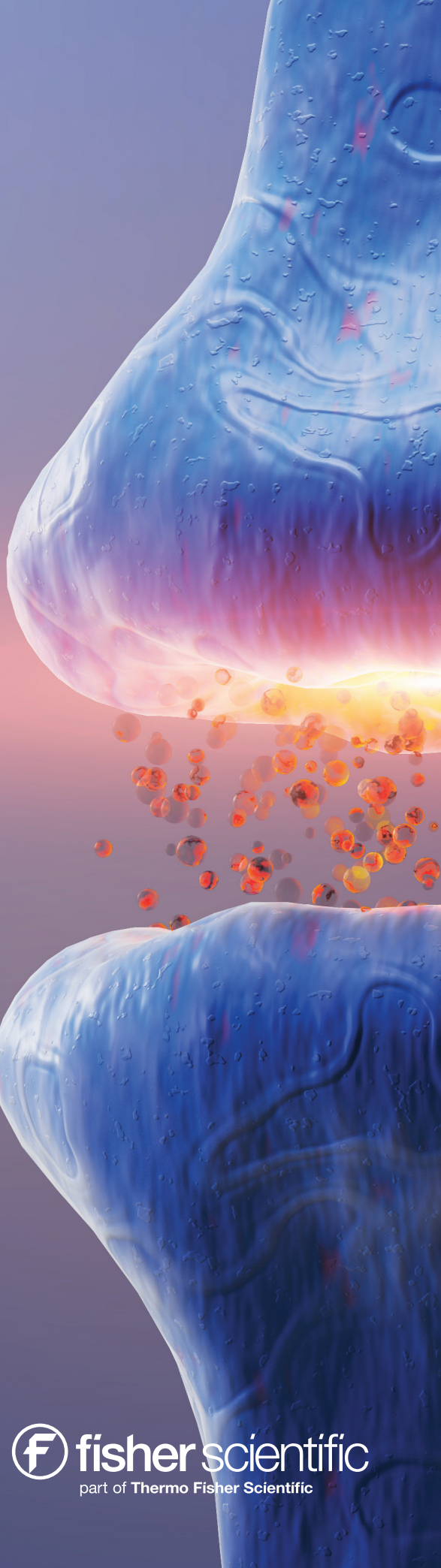
LAB REPORTER

Innovative Products and Science News

NO. 3, 2019



Lab Collab

Teaming Up to Take Down Parkinson's Disease

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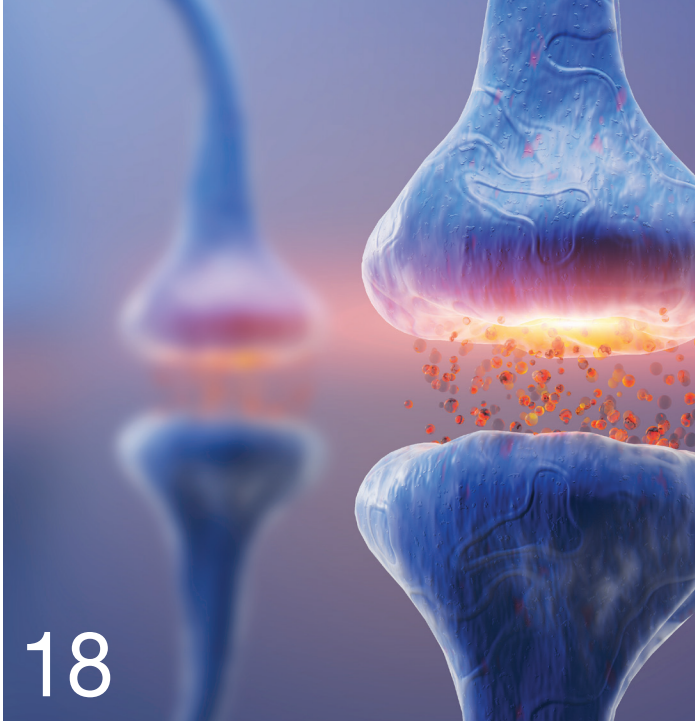

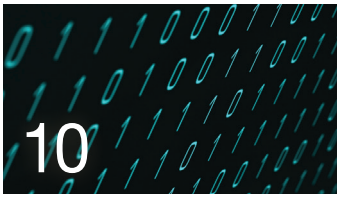

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Cell-Free Gene Editing: Just Add Water

By Gina Wynn

Scientists at Northwestern University have developed a practical and economical new generation of hands-on teaching tools to inspire the next generation of synthetic biologists. As a pilot study, they supplied Chicago-area teachers and high school students with BioBits Health educational kits for conducting normally complex biological experiments that produce results within a few hours.

The classroom-based interactive lab projects require students to simply add water and reagents to freeze-dried cell material in test tubes. The reactions involve proteins that produce fluorescence that enables students to see results quickly and easily.

"We have linked … abstract, really advanced biological concept[s] to the presence or absence of a fluorescent protein," said Jessica Stark, graduate student and leader of the BioBits Health research team. "It's something students can see, something they can visually understand."

Breakthrough Biology

BioBits kits include experimental modules and supplementary materials to help young scientists explore scientific research strategies ethically, cost-effectively, and safely. Michael Jewett, PhD, professor of chemical and biological engineering and the study's principal investigator, has been influential in developing ethical methods of harnessing biological systems without using living cells. He is also co-director of Northwestern's Center for Synthetic Biology.

Working with living cells also requires expensive equipment, and it's time-consuming to keep cells alive and contained for an extended period of time. That's why Jewett's team — made up of researchers from Northwestern University and MIT — included non-living components in the BioBits experimental modules. The components are made of extracted cell structures that have been freeze dried for shelf stability.

"These are essentially test-tube biological reactions," said Stark, a National Science Foundation graduate research fellow. "We break the cells open and use their guts, which still contain all of the necessary biological machinery to carry out a reaction. We no longer need living cells to demonstrate biology."

Classrooms on the Cutting Edge

Since the launch of the BioBits program in the summer of 2018, Jewett and his team have expanded the focus of their kits to tackle two current topics that are important for society: antibiotic resistance and gene editing. The journal *ACS Synthetic Biology* reported on the BioBits Health pilot study and the kit enhancements.

Jewett and Stark were motivated by recent predictions that infections from drug-resistant bacteria will kill 10 million people a year worldwide by 2050 — more than currently die from cancer.

They developed an experimental module where students run two sets of reactions: one set contains an antibiotic-resistant gene and one set does not. When students add an antibiotic, the test tube will glow if a fluorescent protein was produced. This indicates that the organism is resistant to the antibiotic. If it does not glow, then the antibiotic is effective.

"Because we're using cell-free systems rather than organisms, we can demonstrate drug resistance in a way that doesn't create drug-resistant bacteria," Stark explained. "We can demonstrate these concepts without the risks."

CRISPR Conversations

Jewett's team also developed experimental gene editing modules that harness Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR) technology. One of the most significant scientific breakthroughs of the past decade, CRISPR turns off or edits targeted genes by using enzymes to cut DNA strands in specific locations.

According to the Northwestern University website, the new BioBits kits contain the three essential CRISPR components: an enzyme called the Cas9 protein, a target DNA sequence encoding a fluorescent protein, and an RNA molecule that targets the fluorescent protein gene. When students add all three components and water to the freeze-dried cell-free test tube contents, it starts a reaction that edits the DNA that codes for the fluorescent protein. If the DNA is successfully edited, the materials do not glow. If the DNA is not edited, fluorescent protein is made and the tube illuminates.

"There is a lot of excitement about being able to edit genomes with these technologies," Jewett said. "BioBits Health calls attention to a lot of important questions — not only about how CRISPR technology works but about ethics that society should be thinking about. We hope that this promotes a conversation and dialogue about such technologies."

Drug Repurposing: How High-Quality Bioactive Molecules Help Accelerate the Search for New Treatments

Despite advances in technology and our understanding of biology, bringing a new drug to market is now taking longer and becoming increasingly expensive. Among the most widely reported recent estimates, the Tufts Center for the Study of Drug Development put the cost of bringing a single drug to market at around 2.6 billion U.S. dollars in 2014. This represents a 145 percent increase compared to a decade earlier.

Climbing drug development costs aren't just about pharmaceutical bottom lines, however. They're a major concern for human health, limiting the ability of drug developers to reinvest and address unmet patient needs. What's more, additional challenges such as the rise of generics and stricter drug price controls further threaten the ability of pharmaceutical companies to recoup the cost of R&D, putting the sustainability of the drug development pipeline at risk. Facing these growing challenges, pharmaceutical companies are searching for faster and more affordable ways of addressing unmet patient needs.

One potential solution gaining traction within the industry is drug repurposing: harnessing existing medicines for new therapeutic applications. With this strategy increasingly used to find promising new treatments in several key fields, we consider how repurposing bioactive molecules could help accelerate drug development.

From Unexpected Bonus to Cost-Effective Strategy

Drug repurposing isn't an entirely new concept. In fact, a significant number of medicines already on the market

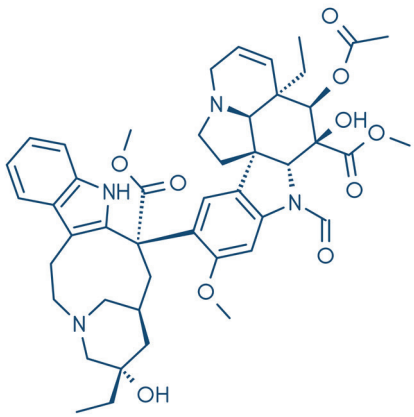

Figure 1. Vincristine

or currently undergoing clinical trials have been repositioned for alternative applications. Perhaps the most well-known example of drug repurposing is that of sildenafil. Originally designed to treat hypertension and angina, the drug's unintended side effects in clinical trials were quickly noted, ultimately resulting in its repositioning as a treatment for erectile dysfunction.

Today, drug repurposing isn't just seen as an unexpected outcome — it's a strategy that's being systematically pursued to deliver more value from squeezed R&D budgets. As a good deal of information is already known about the physicochemical characteristics and safety profile of existing drug molecules, repurposing can simplify much of the early development process, saving pharmaceutical companies valuable time and resources and giving them much greater confidence that a drug candidate will deliver a favorable return on investment.

The Value of Bioactive Molecules

Although drug repurposing can offer a shortcut through the development stage, promising structures still need to be discovered. In order to identify viable structures quickly, bioactive molecules, including a diverse range of existing drugs and commonly used scaffolds, must be tested. Crucially, these structures need to offer good ADME (absorption, distribution, metabolism, and excretion) properties and low toxicities to support subsequent development efforts.

Heterocyclic compounds are cyclic compounds that have carbon and at least one other element as part of their ring structure. Their general structure resembles cyclic organic compounds that contain rings of only carbon. Three examples of drugs that contain heterocycles are vincristine (Figure 1), cabazitaxel (Figure 2), and olaparib (Figure 3), all of which are used to treat different types of cancer.

The presence of heteroatoms such as nitrogen, oxygen, or sulfur gives heterocyclic compounds distinct physical and chemical properties. Heterocyclic structures are extremely important structural features in bioactive compounds and are highly valued in drug design. Around two thirds of the top 100 drugs incorporate heterocycles in their structure, making them a reliable focus point for drug repurposing efforts. Using bioactive molecules with these structures can therefore be a very effective and efficient way of finding new or existing drug molecules for new disease treatments quickly and within a limited budget.

Application Example: Using Heterocyclic Bioactives

A focus on bioactive molecules incorporating heterocyclic structural features has delivered promising results in several therapeutic fields, including neurodegenerative disorders.

