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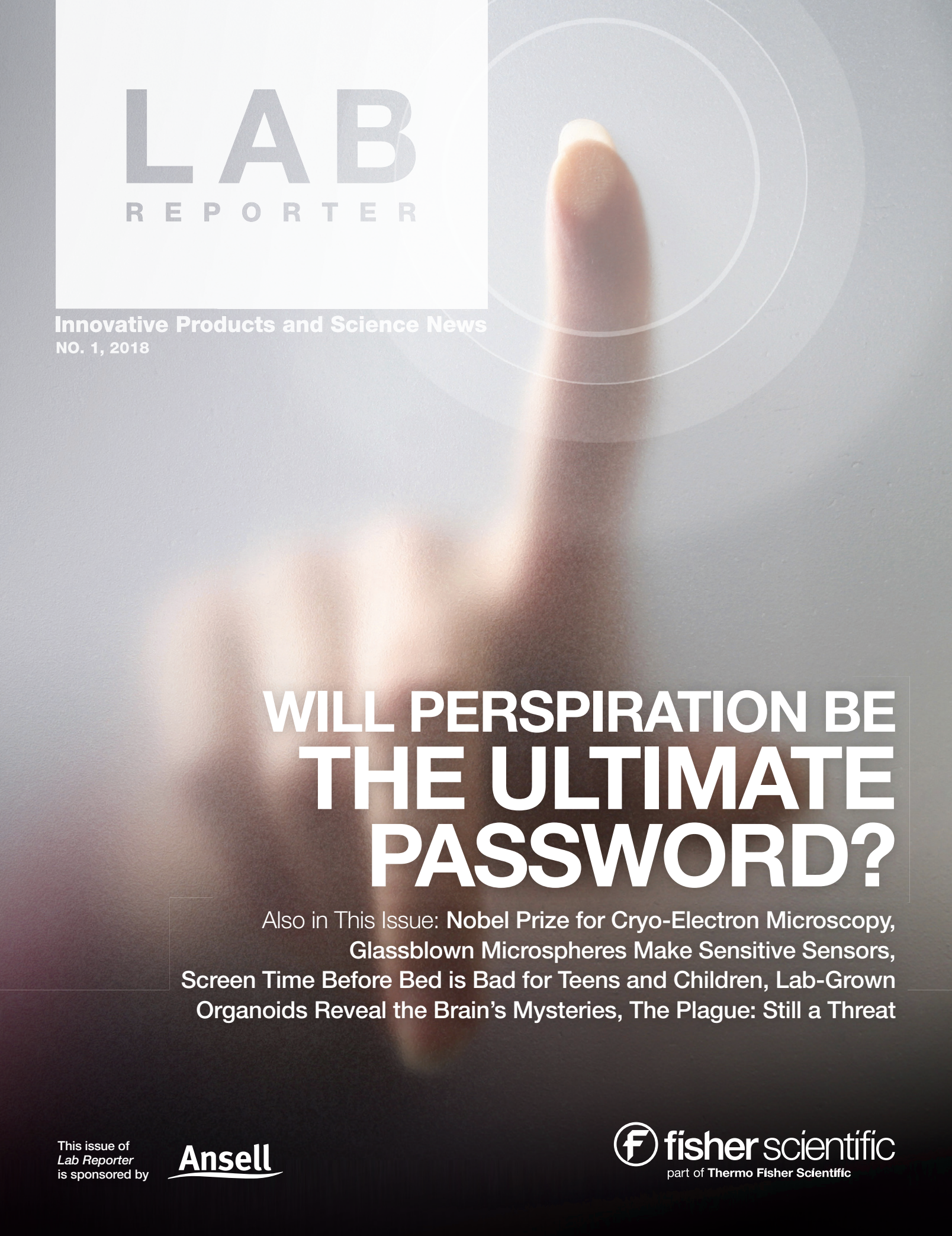
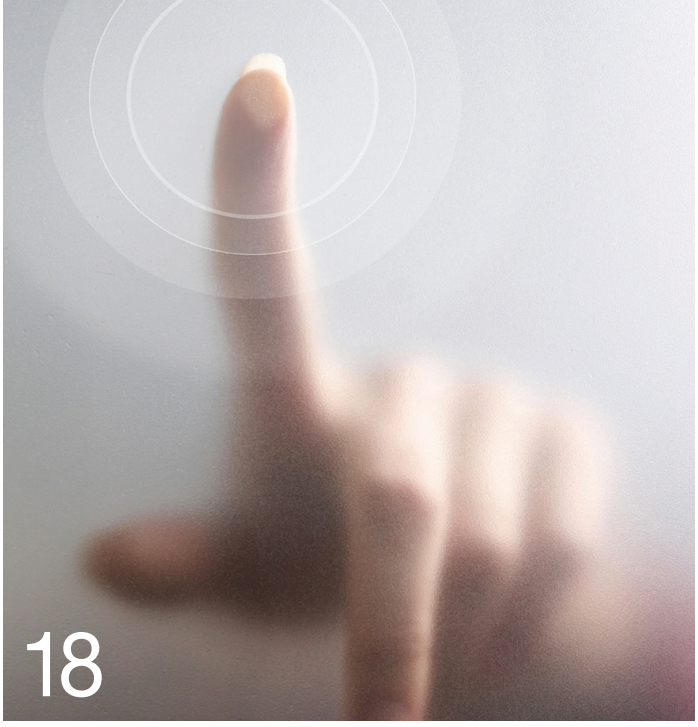
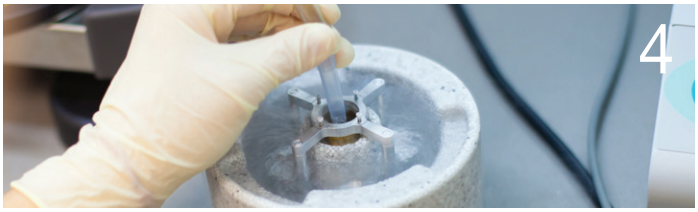
Innovative Products and Science News
NO. 1, 2018



WILL PERSPIRATION BE THE ULTIMATE PASSWORD?

Also in This Issue: **Nobel Prize for Cryo-Electron Microscopy, Glassblown Microspheres Make Sensitive Sensors, Screen Time Before Bed is Bad for Teens and Children, Lab-Grown Organoids Reveal the Brain's Mysteries, The Plague: Still a Threat**





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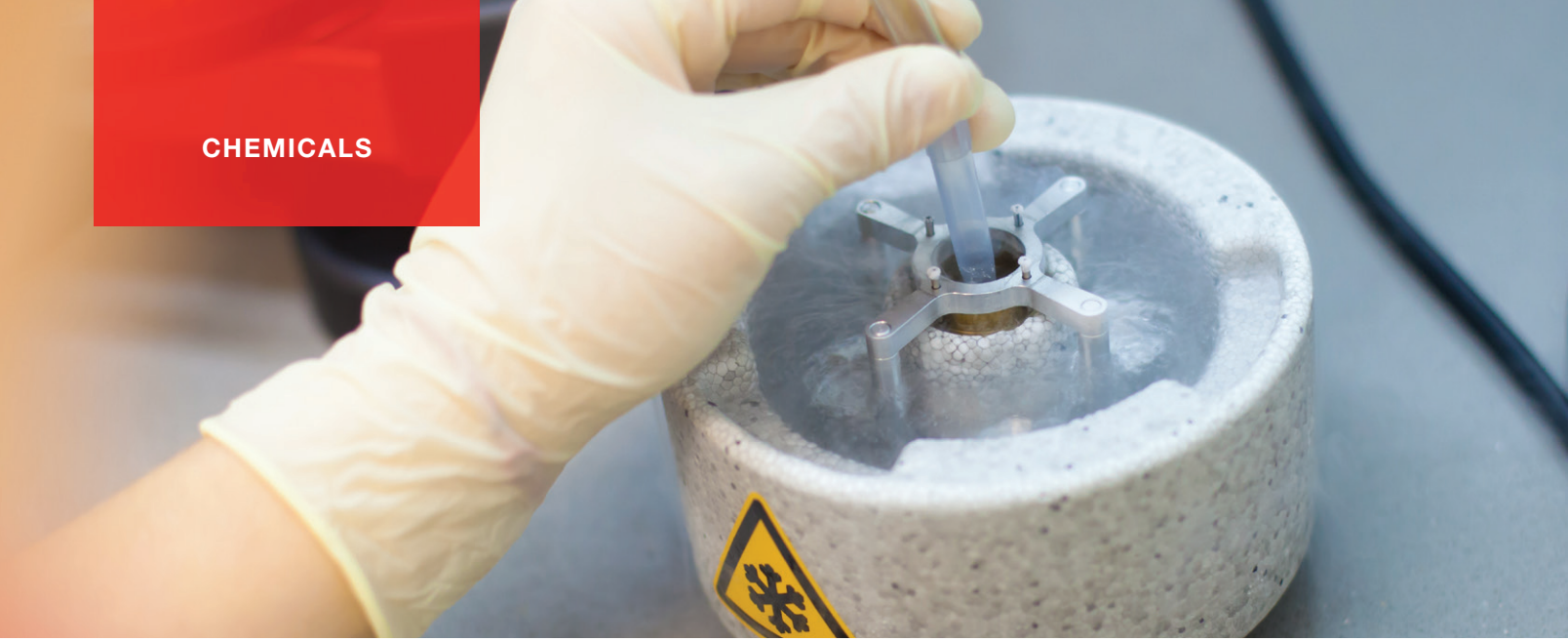

NOBEL PRIZE AWARDED TO SCIENTISTS FOR CRYO-ELECTRON MICROSCOPY

By Michael Howie

On October 4, 2017, the Nobel Prize in Chemistry was awarded to Jacques Dubochet, Joachim Frank, and Richard Henderson for their development of cryo-electron microscopy, which, according to the Noble Committee, "has moved biochemistry into a new era." Thanks to their pioneering work, scientists can now produce highly resolved, three-dimensional images of protein structures that may lead to a better understanding of biological function and the development of new therapies.

