

# DESIGNING A LAB

LESSONS LEARNED FROM A 60,000 SQUARE-FOOT  
DESIGN PROJECT COMPLETED IN 11 MONTHS



Managing Indoor  
Air Quality

**US Biosimilars  
Industry Poised  
for Growth?**



# Fast Forward

The Eppendorf epMotion® Series: Enjoy easy-to-use and flexible automation

The new Eppendorf epMotion liquid handling workstations are the right choice for your highly reproducible and accurate pipetting results. Discover new features, more speed and worktable positions and the new intuitive software assistant concept.

- > Available as ThermoMixer®, vacuum manifold or magnetic separation options
- > User guided, touchable software assistants for easy application programming
- > UV light decontamination and HEPA air filter option



[www.eppendorf.com/automation](http://www.eppendorf.com/automation) • 800-645-3050

# The wrong way to check samples.



# The right way to check samples.

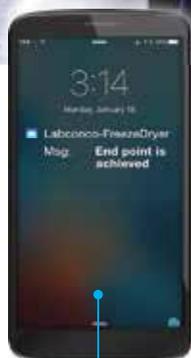
Don't get stuck waiting for your samples to freeze dry. With a FreeZone® Freeze Dryer, you are free to roam.

The FreeZone emails you alert messages and status updates whenever and wherever you choose. Add the End-Zone™ accessory and know precisely when freeze drying is complete.

Freeze drying is now as effortless as child's play:

- **Large, full color display with touch screen navigation gives you parameter status at-a-glance.**
- **Lyo-Works™ OS software provides numerous programming options and stores data for proof of sample integrity.**
- **USB port and Ethernet connection make it easy to output data.**

Find out more at **800.821.5525** or **www.labconco.com**  
— We double dog dare you!



## NEW Labconco FreeZone® Freeze Dryers with End-Zone™



*Protecting your  
laboratory environment*

**LABCONCO®**

Kansas City, MO | 800.821.5525  
www.labconco.com





**10**



**36**



**16**



**32**

feature

**10 Designing a Lab**

Lessons learned from a 60,000 square-foot design project completed in 11 months.

**Kevin Ryan**

**16 Science & Architecture**

How an old brick masonry warehouse became a lab for testing sustainability systems and methods.

**Randy Kreie and David Godfroy**

business management

**24 Managing Indoor Air Quality**

Study looks at IEQ conditions using dynamic control of air change rates.

**Gordon P. Sharp**

**28 Let's Make a Deal**

Tips for negotiating on used lab equipment.

**Erica Tennenhouse**

leadership & staffing

**32 Positive Mentoring**

Training scientists proactively to do good science from the start.

**Donna Kridelbaugh**

technology

**36 Laboratory Robotics**

Improved imaging and touch sensors can provide a valuable option in lab settings.

**Mike May**

health & safety

**42 Handling and Storing Chemicals**

Tips for safely moving, storing, and protecting oneself from laboratory chemicals.

**Vince McLeod**

# HAMILTON<sup>®</sup> HIGHLIGHTS

VOLUME 1, ISSUE 1

© COPYRIGHT 2017 HAMILTON COMPANY

TUESDAY, AUGUST 1, 2017

**COST SAVINGS BECOME A REALITY  
BY BUILDING HIGH-THROUGHPUT  
LAB FOR CLINICAL TESTING**



**Walk-away Solution  
for ELISA Processing**  
MORE, BOOTH 4907



Visit us at  
**AACC 2017**  
**#4907**

## Pushing the Limits Providing Solutions

Hamilton continues at the forefront of laboratory automation technology, delivering the solutions you need to make your science possible. Experience the latest automated liquid handling in San Diego, CA, August 1st – 3rd, 2017.

**HAMILTON<sup>®</sup>**  
THE MEASURE OF EXCELLENCE<sup>®</sup>

[www.hamiltoncompany.com/AACC2017](http://www.hamiltoncompany.com/AACC2017)

© 2017 Hamilton Company. All rights reserved.