Age-related neurodegenerative disorders such as dementia have long been an important research focus for the pharmaceutical industry. However, despite spending decades of research and considerable resources toward developing innovative treatments, the therapeutic impact has been limited. This slow pace of progress is made more disappointing by the fact that some drugs that have shown great promise in the lab have been challenging to translate into a clinical setting.

Many neurodegenerative diseases, including Alzheimer's, Parkinson's, and prion-related disorders, are characterized by the buildup of misfolded proteins in the brain, which are thought to halt the production of proteins that are essential for healthy brain function. In a major breakthrough reported in 2013, a team from the UK's Medical Research Council[1] used an experimental drug to halt signs of neurodegeneration in mouse models of prion disease by restarting protein synthesis. However, despite these promising early findings, the compound

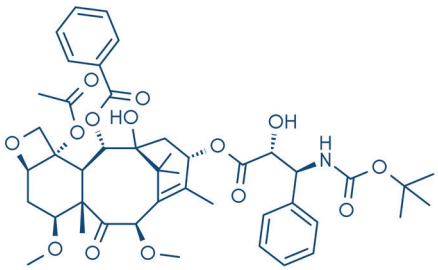

Figure 2. Cabazitaxel

was later found to be toxic to the pancreas and could not be progressed to clinical trials.

Looking to find other compounds that showed similar neuroprotective effects, the team subsequently tested over 1,000 molecules in the National Institute for Neurological Disorders and Stroke screening collection — around three-quarters of which were FDA-approved drugs. One of the compounds identified, trazodone, was a heterocyclic drug already approved by the FDA to treat depression. The compound was found to prevent brain cell damage in mice with prion disease and even restored memory in mice possessing a form of dementia, making it a promising compound to study further.

Although a recent UK study of electronic patient records found no link between trazodone use and a reduced risk of dementia, this example highlights how bioactive molecules can be screened and studied to rapidly determine if any may be a promising drug candidate for further investigation.

Drug Development

With the pharmaceutical industry in need of faster and more efficient ways of bringing effective medicines to market, many drug developers are turning their attention to the untapped therapeutic potential in existing drugs. Given the pharmacological importance and widespread occurrence of heterocyclic moieties in medicines, research that puts a strong focus on these types of structures could help to accelerate the identification of promising medicines.

Thermo Fisher Scientific offers a comprehensive collection of bioactive molecules based on heterocyclic structures and commonly used drug

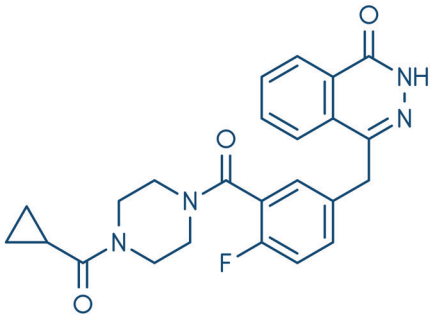

Figure 3. Olaparib

scaffolds through the Acros Organics and Alfa Aesar brands. These highly relevant bioactive structures are available in research quantities and designed to help pharmaceutical companies make efficient use of their resources as the collection covers the most promising structural features. We also offer screening libraries for early stage drug discovery through the Maybridge product line.

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References

1. Oral Treatment Targeting the Unfolded Protein Response Prevents Neurodegeneration and Clinical Disease in Prion-Infected Mice, Julie A. Moreno et al., *Science Translational Medicine*, 09 Oct 2013: Vol. 5, Issue 206, pp. 206ra138, DOI: 10.1126/scitranslmed.3006767

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Sodium Bicarbonate	ACS	RDCS0300-500B1	**RDCS0300500**
Sodium Carbonate, Anhydrous	ACS	RDCS0390-500B1	**RDCS0390500**
Sodium Chloride	ACS	RDCS0430-500B1	**RDCS0430500**
Sodium Hydroxide (Pellets)	ACS	RDCS0530-2.5A5	**RDCS053025**
Sodium Nitroferricyanide, 2-Hydrate	ACS	RDCS0700-100B1	**RDCS0700100**
Sodium Phosphate Monobasic 1-Hydrate	ACS	RDCS0770-500B1	**RDCS0770500**
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Better Data May Speed Path to Drug Trials

By Iva Fedorka

An expert in measurement science has led his research team at Purdue University to develop an electronic signal filter that may help to more accurately determine the results of biological and chemical analyses.

FDA Approval

Data is key to drug discovery, medication development, and efficacy determinations. Pharmaceutical companies in particular make major scientific decisions based on the results of chemical and biological testing. Variations in or uncertainty about those measurements can increase both patient health risks and financial risks to the companies themselves.

According to the Food and Drug Administration, it can take 10 to 15 years or longer to move a drug from discovery to the point of public consumption. This electronic filter may allow for better and more exact measurements earlier in the drug development stage, which would shorten the time required to move a drug to the clinical trials phase.

Filter Development

The data filter was developed by Garth Simpson, professor of analytical and physical chemistry at Purdue's College of Science during his work with the Merck-Purdue Center for Measurement Science. This industrial-academic partnership was formed in 2017 to focus on technologies to improve drug discovery and delivery.

"This center provides real-world test beds for validating emerging technology related to chemical measurements," Simpson said. "Our latest development is this novel filter design for digital deconvolution that helps us remove timing artifacts arising from the response function of the instrument we are using for data acquisition."

Analytical data may contain millions of data points, so Simpson and his team used mathematical formulas to analyze and organize the information into more useable formats for researchers and drug developers.

> "This center provides real-world test beds for validating emerging technology related to chemical measurements."

Light Detection Instruments

The practical measurement of an electronic event is a combination of the actual event and the capabilities of the measuring instrument. Simpson found that most algorithms used to correct for the instrument's response require a significant understanding of how the instrument itself operates.

Many instruments used to measure concentrations depend upon a light emission that produces an electronic signal. These include (but are not limited to) photon counting (PC), chromatography, super resolution imaging, fluorescence imaging, mass spectrometry, and scintillation counting. Each instrument uses an integral algorithm to determine which of the light emissions are coming from the actual sample, and which ones are stray or background interference.

Improved Data Analysis

In contrast, "Our digital filter approach only requires that a user have the data," Simpson said. "Our filter and algorithm then use non-negative matrix factorization over short sections of data to allow the analysis of data sets that are too large to be characterized by other conventional approaches."

The new Purdue filter can be used for microscopy, chromatography, and triboluminescence measurements. These techniques are often used in the early stages of drug development to identify the molecules that demonstrate the greatest potential for further testing and success.

Simpson is working with Purdue University's Office of Technology Commercialization to patent the new filter, and his research team hopes to find researchers and partners who are interested in licensing the software.

Purdue University is currently celebrating its sesquicentennial in a year-long celebration of achievements and advancements that showcase it as an intellectual center that can help solve real-world problems.

The technology is published in the March 25 edition of *Analytical Chemistry*.

Laboratory Sustainability: The Glass Advantage

It is hard to go through a typical day without reading or hearing about the growing concerns of the impact humans have on our planet. Many efforts are being made to raise public consciousness to reduce, reuse, and recycle as the main tenets to reverse the environmental issues that have arisen as a result of our progress over the last century. These same principles can be applied to our work life as laboratory professionals.

Biology and chemistry labs have evolved over the last several decades as new scientific techniques have emerged. With this evolution, the typical laboratory has experienced a shift from reusable glassware products to plastic alternatives. For a variety of reasons, the trends in lab plastics have moved decidedly toward single-use disposable options. While these advancements present a host of benefits, they all pose a significant impact on the environment as well as raise other issues, including leachable and extractable concerns.

For laboratories and individuals trying to do their part to counter the mounting environmental impact and challenges posed by plastics, laboratory glassware offers a viable solution to significantly reduce the waste generated by our endeavors to advance scientific discovery.

DWK Life Sciences offers the widest variety of laboratory glassware to support scientific endeavors across a plethora of applications. We produce lab staples such as beakers, Erlenmeyer flasks, volumetric flasks, pipettes, and graduated cylinders using highly durable and inert 33-expansion borosilicate KIMAX glass, which can be reused for years when properly maintained.

Proper maintenance of laboratory glassware includes cleaning, sterilizing when required, and inspection. Cleaning methods vary based on the applications and can range from soaking in an aqueous solution with detergent for several minutes followed by a rinse of deionized water to more aggressive techniques using acids or other oxidizing reagents.

Depending on the facility or institution, glass washing equipment may be available. Most manufacturers of laboratory glass washing equipment have introduced advancements into newer models that use less energy and reduce the volume of water used in each wash cycle, just like in our home appliances. These improved lines of equipment reduce the carbon footprint and contribute to the reduction of wastewater generation.

While proper cleaning is key in prolonging the life of your lab glass consumables, it is important to routinely inspect glassware for signs of wear. DWK Life Sciences is available to help educate and train your lab personnel on the proper methods for maintaining and inspecting laboratory glassware to ensure your lab realizes the maximum lifecycle of your laboratory products.

As with our life outside of work, the key is finding and achieving the right balance. Depending on the application, the benefits of plastics may be too great to ignore. However, in many cases, tried and true laboratory glassware offers a clear advantage over plastic alternatives and has far less impact on the environment.

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From the status of your cells to the settings of your microscope, many factors can influence the quality of your images in fluorescence microscopy. With so many factors in play, it's important to choose the right vessel for your application to start your microscopy on the right foot. The vessel should have the correct bottom thickness, a planar surface, low autofluorescence, and the right surface chemistry, and it should also prevent cross talk and bleaching.

Bottom Thickness
Microscope objectives are typically calibrated to accommodate a standard cover glass thickness of 175µm. For microscopic applications at higher magnifications, a thicker vessel bottom can make it difficult to adjust the focus and significantly reduce resolution. This effect can be exacerbated with oil or water immersion objectives. Generally, choose a vessel with a bottom thickness of 175µm (#1.5 coverglass) to improve your image quality.

Autofluorescence
Autofluorescence refers to non-specific fluorescence that can occur with proteins, buffers, fixatives, and microplate or slide surfaces, so choose the proper plastic or glass vessel to minimize autofluorescence. For example, polyolefins and glass have low levels of autofluorescence and are ideal for high content imaging. A microplate with black wells can also help to quench any background autofluorescence.

Cross Talk and Bleaching
Well-to-well cross talk occurs when stray light reaches a different well during microscopy. Cross talk can cause bleaching or over illumination of samples in nearby wells. To counteract this, black well sides can block out light and guarantee that each cell produces its maximum signal strength at the beginning of the screening.

Surface Chemistry
Whether your vessel surface is tissue culture treated, has Advanced TC treatment, or is coated with protein, you want adherent cells to attach. The surface chemistry of untreated glass may not promote the attachment of your cells, but surface-treated plastic or glass will enhance the cell binding and improve their morphology. When performing cultures where attachment is not preferred, a vessel with a glass-bottom surface or one made from cell-repellent polystyrene may be ideal.

