patients receive too much fibrinogen, they can also die.

“There are more than 60 tests that can measure fibrinogen concentration. However, these tests require importable machinery on hospital tabletops to use. This means that critical time has to be spent transporting heavily bleeding patients to a hospital — before they even undergo a 30-minute diagnosis.”

The new diagnostic removes the need for centralised hospital equipment to detect, monitor and treat fibrinogen levels — something never achieved until now. Prof Garnier said this will allow emergency doctors and paramedics to quickly and accurately diagnose low levels of fibrinogen in patients, with Monash PhD candidate and study co-author Marek Bialkower adding that the implications are significant.

“Our diagnostic can eliminate the preparation time, labour and transportation difficulties of traditional techniques used in the hospital,” Bialkower said.

“It can diagnose hypofibrinogenemia in critically bleeding patients anywhere in the world, and can drastically reduce the time to treatment needed for fibrinogen replacement therapy. The test can take less than four minutes — about five times faster than the current gold standard methods.”

The test works by placing a pre-mixed droplet of a blood sample and an enzyme solution onto a solid surface, allowing it to clot, and then dropping a paper strip on top. The further that blood moves down the strip of paper, the lower the fibrinogen concentration.

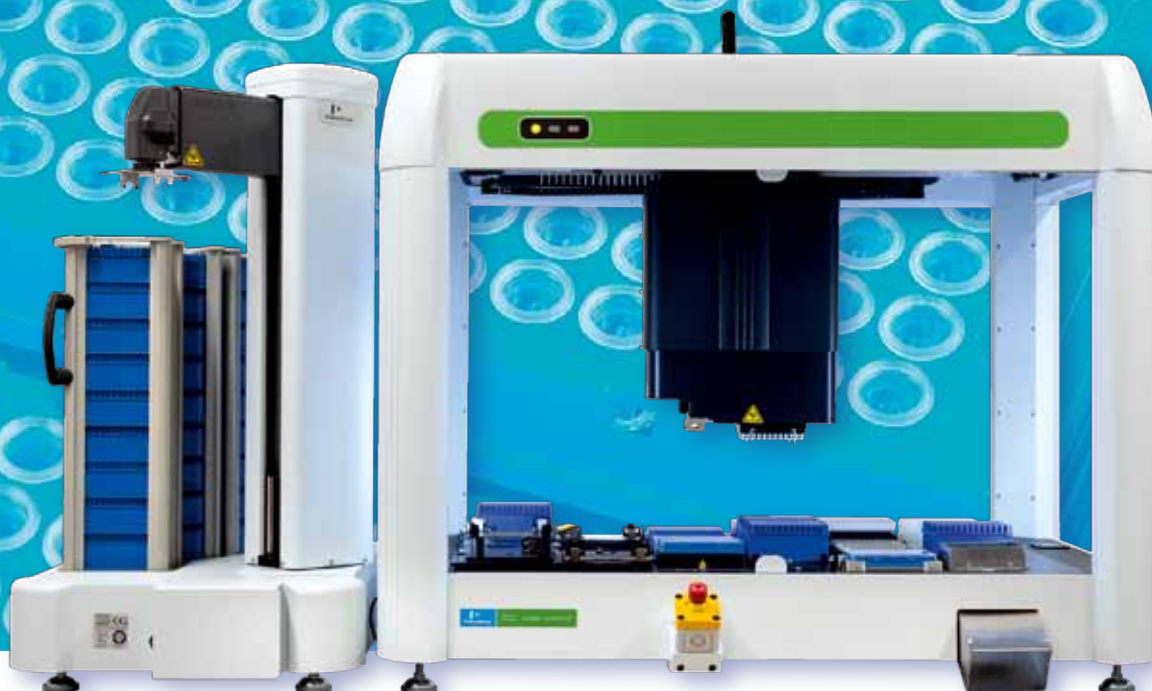
Diluting blood samples not only increases the test’s sensitivity, it also eliminates the effect of interfering substances in the blood. The diagnostic can also work with a variety of blood conditions and could be upscaled into a point-of-care tool for use in ambulances and other first responder vehicles, in regional and remote locations, and in GP clinics.

“The development of the world’s first handheld fibrinogen diagnostic is a game changer for the millions of people who die each year from critical blood loss,” said Dr Clare Manderson, a Research Fellow at Monash and co-author of the study. “It will also ease pressure on emergency departments knowing that this life-saving treatment can be delivered onsite and in quick time.

“Our capacity to develop this diagnostic using cheap and readily available materials means it can be easily commercialised for use across the world.”

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Scanning electron microscope

The Thermo Scientific Axia ChemiSEM is a floor-model scanning electron microscope (SEM) designed to bring speed and simplicity to materials micro-structural analysis and defect discovery.