## ADVICE FROM LINDA

Starting this month, you'll notice a fun new section in the magazine—"Ask Linda"—an advice column where our mascot Linda the Lab Manager answers questions from lab professionals about challenges they're experiencing in managing their labs. With this month's Leadership & Staffing article focused on mentoring, our first Ask Linda column answers a question on that same topic (pg. 84). While this section is a bit offbeat, its aim is to provide serious answers to serious questions, providing helpful tips for our readers to better manage their labs. We hope you find it both a fun break and a useful source of information. Have a question for Linda about tackling a challenge in your lab? Feel free to email her at [LINDA@labmanager.com](mailto:LINDA@labmanager.com).

Lab Manager® (ISSN: 1931-3810) is published 11 times per year; monthly with combined issues in January/February, by LabX, P.O. Box 216, 478 Bay Street, Midland, ON Canada L4R 1K9. USPS 024-188 Periodical Postage Paid at Fulton, MO 65251 and at an additional mailing office. A requester publication, Lab Manager, is distributed to qualified subscribers. Non-qualified subscription rates in the U.S. and Canada: \$120 per year. All other countries: \$180 per year, payable in U.S. funds. Back issues may be purchased at a cost of \$15 each in the U.S. and \$20 elsewhere. While every attempt is made to ensure the accuracy of the information contained herein, the publisher and its employees cannot accept responsibility for the correctness of information supplied, advertisements or opinions expressed. ©2013 Lab Manager® by Geocalm Inc. All rights reserved. No part of this publication may be reproduced without permission from the publisher.

WDS Canadian return: 478 Bay Street, Suite A213, Midland, ON Canada L4R 1K9.

**POSTMASTER: Send address changes to Lab Manager®, PO Box 2015, Skokie, IL 60076.**



## DEPARTMENTS

### industry insights

#### 46 US Biosimilars Industry Poised for Growth?

Battling over the patent dance.

**Angelo DePalma**

#### 48 Gathering Data in Extreme Environments

Testing equipment for or in tricky environments depends on adventuresome scientists and engineers.

**Mike May**

### analytical

#### 52 Ask the Expert

A discussion of trends in 2-D liquid chromatography.

**Rachel Muenz**

#### 54 ICP-MS

Helping scientists dig deeper into the world around us.

**Mike May**

#### 57 Thermal Analyzers Survey

Learn the most common types readers use and more from the latest results.

**Erica Tennenhouse**

### life science

#### 58 Ask the Expert

A discussion of improvements in liquid chromatography.

**Tanuja Koppal**

#### 60 Liquid Handling

Acoustic liquid handling ensures high accuracy at low volume.

**Angelo DePalma**

#### 62 Electrophoresis Survey

Learn about exciting new applications and more from our latest results.

**Erica Tennenhouse**

### laboratory

#### 64 Laboratory Casework

Choices, choices, and more choices.

**Angelo DePalma**

#### 66 Ultracentrifuges

What to consider when choosing an ultracentrifuge for your lab.

**Erica Tennenhouse**

#### 68 Microwave Digesters Survey

Learn readers' most sought-after features and more from our latest results.

**Erica Tennenhouse**

#### 70 Balances Survey

Find out readers' purchasing plans and more from the latest results.

**Erica Tennenhouse**

### in every issue

#### 20 Labs Less Ordinary

Michigan Tech's Cloud Chamber: Unique piece of equipment shines a light on the inner workings and formation of clouds.

**Rachel Muenz**

#### 39 Infographic CO<sub>2</sub> Incubator Care: Best Practices

#### 67 Infographic Generics vs. Biosimilars

#### 72 Technology News

The latest equipment, instruments, and system introductions to the laboratory market.

#### 78 How it Works Oil-Free Vacuum Pumps for GC-MS

#### 80 How it Works Determining End Point During Laboratory Freeze Drying

#### 85 Pre-owned Equipment Marketplace

#### 85 Advertisers Index

#### 86 Lab Manager Online



## It's not just a new freezer. It's a social responsibility.

We now offer time-tested ultra-low temperature freezers operating on natural refrigerants under the Panasonic Healthcare brand, not because they are more energy efficient and environmentally sustainable, but because they perform exactly like we promise.

Model MDF-DU702VH-PA

## VIP<sup>®</sup> ECO

Your Life's Work, Our Brand.