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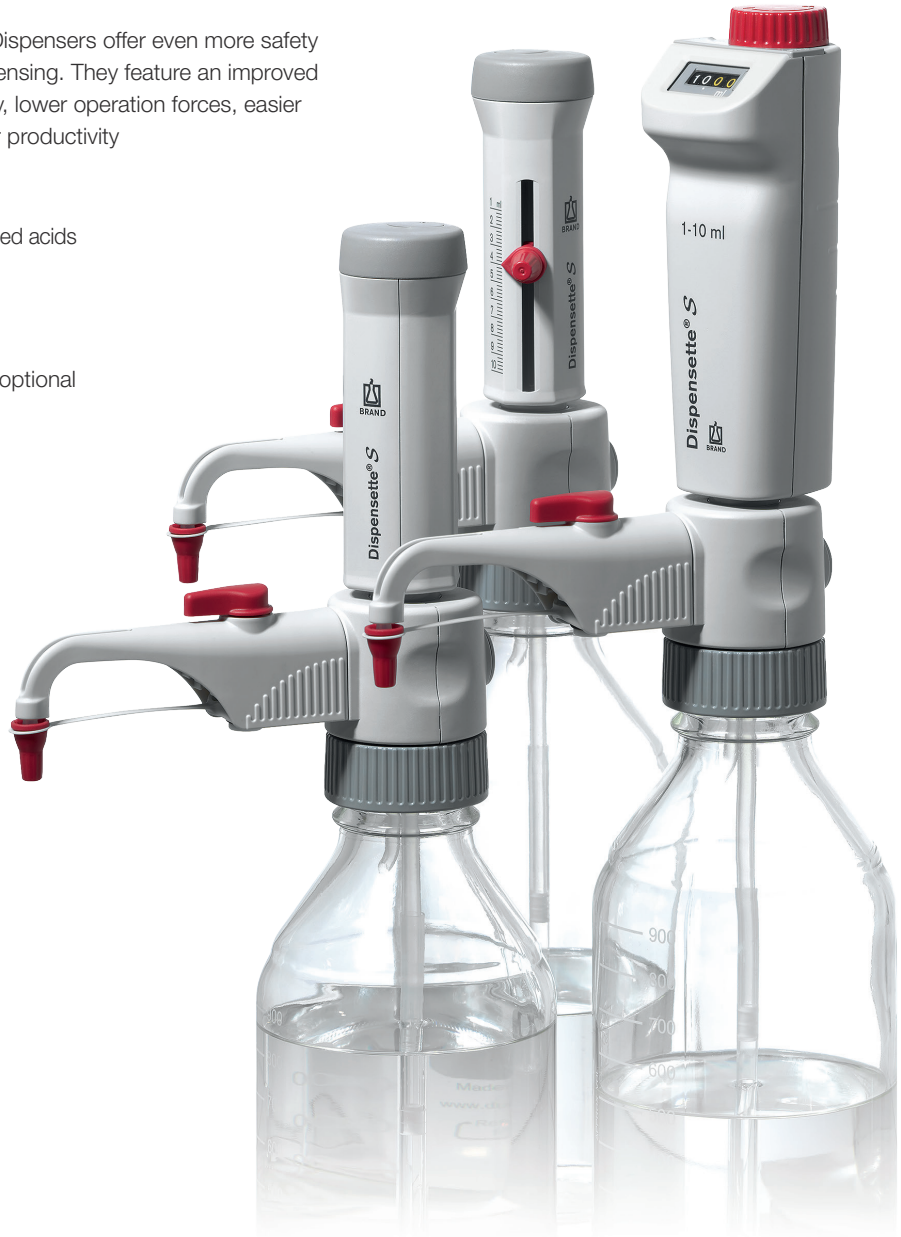

	Analog Adjustable		Digital	
Volume Range	Standard Valve	Recirculation Valve	Standard Valve	Recirculation Valve
	Cat. No.		Cat. No.	
NEW: 0.1 to 1mL	**13-689-019**	**13-689-012**	**13-689-006**	**13-689-000**
0.2 to 2mL	**13-689-020**	**13-689-013**	**13-689-007**	**13-689-001**
0.5 to 5mL	**13-689-021**	**13-689-014**	**13-689-008**	**13-689-002**
1 to 10mL	**13-689-022**	**13-689-015**	**13-689-009**	**13-689-003**
2.5 to 25mL	**13-689-023**	**13-689-016**	**13-689-010**	**13-689-004**
5 to 50mL	**13-689-024**	**13-689-017**	**13-689-011**	**13-689-005**
10 to 100mL	**13-689-025**	**13-689-018**	**N/A**	**N/A**

FEATURED ARTICLE

Lab Collab

Teaming Up to Take Down Parkinson's Disease

By Kylie Wolfe

In March of 2018, the Michael J. Fox Foundation for Parkinson's Research announced its PATH to PD program, a two-year, $6 million grant initiative designed to explore disease onset and progression. The funding was divided equally between three labs, one at the Pittsburgh Institute for Neurodegenerative Diseases, one at Northwestern University, and the other at the National Institute on Aging.

These labs were encouraged to communicate and collaborate regularly, sharing ideas and insights along the way. For the last year and a half, they've investigated three areas known to contribute most to Parkinson's disease: genetics, environment, and age. Researchers believe the disease is triggered by a combination of these factors, making this program fairly comprehensive.

Understanding the Disease

Currently, the only treatments available for Parkinson's patients merely mask symptoms rather than slow or stop disease progression.

Symptoms develop slowly, and each person's experience is different. But what's true for everyone is the loss of neurons in the substantia nigra, which is part of the midbrain. Cells in this region release dopamine, a neurotransmitter or chemical messenger that aids in body movement. Without sufficient neuron signaling and dopamine release, patients develop a variety of movement-related symptoms, including a tremor at rest, slowness of movement, and instability.

The researchers participating in this grant want to better understand the causes of the disease, first and foremost, in the hope that their work might lead to the development of more effective treatments.

Progress in Pittsburgh

Under the guidance of Dr. Timothy Greenamyre, scientists at the Pittsburgh Institute for Neurodegenerative Diseases are tackling four main projects related to environmental and genetic factors. The first examines environmental toxins to see if they activate LRRK2, a gene associated with Parkinson's. Establishing a biological mechanism could uncover a relationship between two causes of the disease.

Their second project investigates calcium signaling within neurons and the role of alpha synuclein, a protein that accumulates in the brains of Parkinson's patients.

A third project seeks to determine if dopamine is toxic when given to patients in response to concerns that Levodopa, a common drug treatment used to increase dopamine levels, may accelerate neurodegeneration. The goal here is to find neuro-protective therapies that slow or stop progression of the disease.

Their fourth study is designed to find biomarkers that can help create a blood-based test for disease detection. These biomarkers would be associated with LRRK2 activity and peripheral white blood cells.

Making Strides in Chicago

Researchers at Northwestern University, led by Dr. D. James Surmeier, are investigating aging and its relation to the dysfunction of dopaminergic neurons.

"Despite the fact that aging is the biggest risk factor in PD, we don't know how it contributes to disease progression, so we decided to attack aging in a different way than people had done before," he said.

Since the loss of mitochondrial function is normal with age, these organelles were their first target. They knew that Parkinson's patients and healthy aging patients alike experience the loss of complex I function, a protein complex within the mitochondria, but whether this was a cause of the disease or only a consequence was unclear.

In an effort to learn more, Surmeier and his team chose to knock out a critical subunit of complex I in the dopaminergic neurons of young mice. Taking this approach allowed them to control other variables associated with aging that might complicate their results. Ultimately, this experiment eliminated the mitochondria's ability to generate adenosine triphosphate (ATP), a key energy source for neurons.

To their surprise, even though the mitochondria stopped generating ATP, the neurons didn't die — at least not right away.

The mice did develop characteristics of Parkinson's, but those symptoms were responsive to therapies used in humans. This suggests that the loss of mitochondrial complex I function is a potential cause of the disease, pointing to new therapeutic possibilities for patients.

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Lab Collab Teaming Up to Take Down Parkinson's

Beginnings in Bethesda

At the National Institute on Aging, Dr. Andrew Singleton and his team are focused on mapping genetic changes related to the disease.

Their initial series of experiments looked at 100 iPS lines, or induced pluripotent stem cells, from participants both with and without Parkinson's disease to produce complete genetic information and an assessment of each person's genetic risk.

The team is mapping molecular markers like transcription, DNA methylation, and protein levels to see the relationship between these points of interest and known genetic information to better understand disease risk.

"It's really forcing us to bring together complex genetic information and complex functional information in a meaningful way," said Singleton. Through this project, they want to create a resource that explains how genetic factors affect the disease pathway.

He emphasized that his team's efforts are really just the beginning. "In many ways it's a pilot grant because we know we're not at scale to do what we want to do. It is, however, an amazing beginning, really only possible because of this innovative funding program. The hope is to expand this to a larger series with more measures and more outcomes."

Collaboration is Key

PATH to PD is especially unique, requiring the awarded labs to communicate at a high level over the duration of the program. Their research is intended to be interactive, exploratory, and flexible.

"These are some of the best labs in the world in terms of PD and they each have resources and technologies and interests that can help each other. It's been very enlightening," said Greenamyre.

"All of us have demonstrated that we know how to do science and are committed to the effort. [The foundation] knew we could make good use of the money and learn something important, even if our hypotheses were wrong," said Surmeier, who sees the grant program as an incubator for innovative research.

The groups interact regularly to share data and update each other on their progress. Monthly calls give researchers the opportunity to share their current findings, suggest new research angles, and make informed hypotheses through their collective results. Discussions are led by post-doctoral candidates from each team, allowing the conversation to flow naturally.

"We also had an in-person meeting where everyone involved got together in Pittsburgh," said Singleton. This past January, in a city celebrated for being a place where three rivers meet, researchers from the three labs, representatives from the foundation, independent assessors, and other experts in Parkinson's disease convened to discuss results and deepen relationships.

Greenamyre said he's passionate about this approach and has also noticed its impact. "Collaboration is really the way of the future. The way of the present, actually. If you want to have a meaningful, impactful study you have to apply multiple analyses that can't be performed by one lab alone."

As promising as their work together has been, the researchers are uncertain about what will happen after the program ends. "Two years is a short amount of time to explain a problem and attempt to solve it," Greenamyre said, specifying that renewed funding for the program is currently not on the horizon.

The labs are looking for ways to continue select projects. Some could lead to more conventional grants from the NIH, while others might foster smaller funding opportunities from the foundation. Regardless, this grant has encouraged thoughtful discussions and allowed these leading labs to work together in a way that uncovers answers to difficult questions.

Grants and Goals for the Future

Through well-funded and specifically targeted grant programs, the Michael J. Fox Foundation hopes to accelerate the path to better therapies and an eventual cure. In February of 2019, the non-profit announced 127 upcoming grants totaling an additional $24 million.

As the foundation continues to fuel Parkinson's research, its PATH to PD program will soon wrap up its second year. Thanks to the encouragement and flexibility of this grant initiative, these scientists are breaking the stigma of discussing unpublished research, pushing them to work toward a crucial common goal — together.

Nail Salons Hazardous for Workers

By Christina Phillis

A new study at the University of Colorado Boulder found that nail salon workers are at an increased risk of serious health issues.

Researchers monitored the levels of volatile organic compounds (VOCs) in six Colorado nail salons, and found high levels of formaldehyde, benzene, and other indoor pollutants. Although the presence of VOCs in nail salons is well known, this is one of the first studies to evaluate the effects of long-term exposure on workers.

"The study provides some of the first hard evidence that these environments are dangerous for workers and that better policies need to be enacted to protect them," said Lupita Montoya, lead author and research associate in CU Boulder's Department of Civil, Environmental and Architectural Engineering.

Study authors likened the working conditions in nail salons to those in oil refineries or automobile repair shops.

Hazardous Conditions

Researchers measured levels of benzene, toluene, ethylbenzene, xylenes (BTEX), and formaldehyde. Benzene, a compound linked to leukemia, was present in all six salons in higher-than-expected concentrations. Formaldehyde levels were similar to those measured in other settings.

This information, combined with the employment and safety practices and health symptoms reported by study participants, makes the situation especially concerning. Workers reported clocking an average of 52.5 hours per week, with some working as much as 80 hours per week. The majority (70%) reported at least one adverse symptom: headaches, skin irritation, or eye irritation.

According to the U.S. Environmental Protection Agency (EPA), long-term exposure to carcinogenic compounds like those commonly found in nail salons significantly raises the chances of workers developing leukemia and Hodgkin's lymphoma. The study also found that the lifetime cancer risk for workers in some salons was up to 100 times higher than baseline EPA-issued predictions.