Their work has spanned decades, starting back in 1975 when Frank, a biophysicist, developed a process to combine fuzzy, two-dimensional images from an electron microscope into a sharper three-dimensional image. While Frank was still at work on his process in the early 1980s, Dubochet, also a biophysicist, succeeded in vitrifying water around a biological sample inside an electron microscope vacuum, which allowed the biomolecules to retain their natural shapes instead of collapsing. And in 1990, Henderson, a biologist, succeeded in using an electron microscope to create a three-dimensional image of a protein at atomic resolution, solidifying the technology's potential and proving that electron microscopes can be used to image more than dead matter.

Revolutionizing Biochemistry

Cumulatively, this field of research has come to be known as cryo-electron microscopy. The technique is used to freeze biomolecules in mid-movement and create accurate, three-dimensional images of sub-cellular and molecular structures and revealing details that were previously impossible to visualize. Over the years, electron microscopes have been tweaked and improved to provide better images, and the desired level of atomic resolution was reached in 2013. According to the Nobel Committee's announcement, cryo-electron microscopy has been used to produce images of "everything from proteins that cause antibiotic resistance to the surface of the Zika virus."

Nobel Committee Chairman Sara Snogerup Linse explained that the technique is revolutionary for biochemistry. "Now we can see the intricate details of the biomolecules in every corner of our cells, in every drop of our body fluids. We understand how they are built and how they act and how they work together in large communities," she said during the announcement.

Frank believes that cryo-electron microscopy "fills an important gap and extends the range of molecules that can be determined at atomic resolution." He also stated that the technique has immense practical uses, though it would be years before the implications are fully understood.

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Acetonitrile	A9561	A9554		A9964	A9994	A9984	A214
Ethyl Acetate				E1954	E1914	E1944	E14520
Hexanes			H3074	H3034	H3004	H3024	H29220
Isopropanol		A4614		A4644	A5194	A4514	A4164
Methanol	A4581	A4564	A4574	A4544	A4504	A4524	A4124
Methylene Chloride			D1544	D1514	D1424	D1434	D3720
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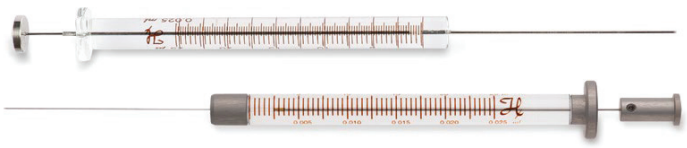

Model	Syringe Type	Needle Gauge*	Needle Point Style	Volume	Mfr. No.	Cat. No.	Price
Gas Chromatography							
75 N	Microliter	26s	AS‡	5µL	6743601	**14-818-130**	$79.49
701 N	Microliter	23s	AS‡	10µL	6744001	**14-818-133**	$57.17
701 N	Microliter	26s	AS‡	10µL	6743801	**14-818-132**	$43.42
1701 N	Gastight	23s	AS‡	10µL	6745401	**14-818-131**	$50.90
1702 N	Gastight	23s	AS‡	25µL	6743001	**14-818-134**	$85.75
1710 N	Gastight	23s	AS‡	100µL	6743401	**14-818-135**	$84.74
Liquid Chromatography							
1701 N	Gastight	22s	3§	10µL	6744401	**14-818-136**	$84.90
1702 N	Gastight	22s	3§	25µL	6744601	**14-818-137**	$126.74
1705 N	Gastight	22	3§	50µL	6745001	**14-818-138**	$112.77
1710 N	Gastight	22s	3§	100µL	6745201	**14-818-139**	$80.09
1725 N	Gastight	22	3§	250µL	6744201	**14-818-140**	$79.49
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§Blunt needle point for sample pipetting and HPLC injection valves

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GLASSBLOWN MICROSPHERES MAKE HIGHLY SENSITIVE SENSORS

By Moira Bell

Just like the slightest sound can travel around the curved walls of a whispering gallery, light can spin around the internal circumference of a sphere to create an optical whispering gallery mode resonator. This kind of ultrasensitive sensor could be used for a variety of applications, but creating a sphere of this kind using microfabrification methods was not possible. Recently, researchers at Penn State University developed an innovative way to "grow" glass microspherical shells on a microchip.

"Whispering gallery mode resonators, which are basically optical resonators, have been intensely studied for at least 20 years," said Srinivas Tadigadapa, PhD, professor of electrical engineering, Penn State University. "What people have done is to take an optical fiber and touch the end with a blow torch. When the melted fiber recondenses, it forms a sphere at the tip. This can be coupled to a light source to make a sensor."

Making the Perfect Sphere

To create the almost perfect bubble spheres, researchers used a glassblowing technique: a thin glass wafer being exposed to high heat and external vacuum pressure. The glass spheres were made hollow by using sealed and pressurized cylindrical cavities etched into silicone substrate. "The bottom of the sphere is thinned until it is basically a hole," said Dr. Tadigadapa.

It took the research team several attempts to make a high-quality sensor. Something they eventually discovered is that the equatorial plane (or center) of the sphere needs to be above the surface of the chip for the sphere formation to be optimal. They also consulted with the doctoral students of Penn State laser expert, Zhiwen Liu, professor of electrical engineering, to get a better understanding of the quality of their spheres.

"You can bring in any analyte that you want to identify, but it goes on the inner surface. That brings in a lot of possibilities. You can do chemical sensing, vapor sensing, biophysical sensing, pressure sensing and really outstanding temperature sensing," said Dr. Tadigadapa.

"We make the bubbles and then take them to Dr. Liu's lab to get the resonance levels and make the measurements," said doctoral student Chenchen Zhang.

The Potential

Researchers theorize about the many possible uses for these sensors.

"You can put the light on the outside of the sphere but do all the chemistry on the inner face of the shell. You can bring in any analyte that you want to identify, but it goes on the inner surface. That brings in a lot of possibilities. You can do chemical sensing, vapor sensing, biophysical sensing, pressure sensing and really outstanding temperature sensing," said Dr. Tadigadapa.

This research is also significant for lab-on-a-chip biophysical sensing for disease, said the team. "Or by adding a polymer coating on the inside of the bubble, you could make a really sensitive humidity sensor," said Zhang.

It is clear that if these highly sensitive sensors can help to capture more accurate measurements, they may become extremely valuable components for a variety of applications.

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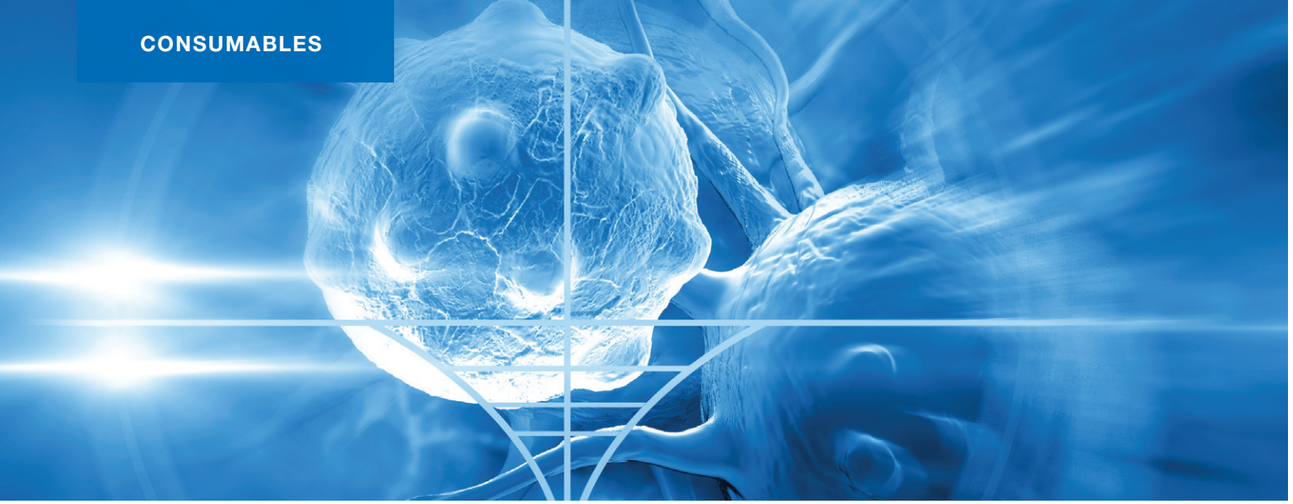

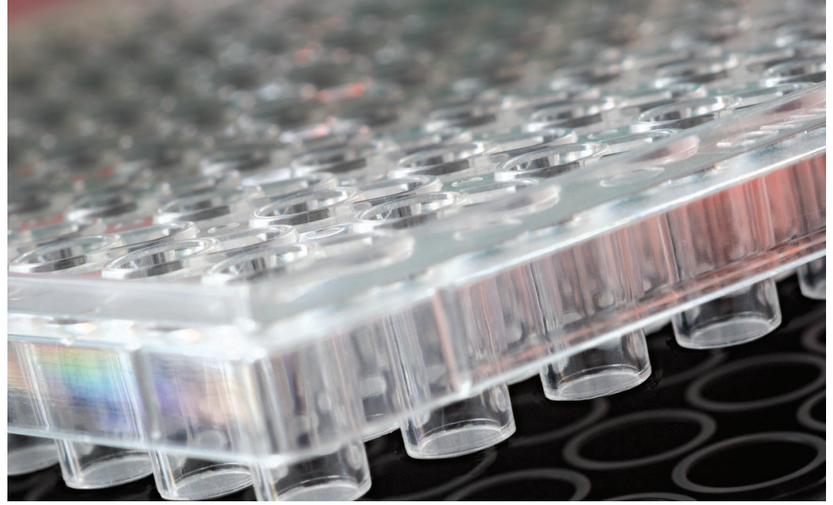

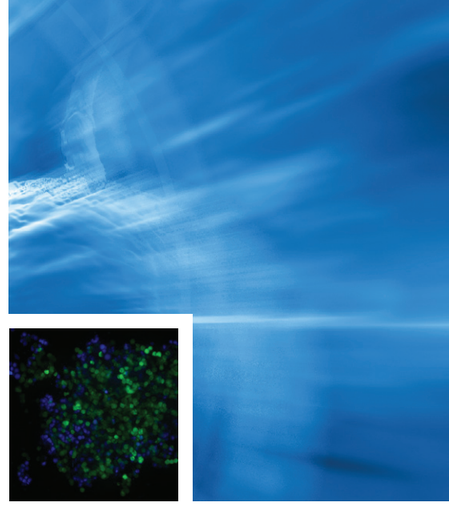

SIMPLIFYING
IMMUNE ONCOLOGY RESEARCH

NOVEL 3D TUMOR MODEL STREAMLINES HIGH THROUGHPUT IMMUNOTHERAPY TESTING

Immunotherapy has become a topic of increased interest for scientists studying cancer. By using a patient's own immune cells to attack cancer cells, immunotherapy treatments have shown positive results, including total cancer remission in some cases. But immunotherapy is not a one-size-fits-all approach; treatment strategy and efficacy can vary by patient and cancer type.