Safe storage of your most critical biological specimens is an obligation we've taken seriously for more than 50 years. Panasonic Healthcare engineers have always placed performance and reliability above any other considerations while evaluating new technologies. Learn more about the new VIP ECO -86°C ultra-low temperature freezers at [www.panasonic-healthcare.com/us/biomedical/vip-eco](http://www.panasonic-healthcare.com/us/biomedical/vip-eco)



New natural refrigerants, smart compressors and integrated electronics combine to lower operating costs without putting reliability and ultra-low temperature performance at risk.

Discovery powered by  
precision™



# unique facilities

Half of my house was built in 1931—as a small summer lake house. Ten years ago it was renovated and expanded into a year-round home, though retaining its bungalow style. However, a small upstairs bedroom in the “old” section had only had cosmetic improvements and suffered from leaky windows and a creaky floor. Not being part of a “fixer-upper” family, my husband and I were at the mercy of local contractors to get the work we needed done. For two years we interviewed carpenters and flooring guys, checked references, and got estimates. But everyone had a different idea of what the job would require and cost. This process—as anyone who has gone through it knows—is the very definition of frustration. Happily, six months ago we hired a local home improvement and painting company to do the work and are very happy with how it all turned out.

Managing a laboratory building project or a retrofit is not any different. Owners and facility managers know what they want and need, but are dependent upon architects and designers to get the job done. Add to that the equipment, software, ducting, regulatory, safety, and other requirements, and it's clearly a daunting task.

This month we look at two fairly different laboratory design projects, both of which illustrate the challenges as well as some solutions for getting a lab up and running.

In our cover story, author Kevin Ryan shares biotechnology company Shire's experience building a new pharmaceutical manufacturing facility, which included a 60,000 square-foot laboratory. “Perhaps the most unprecedented aspect to the start-up challenge was the need to qualify 22 different computerized laboratory systems to the requirements of 21CFR Part 11, *Electronic Records*. Doing this for so many systems in such a short time period called for an intensive team effort with a detailed plan for each system,” says Ryan. Turn to page 14 for more important lessons learned from the experience.

Different in scope and fraught with some very unique structural challenges, our second lab design article, “Science & Architecture” (page 16), looks at the renovation of a six-story brick masonry warehouse built in 1913 into a laboratory for studying sustainable energy technologies. Similar to all construction projects, “good communication and flexibility were essential for the success of both the working laboratory and the exterior building renovation.”

Clearly, the demands of scientific research dictate a wide range of laboratory facilities and equipment. This month's “Lab Less Ordinary” looks at Michigan Technological University's cloud chamber, located on the ground floor of MTU's Dow Environmental Sciences and Engineering Building. Because of its unique research capabilities, Michigan Tech physics professor Will Cantrell worries less about funding, though it's still a main challenge, saying, “I think we're in a pretty good position because there's no other chamber like this in the world. We can do things that other people can't, so that gives us some substantial advantages for a lot of the kinds of things that we want to do.” (Turn to page 20 to learn more.)

Beyond laboratory design, this month's issue also looks at the important role of mentoring in developing scientific talent, negotiating the price of pre-owned lab equipment, managing indoor air quality, laboratory robotics, and much more.

Enjoy.