Customers do not face the same level of risk, since the duration of their exposure is significantly lower, but clients who are pregnant or suffer from serious asthma are at a greater risk than others.

"It really depends on how much time you spend in and around that environment," Montoya said. "Customers spend a fraction of the time in salons that workers do. Unless they have pretty severe allergies or asthma, there's not much for customers to be concerned about."

> Study authors likened the working conditions in nail salons to those in oil refineries or automobile repair shops.

Creative Solutions

For the majority of nail salons, solutions to correct this situation may be problematic. Many are small businesses that employ mostly minority populations and don't have the financial resources to resolve these issues. Study authors enlisted the help of engineers and artists to develop low-cost systems that could be installed in a nail salon without disrupting business.

One idea involved using absorbent materials like heat-treated coal or wood to remove VOCs from the air. Materials like these have a strong affinity for organic molecules like BTEX compounds. The only downfall is that this process can take a long time. "We've seen high rates of VOC removal with this method in controlled lab settings — nearly 100%," said Lamplugh. "We're still optimizing it for the field, where conditions are more unpredictable."

Another option under development is the use of activated carbon-based materials to create gallery-worthy artwork for the walls. Small jets at the end of each table could direct chemical fumes toward the artwork, allowing it to absorb harmful substances while creating a pleasant atmosphere.

Combining science, technology, and art is not only beautiful, it can be a practical and effective way to tackle real-world issues outside of the lab.

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ELIMINase	250mL 950mL	1101 1102	**04-355-31** **04-355-32**

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Description	Cat. No.	Quantity
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White, X-Small	17-100-960	25/Case
White, Small	17-100-961	25/Case
White, Medium	17-100-962	25/Case
White, Large	17-100-963	25/Case
White, X-Large	17-100-964	25/Case
White, 2X-Large	17-100-965	25/Case
White, 3X-Large	17-100-966	25/Case
White, 5X-Large	17-100-967	25/Case

Description	Cat. No.	Quantity
Polypropylene Isolation Gowns: Knee-Length, Elastic Cuffs, Neck and Waist Ties		
White, Large	17-100-408	10/Pack 5 Packs/Case
White, X-Large	17-100-409	10/Pack 5 Packs/Case
White, 2X-Large	17-100-410	10/Pack 5 Packs/Case
Blue, Large	17-100-411	10/Pack 5 Packs/Case
Blue, X-Large	17-100-412	10/Pack 5 Packs/Case
Blue, 2X-Large	17-100-413	10/Pack 5 Packs/Case
Yellow, Large	17-100-414	10/Pack 5 Packs/Case
Yellow, X-Large	17-100-415	10/Pack 5 Packs/Case
Yellow, 2X-Large	17-100-416	10/Pack 5 Packs/Case

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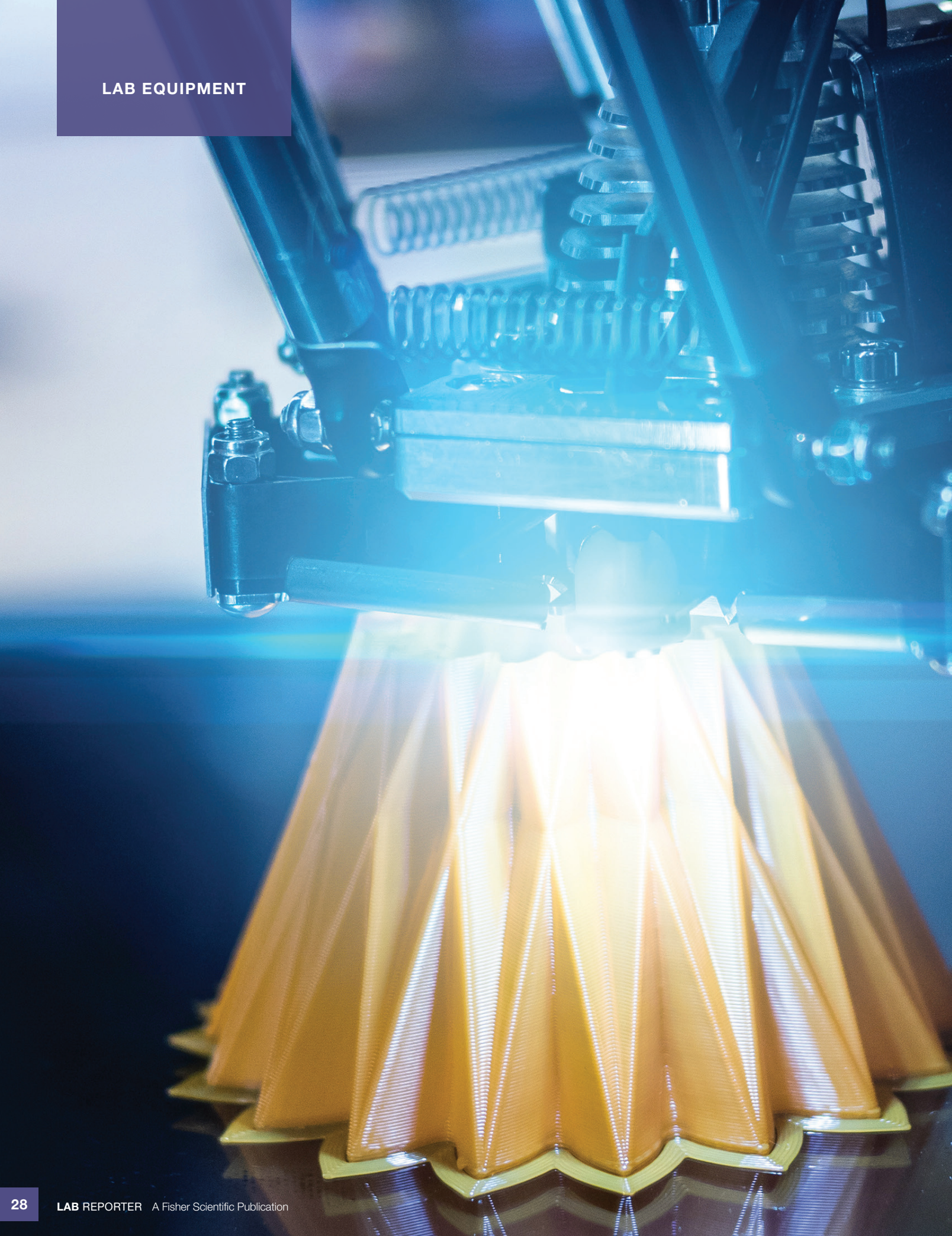

Putting Tissue to the Test: 3D Organ Bioprinting

By Kevin Ritchart

A recent breakthrough has brought bioengineers even closer to creating replacement organs using 3D printing.

Scientists have discovered a new technique for bioprinting tissues that includes structures that function like the body's complicated natural vascular networks. Their research was published in an issue of *Science* earlier this year.

A team of scientists worked with a Massachusetts design firm called Nervous System to create a hydrogel model of a lung-like air sac that has airways to deliver oxygen to the blood vessels that surround it.

"One of the biggest road blocks to generating functional tissue replacements has been our inability to print the complex vasculature that can supply nutrients to densely populated tissues," said Jordan Miller, assistant professor of bioengineering at Rice's Brown School of Engineering.

Supply and Demand

The primary impetus for bioprinting healthy, functional organs is the overwhelming demand for organ transplants. In the U.S. alone, more than 100,000 people are on transplant waiting lists. Those who are fortunate enough to receive a transplant must still fight with immuno-suppressing drugs to keep their bodies from rejecting the transplants.

Organ bioprinting, once perfected, may be able to solve both problems. Organ replacements can be produced based on need, reducing the long waiting lists for healthy and compatible matches. And the replacement organs could be printed using the patient's own cells, which would eliminate the potential for rejection.

To tackle this challenge, the research team created a new, open-source bioprinting technology called the "stereolithographing apparatus for tissue engineering" or SLATE for short. The system employs an additive manufacturing technique to construct soft hydrogels one layer at a time.

Let There Be Light

The layers are printed using a liquid pre-hydrogel solution that transforms to a solid when it's exposed to blue light. A digital light-processing projector shines light from below at 2D slices of the structure. When each layer is solidified, an arm raises the growing (and now 3D) gel just enough for the next liquid layer to be exposed to the light.

A key component of the process is the use of food dyes that can absorb the blue light. This allows extremely thin layers to be solidified and makes the SLATE system ideal for quickly producing soft, water-based, and biocompatible gels that have complex internal structures.

Go with the Flow

Tests of a lung structure that was created using this process produced tissues that are strong enough to avoid bursting during blood flow and the pulsatile and rhythmic intake and outflow of air that mimics human respiration.

Red blood cells could also take up oxygen as it flowed through the vessels surrounding the 3D printed "breathing" air sac. This movement of oxygen is analogous to the gas exchange that occurs in the lungs' alveolar air sacs.

The teams are also experimenting with implanting liver cell-containing bioprinted constructs into mice. These "tissues" had separate compartments for blood vessels and liver cells and were implanted in mice with chronic liver injuries. Tests showed that the liver cells survived the implantation.

Access for All

Because this groundbreaking research was facilitated and enabled by open-source projects, Miller and his team are supporting the further development of this potentially life-saving technology. He and the team have made all of the SLATE-related source data from their experiments and the 3D printable files freely available to other bioengineers.

Miller's lab is already using the new design and bioprinting techniques to explore even more complex structures. "We are only at the beginning of our exploration of the architectures found in the human body," he said. "We still have so much more to learn."

Transitioning from Academia to Cell Therapy

By Mary Kay Bates, M.S., Senior Global Cell Culture Specialist

There is much excitement and optimism for treating cancer, neurological and muscular disorders, orphan diseases, and more with new cell and gene therapy technologies. In 2018, two CAR-T approaches were approved by the U.S. Federal Drug Administration, with many more to follow. These successes have been built on many years of painstaking research across multiple disciplines and institutions.

In bringing new cell and gene therapies to the clinic, scientific leaders transitioning to therapy or production for the first time may find the wealth of planning and the regulatory environment required to be overwhelming. But there is good news: the essential cell culture equipment that you have used in your lab and trusted with your work for many years is perfectly positioned to transition with you.