To more carefully study immunotherapy as a cancer treatment, scientists need efficient, *in vitro* screening models to examine targeted therapy options. This type of research has historically been conducted with cell culture models that allow for the study of immune cell migration, which can be easily adapted for high throughput screening. However, these models typically utilize two-dimensional (2D) cell culture monolayers that do not accurately reflect a tumor's complexity in the human body. The current growing trend is to use more *in vivo*-like three-dimensional (3D) models.

To incorporate the immune cell component, these 3D models require the direct addition of immune cells to 3D spheroids. However, this may not be an accurate reflection of how immune cells migrate toward and further invade tumors *in vitro*. According to Hannah Gitschier, Corning Life Sciences Applications Lab Manager in Kennebunk, Maine, "With immunotherapy, it is imperative that researchers have solid models to best recapitulate the *in vivo* microenvironment and interactions between the engineered immune cells and patient tumor samples. These models must be easy to use and transferrable to a high throughput screening environment, enabling rapid screening of conditions to best predict clinical outcomes."

Traditionally, 2D assays were the method of choice given the high proliferation rate of cells in 2D culture, as well as the reproducibility of assays. However, with emerging technologies and the development of novel lab consumables, 3D assays are becoming easier to adapt and more relevant for researchers' end goals.

Creating a Better Way

Hilary Sherman, a Corning Applications Scientist, created a 3D culture model to observe immune cell and tumor cell interactions; she combined the Corning 96-well spheroid microplate with the high throughput screening (HTS) Transwell-96 tissue culture system. Coated with Corning's unique Ultra-Low Attachment surface, the spheroid microplate allows for highly reproducible, single multicellular tumor spheroids to form in each well. The HTS Transwell permeable support systems are commonly used in migration and invasion studies, with a flat-bottom receiver plate for monolayer culture. This novel combination of both products allows researchers to observe changes to tumor behavior — by adding immune cells to the Transwell insert, the rates of migration through the membrane and toward the tumor spheroids in the receiver plate can be observed. Combining the technologies allows one to study how these two cell types interact in a more *in vivo*-like environment.

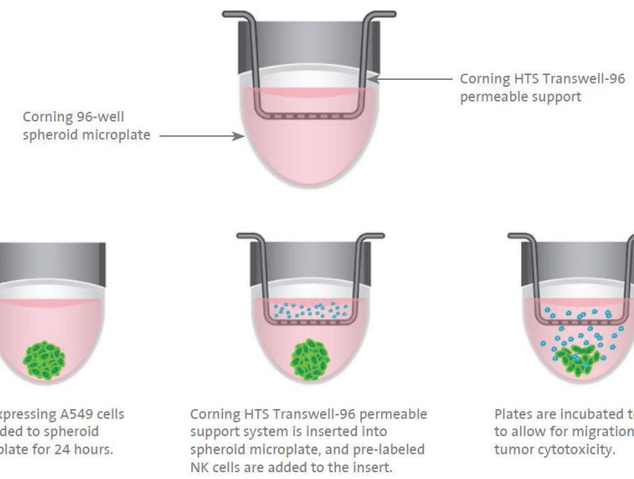

Figure 1. HTS Transwell 96-well permeable supports were placed into 96-well spheroid microplates for 3D immune cell migration and tumor invasion assays.

Sherman placed the spheroid microplate under the HTS Transwell insert plate instead of using the flat-bottom Transwell receiver plate. This enabled her to observe tumor cell activity in a 3D system while also facilitating migration of immune cells toward the tumor cell model. This technique supports the investigation of immune cell homing, tumor toxicity, and tumor immune evasion in an easy-to-use, reproducible, 3D high throughput assay.

Study Methods

Cells from a cancerous lung tissue cell line (A549 cells) were seeded into 96-well spheroid microplates to form the tumor spheroid models. The following day, Sherman placed the HTS Transwell 96-well permeable supports in the spheroid microplates. To assess immune cell homing and migration, natural killer (NK) cells were added into the inserts and were allowed to migrate for 24 hours. (See Figure 1.)

Implications on Future Research

A successful model allows for the immune cells to reach the tumor cells of interest in order to effectively study the body's response to targeted immunotherapy. Sherman's novel research model confirmed the NK cells in this study were not only able to reach the target tumor cells but could also infiltrate the 3D spheroid structure and lead to the desired cytotoxic outcome.

This creates a more streamlined model to observe all necessary components of this immunotherapy research in a single, high throughput, reproducible *in vivo*-like format.

"This model allows researchers to study immune system-tumor interactions in a more comprehensive way that also has the benefit of being high throughput and easy to use. The system can also be used to study other immune and cancer cells as well as the ability to form more complex models by adding endothelial or glial cells to the Transwell membrane to create more advanced blood brain barrier models," says Gitschier.

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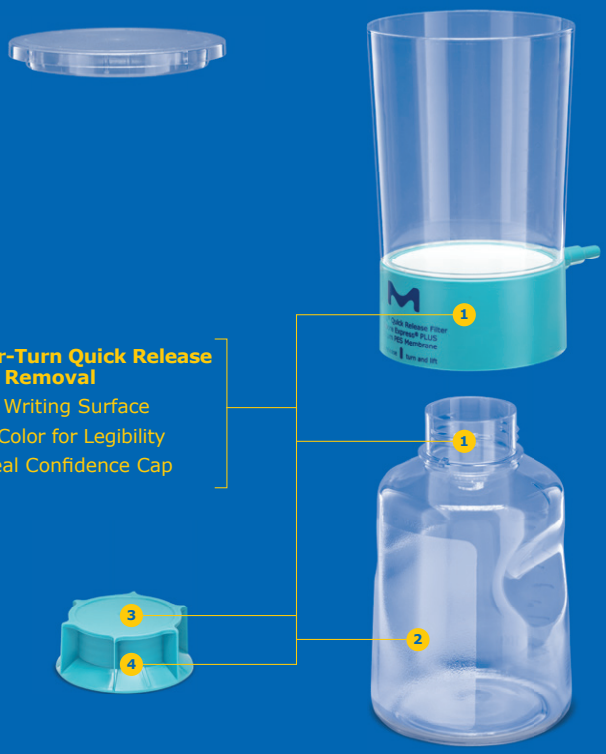

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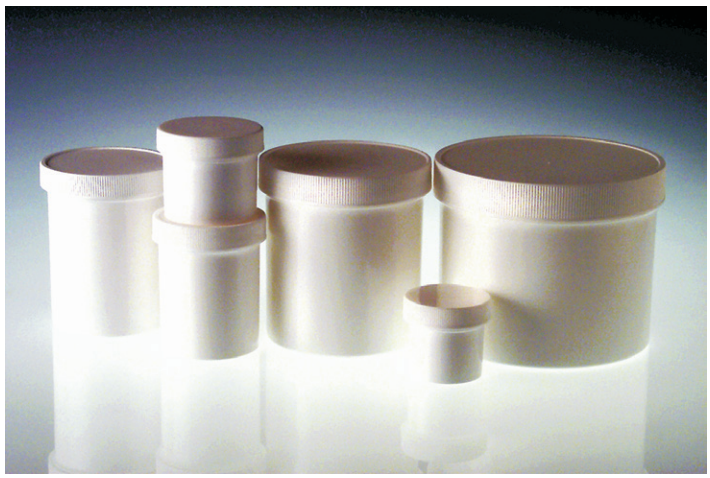

Capacity	Closure Size	Mfr. No.	Cat. No.	Quantity	Price
30mL (1 oz.), Foam-Lined Caps	43-400	PLC07184	**02-991-728**	72/Case	$72.96
60mL (2 oz.), Foam-Lined Caps	53-400	PLC07185	**02-991-653**	48/Case	$51.01
120mL (4 oz.), Foam-Lined Caps	53-400	PLC07186	**02-991-654**	36/Case	$38.63
240mL (8 oz.), Foam-Lined Caps	70-400	PLC07187	**02-991-630**	36/Case	$78.60
240mL (8 oz.), Foam-Lined Caps, Bulk	70-400	PLC07461	**02-991-160**	336/Case	$398.85
480mL (16 oz.), Foam-Lined Caps	89-400	PLC07188	**02-991-632**	24/Case	$61.81
480mL (16 oz.), Foam-Lined Caps	89-400	PLC03714	**02-991-910**	112/Case	$238.09
960mL (32 oz.), Foam-Lined Caps	120-400	PLC07189	**02-991-626**	24/Case	$88.39
960mL (32 oz.), Foam-Lined Caps, Bulk	120-400	PLC07197	**02-993-246**	60/Case	$190.33
480mL (16 oz.), Unlined Caps, Bulk	89-400	PLC07196	**02-992-291**	112/Case	$178.87

A BETTER WAY TO **CULTURE YOUR CELLS**

PEOPLE MAY NEED OXYGEN TO LIVE, BUT CELL CULTURES MAY NEED LESS OF IT TO THRIVE.