Best,

**Pamela Ahlberg**  
Editor-in-Chief

editor-in-chief

**Pamela Ahlberg**

pam@labmanager.com  
973.729.6538

associate editor

**Rachel Muenz**

rachelm@labmanager.com  
888.781.0328 x233

technology editor

**Erica Tennenhouse**

etennenhouse@labmanager.com  
647.500.7039

director of creative services

**Trevor Henderson**

thenderson@labmanager.com  
888.781.0328 x291

contributors

**Angelo DePalma, PhD**

**Sara Goudarzi**

**Tanuja Koppal, PhD**

**F. Key Kidder**

**Donna Kridelbaugh**

**Mike May, PhD**

**Vince McLeod, CIH**

**Bernard Tulsi**

art director & production manager

**Greg Brewer**

gregb@labmanager.com  
888.781.0328 x241

senior designer

**Danielle Gibbons**

danielleg@labmanager.com  
888.781.0328 x237

business coordinator

**Andrea Cole**

andreac@labmanager.com  
888.781.0328 x296

audience development manager

**Brian McGann**

bmcgann@labmanager.com  
917.678.7082

custom article reprints

**The YGS Group**

labmanager@theygsgroup.com  
800.290.5460  
717.505.9701 x100

subscription customer service

labmanager@halldata.com

senior account manager

**Alyssa Moore**

Mid-Atlantic, Southeast  
& International  
amoore@labmanager.com  
610.321.2599

advertising account managers

**June Kafato**

Canada / Key Accounts  
junek@labmanager.com  
705.812.2332

**Larry Frey**

Midwest/West  
larry@labmanager.com  
845.735.5548

**Reece Alvarez**

Northeast  
ralvarez@labmanager.com  
203.246.7598

**Published by LabX Media Group**

president

**Bob Kafato**

bobk@labmanager.com  
888.781.0328 x223

managing partner

**Mario Di Ubaldi**

mariod@labmanager.com  
203.858.6207

general manager

**Ken Piech**

kenp@labmanager.com  
888.781.0328 x226

publisher

**Edward Neeb**

edwardn@labmanager.com  
203.448.0728

**Lab Manager**  
Run Your Lab Like a Business

P.O. Box 216, 478 Bay Street,  
Midland, ON, Canada L4R 1K9

# MAGIC CIRCULATOR DEAL!

▶ **BUY A UNISTAT 815  
AND GET FREE:**

- + **INSTALLATION** (Domestic US)
- + **3-2-2 WARRANTY EXTENSION**
- + **LEATHERMAN WAVE**

The Dynamic Temperature Control Systems of the Unistat 815 range inspires with unique thermodynamic properties and a range of functions to meet the highest demands:

- Working temperatures from -85°C to +250°C
- Brilliant 5,7" TFT touchscreen controller
- Heating Power 2,6 kW
- Cooling powers up to 1,5 kW
- Air- or water-cooled

*Go for the  
real magic!*



**39,500 US \$**



**3-2-2**

Garantie / Warranty

[www.huber-online.com/register](http://www.huber-online.com/register)

Erweitert die Garantie Ihres HUBER Gerätes!  
Extended the Warranty of your HUBER Unit!

**Register now!**



**Huber USA Inc.**

100 Centrewest Ct. • Cary NC 27513

Phone 1-800 726 4877 • [info@huber-usa.com](mailto:info@huber-usa.com)

[www.huber-usa.com](http://www.huber-usa.com)

**huber** USA

# Designing a Lab

Lessons learned from a 60,000 square-foot design project completed in 11 months By Kevin Ryan



▲Shire's new manufacturing facility near Atlanta.

Shire, the leading global biotechnology company focused on serving people with rare diseases and other highly specialized conditions, recently completed construction and commissioning of a new pharmaceutical manufacturing facility located 35 miles east of Atlanta, Georgia. The plant is a one-million-square-foot complex built on a 100-acre green field site. Operations are dedicated to the manufacture of human plasma-derived protein therapies used to treat patients with immune disorders and other rare diseases. Laboratory professionals can learn from Shire's design and start-up experiences because the plant includes a 60,000 square-foot laboratory building.

## Laboratory design

The three-level laboratory building was designed with the same open-space concept as the entire facility. Floor-to-ceiling windows cover two full sides of the building, allowing generous amounts of natural light into the workspace. The first floor consists of chemistry and immunology laboratories for quality control testing of product and raw materials, a sample control suite, and rooms for consumables storage and waste staging. The second floor includes a method remediation laboratory, microbiology laboratories, and rooms for cold storage

and document control. The third level houses a building-specific purified water system and equipment for nitrogen, vacuum, and air distribution.

The facility was designed to meet regulatory requirements for pharmaceutical production in the U.S., Europe, and other markets. To that end, the laboratories are tour friendly due to the large windows separating office and laboratory areas. This makes the work being done highly visible, easier to manage, and safer.



▲The laboratory building was designed for maximum visibility.

# The results are in.

Starline Plug-In Raceway enables labs to easily expand power.