The microscope includes always-on energy dispersive spectroscopy (EDS) analysis with Thermo Fisher Scientific's ChemiSEM technology, providing academic and industrial users with near instant access to quantitative compositional imaging with the click of a button and without needing additional set-up or switching between user interfaces. The result is that the product provides actionable data up to twice as fast as other competing SEM-EDS solutions currently on the market, the company claims.

Next-generation auto-alignment and auto-focus technology lower the need for training, while the instrument's large and flexible chamber makes it easy to investigate samples of all shapes and sizes — including heavy samples up to 10 kg that would traditionally be considered too heavy for investigations involving electron microscopy. The product's column automation technology is always ready to image, enabling users to focus on data collection rather than instrument management.

The device is easy to deploy, use and train on, and provides rapid microstructural and elemental information. It provides fast access to the compositional data necessary for failure analysis and defect discovery by collecting chemical information in the background, before users need it.

The product provides live, integrated EDS data and minimises the time spent managing the tool. With auto-alignment and auto-focus technology, users can focus on data collection, rather than instrument operation. It also offers easy sample navigation and handling of heavy samples, intuitive software and imaging automation workflows.

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CO₂ incubators

The CellXpert CO₂ incubator family is designed to optimise cell growing conditions and reduce running costs. With 180°C high-temperature disinfection, smooth interior, fanless design and minimal internal parts, the CellXpert C170i offers easy cleaning and contamination prevention.

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Whether the user is performing basic cell culture or more demanding applications like assay-development or culture of stem cells, primary cells or tissues, the CellXpert C170i CO₂ incubator can adapt to evolving cell culture requirements by allowing users to add on options as they need them. Choose from oxygen control, humidity monitoring, water level sensor, door handle position, copper accessories and segmented inner doors.

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Pipette verification tool

The RAININ SmartCheck is an innovative instrument from METTLER TOLEDO that quickly verifies the performance of any brand of single- or multichannel pipette that dispenses volumes between 10 and 1000 μ L.

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Simply dispense deionised water into the liquid chamber and SmartCheck automatically detects the test volume, then prompts the user to dispense the same volume three more times. The product collects volumetric measurements using the gravimetric method, calculates the random and systematic error based on four measurements, and yields a pass/fail result that can be automatically documented by RAININ PipetteX software.

SmartCheck fits easily alongside other equipment on the bench. The convenient size makes it easy to test a pipette to be sure it is performing to tolerance before starting an experiment.

The product is designed to reduce risk of experimental failure and improve reproducibility when used to check pipettes regularly.

Mettler-Toledo Ltd
www.mt.com



Hygiene testing system

Dirty laboratories and undesired microorganisms in healthcare facilities, in patient rooms or on surgical equipment can cause cross-contamination. Even worse is the spread of infection on dirty surfaces when they are touched.

Kikkoman's Lucipac A3 Sanitation System with patented A3 technology detects residues and microorganisms on surfaces that look clean but others miss. It is easy to use: just one swab detects ATP+ADP+AMP to give users the whole picture in 10 s. The system features high levels of sensitivity and detection power.

The patented system is AOAC certified, providing confidence in the results. Independent laboratory testing also confirms that A3 technology provides detection of residues at levels much lower than other tests on the market, the company states.

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Laser diode illuminator

The LDI (laser diode illuminator) is a multiline, solid-state laser illuminator offering up to 1000 mW of output power via a multimode fibre. With feedback-controlled output stability and up to a 100:1 linear dynamic range, the LDI is a suitable light source for a wide range of applications, including spinning disk confocal microscopy, structured illumination microscopy, FRAP, photoactivation/photoconversion, optogenetics, whole animal imaging and PALM/STORM.

The product offers high output power with short exposures, fast imaging, fast activation times in optogenetics and photoactivation experiments and fast bleaching times in FRAP experiments. Six or seven laser lines are available depending on the model. Laser wavelengths are either LDI-6-405/445/470/520/528/640 (LDI-6) or 405/445/470/520/528/555/640 (LDI-7).

The 100:1 linear dynamic range gives users the ability to turn down the power when needed and to maintain stability and quantitative imaging. The product has a stability of <1% RMS (at 100% laser power) and there is no need for software-specific drivers.

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From sea sponge to *Homo sapiens*

Genomic elements preserved across 700 million years of evolution

In a discovery 700 million years in the making, Australian scientists have found that humans — and most likely the entire animal kingdom — share important genetic mechanisms with a prehistoric sea sponge that comes from the Great Barrier Reef.

Published in the journal *Science*, the team's research reveals that some elements of the human genome are functioning the same way as in the jelly-like sea sponge, which dominated life on planet Earth even before the dinosaurs. The mechanism drives gene expression — a key to species diversity across the animal kingdom — and has incredibly been preserved across 700 million years of evolution.

"This is a fundamental discovery in evolution and the understanding of genetic diseases, which we never imagined was possible," said lead researcher Dr Emily Wong, from the Victor Chang Cardiac Research Institute and UNSW Sydney. "It was such a far-fetched idea to begin with, but we had nothing to lose so we went for it.