Considering hypoxic conditions for your cells is one of many decisions you'll make that will have an impact on your work — but depending on the types of cells, it can be key to your success.

Why Hypoxia?

Most cells *in vivo* are exposed to lower oxygen levels than atmospheric or common culture concentrations. With the exception of the skin and eye variety, cells don't normally live in the 21% oxygen levels of Earth's atmosphere. Depending on their distance from arterial blood, cells in solid tissues simply have less: the bloodstream is exposed to 12% oxygen, the brain ranges between 0.5% and 7%, bone marrow between 0% and 4%, and heart, liver and kidneys between 4% and 12%.

So if modeling the *in vivo* state is critical to your work (and it will be for primary cells, stem cells, neural cells, and cancer cells), you'll need to mimic the levels in which these cells will thrive: hypoxia, also known as *in situ* normoxia.

Less is More: Longer Life and Greater Viability

What effects does oxygen have on cells? Turn up the levels, and you'll see an increase in oxidative stress, DNA damage, and stem cell differentiation. Turning down oxygen concentration increases the lifespan of the cells, limits oxidative damage and genetic instability, and reduces differentiation signals.

The impact of oxygen levels on cancer research is especially notable. As we look deep into a solid tumor, oxygen levels decrease, ending with very low oxygen and necrotic conditions at the center. Cells at the center of a tumor are dying and resistant to chemotherapy and radiation, and are therefore tied to cancer recurrence. To effectively model solid tumors for developing cancer therapeutics, turn the oxygen levels down.

So how do you begin culturing in hypoxia? Consider an incubator with variable oxygen control.

Watch the Webinar

To learn more about culturing in hypoxia, view our Cell Culture Café on-demand webinar (access and watch at any time). Visit the learning center at thermofisher.com/cellculture and search in webinars for "Culture Your Cells Using Less Oxygen for Biologically Relevant Results."

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WILL PERSPIRATION BE **THE ULTIMATE PASSWORD?**

By Hamilton Waldron

In the future, the key to securing our electronic and personal devices may be our own sweat. Because much like fingerprints, sweat types differ by person — and the factors that contribute to determining an individual's perspiration profile aren't limited to variations in lifestyle habits alone.

Jan Halámek, assistant professor of chemistry at the University of Albany, is working on a sweat-based authentication process for unlocking mobile and wearable devices. While still in development, it's a security method that might eventually prove more effective than facial recognition technology.

A Safer, More Secure Digital Age

Halámek's methodology involves the analysis of skin secretions to generate an amino acid profile that only the owner of a device will be able to access. The profile would be stored in the device and utilized for identification if any attempt is made to unlock it.

Each person's perspiration is distinctive, but the reasons why are many. For instance, the things we eat, our environment, the genes that determine our metabolism and other factors all contribute to the unique mix of complex chemicals that comprise our sweat.

Halámek asserts that this new form of security could completely redefine the authentication process for electronic devices. Because the proprietary properties of each individual's sweat cannot easily be hacked, Halámek believes his work will yield a foolproof security method.

More Secure Than a Password or PIN

To properly construct an amino acid profile, the device would determine a monitoring period to allow for the device owner's sweat levels to be continuously measured throughout the day. Halámek has acknowledged that his lab is still figuring out how frequently the personal device would need to recalibrate.

When asked about the threat of hackers "stealing" sweat, Halámek explains that such a tactic would prove impractical because sweat decomposes and doesn't remain stable for very long. Compared to passwords and PINs, which can be obtained simply by peering over someone's shoulder, the sophistication of perspiration-based security exceeds that of traditional security measures. As he points out, "Metabolization is not constant. It is not a Social Security number."

Beyond Electronic Security

Applications for the signature of our own sweat could go well beyond securing devices. In time, sweat measurement could prove to be an effective diagnostic tool for personalized medicine; the increase or decrease of metabolites caused by illnesses might even produce real-time updates on particular medical conditions.

Using sweat for device verification could make life easier for those with certain disabilities as well, especially for people unable to move their fingers. And few would complain about never having to memorize a password again.

Using Biomarkers to Catch Criminals

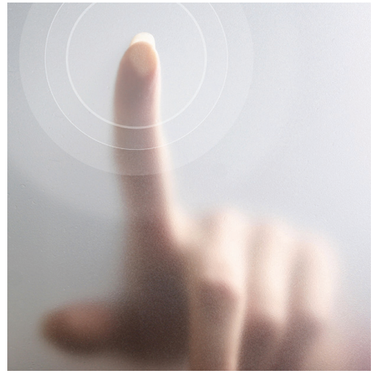
Despite the fact that Halámek's research is largely focused on cybersecurity, some of his findings overlap with other ongoing research. For instance, some studies suggest that testing biomarkers might be a viable way to fight crime.

Certainly Halámek and his team believe that it's all about the biomarkers when it comes to determining human attributes. By testing physical evidence like fingerprints or blood left behind at crime scenes, they assert that key characteristics of potential criminals could be detected within minutes, including age range, gender, and ethnicity.

The Future Depends on More Funding

Halámek has already successfully tested the new cybersecurity method in his lab, so the next step, which will require more time and money, will involve collaboration with an engineer. Halámek has already secured some additional funding and his team is in the process of creating proposals to get smartphone makers involved.

While the technology is not yet ready for commercial use, its ongoing development is a promising sign of new, even stronger security measures to emerge in the near future.



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- ASTM E126, Standard Test Method for Inspection, Calibration, and Verification of ASTM Hydrometers
- Calibration reference standards traceable to NIST (National Institute of Standards and Technology)

Specific Gravity Range	Volume	Length	Cat. No.	Price	Cat. No.	Price
Meet ASTM E100, ASTM E126			**Uncalibrated**		**Calibrated (3-point)**	
0.69 to 0.80	140mL	180mm	**11512A**	$69.00	**11512AC**	$339.00
0.79 to 0.90	140mL	170mm	**11512B**	$59.00	**11512BC**	$338.00
0.89 to 1.00	140mL	180mm	**11512C**	$59.00	**11512CC**	$338.00
0.65 to 1.00	140mL	165mm	**11512D**	$53.00		
1.00 to 1.225	140mL	185mm	**11522A**	$59.00	**11522AC**	$327.00
1.20 to 1.425	140mL	160mm	**11522B**	$59.00	**11522BC**	$338.00
1.40 to 1.625	140mL	160mm	**11522C**	$59.00	**11522CC**	$338.00
1.00 to 2.00	140mL	165mm	**11522D**	$55.00	**11522DC**	$328.00
0.695 to 0.81	250mL	310mm	**11510A**	$59.00	**11510AC**	$338.00
0.795 to 0.91	250mL	310mm	**11510B**	$59.00	**11510BC**	$340.00
0.895 to 1.01	250mL	305mm	**11510C**	$59.00	**11510CC**	$335.00
0.65 to 1.00	250mL	305mm	**11510D**	$55.00	**11510DC**	$336.00
1.00 to 1.22	250mL	305mm	**11520A**	$55.00	**11520AC**	$330.00
1.20 to 1.42	250mL	305mm	**11520B**	$59.00	**11520BC**	$338.00
1.40 to 1.62	250mL	285mm	**11520C**	$59.00	**11520CC**	$338.00
1.60 to 1.82	250mL	290mm	**11520D**	$63.00	**11520DC**	$338.00
1.00 to 2.00	250mL	305mm	**11520E**	$53.00	**11520EC**	$338.00
1.00 to 1.60	250mL	290mm	**11520F**	$72.00	**11520FC**	$365.00
Meet NIST, ASTM E100, ASTM E126			**Uncalibrated**		**Calibrated (3-point)**	
0.70 to 0.77	140mL	160mm	**11556A**	$67.00		
0.76 to 0.83	140mL	160mm	**11556B**	$67.00	**11556BC**	$341.00
0.82 to 0.89	140mL	160mm	**11556C**	$67.00	**11556CC**	$341.00
0.88 to 0.95	140mL	170mm	**11556D**	$67.00	**11556DC**	$338.00
0.94 to 1.01	140mL	165mm	**11556E**	$67.00	**11556EC**	$343.00
1.00 to 1.07	140mL	150mm	**11556F**	$67.00	**11556FC**	$333.00
1.06 to 1.13	140mL	150mm	**11556G**	$67.00	**11556GC**	$342.00
1.12 to 1.19	140mL	170mm	**11556H**	$67.00	**11556HC**	$342.00
1.18 to 1.25	140mL	160mm	**11556J**	$67.00	**11556JC**	$334.00
1.24 to 1.31	140mL	185mm	**11556K**	$67.00	**11556KC**	$342.00
1.30 to 1.37	140mL	172mm	**11556L**	$68.00	**11556LC**	$321.00
1.36 to 1.43	140mL	170mm	**11556M**	$69.00	**11556MC**	$326.00
1.42 to 1.49	140mL	175mm	**11556N**	$69.00		
1.48 to 1.55	140mL	170mm	**11556P**	$67.00	**11556PC**	$342.00
1.54 to 1.61	140mL	170mm	**11556Q**	$67.00	**11556QC**	$322.00
1.60 to 1.67	140mL	165mm	**11556R**	$69.00		
1.66 to 1.73	140mL	165mm	**11556S**	$69.00		
1.78 to 1.85	140mL	165mm	**11556U**	$69.00		

Rapid Sample Homogenization

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Fisher Scientific Bead Mill Homogenizers and Fisherbrand Mix Tubes

Fisher Scientific Bead Mill Homogenizers pulverize samples by using beads and abrasives to disrupt organic structures.