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VIOS 250i CO_2	255L (9.0 cu. ft.)	Copper	TC	51030963	**13-998-228**
VIOS 250i CO_2	255L (9.0 cu. ft.)	Copper	IR	51030991	**13-998-230**
VIOS 160i Tri-Gas	255L (9.0 cu. ft.)	Stainless steel	TC	51031047	**13-998-237**
VIOS 160i Tri-Gas	255L (9.0 cu. ft.)	Stainless steel	TC	51031048	**13-998-236**
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Model	Size	Mfr. No.	Cat. No
HeraSafe 2030i with UV, 120V	4 ft.	51032334	**09-034-250**
HeraSafe 2030i with UV, 120V	6 ft.	51032335	**09-034-251**
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Adjustable stand	6 ft.	50155691	**09-034-257**

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*SFX250	0.2mL to 500mL	250W, 120V	½ in. Tapped	101-063-965R	**15-345-138**
*SFX550	0.2mL to 1000mL	550W, 120V	½ in. Tapped	101-063-969R	**15-345-141**
*SFX550	0.2mL to 1000mL	550W, 120V	¾ in. Solid	101-063-968R	**15-345-140**

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CPX2800H	0.75 gal. (2.8L)	CPX-952-218R	**15-336-121**
CPX3800H	1.5 gal. (5.7L)	CPX-952-218R	**15-336-122**
CPX5800H	2.5 gal. (9.5L)	CPX-952-518R	**15-336-123**
CPX8800H	5.5 gal. (20.8L)	CPX-952-818R	**15-336-124**

Model No.	Capacity	Mfr. No.	Cat. No
120V			
CPX1800	0.5 gal. (1.9L)	CPX-952-119R	**15-336-130**
CPX2800	0.75 gal. (2.8L)	CPX-952-219R	**15-336-131**
CPX3800	1.5 gal. (5.7L)	CPX-952-319R	**15-336-132**
CPX5800	2.5 gal. (9.5L)	CPX-952-519R	**15-336-133**
CPX8800	5.5 gal. (20.8L)	CPX-952-819R	**15-336-134**

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Model	Width	Mfr. No.	Cat. No.
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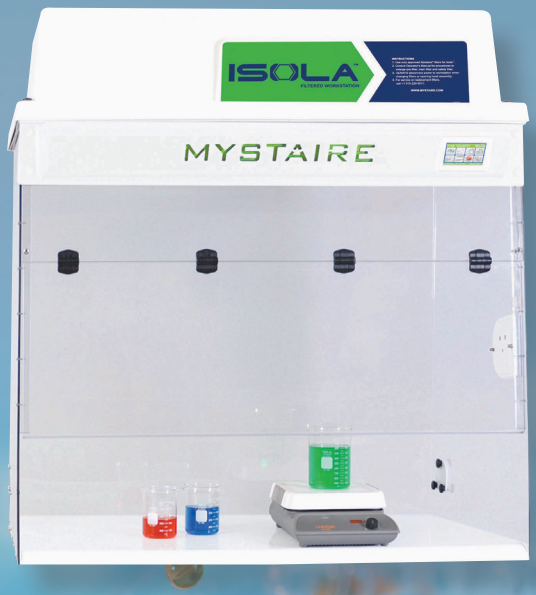
Isola Vue	72 in.	MY-ISL72	**15-338-902**

Isola filters sold separately; application dependent



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MY-PCR	32 in.	MY-PCR32	**15-338-366**
MY-PCR	48 in.	MY-PCR48	**15-338-367**

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Fostering the Next Generation of Scientists

Laxco has started a nationwide buyback and donation program that supplies refurbished microscopes to elementary schools and promotes science education. Instead of discarding old models, colleges and universities can donate or trade in their microscopes for credit that never expires. For each microscope, Laxco offers $100 of credit that can be applied to up to 10% of an individual order. The donated microscopes are then cleaned, repaired, and donated to elementary schools, which typically do not have funds for microscopes in their budgets.

Through the program, Laxco hopes to connect resources with schools that really need them, stimulate science education for young students, and support educators, STEM schools, school districts, and science teachers' associations. But this is just one of Laxco's education initiatives — they're designing new programs to stimulate science education in all grade levels.

Want to trade in an old microscope and support the next generation of scientists? Contact your Fisher Scientific representative to get started.

Bringing Innovative Technology to the Classroom

Laxco SeBa Microscopes feature a fully integrated tablet that uses the same touchscreen technology students are used to using on phones and tablets. This helps create a connection between everyday life and science that makes it easy for students to dive into their work. At the Diversity for Science Conference in June 2019, 21 high school students were able to use the Laxco SeBa2 Microscope to search for live algae. The students were captivated with what they saw, and they were easily able to send images directly to their phones with the built-in Bluetooth connectivity.

For second grade students in Maine, the Laxco SeBa2 Microscope brought to life a whole world that's invisible to the naked eye. From seemingly nothing, living organisms swam across a projector screen connected with the microscope's built-in Bluetooth. Plus, the students were able to get hands-on experience at 10 different stations where they could take pictures, record videos, and author their personal findings by typing their names on the screen.

But Laxco microscopes aren't just easy for students to use — they're also convenient for instructors. The new Laxco SeBa Pro4C System allows teachers to remotely see what a student is viewing in real time, completely wirelessly, and with no lag. The SeBa Pro4C can connect with up to 29 microscopes, and it can display images from a single device or all 29 at once.

Visit **fishersci.com/laxco** or **fishersci.ca/laxco** to find the right microscope for your work.

Content provided by:

LAXCO™

A Microscope for Everyone

Convenient and Efficient

BUCHI Rotavapor R-300 Rotary Evaporators

The newest BUCHI Rotavapor R-300 Rotary Evaporators meet the highest expectations for convenience and versatility. The modular design allows users to extend to a fully integrated system, including:

- Central interface: control all components, run programs, and receive push notifications
- Vacuum pump: chemically resistant and speed-regulated pump only runs when needed
- Recirculating chiller: designed with energy-efficient settings

Contact your Fisher Scientific sales representative for more information about BUCHI rotary evaporators, vacuum pumps, and chillers.

Condenser Type	Glassware	Lift Type	With I-300 Controller	With V-300 Pump	Cat. No.
Cold Trap	Uncoated	Manual	No	No	**05-000-455**
Cold Trap	Safety Coated	Manual	No	No	**05-000-461**
Vertical	Uncoated	Manual	No	No	**05-000-485**
Cold Trap	Safety Coated	Electronic	No	No	**05-000-947**
Cold Trap	Safety Coated	Electronic	Yes	No	**05-000-949**
Vertical	Safety Coated	Electronic	No	No	**05-000-977**
Vertical	Safety Coated	Electronic	Yes	No	**05-000-979**
Vertical	Safety Coated	Electronic	Yes	No	**05-000-980**
Cold Trap	Safety Coated	Electronic	Yes	Yes	**05-001-070**
Vertical	Safety Coated	Electronic	Yes	Yes	**05-001-076**

Oil-Free, Corrosion Resistant

KNF LABOPORT Vacuum Pumps

LABOPORT vacuum pumps from KNF Neuberger are the perfect choice for a wide range of laboratory vacuum applications, including rotary evaporation, filtration, desiccation, vacuum ovens, and more. These vacuum pumps are non-contaminating and provide a clean, reliable, environmentally friendly benchtop vacuum source.

- Premium, metal-free, chemical-resistant parts for long product life
- Oil free for clean, maintenance-free performance
- Compact design is portable and quiet

Model	Pump Configuration	Flowrate	Vacuum	Cat. No.
Chemical-Resistant Vacuum Pumps: for Evaporation, Vacuum Ovens, Vacuum Concentration				
UN820.3FTP	2 Stage	20L/min.	6 torr (8mbar)	**13-878-27**
UN840FTP	Single Stage	34L/min.	75 torr (99mbar)	**13-878-44**
UN840.3FTP	2 Stage	34L/min.	6 torr (8mbar)	**13-878-29**
UN842.3FTP	2 Stage	34L/min.	1.5 torr (2mbar)	**13-878-35**
Mini Vacuum Pumps: for Vacuum Desiccation, Degassing, Solvent Filtration				
UN86KTP		5.5L/min.	120 torr (160mbar)	**13-878-38**
UN811 KVP		13L/min.	75 torr (100mbar)	**13-880-34**
UN816.3KTP		16L/min.	15 torr (20mbar)	**13-880-30**
UN816.1.2KTP		30L/min.	120 torr (160mbar)	**13-880-32**

OHAUS Explorer Balances: Minimizing Result Uncertainty

"Garbage in, garbage out" applies to every scientific endeavor from computer science to microbiology. It means that the end results can only be as good as the data collected and used to reach them. Several organizations, including the Federal Drug Administration (FDA) and the United States Pharmacopeia (USP), have created standards by which all aspects of data generation are governed. For example, analytical instruments must be periodically calibrated, and the data they produce must be verifiable, traceable, and accurate.

There are few analytical instruments that are more ubiquitous (and potentially overlooked) in the lab than balances. They're responsible for measuring all sorts of samples and generating critical data. How certain are you that your weighing results are trustworthy? How comfortable would you be having your weighing process and results audited? Ohaus Explorer balances provide many features that help minimize result uncertainty and are available at an economical price.

Weighing Performance

Measurement uncertainty can occur with high-quality instruments. It's a common mistake to assume that the "readability" of a balance (or the least significant digit that a balance can display) is the same as the "accuracy" of a balance, which is not the case. All measurement devices are subject to measurement uncertainty — the degree to which a measured value and the true value could potentially differ. Many manufacturers offer many balances at many price points, so choosing the right one could be difficult. Ohaus Explorer balances offer exceptional weighing performance and provide results with minimal uncertainty.

Connectivity and Data Integrity

Once generated, quality data must be recorded and archived. A balance can be a stand-alone piece of equipment connected to a printer, but it's becoming more common for balances to be connected to larger systems: a commercial LIMS, an internal local area network, or simply a single PC. Ohaus Explorer balances provide several connectivity options, including RS-232, USB, and ethernet. Once connected, weighing results can be automatically collected and stored in a digital format (such as an Excel worksheet, a database, and more) with attributes, including a data and time stamp, identification of the balance from which it came, the user who made the measurement, and sample ID. Furthermore, Ohaus' standard communication protocol and response format make collecting and storing data easy.

Automatic Calibration

To minimize result uncertainty, its critical to ensure that results are consistent over time and not affected by changing environmental factors, such as temperature and humidity. Ohaus Explorer balances offer automatic calibration (or AutoCal) that uses an internal calibration mechanism with a motor and one or more weights of known mass that are housed within the balance. AutoCal automatically triggers internal calibration and adjustment when a change of temperature is detected or after a given period of time. This is done without user input when the balance is not in use. AutoCal guarantees that the balance is adjusted to produce accurate results in the current environment and that the balance is always ready for use, eliminating the need for manual calibration and adjustment.

Ohaus Explorer semi-micro, analytical, precision, and high-capacity balances are durably constructed and offer capacities up to 35kg as well as readabilities from 0.01mg to 0.1g. They are well suited for laboratory applications where high accuracy, data integrity, and minimal result uncertainty is paramount.

Content provided by:

OHAUS®

Your Balance, Your Way

Sartorius Cubis II Balances

When Neil Armstrong brought 22.2mg of moon rocks back to Earth from the Apollo 11 mission in 1969, a Sartorius balance — one of the most precise weighing instruments available at the time — weighed them. From its very beginning in 1870, Sartorius was an innovator of new weighing technologies.

Now, the next generation of Sartorius premium balances is here: Cubis II. The state-of-the-art Cubis II sets a new standard in modularity, connectivity, and workflow integration. It's the only laboratory balance on the market that offers fully customizable hardware, software, and connectivity.

Improve your operational efficiency and experimental outcomes with modern user interfaces, pharmaceutical and GxP compliance features, data handling, integrity, connectivity, ergonomic sample handling, easy process integration, and unlimited communication.

- Leading performance: monolithic weighing system, integrated climate sensors, individual sample holders
- Error-free operation: individual QApp workflows; motorized auto-leveling for all models up to a maximum capacity of 8.2kg
- End-to-end data integrity: 21 CFR Part 11 compliance, integrated audit-trail, state-of-the-art user management
- Outstanding service support: integrated status center, service functions, and preventative maintenance based on accredited standard

Combine a display unit, weighing module, draft shield, software packages for various applications and functions, and a comprehensive range of accessories to adapt the Cubis II balance to any weighing task. A weight range from 2.1g to 70kg with readabilities between 0.1µg and 1g offers a solution for any application.

Type	MCA Models
Display	Large high-end 7" color touch TFT display in 16:9 format with new user interface
Software	Factory installed basic set of essential weighting applications (license free) and packages with special weighing applications and function extensions (license required)
Operation	Activated by touch key or touch-free using IR sensor (draft shield M) or gesture sensor (optional), learning capability

Type	MCE Models
Display	State-of-the-art TFT touchscreen operation with brilliant, readable display, but uncomplex, easy-to-operate user interface
Software	Factory-installed basic set of essential weighing applications
Operation	Activated by touch key or touch-free using IR sensor (draft shield M) or gesture sensor (optional), learning capability

Ductless Chemical Workstations
Laminar Flow Workstations

AirClean Systems

Combination PCR Workstation

The AirClean Systems Combination PCR Workstation combines an ISO 5/Class 100 Clean Air Environment with UV light sterilization for optimal protection from sample contamination. A UVTect microprocessor constantly monitors workstation functions.