"We collected sea sponge samples from the Great Barrier Reef, near Heron Island. At The University of Queensland, we extracted DNA samples from the sea sponge and injected it into a single cell from a zebrafish embryo. Without harming the zebrafish, we then repeated the process at the Victor Chang Cardiac Research Institute with hundreds of embryos, inserting small DNA samples from humans and mice as well.

"What we found is, despite a lack of similarity between the sponge and humans due to millions of years of evolution, we identified a similar set of genomic instructions that controls gene expression in both organisms. We were blown away by the results!"

According to Dr Wong and her colleagues, the sections of DNA that are responsible for controlling gene expression — known as 'enhancers' — are notoriously difficult to find, study and understand. Even though they make up a significant part of the human genome, researchers are only at the beginnings of understanding this genetic 'dark matter'.

"They can't generally be found by comparing sequences like we can with genes, because they evolve so rapidly," Dr Wong explained.

"Trying to find these regions based on the genome sequence alone is like looking for a light switch in a pitch-black room. And that's why, up to this point, there has not been a single example of a DNA sequence enhancer that has been found to be conserved across the animal kingdom.

"So just the fact that we're able to identify these sequences, despite such a long period of evolutionary time, is very exciting."

Working alongside Dr Wong was her husband and co-senior author on the paper, Associate Professor Mathias Francois from the Centenary Institute. He

said, "This work is incredibly exciting as it allows us to better 'read' and understand the human genome, which is an incredibly complex and ever-changing instruction manual of life.

"The team focused on an ancient gene that is important in our nervous system but which also gave rise to a gene critical in heart development." The findings, he said, will drive biomedical research and future healthcare benefits too.

"Being able to better interpret the human genome aids our understanding of human processes, including disease and disorders, many of which have a genetic basis. The more we know about how our genes are wired, the better we are able to develop new treatments for diseases."

Professor Marcel Dinger, Head of UNSW's School of Biotechnology and Biomolecular Sciences (BABS), said there is much about the information stored in the genome that we still don't understand fully. "This study is an important step towards decoding life's programming language — the new knowledge it presents will help inform future research across the medical, technology and life sciences fields," he said.

"It's terrific to see such important research recognised by one of the world's most prestigious scientific journals."

Coomassie protein stain

Abcam's InstantBlue (ab119211) is a ready-to-use Coomassie protein stain for polyacrylamide gels. Its mechanism of action stains proteins in 15 min while leaving a clear background, eliminating the need to fix, wash or destain.

Formulated for safe use and easy disposal, it is ready to use straight out of the bottle and comes in convenient premixed 1 L volumes. The patented mechanism for rapid Coomassie blue staining of protein gels begins in moments, and results are achieved within 15 min. Some premade and traditional homemade Coomassie R-250 protein stains can take 3 h or more to fully stain gels.

The product means there is no longer any need to wash, fix, microwave or destain gels. Homemade stains often require all these steps and most premade solutions require at least one. InstantBlue uses a simple and easy-to-use, one-step protocol. High sensitivity allows protein levels as low as 5 ng per band to be detected (BSA) when staining overnight.

Key benefits include ultrafast staining in 15 min or less; a one-step procedure with no washing, fixing, microwaving or destaining; high sensitivity with 5 ng bands detectable; clear background with a high signal-to-noise ratio; flexible with no over staining; efficiency at only 25 mL per mini gel; safe nontoxic composition with no fume hood or solvent disposal required. It is also methanol-free for no gel shrinkage or protein methylation; acetic acid-free for no protein acetylation; mass spectrometry compatible; and destainable with no residual methylation or acetylation.

Abcam Australia Pty Ltd
www.abcam.com



Modular shaking incubator

Kuhner, a company with decades of experience in shaking technologies, has introduced the LS-Z/Kelvin+ combination. The LS-Z is a sturdy benchtop shaker designed for continuous and maintenance-free operation. The Kuhner Kelvin+ is a compact-sized incubator with an optimal temperature distribution. Together, they form a modular system for maximum flexibility and economical culturing.

The magnetic drive of the LS-Z is designed to ensure precise shaking speed and a long and failure-free working life. Additionally, the drive system allows the setting of three different shake diameters: 12.5, 25 and 50 mm. The Kuhner Kelvin+ incubator features a stainless steel chamber which can be added to the LS-Z shaker platform for precise temperature control and consistent temperature distribution, facilitating reproducible cultivation processes.

The system allows three different configurations: the LS-Z alone can be used as a benchtop shaker in the lab or in a temperature/humidity controlled room (even up to 90% RH) due to detachable electronics; the LS-Z can be installed in other manufacturers' incubators, with or without CO₂/humidity control, to convert them to a shaking incubator; and the Kelvin+ can be added to the LS-Z to create a fully capable culturing environment, with the addition of Kuhner FlowCon allowing CO₂, oxygen and humidity control.