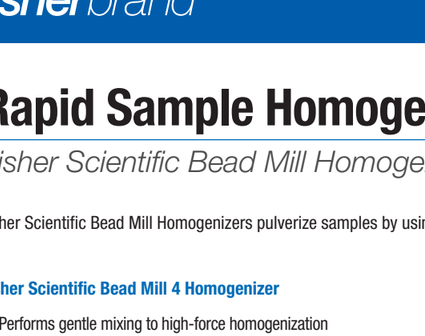
Fisher Scientific Bead Mill 4 Homogenizer

- Performs gentle mixing to high-force homogenization
- Reproducible extraction of proteins and nucleic acids
- Simultaneously process 4 x 0.5mL, 4 x 1.5mL, 4 x 2mL or 1 x 7mL samples

Fisher Scientific Bead Mill 24 (shown)

- Performs gentle mixing to high-force homogenization
- Reproducible extraction of proteins and nucleic acids
- Simultaneously process 24 x 1.5mL, 24 x 2mL, 12 x 7mL, 3 x 15mL, 6 x 30mL or 3 x 50mL samples.

Fisherbrand Mix Tubes contain various abrasive materials and beads to help homogenize samples for subsequent RNA and DNA extraction procedures. Choose from a range of tubes designed to pulverize soft and hard tissues or microorganisms.



Description	Cat. No.	Quantity	Price
Fisher Scientific Bead Mill 4 Homogenizer	**15-340-164**	Each	$2,075.00
Fisher Scientific Bead Mill 24 Homogenizer	**15-340-163**	Each	$7,200.00
Fisherbrand Mix Tubes*			
Fisherbrand Soft Tissue Homogenizing Mix Tubes, For Processing Brain, Liver, Kidney, Lung, Spleen	**15-340-153**	50/Pack	$150.00
Fisherbrand Hard Tissue Grinding Mix Tubes, For Processing Bone, Hair, Nails, Muscles, Seeds, Corn, Nuts	**15-340-151**	50/Pack	$150.00
Fisherbrand Hard Tissue Homogenizing Mix Tubes, For Processing Brain, Liver, Muscle, Skin, Leaves	**15-340-154**	50/Pack	$150.00
Fisherbrand Tough Microorganism Lysing Mix Tubes, For Processing Yeast, Cells, Fungi, Bacteria, Spores	**15-340-152**	50/Pack	$150.00

*Fisherbrand Mix Tubes are compatible with all other bead mill homogenizers.

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- **Compact, stylish design** — For convenient access, your MaximaDry Oil-Free Pump fits easily where you need it — on your bench or inside your fume hood

13-880 Series

Head Configuration	Capacity	Vacuum	Pressure	Motor	Dimensions (L x W x H)	Cat. No.	Price
Single Stage	20L/min.	75 torr	15psig	⅙ hp	13 × 6.5 × 8.5 in.	**13-880-14**	$1,610.00
Single Stage	40L/min.	65 torr	15psig	⅙ hp	15 × 6.5 × 8.5 in.	**13-880-16**	$2,170.00
Two Stage	20L/min.	6 torr	15psig	⅙ hp	15 × 6.5 × 8.5 in.	**13-880-18**	$2,080.00
Two Stage	35L/min.	6 torr	15psig	⅓ hp	16 × 7 × 9 in.	**13-880-20**	$2,760.00
Two Stage	35L/min.	1.5 torr	15psig	⅓ hp	16 × 7 × 9 in.	**13-880-22**	$3,925.00

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Description	Cat. No.	Quantity	Price
Fisherbrand Safety Goggles, Clear Lens, Clear Frame	**19-181-512**	Each	$11.00
		12/Pack	$125.08
Fisherbrand Safety Goggles, Clear Lens, Grey Frame	**19-181-513**	Each	$16.00
		12/Pack	$177.62
Fisherbrand Safety Glasses, Clear Lens (No Frame)	**19-181-514**	Each	$3.50
		12/Pack	$39.00

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- Black, powder-coated steel tubular sled base with scuff-resistant glides
- Foam cushioning covered with durable black nylon mesh fabric
- Five-year warranty

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- Highly durable sled base
- Foam cushioning covered with durable black nylon mesh fabric
- Five-year warranty

Description	Style	Cat. No.	Price
Hillendale Upholstered Guest Chairs, Black	Fixed Arm Rests, Upholstered Pads	**14-359-523**	$153.00
Oxford Modern Guest Chairs, Black	With Adjustable Arms	**14-359-524**	$208.00
	Without Arms	**14-359-525**	$188.00
Windrowe Executive Guest Chairs, Black	With Arms	**14-359-526**	$240.00
	Without Arms	**14-359-527**	$223.00

SCREEN TIME BEFORE BED HAS **GREATER EFFECT ON TEENS AND CHILDREN**

By Christina Phillis

Children and teens are some of the most proficient and frequent users of smartphones and computers. And, according to a new study, these age groups are also the most vulnerable to the sleep-disrupting effects of screen time. In 90 percent of the studies involving youths aged 5 to 17, researchers found that more screen time is associated with delayed bedtimes, fewer hours of sleep and poorer sleep quality.

"The vast majority of studies find that kids and teens who consume more screen-based media are more likely to experience sleep disruption," said first author Monique LeBourgeois, an associate professor in the Department of Integrative Physiology at the University of Colorado Boulder. "With this paper, we wanted to go one step further by reviewing the studies that also point to the reasons why digital media adversely affects sleep."

How Screens Affect Us

It appears that the amount of screen time is not the only factor to consider. One study found that melatonin levels fell twice as much in children than in adults when they were exposed to the same amount and intensity of light. Researchers theorize that light has a greater impact on the internal body clocks of children because their eyes are not fully developed. When light hits the retina, it suppresses the sleep-promoting hormone melatonin, which delays the readiness to sleep and pushes back the body clock.

"Light is our brain clock's primary timekeeper," said LeBourgeois. "We know younger individuals have larger pupils, and their lenses are more transparent, so their exposure and sensitivity to that light is even greater than in older individuals."

Certain studies found that blue light, the part of the spectrum that is emitted by most hand-held electronics, is especially effective at suppressing melatonin. And the mental stimulation of the media being consumed — no matter the type of content — can arouse cognitive function, which also delays sleep. Even just having a phone or computer in their bedrooms overnight significantly affects the sleep habits of children and adolescents.

How Much is Too Much?

Commonsense Media reported that mobile media usage among young children has tripled since 2011. Researchers have also noted that the digital media landscape is evolving rapidly and that answering even the most basic of questions requires more study.

In new research launched by LeBourgeois, researchers will visit the homes of volunteer families to observe how exposure of children to varying intensities of light changes the melatonin levels and the timing of their biological clocks. In an effort to develop science-based guidelines for parents and device makers, they hope to learn exactly the amount of light that it takes to affect circadian rhythms in young children.

> "The vast majority of studies find that kids and teens who consume more screen-based media are more likely to experience sleep disruption."
>
> — **Monique LeBourgeois**
> Associate Professor
> Department of Integrative Physiology
> University of Colorado Boulder

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Freeze drying (or lyophilization) is a method of preserving samples by gently sublimating the solvents to preserve the integrity of temperature-sensitive materials. A typical freeze-drying process can be subdivided into three phases — freezing, primary drying, and secondary drying.

First, the sample is frozen. The frozen solute is then removed by sublimation at a low temperature while applying a vacuum. To maintain the drying process, the heat losses must be counterbalanced by the introduction of heat. Lyovapor Freeze Dryers use temperature-regulated shelves for this heat replacement.

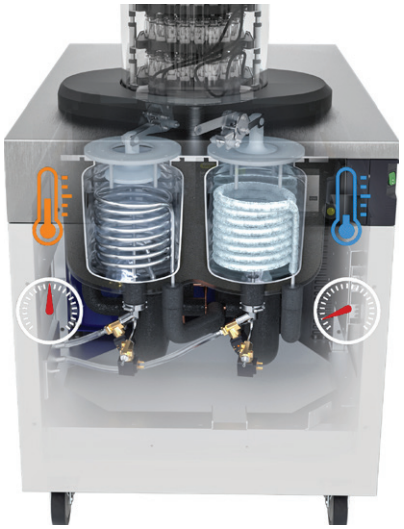
Freeze Dryers

BUCHI offers two new Lyovapor freeze drying platforms: models L-200 and L-300. The L-200 incorporates a chiller capacity of 6kg, which is best suited for aqueous samples (-55°C). The Lyovapor L-300 is the first freeze dryer to offer unlimited capacity that BUCHI calls Infinite-Technology; L-300 systems are suitable for both aqueous and organic solvents (-105°C).

Both platforms can be configured to meet your specific needs and readily adapted to changing requirements. Choose drying chambers with heated or non-heated shelves and manifold configurations from 12 to 36 places. The heated shelves can accommodate bulk sample trays or vials, and each shelf's temperature can be separately controlled.

Endless Capacity

Standard freeze dryers have a single condenser to collect ice from aqueous and organic solvents. The freezing capacity decreases when the condenser is full, and the unit must be defrosted and cleaned. This causes significant downtime and interrupts the process. The Infinite-Technology of the L-300 includes dual condensers for unlimited capacity. One condenser collects ice while the other is automatically and hygienically emptied and steam-cleaned. This innovation does not interrupt the freeze-drying process, thereby reducing downtime and maintenance.



Full Process Control

All Lyovapors include Infinite-Control software for a flexible and easy user experience. This advanced software offers data recording, customized reporting, quick methods designs and real-time data monitoring (on computers or on the BUCHI mobile app). Additional features designed to safeguard your samples include a sample protective state and end-point detection.

The Lyovapor sets a new standard for laboratory freeze drying capacity and convenience.

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The XPR and XSR precision balances are the missing pieces to your lab operation. Building off of the success of the XPE balance line, the XPR features a large, vibrant color touchscreen with a redesigned user interface. The platform provides essential user management options and a notepad for electronic documentation.

The XSR, successor to the XS balance line, boasts a new color touchscreen with the intuitive StatusLight. Combined with multiple interface options and method parameters, the XSR assures your balance is always connected and ready for use.

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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 in 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	Cat. No.	Price
AC632A 32" Workstation	**36-100-4271**	$3,577.65
AC632TA 32" Workstation, Tall Version	**36-100-4272**	$3,991.30
AC648A 48" Workstation	**36-100-4274**	$4,808.26
AC648TA 48" Workstation, Tall Version	**36-100-4275**	$5,027.03

* Filters sold separately, application worksheet required.