Standard Features:
- Class 100 clean vertical laminar flow air
- Polycarbonate and polypropylene design to reflect UV energy
- Digital UV light timer: 0 to 59 minutes
- UV shelf with integrated pipette holder

Description	Mfr. No.	Cat. No.
32” PCR Workstation	AC632LFUVC	**36-101-8894**
48” PCR Workstation	AC648LFUVC	**36-101-8897**

Endeavour Ductless Fume Hood

The Endeavour Ductless Fume Hood is designed to provide superior operator protection from potential toxic fumes, vapors, and particulates. AirSafe NXT provides simple and effective user interaction with fume hood operational parameters.

Standard Features:
- Microprocessor controller with audible and visible alarms for both airflow velocity and filter change
- Bonded carbon filters — no dust!
- Polypropylene construction — excellent chemical resistance

Description	Mfr. No.	Cat. No.
48” Ductless Fume Hood	ACPT4000	**36-100-0063**
60” Ductless Fume Hood	ACPT5000	**36-100-0067**
72” Ductless Fume Hood	ACPT6000	**36-100-0069**

Filters sold separately; application worksheet required.

AC600 Series Ductless Chemical Workstation

The AC600 Series Ductless Chemical Workstation is an economical solution for protection of the operator and environment from toxic vapors, gases, fumes, and particulates. Ships fully assembled and can be configured for a variety of common applications.

Standard Features:
- Microprocessor controller has audible and visible alarms for both airflow velocity and filter change
- 360° visibility
- Ideal for low-volume chemical applications

Description	Mfr. No.	Cat. No.
32” Workstation	AC632A	**36-100-4271**
32” Workstation, Tall Version	AC632TA	**36-100-4272**
48” Workstation	AC648A	**36-100-4274**
48” Workstation, Tall Version	AC648TA	**36-100-4275**

Filters sold separately; application worksheet required.

Avoid Harsh Chemicals when Cleaning Instruments

Fisherbrand Ultrasonic Cleaners

Fisherbrand Ultrasonic Cleaners allow you to decontaminate medical and lab instruments and remove viruses, animal tissue, and blood without using harsh chemicals. With a mild solution, they can clean a variety of lab items, including:

- Test tubes
- Petri dishes
- Glass beakers and flasks
- Pipettes

Before

After

Fisherbrand 112xx Series Advanced Ultrasonic Cleaners are more powerful than conventional cleaners. They feature a wide range of adjustable parameters for lab applications, including cleaning, mixing, and degassing.

- Maximum versatility: choose frequency, power level, time, temperature, and mode
- Modes: normal, pulse, sweep, and de-gas
- Six tank sizes: 0.7 to 7.4 gallons
- Compatible with multiple cleaning solutions
- Full line of accessories (sold separately)
- Products in stock and ready to ship

Model	Capacity	Cat. No.
FB-11201	2.75L (0.7 gal.)	**FB11201**
FB-11203	5.75L (1.5 gal.)	**FB11203**
FB-11205	6.9L (1.8 gal.)	**FB11205**
FB-11207	12.75L (3.3 gal.)	**FB11207**
FB-11209	18L (4.75 gal.)	**FB11209**
FB-11211	28L (7.3 gal.)	**FB11211**

Protective Coating, Functional Accessories

Fisherbrand Maxima Rotary Vane Vacuum Pumps

Fisherbrand Maxima Rotary Vane Vacuum Pumps are durable, have superior vapor handling capability, and include an exhaust filter, funnel, and hose clamp. They can be used for vacuum furnaces, rotary evaporation, freeze drying, vacuum distillations, and other processes.

- Low maintenance requirements
- Corrosion-resistant coatings protect against chemicals
- Large oil reservoir dilutes harsh chemicals
- Built-in cooling system reduces chemical activity and slows oil consumption

Model	Displacement (Flow Rate) at 60Hz	Ultimate Vacuum	Dimensions (L x W x H)	Shipping Weight	Cat. No.
M4C	2.7 CFM (78L/min.)	5×10^{-4} torr (4×10^{-4}mbar)	18.2 x 6.1 x 9.1 in. (46 x 16 x 23cm)	63 lb. (29kg)	**01-184-202**
M6C	4.2 CFM (118L/min.)			63 lb. (29kg)	**01-184-203**
M8C	5.6 CFM (158L/min.)			65 lb. (30kg)	**01-184-204**
M16C	12.8 CFM (363L/min.)	3×10^{-4} torr (2×10^{-4}mbar)	22.4 x 8.1 x 11.4 in. (57 x 21 x 29cm)	200 lb. (91kg)	**01-184-205**
M24C	18.3 CFM (519L/min.)			103 lb. (47kg)	**01-184-206**
M30C	22.1 CFM (627L/min.)			106 lb. (48kg)	**01-184-207**

All models include an exhaust filter, funnel, and hose clamp.

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Fisherbrand Heat/Cool Thermal Mixer II

Use the Fisherbrand Heat and Heat/Cool Thermal Mixer II for tissue, cell, and biochemical analysis. Precise temperature and mixing controls allow for enzymatic digestion, nucleic acid purification, immunoassays, protein analysis and expression, and other biochemical assays.

- Large, intuitive color touchscreen makes it easy to use and program
- Interchangeable sample blocks support most container shapes and sizes
- Block autorecognition
- Storage for up to 25 programs

Description	Cat. No.
Heat/Cool Thermal Mixer II	**15-600-330**
Heat Only Thermal Mixer II, Includes Block (Cat. No. 15-600-333)	**15-600-331**
Heating Blocks	
Block for 24 x 0.5mL Tubes	**15-600-332**
Block for 24 x 1.5mL Tubes	**15-600-333**
Block for 24 x 2mL Tubes	**15-600-334**
Block for 8 x 5mL Tubes	**15-600-335**
Block for 24 x 12mm Diameter Tubes	**15-600-336**
Block for 8 x 15mL Conical Tubes	**15-600-338**
Block for 4 x 50mL Conical Tubes	**15-600-339**
Block for 24 Cryo Tubes	**15-600-342**
Block for Microplates	**15-600-340**
Block for 96-Well PCR Plate	**15-600-341**
Block for 384-Well PCR Plate	**15-600-337**

Comfort and Dependability

Fisherbrand HandyStep S Pipette and Tips

Get comfortable, dependable, easy operation with the new Fisherbrand HandyStep Repeating Pipette. When used with Fisherbrand dispenser tips, the pipette offers 59 different volume settings.

- Comfortable: slim, lightweight, well-balanced; control layout lets you select a volume with just one hand
- Reliable: purely mechanical operation (no batteries needed); made from corrosion-resistant polymers for durability
- Contact free: tip ejection system removes tips without handling
- Flexible: 10 tip sizes with both sterile and nonsterile options

Fisherbrand dispenser tips are made from high-quality virgin plastics with no chemical additives. They form a tight seal between the piston and cylinder for smooth operation, plus better accuracy and precision.

Description	Cat. No.
Fisherbrand HandyStep S Repeating Pipette	**13-668-722**

Capacity	Cat. No.	Cat. No.	Quantity
	Nonsterile	**Sterile**	
0.1mL Tips	**13-668-700**	**13-668-710**	100/Pack
0.5mL Tips	**13-668-701**	**13-668-711**	100/Pack
1mL Tips	**13-668-702**	**13-668-712**	100/Pack
1.25mL Tips	**13-668-703**	**13-668-713**	100/Pack
2.5mL Tips	**13-668-704**	**13-668-714**	100/Pack
5mL Tips	**13-668-705**	**13-668-715**	100/Pack
10mL Tips	**13-668-706**	**13-668-716**	100/Pack
12.5mL Tips	**13-668-707**	**13-668-717**	100/Pack
25mL Tips	**13-668-708**		50/Pack
25mL Tips		**13-668-718**	25/Pack
50mL Tips	**13-668-709**	**13-668-719**	100/Pack
Tip Adapters for 25 and 50mL Tips	**13-668-720**		10/Pack
Tip Adapters for 25 and 50mL Tips		**13-668-721**	5/Pack

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UVEX

New Monogenic Disease Identified in Five Individuals

By Mike Howie

In a collaborative effort led in part by the Indiana Biosciences Research Institute (IBRI) and Columbia University, researchers have discovered a new monogenic disease. Dubbed "DHPS Deficiency" and caused by mutations in the gene encoding deoxyhypusine synthase (DHPS), the disease affects an enzyme essential to the production of hypusine, which is used by the body to make proteins. The researchers published their work in the *American Journal of Human Genetics* in January 2019.

To date, DHPS Deficiency has been identified in five individuals from four unrelated families in North America. Two are siblings — the oldest and youngest of three. The older of the two had been experiencing seizures and other health problems since birth, and the family's medical team suspected an undiagnosed genetic condition. In 2016, Dr. Orrin Devinsky of New York University, their epileptologist, referred them to Dr. Wendy Chung of Columbia University, a medical geneticist whose lab works to understand unexplained genetic diseases.

The First DHPS Gene Mutation in a Human

Dr. Chung's lab performed exome sequencing on DNA from both affected children to search for a possible cause of the seizures. They discovered mutations in the DHPS gene — the first found in humans. To understand if the mutations could be causing the clinical symptoms in the children, Dr. Chung enlisted the help of Dr. Teresa Mastracci of the IBRI, who first met Dr. Chung when she was a postdoctoral fellow at Columbia University, where Dr. Chung has her lab. Dr. Mastracci's lab studies the DHPS gene as it relates to diabetes.

Dr. Leah Padgett, a postdoctoral fellow who works in Dr. Mastracci's lab, performed some of the in vitro studies that confirmed the mutations discovered in Dr. Chung's lab caused problems with the DHPS enzyme. In combination with work from a collaborating lab at the National Institutes of Health (NIH), the researchers concluded that the mutations caused the enzyme to dysfunction, which ultimately may explain the clinical symptoms in the affected individuals.

In addition to seizures, DHPS Deficiency leads to neurodevelopmental delay and altered growth and gait. Currently, it is unclear how these symptoms will evolve or if they will resolve as the individuals age. Follow-up studies are in progress to gain a deeper biological understanding of this disease.

Unknown Origin and Prevalence

Researchers don't know how many people around the world could be affected by this disease. They're beginning to search outside North America, but the five affected individuals could be the extent of the disease's prevalence. Interestingly, the affected individuals share some common ancestry: all of the families reported at least one parent of Irish and/or English heritage, which gives researchers a starting point to investigate the incidence of DHPS Deficiency.

While DHPS Deficiency is currently categorized as a rare or orphan disease, it may be biologically related to other diseases. One possible related disease is Snyder-Robinson Syndrome, which affects a protein that's in a parallel pathway to DHPS and results in delayed development and other symptoms. Similarly, a group of researchers in Michigan recently identified a mutation that overexpresses an enzyme that's upstream of DHPS and results in a neurological phenotype. These diseases currently affect fewer than 20 people, but their similar pathways could mean that they're related. Working together, researchers studying the three diseases hope to find common mechanisms that would help explain them all.

Early Stages of Research

Most questions about DHPS Deficiency are still unanswered. Dr. Mastracci's lab is just beginning to study basic characterization of the disease in animal models, performing metabolic tests and even examining how the animals develop in utero. They're also using lymphoblast cell lines from the patients and their families to study the basic functions and growth of the cells.

In the end, researchers hope to reach two goals: find a way to test for the disease, and develop a method to treat it. If DHPS Deficiency can be identified during pregnancy or early in life, doctors could help prepare parents or possibly intervene. And if they can develop a way to treat the disease, they can dramatically improve the quality of life for the affected individuals.