The Kuhner TOM (transfer-rate online measurement) system can be optionally added for the online measurement of OTR, CTR and RQ in up to 16 individual shake flasks for precise process analysis. The TOM is easily installed and has no footprint on the shaker tray as it is mounted above.

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A flexible new facility for Planet Innovation

With a team of over 250 experts and rising — in the research, design, engineering, manufacture, funding and marketing of new products and businesses across healthcare industries — Planet Innovation needed a brand new space providing flexibility for their impending growth.

Despite level 4 restrictions in Melbourne, Planet Innovation, a leading health-tech innovation and commercialisation company, engaged Amicus in collaboration with designers Hot Black and service engineers Aston on the Stage 1 works of their new facility in Box Hill, Victoria. The brief was to design a range of different laboratories including cleanrooms, project laboratories and an electrical workshop.

Due to our proven and extensive experience in understanding compliant PC2 facilities, we were well positioned to deliver this exciting project, achieving the desired look and feel and technical requirements.

This complex project comprises of an electrical workshop with EMC chamber, with copper lined vinyl to earth the room, along with PC2 laboratories and three cleanrooms. Additionally, the large 'project build space'

functions as a scientific manufacturing plant. This space is the 'creative showcase space', not just a workshop laboratory.

With a focus on flexibility, the concept is modular by design, providing an abundance of workspaces and moveable joinery pieces, also repurposing some existing furniture.

Amicus has developed and provided a solution to get electrical and data to their laboratory benches and reagent racks whilst maintaining a flexible and modular laboratory bench layout, allowing for the reorganisation of different lab spaces based on the projects that are facilitated.

One of the key challenges in taking on building projects during the COVID-19 lockdown was workshoping ideas that could de-risk programmes ensuring the project is completed to the agreed budget and schedule, enabling the team to move into their new premises by their preferred date and therefore not having to extend their current lease. In conjunction with Planet Innovation, Amicus has been able to review the original PC2 lab design and propose several value engineering alternatives to aid in cost savings, reduce the complexity of

the project and improve flexibility for future growth.

Due to our knowledge and nationwide capability, we have successfully managed this project remotely with our project manager Jon Rogow, based in Sydney — unable to travel due to COVID-19 restrictions. A credit also to our experienced local delivery team in Melbourne.

We are thrilled to be collaborating with Planet Innovation during this exciting chapter. This project is on track for completion and handover mid-December. Watch this space!

For more information on our Laboratory Solutions visit our website:

<https://www.amicus.com.au/spaces/laboratory>



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Single daily pill for Parkinson's disease developed

Materials scientists from Nanyang Technological University, Singapore (NTU Singapore) have developed a new pill which uses the stomach as a drug reservoir and delivers medicines slowly over time to patients with Parkinson's disease (PD).



Parkinson's disease is a neurodegenerative disorder which can be treated with levodopa (L-dopa) taken orally. L-dopa is turned into dopamine by the human body — a chemical which is needed by the brain to relay signals needed for muscle control.

Currently, PD patients taking L-dopa may need to take up to six pills (doses) per day, with patients experiencing 'wearing off' effects between medications. Some patients also encounter a side effect after a long duration of treatment, in which their limbs jerk or experience involuntary spasms, known as levodopa-induced dyskinesia (LID).

An NTU-incubated start-up is now commercialising a slow-release pill that delivers L-dopa over a period of 24 hours, which could help to alleviate these symptoms. The start-up, called LiberaTx, aims to use the new pill to tackle LID and low drug compliance by patients, in which they fail to take the multiple pills of L-dopa prescribed daily.

LiberaTx founder Associate Professor Joachim Loo, who also led the research, said that encapsulating the drug in a floatable micro-capsule retains it in the stomach for an extended period, and controls its release rate.

"We engineered our micro-capsules to float in the stomach, thereby allowing for a slow but continuous delivery of drugs into the upper intestine

for improved absorption," he said. "This is key in maintaining the drugs' concentration in the blood, so that dopamine levels in the brain are kept constant over prolonged periods rather than fluctuating, which is the case for current tablets.

"We hope that reducing dosage to just once a day would greatly improve patient compliance, lower the pill burden of these patients, while alleviating the 'off' periods that these patients experience. Achieving this would greatly improve quality of life for the patient."

The FDA-approved materials poly-L-lactide (PLLA) and poly (caprolactone) (PCL) are used to make the micro-capsules, which metabolise into carbon dioxide and water in the human body. The micro-capsules are then loaded with PD drugs, which are localised in both the hollow cavity and the shell of the micro-capsules. Being hollow, the micro-particles float on top of the gastric juices in the stomach and stay in the stomach.

Two separate research papers based on animal study results, published in the journals *Small* and *NeuroMolecular Medicine*, suggest that the pill could deliver drugs over a 24-hour period. Pharmacokinetics studies of the new micro-encapsulation formulations also show that the new formulations have longer half-lives and mean residence times, with enhanced drug bioavailability, when compared against current L-dopa tablets or formulations used in the clinic.