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 has audible and visible alarms for both airflow velocity and filter change
- Bonded carbon filters — no dust
- Polypropylene construction — excellent chemical resistance

Description	Cat. No.	Price
ACPT4000 48" Ductless Fume Hood*	**36-100-0063**	$8,569.25
ACPT5000 60" Ductless Fume Hood*	**36-100-0067**	$9,159.47
ACPT6000 72" Ductless Fume Hood*	**36-100-0069**	$10,294.37

* Filters sold separately, application worksheet required.

PowderSafe Type B Enclosure

Seamless polypropylene construction provides vibration resistance crucial for accurate powder weighing, while AirSafe automatic safety controller monitors airflow and filter condition. HEPASafe technology allows filters to be safely and easily changed under negative pressure.

Standard Features:
- Horizontal, HEPA-filtered-airflow pattern
- HEPASafe filtration system for simple and easy maintenance
- Thermally fused design for vibration reduction and balance stability

Description	Cat. No.	Price
AC730C 32" PowderSafe Enclosure	**36-100-4292**	$7,119.68
AC740C 48" PowderSafe Enclosure	**36-100-4293**	$7,770.75

Horizontal Clean Bench

AirClean Systems manufactures a complete range of horizontal and vertical ISO 5/Class 100 laminar-flow clean benches. Application-specific plastics allow for easy cleaning and sterilization, which helps prevent cross-contamination.

Standard Features:
- Seamless polypropylene construction
- ISO 5 or better air quality
- Microprocessor controlled
- Available in 4-, 5-, 6- and 8-foot versions

Description	Cat. No.	Price
AC4000 48" Horizontal Clean Bench	**36-100-4381**	$7,256.20
AC5000 60" Horizontal Clean Bench	**36-100-4382**	$8,599.63
AC6000 72" Horizontal Clean Bench	**36-100-4383**	$10,552.50
AC8000 96" Horizontal Clean Bench	**36-100-4384**	$12,955.00

Combination PCR Workstation

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

Standard Features:
- Class 100 clean vertical laminar-flow air
- Polycarbonate and polypropylene design to reflect UV energy
- Full access folding sash
- Rolled plastic design — no joints or gaps in construction
- Digital UV light timer, 0-59 minutes
- UV shelf with integral pipette holder

Description	Cat. No.	Price
AC632LFUVC 32" PCR Workstation	**36-101-8894**	$3,396.63
AC648LFUVC 48" PCR Workstation	**36-101-8897**	$4,528.84

PowderSafe Type C Enclosure

The PowderSafe Type C Balance Enclosure incorporates the airflow dynamics and HEPASafe features of the PowderSafe Type B with the user-friendly features and chemical fume containment capabilities of the ductless fume hood. Thermally fused polypropylene makes the PowderSafe Type C perfect for weighing powders or solvents.

Standard Features:
- Horizontal, HEPA-filtered airflow pattern
- HEPASafe filtration system for simple and easy maintenance
- Thermally fused design for vibration reduction and balance stability

Description	Cat. No.	Price
AC760C 36" Type C Enclosure	**36-101-8906**	$9,167.61
AC770C 48" Type C Enclosure	**36-101-8908**	$9,768.31
AC780C 72" Type C Enclosure	**36-101-8910**	$13,728.75

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Mystaire manufactures fume hoods and laminar-flow hoods to provide operator or process protection from toxic fumes, vapors and particulates.

MY-PCR Workstations

MY-PCR Workstations establish an ISO 5 clean work area with timed UV light and clean work zone.

Standard Features:
- Combines vertical ISO 5 air with UV light sterilization
- Safety switch to eliminate UV light exposure
- Polycarbonate construction with polypropylene base

Description	Cat. No.	Price
MY-PCR24 24" PCR Workstation	**15-338-365**	$2,554.29
MY-PCR32 32" PCR Workstation	**15-338-366**	$3,202.93
MY-PCR48 48" PCR Workstation	**15-338-960**	$3,850.00

MY-PCR Filters included in the purchase price.

Isola Vue Filtered Chemical Workstation

Isola Series Filtered Workstations provide chemical and particulate containment. Advanced monitoring and control are key components of each Isola Filtered Workstation.

Standard Features:
- EverSafe III Touch Control with electronic monitoring of face velocity, filter saturation, and temperature and humidity with audible and visible alarms
- Polycarbonate construction for 360° visibility — excellent for demonstrations
- Solid-state gas detection with three sensitivity set points

Description	Cat. No.	Price
MY-ISL36 36" Isola Workstation	**15-338-900**	$4,522.50
MY-ISL48 48" Isola Workstation	**15-338-901**	$5,628.00
MY-ISL72 72" Isola Workstation	**15-338-902**	$7,236.00

Isola Filters sold separately — application dependent.

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Accurate, Affordable, High-Quality Balances

For over 110 years, OHAUS has been providing balances with exceptional weighing performance and value. With our modern family of precision and analytical balances, from the high-end Explorer to the entry-level workhorse Pioneer, OHAUS has a balance to fit your application and budget.

Intelligent Evaporation

heidolph
research made easy

Heidolph Hei-VAP Series Rotary Evaporators

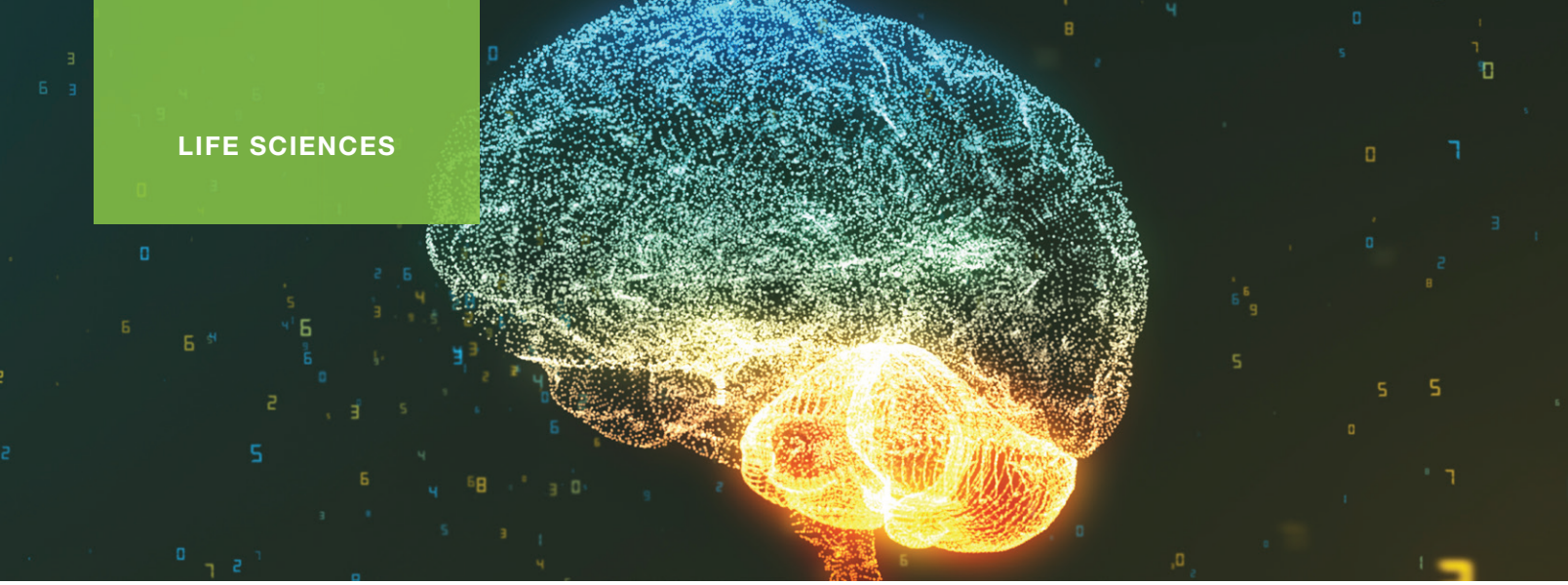
Hei-VAP Value† and Hei-VAP Value Digital†

Hei-VAP Rotary Evaporators are your best choice for a broad range of applications. The Value/Value Digital models can handle your basic distillation needs. The Hei-VAP Advantage and Precision models are ideal for more complex distillation processes. All German-built Heidolph equipment is backed by a three-year warranty and has an average operational lifespan of 10 years.

- Hand lift only model
- Economic smart knobs for setting rotation angle and bath temperature
- Value Digital displays both set point and actual bath temperature

Model	Condenser Type	Glassware Set	Mfr. No.	Cat. No.	Price
Value	Diagonal	G1 Standard	036000030	**13-876-300**	$5,841.18
Value	Vertical	G3 Standard	036000050	**13-876-302**	$6,295.41
Value	Vertical	G3 XL	036000057	**13-889-361**	$6,121.00
Value	Diagonal	G1 Coated	036000090	**13-876-306**	$6,121.29
Value	Vertical	G3 Coated	036000110	**13-876-308**	$6,764.44
Value	Vertical	G3B XL Coated	036000117	**13-880-261**	$6,526.08
Value	Dry ice	G5 Standard	036000070	**13-876-304**	$6,844.81
Value	Dry ice	G5 Coated	036000130	**13-876-310**	$7,574.83
Value Digital	Diagonal	G1 Standard	036000032	**05-404-500**	$6,455.47
Value Digital	Diagonal	G1 Coated	036000033	**05-404-501**	$6,735.58
Value Digital	Vertical	G3 Standard	036000052	**05-404-502**	$6,849.14
Value Digital	Vertical	G3 Coated	036000053	**05-404-503**	$7,142.23
Value Digital	Vertical	GS XL	036000067	**13-889-360**	$6,633.00
Value Digital	Vertical	G3B XL Coated	036000097	**13-880-262**	$6,904.00
Value Digital	Dry ice	G5 Standard	036000072	**05-404-504**	$7,014.20
Value Digital	Dry ice	G5 Coated	036000073	**05-404-505**	$7,782.47

† *Vacuum controller not included, we recommend the Heidolph Manual Vacuum Controller (Cat. No. 13-889-343)*



LAB-GROWN ORGANOIDS **REVEAL THE BRAIN'S MYSTERIES**

By Mike Howie

The human brain sets us apart from other life on this planet. Relative to body size, it's larger than the brain of any other creature. And, perhaps more importantly, the way in which the human brain develops, and the genes that help it take shape and have guided its evolution, are unique — and still not entirely understood.