"Ultimately all of us are working to help the children with this disease," Dr. Mastracci said. "We hope we'll be able to identify some way to lessen the clinical presentation or, ideally, provide a treatment that altogether eliminates the symptoms of the disease."

To learn more about DHPS Deficiency and stay up to date with the latest research, visit **dhpsfoundation.org**.

Microplate-Based Cell Viability Assays Using Absorbance, Fluorescence, or Luminescence Detection

As many as one third of all putative drugs fail from toxicity issues, which contributes to the high cost of pharmaceutical R&D, particularly if toxicity is proven in clinical trials. Thus, toxicity testing of small molecules is typically performed pre-clinically using cell-based in vitro assays as a first step to identifying any toxicity issues.

There are numerous assay technologies available commercially for probing cellular viability where adverse effects cause a drop in assay signal. These assays are typically designed for workflows that use microplates and optical detection typical of microplate readers. In this technical bulletin, we demonstrate three of these cell viability technologies that use absorbance, fluorescence, or luminescence detection all measured on the low-cost BioTek Synergy LX Multi-Mode Reader.

Materials and Methods

Toxicity Experiments

Human prostate cancer cell line (PC-3) cells were cultured in Hams F12K Nutrient mixture supplemented with 10% fetal bovine serum and penicillin-streptomycin at 37°C in 5% CO_2. Cultures were routinely trypsinized (0.05% Trypsin-EDTA) at 80% confluence.

Cells were plated into Corning 3904 black-sided, clear-bottom 96-well microplates using DMEM/F12 media without phenol red to create 30,000 total cells per well in 100µL. After 24 hours to allow for attachment, the cytotoxic compounds cycloheximide and tamoxifen were added to the cultures at various concentrations in 100µL. After 24 hours of exposure, 100µL of cell media was removed and diluted reagent added according to the outlines below.

Colorimetric MTT Assay

10µL of 12mM Vybrant MTT Cell Proliferation Assay Reagent (Cat. No. V13154) was added. Reaction was allowed to proceed for four hours at 37°C in a humidified environment. The reaction was stopped and the insoluble formazan product resolubilized by the addition of 100µL of 10% SDS in 0.01 N HCl solution and incubation for 16 hours at 37°C in a humidified environment. Absorbance at 570nm was measured with a Synergy LX Multi-Mode Reader using the dedicated UV-Vis monochromator.

Fluorometric Calcein AM Assay

100µL of 5µM Calcein AM (Cat. No. C34852) was added. Cells were incubated at 37°C for 30 minutes, after which fluorescence was determined with a Synergy LX Reader using a green fluorescence cube. The green fluorescence cube was configured with a 485/20 excitation filter, a 528/20 emission filter, and a 510nm cut off dichroic mirror.

Luminescent CellTiter-Glo Assay

100µL of reconstituted CellTiter-Glo Cell Viability reagent (Cat. No. PR-G7572) was added. The plate was shaken on an orbital shaker for two minutes, then incubated for 10 minutes in the dark at room temperature within the Synergy LX Reader prior to luminescence determination using a dedicated luminescence cube. This cube allows direct passage of light from the microplate well to the PMT detector. The default settings for PMT gain (135) and collection time (one second) were used.

Cell Titration Experiments

For cell titration experiments, a range of PC-3 cell concentrations were used up to 36,000 cells/well. After 24 hours, reagent was added according to the manufacturer's specifications and read on the Synergy LX Reader using the detection modes described above.

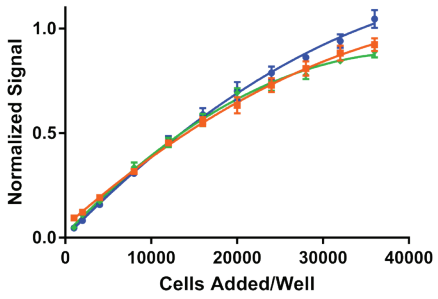

Figure 1. Cell titration curves for colorimetric MTT, fluorometric Calcein AM, and luminescent CellTiter-Glo

All data were normalized to the maximum signal for each detection technology. Each data point represents an average of eight replicates.

Results and Discussion

Each of the reagents tested probes cell health, albeit in different ways. The colorimetric MTT assay relies on endogenous NAD(P)H oxidoreductase enzymes to reduce MTT to a colored formazan dye. The Calcein AM reagent is converted by endogenous cytoplasmic esterases from a non-fluorescent to a fluorescent compound. CellTiter-Glo is based on the quantification of ATP present, which indicates the presence of metabolically active cells. Thus, for each reagent, one would expect greater assay signals as more viable cells are present. This is evident in Figure 1, which demonstrates cell titrations for each of the detection technologies tested.

In the case of a toxicity experiment, in which cell health is probed after the addition of small molecule compounds, one would expect a reduction in signals for each of these detection technologies should the compound display toxicity. The extent of reduction depends on how the specific enzymes involved in generating signal are affected or the metabolic activity of the cells in the case of ATP measurement. Figure 2 illustrates these impacts when the cells are treated with cycloheximide and tamoxifen.

Cycloheximide is used widely in biomedical research to inhibit protein synthesis in eukaryotic cells studied in vitro. Its toxic effect is plainly seen in Figure 2, where for each technology a significant drop in signal is evident with increasing dose of the compound. For each technology, the dose at half the maximum signal drop is approximately 0.1µM. Note also that the extent of cytotoxicity appears to be greater for the detection technologies based on cytosolic enzyme turnover (MTT and Calcein AM) compared to ATP measurement (CellTiter-Glo). Conversely, tamoxifen demonstrates little toxicity over its full dose range, which is not unexpected for this medication widely used to treat breast cancer.

Conclusions

The Synergy LX Multi-Mode Reader is a low-cost solution for the most common detection technologies used in life sciences research, including absorbance, fluorescence, and luminescence detection. Here we demonstrated its utility to quantify cellular toxicity using widely used cell viability assays that employ these common detection modes.

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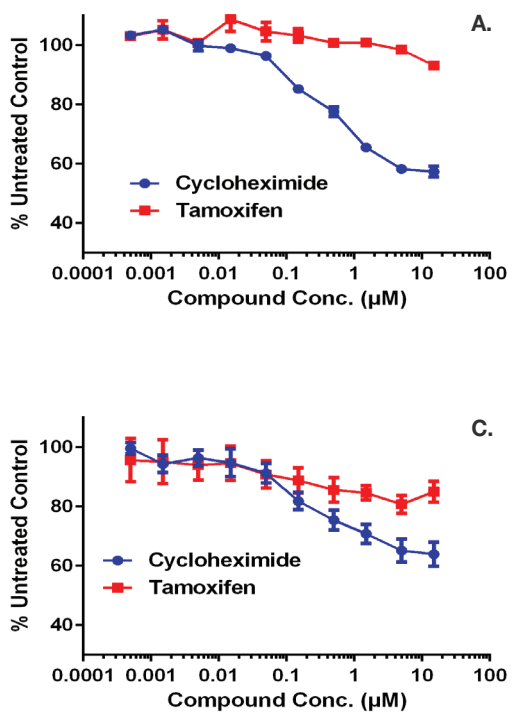

Figure 2. Dose response curves of the compounds cycloheximide and tamoxifen for colorimetric MTT assay (A), fluorometric Calcein AM assay (B), and luminescent CellTiter-Glo assay (C)
Signal is represented as a percentage of the negative control. Each data point represents an average of eight replicates

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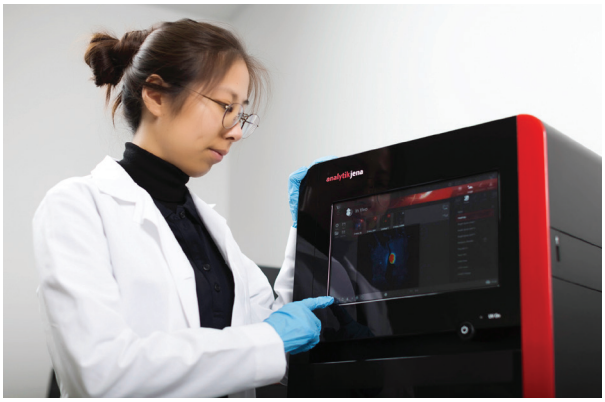
Analytik Jena UVP iBox Studio

Capture high-resolution images of small lab animals with the sophisticated, easy-to-use UVP iBox Studio. From quick screening to in-depth in vivo studies, this compact and powerful imaging system performs your choice of applications at an affordable price.

- Two high-performance cooled camera options
- Multiple illumination sources — both RGBW LEDs and NIR lasers
- Warming plate on an ergonomic slide-out tray holds up to three mice
- GFP and RFP emission filters included for common fluorescence applications
- Powerful VisionWorks software lets you create custom one-touch workflows or use preinstalled templates
- Free application training offered with each purchase



For pre-clinical applications, the UVP iBox Studio offers high-sensitivity imaging and accurate fluorescent source quantification.

The models below include GFP and RFP filters, VisionWorks software, and NIR laser modules.

Model	Camera Type	Voltage	Mfr. No	Cat. No.
815	8.1 MP 815 CCD	115V 230V	849-97-0932-03 849-97-0932-04	**UVP97093203** **UVP97093204**
615	3.2 MP 615 CCD	115V 230V	849-97-0933-03 849-97-0933-04	**UVP97093303** **UVP97093304**

Microvolume UV-Vis Spectrophotometry

thermoscientific

Thermo Scientific NanoDrop One Spectrophotometers

Quantify and qualify DNA, RNA, and protein samples in seconds with only 1 to 2µL of sample using the Thermo Scientific NanoDrop One Microvolume UV-Vis Spectrophotometer. The included Thermo Scientific Acclaro Sample Intelligence technology helps you qualify your sample first to prevent costly delays to your research.

- Upfront sample quality verification — prevents costly troubleshooting
- Walk-up convenience with on-board HD touchscreen
- Easy data transfer to PC or network via Wi-Fi, USB, or ethernet

Description	Mfr. No	Cat. No.
NanoDrop One	840-274100	**13-400-518**
NanoDrop One^{C*}	840-274200	**13-400-519**

**Includes cuvette use option*

Visit **thermofisher.com/NanoDropOne** to learn more and visit **thermofisher.com/NDpromos** to see special offers.

Uncover the Range of Novel Genetic Events in Your Sequence Data with Unrivaled Simplicity

Since their inception, genetic analyzers have evolved to support diverse applications that extend beyond long-read DNA sequencing and fragment analysis. Whether you are looking for a single mutation, investigating a new genome, or profiling gene expression, capillary electrophoresis (CE) genetic analyzers can be customized for your diverse research endeavors.

SeqStudio: Rapidly Access an Array of Applications

The latest innovation for Sanger sequencing and fragment analysis is the Thermo Scientific SeqStudio Genetic Analyzer. It features a click-in cartridge with four capillaries that comes pre-loaded with a universal polymer, making it easier and faster to perform Sanger sequencing and fragment analysis in the same run. Plus, SeqStudio offers an intuitive software interface on a benchtop platform that minimizes hands-on time and enables ready access to various research applications.