The LiberaTx team is now in the midst of planning clinical trials to test the pill's efficacy and has initiated discussions with Professor Louis Tan, Senior Consultant, Neurology and Deputy Director, Research at Singapore's National Neuroscience Institute (NNI).

"People living with Parkinson's disease (PD) often need to take levodopa up to six times a day and at set times to prevent the wearing-off effect — a delay of just 30 minutes in taking the next dose can result in a marked increase in their symptoms such as tremor and muscle stiffness," Prof Tan said.

"This new drug formulation by the NTU team has the potential to enable oral delivery of levodopa in a steady sustained manner over 24 hours that will prolong the effectiveness of levodopa in PD patients experiencing wearing-off effects of levodopa. It may also prevent the development of troublesome long-term motor complications of wearing off and LID when initiated in patients with early PD."

If proven successful for treatment of PD, the oral micro-capsule may be trialled in patients with other conditions that require multiple drugs daily, such as hypertension, hyperlipidemia and diabetes. The researchers expect the technology platform should not only work with oral drugs currently available on the market, but also with novel chemical compounds that need better oral bioavailability — that is, improving the amount of drug taken orally that reaches its target and so benefits the patient.



Ultra-low temperature laboratory freezers

Liebherr is introducing two innovative Ultra-Low Temperature Freezer models into its already extensive range of bio-medical refrigerators and freezers.

The 500- and 700-litre volume models offer extreme low temperatures of between -40°C and -86°C, allowing laboratories to cover a wide range of applications — from low-temperature tests of materials and mid-term storage in the -40°C to -60°C range, through to long-term storage of biological products, chemical reagents, vaccines and bacteria in the ultralow -60°C to -86°C range.

The freezers have been engineered to offer safe long-term storage and high levels of performance with minimal temperature fluctuations, ensuring the quality of sensitive and valuable stored samples is always maintained. State-of-the-art refrigeration technology, including climate-neutral refrigerants and extensive vacuum heat insulation, means the freezers also provide low energy consumption and, as a result, lower ongoing running costs.

A three-stage monitoring system consisting of integrated alarm notifications for temperature, door or mains electrical faults, and upgradable features such as CO₂ emergency cooling and online monitoring, should ensure high levels of protection for stored items. In the event of a power failure, integrated 12 V batteries immediately supply the electronics for continued cooling and the protection of samples.

Andi-Co Australia

andico.com.au/liebherr-bio-medical/

LC/MS/MS system for complex samples

When it comes to analysing complex samples like food, cannabis and biological matrices, it is important to have the right system that can help to comply with regulations and detection limits. PerkinElmer's QSight LC/MS/MS system, with the QSight LX50 UHPLC, has been designed to provide the capability and confidence required to analyse the most challenging samples, all in a compact, easy-to-use design.

One of the major challenges in food safety testing is pesticide residue screening, which requires a combination of LC and GC analysis. This relies on multiple sample extraction procedures and analytical methods, which directly impacts sample turnover and costs. The dual-source configuration (ESI/APCI) of the QSight LC/MS/MS system provides true multiplexity. Laboratories can maximise the output from a single injection with the two complementary ionisation modes and transfer the analysis of GC amendable pesticides on a single LC/MS/MS platform.

Matrix complexity is another common challenge faced by many laboratories, affecting analyte response and instrument performance over time. Sample clean-up and periodic maintenance reduce this problem, but they inevitably affect throughput and productivity. QSight StayClean technology is designed to deliver high sensitivity and uptime for even the most challenging matrices. Due to a built-in hot-surface-induced desolvation (HSID) system, a continuous stream of hot gas is used as an acting self-cleaning agent, allowing the LC/MS/MS system to work with 'dirty' samples while maintaining the system free of contaminants. As a result, laboratories should be able to increase their throughput by simplifying sample extraction protocols and maintaining higher productivity with 35 more days of analysis per year.

PerkinElmer Pty Ltd

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HLA-typed cells

Lonza now provides an expansive selection of high-resolution human leukocyte antigen (HLA)-typed primary cells spanning all major cell and tissue types. The ready-typed lots should eliminate the need for burdensome in-house sequencing processes and provide drug developers with a critical tool for the effective development of personalised therapies.

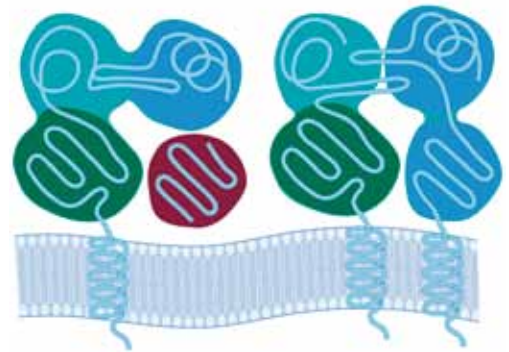
Nearly 50 different cell types are available from Lonza's broad donor inventory, with detailed HLA data derived from gold-standard next-generation sequencing techniques. The offering builds on the company's human primary cell capabilities to meet rapidly growing market demand for deeper and more comprehensive cell characterisation.