With new tools, scientists are learning more about the human brain every day. One tool is a cerebral organoid, a three-dimensional miniature brain created in a lab using stem cells. While these mini brains are incomplete and don't fully function, they resemble the brain of a human embryo at nine to ten weeks of development.

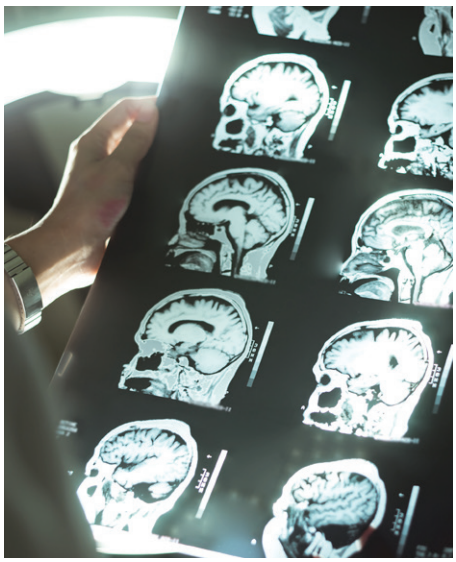
But it's not important that the mini brains function, and the scientists using them aren't looking to make a functioning brain. What is important is that the organoids can help scientists learn more about how the brain develops, what makes it unique, and how brain diseases may develop.

Exploring Brain Development

Molecular cell biologist Wieland Huttner, paleogeneticist Svante Pääbo and biophysical chemist Barbara Treutlein are working together to grow organoids of human brains, chimpanzee brains, and brains of other great apes. Watching the organoids develop side by side, the researchers learned that they all develop in remarkably similar ways, although progenitor cells in human brains took 50 percent longer to arrange their chromosomes before splitting into daughter cells. According to Huttner, this lengthened phase appears to cause the creation of more progenitor cells later in development.

At the Institute of Molecular Biotechnology at the Austrian Academy of Science in Vienna, Madeline Lancaster and her team are using organoids to study microcephaly, a neurodevelopmental disease that most severely impacts the dorsal cortex. They compared two organoids: one grown with cells from a patient with a genetic form of microcephaly, and another grown with cells from a healthy subject. In the organoid grown from microcephalic cells, more of the stem cells became neurons, suggesting that the disease mechanism could involve the premature differentiation of neurons.

While the technology is still in its infancy, it shows great promise for the future of brain research and the treatment of mental diseases and disorders. When the process for creating organoids matures, the mini brains may be helpful for modeling Alzheimer's, dementia, and other brain traumas. This could help researchers develop more robust treatments — and possible cures — that could greatly improve the quality of life for patients around the world.



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BioTek

BioTek Epoch Microplate Spectrophotometer & Take3 Plate

The BioTek Epoch Microplate Spectrophotometer provides precise UV/Vis measurements in a compact, highly versatile unit. Take3 Micro-Volume Plates reduce sample volume, cost, and time required for routine quantification.

- Monochromator-based absorbance
- 200 to 999nm for UV-Vis applications
- Wavelength scanning, endpoint and kinetics
- Gen5 Software for simple programming and powerful data analysis
- 2µL samples

Model	Description	Cat. No.	Price
Epoch	For 6- to 384-Well Plates, 200 to 999nm Detection, Includes Gen5 Software	**11120570**	$9,650.00
Take3	For 2µL Microspots, BioCells or Standard Cuvettes	**11120571**	$2,970.00

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- Seamless image capture to publication-ready data with minimal training
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- Live cell-friendly design: 4-zone incubation to 45°C

Description	Cat. No.	Price
Fluorescence and High-Contrast Brightfield Imaging, Includes Gen5 Software	**BTCYT1V**	$35,900.00

Restrictions may apply. See page 44 for full details.

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BioTek, the most trusted name in plate readers and washers, introduces the 800 TS and 50 TS Reader/Washer Series.

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Model	Description	Cat. No.	Price
800 TS	For 6- to 96-Well Plates, 400 to 750nm Detection	**BT800TS**	$6,250.00
50 TS	For 96-Well Strip or Full Plates, 8-Well Manifold	**BT50TS8**	$6,250.00

Catalog numbers shown may not reflect all product features listed.
Contact your **Fisher Scientific Sales Representative** to learn more about other available configurations and for full promotion details. *Restrictions may apply. See page 44 for full details.*

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Take control of your archives with the Thermo Scientific Arcos Block Management System. The Arcos system is designed to increase productivity, minimize errors, and keep your laboratory's resources focused on what matters most — positive patient outcomes.

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- To file, place the block in the next tray and scan to automatically update its information

Description	Mfr. No.	Cat. No.	Price
Arcos Block Management System, Includes Scanner, PC, Monitor, PDA, and Label Printer	B84700001	**B84700001**	$33,850.00

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The Invitrogen E-Gel Power Snap Electrophoresis System combines rapid, real-time nucleic acid analysis with high-resolution image capture for unmatched convenience. The integrated design helps reduce workflow time and accelerate discovery, offering:

- **Faster analysis** — go from sample loading to image capture in as little as 15 minutes
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- **Safer handling** — minimize handling of hazardous chemicals when used with Invitrogen E-Gel precast gel cassettes

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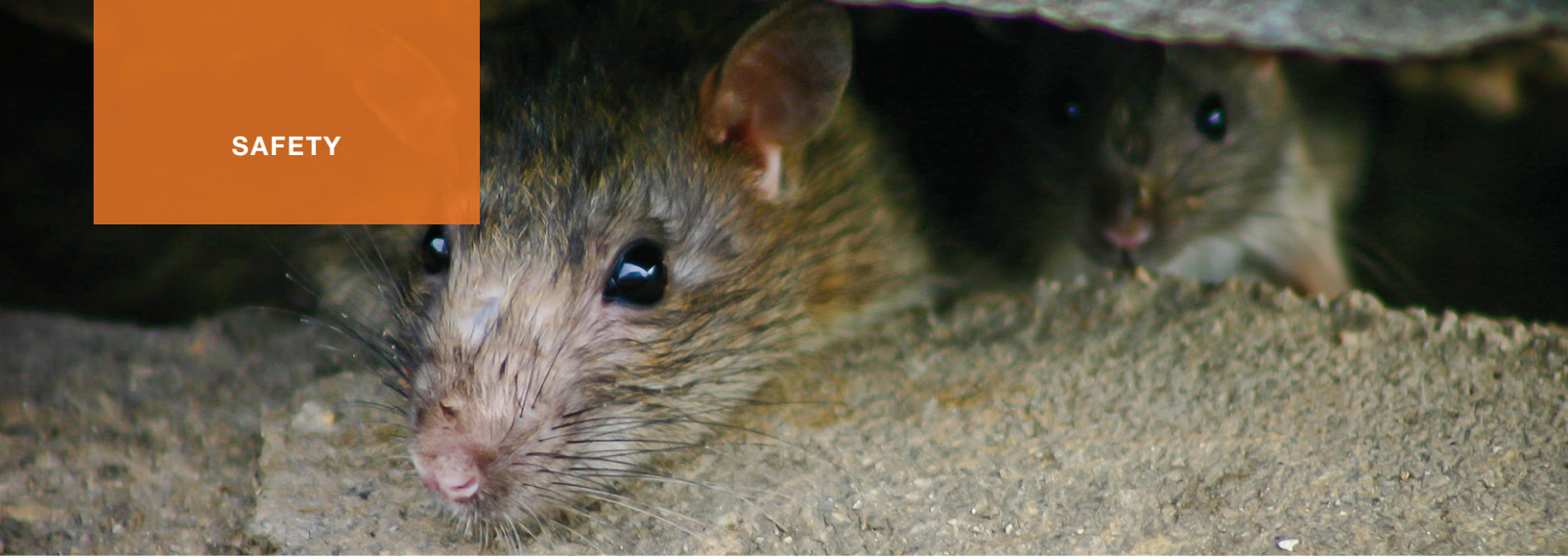


THE PLAGUE: MUCH MORE THAN AN ANCIENT THREAT

By Kevin Ritchart

Though the plague is primarily thought of as a disease that decimated the world's population more than 650 years ago, its presence is still being felt today.

In 2017, nearly 1,200 people in Madagascar were infected with the plague, and more than 100 people died from it, according to the United Nations Office for the Coordination of Humanitarian Affairs and Madagascar's National Bureau of Risk Management and Disaster.

The plague is caused by the Yersinia pestis bacterium and is typically spread by the bite of infected fleas — frequently carried by rats — causing the bubonic plague. Symptoms include swollen lymph nodes (known as bubos), headache fever, chills, and coughing.

A Closer Look

The majority of cases in Madagascar — about 67 percent — were the pneumonic form of the disease. Pneumonic plague is a more virulent, damaging form of the affliction, characterized by a severe lung infection that can be transmitted from one person to another via airborne droplets caused by coughing or sneezing. The incubation period of pneumonic plague is short and can cause death within 12 to 24 hours.

Both the bubonic and pneumonic forms can be treated with antibiotics, making early detection and diagnosis a high priority.