Plasmid Sequencing
- Accurately analyze subcloned inserts
- Get flexible read lengths ranging from <300 bp to >600 bp

Oncology
- Profile cancers and detect low-level variants
- Discover low-level variants at frequencies as low as 5% with the sensitivity and accuracy of Sanger sequencing

Genome Editing
- Reliably detect genome editing or CRISPR-mediated events
- Analyze the efficiency of events using the tracking of Indels by decomposition (TIDE) software

Next-Generation Sequencing (NGS) Confirmation
- Rapidly confirm the variants identified by NGS
- Import .vcf files
- Verify variants using the cloud-based NGC module

Human Cell Line Authentication
- Bypass errors due to contamination
- Integrate with Identifiler Plus and Identifiler Direct workflows to safeguard research quality

Multiplex Ligation-Dependent Probe Amplification (MLPA)
- Determine copy number across multiple DNA sequences

Species Identification
- Identify species in an unknown sample by sequencing DNA of "fingerprint"
- Use the 16S ribosomal RNA (rRNA) gene, now considered to be the gold-standard method for bacteria taxonomic classification and identification

The new SeqStudio Genetic Analyzer offers access to these applications in an easy-to-use platform that streamlines your CE experiments and minimizes hands-on time. The cloud-based sharing expands your impact and helps increase your efficiency.

Visit **fishersci.com/SeqStudio** or **fishersci.ca/SeqStudio** to learn more.

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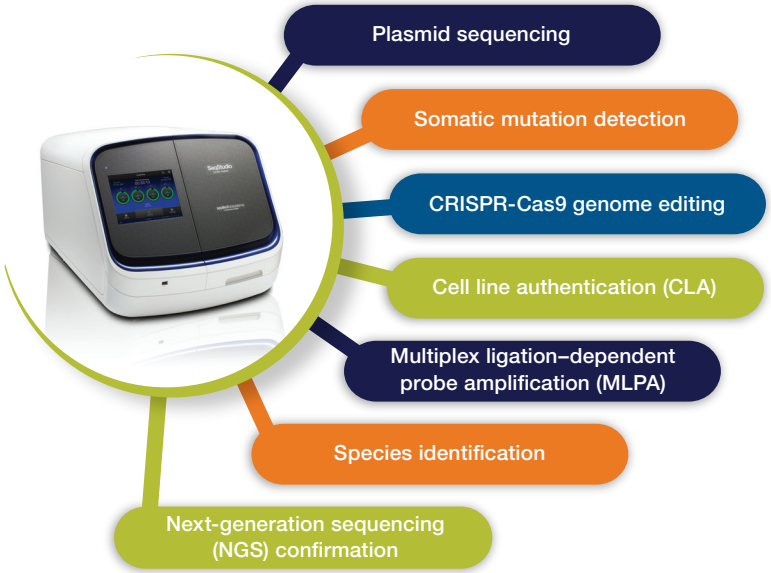


Effortless Pipetting, Reliable Results

CORNING

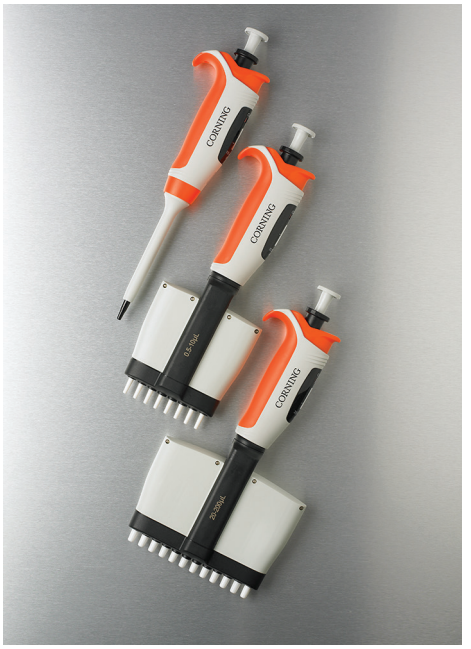
Corning Lambda EliteTouch Pipettors

Corning Lambda EliteTouch pipettors are engineered for ergonomics, accuracy, and precision. They feature lightweight construction, a contoured handle, a four-digit counter, smooth plunger movement, and extremely low pipetting forces that reduce wrist strain, fatigue, and injury. The included colored pushbuttons help identify users or applications to lower the risk of cross contamination.

- Ergonomic handle design fits either hand
- Convenient one-handed volume setting with auto-lock prevents accidental changes
- Fully autoclavable and UV-resistant
- Effortless tip ejection
- Easy in-lab calibration procedure
- Individually tested and supplied with certificate of quality

Single-Channel Pipettors

Volume Range	Tip Size	Mfr. No	Cat. No.
0.1 to 2µL	10µL	6050	**07-201-040**
0.5 to 10µL	10µL	6051	**07-201-041**
2 to 20µL	200µL	6052	**07-201-042**
5 to 50µL	200µL	6053	**07-201-043**
10 to 100µL	200µL	6054	**07-201-044**
20 to 200µL	200µL	6055	**07-201-045**
100 to 1000µL	1000µL	6056	**07-201-046**



Eight-Channel Pipettors

Volume Range	Tip Size	Mfr. No	Cat. No.
0.5 to 10µL	10µL	6057	**07-201-047**
5 to 50µL	200µL	6058	**07-201-048**
20 to 200µL	200µL	6059	**07-201-049**
30 to 300µL	300µL	6060	**07-201-050**

12-Channel Pipettors

Volume Range	Tip Size	Mfr. No	Cat. No.
0.5 to 10µL	10µL	6061	**07-201-051**
5 to 50µL	200µL	6062	**07-201-052**
20 to 200µL	200µL	6063	**07-201-053**
30 to 300µL	300µL	6064	**07-201-054**

Corning Lambda EliteTouch Starter Kit

Description	Mfr. No	Cat. No.
• Four single-channel pipettors (0.5 to 10µL, 2 to 20µL, 20 to 200µL, 100 to 1000µL) • Universal linear stand for four single-channel pipettors • Corning DeckWorks pipettor tips (10µL, 200µL, 1000µL) • Three colored pushbuttons (four sets)	6065	**07-201-055**

Performance, Flexibility, and Value

BioTek

BioTek Instruments

BioTek's comprehensive product line enables life sciences research by providing high-performance, cost-effective analysis and quantification of biomolecules, biomolecular interactions, and cellular structure and function across diverse applications.

Lionheart FX Automated Microscope

- 1.25x to 60x air, 60x and 100x oil immersion magnification
- Automated image capture, processing, and analysis for publication-ready images
- Integrated, compact design offers quick installation and setup
- Available Scratch Assay Starter Kit for automated cell migration and invasion assays

Model	Description	Cat. No.
Lionheart FX	Fluorescence, Brightfield, Color Brightfield, and Phase Contrast Imaging; Includes Gen5 Software	**BTLFX**
Scratch Assay Starter Kit	Everything needed to implement automated, kinetic cell migration and invasion scratch wound assays in conjunction with Lionheart FX	**BT1750012**

Synergy Neo2 Hybrid Multi-Mode Reader

- Patented Hybrid Technology with independent filter and monocromator-based optics
- Ultra-fast plate processing speeds with multiple PMT detectors
- Two lasers: laser for TRF, TR-FRET, and laser-based Alpha detection
- Variable bandwidth scientific quad monochromators for optimal sensitivity and flexibility

Model	Description	Cat. No.
Synergy Neo2	Absorbance, Fluorescence, Fluorescence Polarization, Time Resolved Fluorescence, TR-FRET and Luminescence Detection; Lasers for TRF, TR-FRET and AlphaScreen/AlphaL-ISA; Includes Gen5 Software	**NEO2MALPHABT**

Synergy LX Multi-Mode Reader

- Supports common endpoint assays
- Micro-volume quantification with Take3 plates
- Touchscreen: easy operation, immediate data display
- Output to USB drive, printer, or Gen5 Software

Model	Description	Cat. No.
Synergy LX	Absorbance, Fluorescence and Luminescence Detection; Touchscreen UI; Includes Gen5 Software	**BTSLXFATS**

405 TS Microplate Washer

- Fast 96- and 384-well plate washing
- Cell-friendly angled dispense tubes and low flow rates
- Automated four-buffer switching facilitates complex wash processes
- Patented Ultrasonic Advantage automatically cleans manifolds

Model	Description	Cat. No.
405 TS	96-/384-Well Microplate Washing; Ultrasonic Advantage; Buffer Switchig	**BT405TSUVS**

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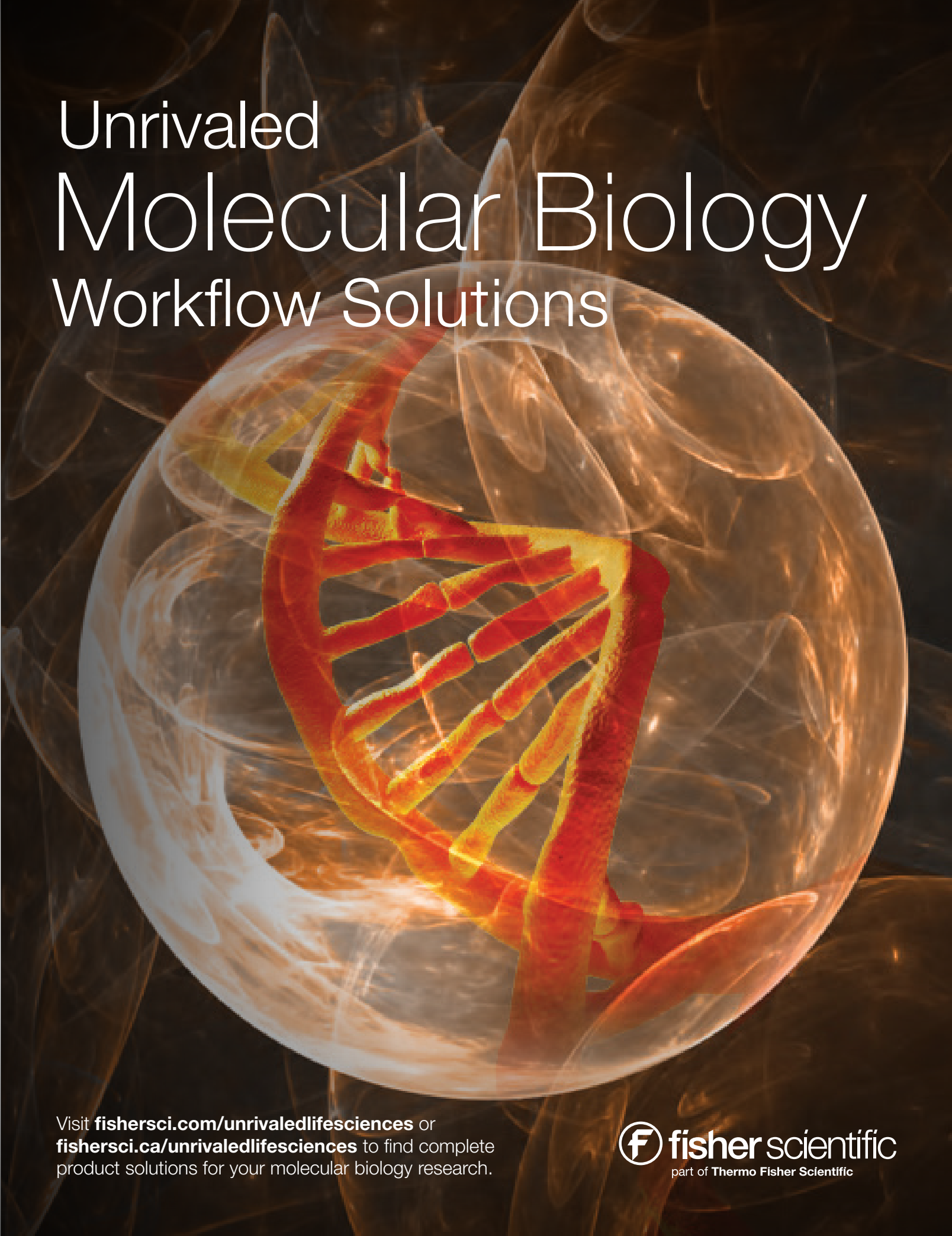
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