A person's HLA type is a key determinant of the immune system's response to foreign substances. HLA data is critical for preclinical exploration of cross-reactivities and off-target drug effects. HLA information is also needed for the development of engineered biotherapeutic T cell receptors and antibodies, patient stratification to optimise the clinical effectiveness of cancer therapies and the development of new cancer vaccines. As such, there is a rapidly growing market need for high-quality HLA-typed primary cells.

However, screening cell lots for HLA type can be lengthy and cumbersome to conduct in-house, and there is no guarantee that unscreened purchased lots will be the desired HLA type. Further, many vendors are only able to offer lots with lower-resolution HLA information obtained from serological typing methods, which can lead to incomplete HLA matching and poorer predictivity of in vitro models as a result. Being able to select lots with the desired high-resolution HLA data thus enables efficient preclinical development and boosts chances of drug development success.

Having previously offered HLA-typing services on a custom basis, Lonza is now providing high-resolution HLA information at no additional cost for a wide selection of its cell lots. With a diverse donor inventory that includes different age groups, genders and ethnicities, a broad range of donor cell lots with various HLA types is currently available, including HLA-A2*01.

Lonza Australia Pty Ltd
www.lonza.com



Real-time PCR systems

Bio-Rad Laboratories' CFX Opus 96 and CFX Opus 384 Real-Time PCR Systems are suitable for research and genomic testing as well as

in pathogen detection and infectious disease testing. The systems employ the same optical design used across the company's portfolio of CFX products and offer enhanced usability with features designed for academic, commercial and biopharma labs to conduct basic and translational research, process development and quality control.

The products' block design is said to deliver tight thermal uniformity for improved well-to-well consistency during real-time PCR experiments. A redesigned touchscreen interface and flexible connectivity options meanwhile provide an intuitive and efficient experience for real-time PCR users.

Bio-Rad has also announced early access to BR.io — a cloud-based software platform that enables users to design experiments, analyse data and access their experiments remotely. Integration with the platform provides seamless data transfer and the ability for users to monitor instrument status anywhere from the cloud, offering users a simplified qPCR experience.

Bio-Rad Laboratories Pty Ltd
www.bio-rad.com

Liquid handling system

CELLINK has launched the C.WASH — an innovative liquid handling system for media change in cellular assays and tipless magnetic bead washing. Among other workflows, the product will help with high-throughput COVID-19 testing and research.

The system offers a non-contact method of performing complex washing tasks, enabling automated and reproducible washing of microwell plates using centrifugal forces. It is designed to improve workflows by saving time when performing high-throughput screening, cell-based assays and magnetic bead-based nucleic acid extractions.

The product should provide users in the life science community with efficient workflows for high-throughput screening and library prep for sequencing. Potential applications include drug discovery, single-cell analysis and next-generation sequencing.

TrendBio Pty Ltd
www.trendbio.com.au



SARS-CoV-2 whole virus and full process IVD controls

Microbiologics is launching IVD process controls and inactivated whole virus controls to meet the complex research and diagnostic challenges of the COVID-19 pandemic. The controls are designed to provide broad yet simplified QC solutions for SARS-CoV-2 testing.

The process controls and inactivated whole virus controls are available in ready-to-use swab and pellet formats that mimic patient samples to challenge every step of molecular testing, including sample collection and handling. Featuring a matrix of human epithelial lung cells, each control performs like a true sample within the nucleic assay procedure. By mimicking the patient sample format and performance, the controls challenge not only assays, but also processes and techniques.

The IVD controls each provide a complete validation for extraction, amplification and detection within a molecular assay. The inactivated whole virus controls contain the entire SARS-CoV-2 genome in a non-infectious state confirmed by a validated assay. The process controls provide diagnostically relevant gene sequences (Orf1ab/RdRP/S/E/ORF8/M/N gene regions) to match multiple diagnostic protocols. The synthetic RNA within the process controls is encapsulated in a phage protein envelope to validate the extraction process. Lyophilised for stability and convenience, the controls can be shipped without dry ice.

Cell Biosciences Pty Ltd
www.cellbiosciences.com.au

Multipurpose FT-NIR analyser

The MPA II is the result of more than 40 years of experience in the engineering and production of FT-IR and FT-NIR spectrometers. It is a powerful tool for developing sophisticated calibration methods for laboratory or process needs, yet also an easy-to-use and robust QA/QC instrument for routine work. With its modular technology, it can be configured individually for each analytical task.



In contrast to most wet-chemistry and other reference methods, FT-NIR technology is quick, non-destructive and safe, since it does not use chemicals, solvents or gases. It simply measures the absorption of near-infrared light of the sample at different wavelengths, recording molecular vibrations of all molecules containing C-H, N-H or O-H groups. This makes NIR spectroscopy suitable for the analysis of all kind of organic materials.