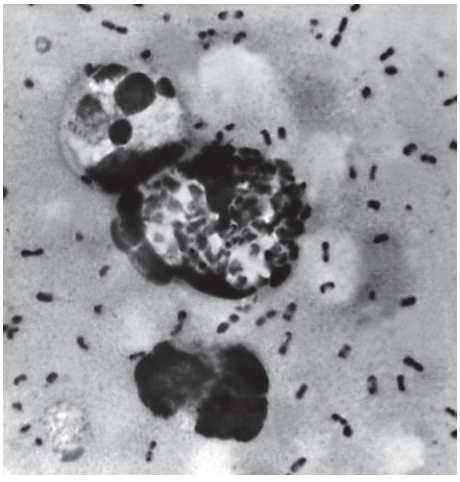
The plague is endemic to Madagascar, with an estimated 400 cases reported in a typical year. In 2017, the outbreak started earlier than usual and infiltrated some larger urban areas, according to the World Health Organization (WHO).

Containment Efforts

At the height of the epidemic, public schools were closed and public gatherings were forbidden in an attempt to keep the plague from spreading. The WHO also worked closely with Madagascar's airport authorities to ensure proper measures were being taken to prevent the spread of the infection outside of the country.

Within the country, Madagascar's poorly equipped health system is one of the biggest challenges in helping its residents battle the disease. Local health centers lack the proper protective garments to guard against infection. Many of the country's residents are impoverished and tend to self-medicate with cheap, over-the-counter medication rather than going to a hospital or clinic to receive proper treatment.

Madagascar's plague season typically runs from September through April, which spans the spring, summer and fall in the Southern Hemisphere. In 2017, cases of the plague were reported as early as August. Those afflicted with typical plague symptoms may have thought they had malaria, a common illness throughout Africa. The ability to educate the public and quickly diagnose the plague in its early stages will be a key to curtailing the impact of the plague throughout Madagascar in the years to come.



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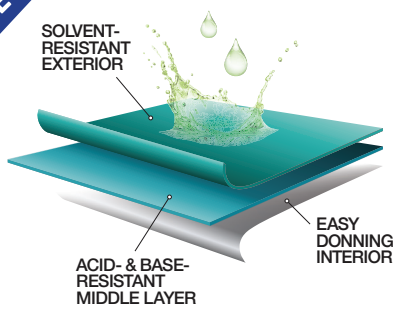

MICROFLEX 93-260: THE THINNEST CHEMICAL RESISTANT DISPOSABLE GLOVE

Meet the new glove that's changing the face of chemical hand protection. With an innovative three-layer design*, the Microflex 93-260 offers the reliable protection workers need when handling chemicals. And because it's the thinnest chemical resistant disposable glove available, it goes beyond protection to offer the comfort, dexterity and tactility workers need to be their most productive.

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pure • product • protection

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World's first true aseptic gowning technique for disposable coveralls

Constructed from antistatic, low-linting durable CleanTough fabric, these coveralls feature an innovative drop-down design and quick-release tab system to enable fast, 100% touch-free donning, with no risk of cross contamination, resulting in greater productivity.

Standard Disposable Garment	BioClean Drop-down Garment
	
Don in 50 sec.	Don in 30 sec.

Red marks (above) show the areas where cross contamination occurred during donning.

Ansell

STEP -by- STEP

BioClean Sterile Drop-Down Garment

DONNING PROCEDURE

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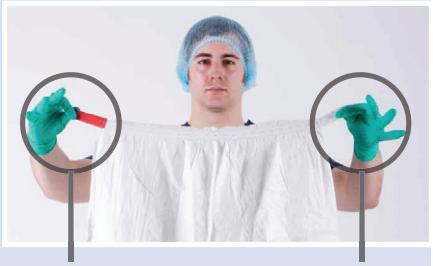
1

Remove drop-down coverall.

2

Hold internal red tab in your right hand and white tab in your left. Shake the garment to unfold.



3

Insert one arm and then the other.

Hold the inside of the coverall and bring over your head.

Shake garment down allowing it to dropdown over body or use external tabs to pull garment down.

4

Put right foot through ankle opening and then foot-loop.

5

Hold blue tab on right side of waist. Pull zip up ensuring you keep your right leg straight.

6

Still holding blue tab pull zip round to the blue tab on the left hand side of waist.

7

Pull off blue tab on the right hand side.

8

Hold the blue tab on the left side of waist with your left hand.

Pull zip down with your right hand and remove the blue tab at the waist as you do so.

9

Remove the zip tab by pulling the tab through the zip hole. Discard all tabs.

10

Don sterile BioClean-D overboots using aseptic technique. Complete gowning by donning goggles and a second pair of sterile gloves.

Nitritex Ltd recommend these instructions are used as an operators SOP for donning the drop-down garment, however the actual procedure is subject to the Standard Operating Procedure in force in each cleanroom.

BeMicron Patent # EP2303044B1

Sturdy, Washable and Reusable

Purus International Cut-Resistant Glove Liners

Purus Glove Liners are 100% nylon, low-linting, and ergonomically constructed. They are offered in a full-finger style and the color-coded cuffs indicate size. Glove liners come packaged in clean silicon, amide and DOP-free PE bags. Their 15 denier thickness offers protection and comfort for use under latex, nitrile, PVC and all disposable gloves.

- ANSI Cut Level 2 Protection
- Increased worker safety and satisfaction
- Ambidextrous; color-coded cuff for visual size identification
- Full-fingered style
- 13-gauge white nylon with HPPE
- Quality control inspection

Size/Cuff Color	Mfr. No.	Cat. No.	Quantity	Price	Quantity	Price
Small/Green	GLFFSCR	**19-126-900**	20/Pack	$197.50	200/Case	$1,580.00
Medium/Orange	GLFFMCR	**19-126-901**	20/Pack	$197.50	200/Case	$1,580.00
Large/Blue	GLFFLCR	**19-126-902**	20/Pack	$197.50	200/Case	$1,580.00
X-Large/Red	GLFFXLCR	**19-126-903**	20/Pack	$197.50	200/Case	$1,580.00

ZENON Z-LYTE™

FIT	Universal
BRIDGE	Molded
TEMPLE	Spatula
BASE CURVE	9.5
STANDARDS MET	ANSI Z87.1+

PIP	FISHER SCIENTIFIC CAT. NO.	LENS	COATING	FRAME
250-09-0000	**19-824-201**	Clear	Anti-Scratch	Clear
250-09-0020	**19-824-204**	Clear	Anti-Scratch / Anti-Fog	Clear

CONTEMPO

FIT	Fit Over Prescription Glasses
APPLICATIONS	Industrial, Construction, Medical
FRAME	PVC
HEADBAND	Elastic
BASE CURVE	5.75
STANDARDS MET	ANSI Z87.1+

INDIRECT VENTILATION

PIP	FISHER SCIENTIFIC CAT. NO.	LENS	COATING	FRAME
251-5300-000	**19-148-214**	Clear	Anti-Scratch	Blue

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Select a Bullard Powered-Air Purifying Respirator (PAPR) and get the highest air flow available today. The PAPR device uses a battery-powered blower to draw ambient air through a filter cartridge and delivers the filtered air via a breathing tube to the user's hood, helmet, or facepiece.

EVA (Evolutionary Air) PAPRs are lightweight and compact for wearer comfort. An innovative technology automatically maintains constant air flow regardless of filter type, hood type, filter loading or battery capacity. EVA HL PAPRS are NIOSH-approved for use in hazardous locations.

The PAPR kits include a blower, belt, battery, breathing tube, head top, single charger and air-flow indicator. Complete your unit by selecting the appropriate filter cartridge. Other replacement parts and accessory items like head tops, breathing tubes, and gang chargers can also be purchased separately.

Description	Mfr. No.	Cat. No.	Quantity	Price
EVA PAPR System with RT Series Hood	EVA RT3T	**17-989-615**	Each	$1,465.00
EVA PAPR System with Quick-Attach T-Series Hood	EVA 20TICT	**17-989-610**	Each	$1,443.00
EVA PAPR System with RT4 Quick-Attach T-Series Hood	EVA RT4T	**17-989-616**	Each	$1,443.00
EVAH PAPR System with RT Series Hood	EVAH LRT3T	**17-989-530**	Each	$1,642.00
EVAH PAPR System with Quick-Attach T-Series Hood	EVAH L20SICHT	**17-989-510**	Each	$1,631.00
EVAH PAPR System with Quick-Attach T-Series Hood	EVAH L20TICT	**17-989-518**	Each	$1,620.00
EVAH PAPR System, 20LF Series, Large	EVAHL20LFL	**17-989-500**	Each	$1,571.00
EVAH PAPR System, 20LF Series, Medium	EVAHL20LFM	**17-989-501**	Each	$1,637.00

Description	Mfr. No.	Cat. No.	Quantity	Price
Facepiece, 20LF Series, Large	20LF2L	**18-998-002**	10/Case	$350.50
Facepiece, 20LF Series, Medium	20LF2M	**18-998-003**	10/Case	$350.50
Cartridge, HEPA Filter	PAPR FC3	**17986282**	6/Pack	$277.50
Cartridge, for Organic Vapors: Cl, SO_2 Gas, ClO_2, HCl, and HFl	PAPR FC4	**19-824-560**	6/Pack	$705.50
Cartridge, for Particulates, Ammonia, Formaldehyde, Methylamine, Cl, HCl, SO_2, ClO_2, and HFl	PAPR FC5	**19-808-700**	6/Pack	$844.50
Hood, RT Series, Serged Seams	RT3T	**19-321-725**	Each	$47.75
			10/Case	$399.00
Hood, RT Series, Sealed Seams	RT4T	**19-321-730**	Each	$93.40
Hood, T-Series, Quick Attach	20TICNT	**18-998-055**	Each	$41.65
			10/Case	$403.00
Breathing Tube, T-Series Hood, Regular	PAHBT	**19-321-700**	Each	$53.80
Breathing Tube, Loose-Fitting Facepiece	PA20LFBT	**19-021-238**	Each	$76.20
Battery Charger, EVA, 6 Ports	EVAGC	**17-986-281**	Each	$1,365.00
Battery Charger, EVAH, 6 Ports	EVAHLGC	**17-989-544**	Each	$1,732.00

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