Dedicated sampling accessories are available for any type of liquid, powdered, semi-solid or solid sample. Any person in production or in the lab can perform an analysis since there is no sample preparation necessary. The fast measurement and the simultaneous determination of multiple parameters means many samples can be analysed in a given time.

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Water discovered on the sunlit surface of the Moon

NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA) aircraft telescope has confirmed the presence of water on the sunlit surface of the Moon — a breakthrough indicating that water may be distributed across the lunar surface and not limited to cold, shadowed places. The discovery, described in the journal *Nature Astronomy*, builds on years of previous research examining the presence of water on the Moon.

When the Apollo astronauts first returned from the Moon in 1969, it was thought to be completely dry. Orbital and impactor missions over the past 20 years, such as NASA's Lunar Crater Observation and Sensing Satellite, confirmed ice in permanently shadowed craters around the Moon's poles. Meanwhile, several spacecraft as well as NASA's ground-based Infrared Telescope Facility have looked broadly across the lunar surface and found evidence of hydration in sunnier regions. Yet those missions were unable to definitively distinguish the form in which it was present — either H₂O or its close chemical relative, hydroxyl (OH).

"Prior to the SOFIA observations, we knew there was some kind of hydration," said study lead author Casey Honniball, a postdoctoral fellow at NASA's Goddard Space Flight Center. "But we didn't know how much, if any, was actually water molecules — like we drink every day — or something more like drain cleaner."

SOFIA offered a new means of looking at the Moon. Flying at altitudes of almost 14,000 m, this modified Boeing 747SP jetliner with a 2.7 m-diameter telescope reaches above 99% of the water vapour in Earth's atmosphere to get a clearer view of the infrared universe. Using the faint object infrared camera for the SOFIA telescope (FORCAST), the instrument was able to pick up the specific wavelength unique to water molecules, at 6.1 µm, and discovered a relatively

surprising concentration of H₂O molecules in the sunny Clavius crater — one of the largest craters visible from Earth, located in the Moon's southern hemisphere.

Data from the crater location reveal water in concentrations of 100 to 412 ppm — roughly equivalent to a small bottle of water — trapped in a cubic metre of soil spread across the lunar surface. As a comparison, the Sahara Desert has 100 times the amount of water than what SOFIA detected in the lunar soil. Yet despite the small amounts, the discovery raises new questions about how water is created and how it persists on the harsh, airless lunar surface.

"Without a thick atmosphere, water on the sunlit lunar surface should just be lost to space," said Honniball. "Yet somehow we're seeing it. Something is generating the water, and something must be trapping it there."

Several forces could be at play in the delivery or creation of this water. Micrometeorites raining down on the lunar surface, carrying small amounts of water, could deposit the water on the lunar surface upon impact. Another possibility is there could be a two-step process whereby the Sun's solar wind delivers hydrogen to the lunar surface and causes a chemical reaction with oxygen-bearing minerals in the soil to create hydroxyl. Meanwhile, radiation from the bombardment of micrometeorites could be transforming that hydroxyl into water.

How the water then gets stored — making it possible to accumulate — also raises some intriguing questions. The water could be trapped into tiny beadlike structures in the soil that form out of the high heat created by micrometeorite impacts. Another possibility is that the water could be hidden between grains of lunar soil and sheltered from the sunlight — potentially

making it a bit more accessible than water trapped in beadlike structures.

A separate study in the same issue of *Nature Astronomy* meanwhile suggests that water could be trapped in permanently shadowed areas — known as cold traps — where temperatures stay below freezing, across more of the Moon than currently expected. Using theoretical models and data from NASA's Lunar Reconnaissance Orbiter, Paul Hayne and colleagues assessed a whole range of possible sizes for cold traps, from 1 cm to 1 km in diameter. They found that small-scale 'micro' cold traps are hundreds to thousands of times more numerous than larger cold traps, and they can be found at both poles. The authors suggest that approximately 40,000 m² of the lunar surface has the capacity to trap water, which could be accessible as a resource for future missions.

"Water is a valuable resource, for both scientific purposes and for use by our explorers," said Jacob Bleacher, Chief Exploration Scientist for NASA's Human Exploration and Operations Mission Directorate. "If we can use the resources at the Moon, then we can carry less water and more equipment to help enable new scientific discoveries."

Follow-up flights from SOFIA will look for water in additional sunlit locations and during different lunar phases to learn more about how the water is produced, stored and moved across the Moon. The data will add to the work of future Moon missions to create the first water resource maps of the Moon for future human space exploration. NASA is eager to learn all it can about the presence of water on the Moon in advance of sending the first woman and next man to the lunar surface in 2024 and establishing a sustainable human presence there by the end of the decade.

Cryo-electron microscope

Cryo-electron microscopy (cryo-EM) is speeding the path to disease understanding and treatment; however, many institutions find these instruments to be out of reach because they are too complex for some researchers. The Thermo Scientific Tundra Cryo-TEM uses artificial intelligence (AI), guided automation and loader technology to simplify use, extending cryo-EM to researchers of any experience level.

AI and guided automation help non-experts quickly identify the quality of their samples and easily navigate an otherwise complex workflow. As the sample moves through the cryo-EM process, the results are displayed in a 'traffic light' style that helps scientists quickly determine if their sample is viable.

The integrated cryo-loading station replaces previous manual manipulation, enabling quick, effortless and robust sample loading and transfer to the microscope for immediate assessment and structure determination. Scientists can exchange sample carriers in about 2 min; this allows researchers to rapidly optimise biochemistry sample conditions as results can be checked immediately.

The product makes it possible for institutions and pharmaceutical companies to obtain structural insights at biologically relevant resolutions as high as 3.5 Å, with throughput within 24–72 h. It also delivers a compact footprint that fits most of today's standard-sized labs, eliminating the need for potential renovations.

Thermo Fisher Scientific
thermofisher.com



Laboratory instrument bench

LabBench has released a simple bench design for those on a small budget. The mobile instrument bench can be used as an ergonomic instrument stand or workstation in the laboratory.

With a stainless steel base frame, swivel locking castors and overtop locking carcass cabinetry, the 1190 Carcass bench has numerous practicalities to improve the researcher's workspace. Without the frills of the modular LabBench instrument bench range, the product can be packaged with a PC tower hanger and monitor mount.

The workspace is 1600 mm wide, 850 mm deep and 870 mm in height. The product is made in Australia.

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The Australian Meteorological and Oceanographic Society's 2021 conference will bring together leading experts in meteorology, oceanography, climate and other related sciences to focus on the latest research. The theme 'Science for Impact' highlights the real-world benefits science has, and can continue to have, through collaboration and partnerships. Around 40 thematic sessions will cover the impact of science on areas such as climate projections, weather and seasonal forecasting, extreme events, renewable energy, health, water, agriculture, economics, social change and education. Delegates will include researchers, government representatives, NGOs, businesses, students and the media.
<https://amos.eventsair.com/amos-2021/>

43rd COSPAR Scientific Assembly

January 28–February 4, Sydney and online
<http://www.cospar2021.org/>

Lorne Proteomics 2021

February 4–5, Lorne and online
<https://www.lorneproteomics.org/>

Lorne Proteins 2021

February 8–10, Lorne and online
<https://www.lorneproteins.org/>

Lorne Cancer 2021

February 11–13, Lorne and online
<https://www.lornecancer.org/>

ICHS Symposium on Infections in the Immunocompromised Host

February 17–19, online
<https://ichs2021.org/>

Lorne Infection & Immunity 2021

February 17–19, online
<https://www.lorneinfectionimmunity.org/>

Science Meets Parliament 2021

March 15–17, Canberra
<https://scienceandtechnologyaustralia.org.au/what-we-do/science-meets-parliament/>

ASID Annual Scientific Meeting 2021

March 24–26, Melbourne
<https://www.asid.net.au/meetings/ASM2020>

TSANZSRS 2021

May 1–2, Auckland and online
<https://www.tsanzsrs2021.com/>

AMSA 2021 Conference

June 27–July 2, Sydney
<https://amsa2021.amsa.asn.au/>

Pathology Update 2021

July 2–4, Sydney and online
<https://www.rcpa.edu.au/Events/Pathology-Update>

2021 ISFPX and ASP Annual Conference

July 5–8, Cairns
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July 18–22, Adelaide
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foodpro 2021

July 25–28, Sydney
<https://foodproexh.com/>

HGSA 44th Annual Scientific Meeting

August 14–17, Adelaide
<https://aacb.eventsair.com/hgsa-44th-annual-scientific-meeting/>

ACS 43rd Annual Scientific Meeting 2021

August 24–28, Queenstown
<https://acs2020.org.au/>

ASCI 2021 Conference

September 1–3, Melbourne
<https://www.ascia2021.com/>

Energy Oceania 2021

September 6–8, Melbourne
<https://www.energyconferenceaustralia.com/>

Australasian Exploration Geoscience Conference

September 15–20, Brisbane
<https://2021.aegc.com.au/>

AACB 58th Annual Scientific Conference

September 28–30, Brisbane
<https://aacb.eventsair.com/aacb-58th-annual-scientific-conference/>

Materials Oceania 2021

October 11–14, Brisbane
<https://www.materialsconferenceaustralia.com/>

16th Congress of the FAOBMB

November 22–25, Christchurch
<https://www.faobmb2021.org/>

ASI 2021

November 30–December 3, Melbourne
<https://asi2021.org/>



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Printed and bound by
 Dynamite Printing

Print Post Approved PP100008671

ISSN No. 2203-773X

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