Starline Plug-In Raceway gives you the power to meet the ever-changing needs of your hospital or lab by allowing you to easily expand, reconfigure or relocate power. Our pre-assembled modules simply snap into place along the backplane of the raceway wherever a connection to power is required. And not only does Plug-In Raceway install quickly, but there is no need to call in an electrician to expand power, which will lower future maintenance costs. To learn more, visit [starlinepower.com/raceway](http://starlinepower.com/raceway).

**STARLINE**<sup>®</sup>  
PLUG-IN RACEWAY





▲ Mobile benches and overhead service carriers make the laboratory highly configurable.

Design of the laboratory building also meets occupational safety and environmental regulations with state-of-the-art features. Unique safety features include eyewash stations embedded in the walls that operate automatically when pulled down, and safety showers at color-coded floor sections for ease of location during an emergency.

“The temperature and humidity of stability chambers is monitored by the BAS and displayed on real-time monitoring screens in the laboratory.”

Laboratory drains flow directly to the facility’s wastewater treatment plant, and automated fire walls can isolate buildings and floors throughout the facility as needed. The sterility isolator includes visual and audible alarms for the control of vaporized hydrogen peroxide.

The laboratory building includes its own reverse osmosis (RO) water generator and distribution loop. The loop provides RO-quality water to 17 points of use throughout the building. Eleven of these points supply water polishers that further purify the water used for analysis.



▲ Sterility testing at Shire’s new manufacturing facility.

All critical equipment throughout the facility, including controlled temperature units (CTUs), the RO water system, and the air handling system, is monitored by a building automation system (BAS). Set points in the BAS control these systems and define operating ranges for alarm notifications.

### Unique features

The laboratory design facilitates sample flow. Samples come in via a drop-off station at one end of the building and flow through the testing process toward the other end where waste disposal is managed. In the areas between, rooms are dedicated to chemical weighing, glass washing, sample incubation, and CTU storage. The building also has conveniently located copy rooms, office areas, conference rooms, restrooms, and elevators.

Seven stability chambers qualified to conditions defined by the International Council for Harmonization are located in the warehouse just a short walk down the hallway that connects all of the facility’s buildings. The temperature and humidity of stability chambers is monitored by the BAS and displayed on real-time monitoring screens in the laboratory.

Another unique feature of the laboratory space is mobile benches that can be redistributed as needed. Additionally, overhead service carriers provide gases and

power to each workstation and can be customized for current needs. Argon, helium, oxygen, hydrogen, and nitrogen are routed to the carriers from specialty gas cabinets and generators located throughout the building. Power options can be configured via color-coded outlets at each workstation, and supply up to 300 V and uninterrupted power where needed.

“Analyses of specific analytical work flows were performed to ensure optimal placement of equipment and supplies.”

On the first level, testing is performed using approximately 100 product-specific analytical methods. Raw materials and utilities are tested by way of USP-NF and EP compendia. All methods were validated, transferred from other sites, or verified according to a detailed method implementation plan.

Prior to occupation of the building, analyses of specific analytical work flows were performed to ensure optimal placement of equipment and supplies. These reviews included spaghetti diagrams to evaluate work cell movement and 5S planning for placement of tools and consumables.

In the microbiology laboratories on the second level, samples are tested in designated areas for bioburden, endotoxin, and sterility. Additionally, there is a specialized microbial identification suite utilizing MALDI-TOF mass spectrometry. The second level also includes an autoclave suite and a large walk-in cooler for media and sample storage.

### Construction and start-up challenges

The start-up challenge facing the laboratory team was to be ready to support all critical utilities, cleaning validation, environmental

monitoring, raw material release, and product testing for three separate manufacturing buildings. The timeline for readiness was 11 months from the day of entering an empty QC building. In this timeframe, the team had to install and qualify 600 pieces of equipment and analytical instrumentation, hire and train approximately 50 new employees, implement hundreds of procedures, and transfer or validate 100 analytical methods.



## Fast, Confident Compositional Analysis for the Food Industry

Easily and quickly analyze your most challenging food samples with our total protein and moisture/ash determination solutions, offering industry-leading analysis times and automation features to increase your lab's productivity.

### Total Protein Analysis

- Macro sample mass (500 mg nominal)
- 3.5 minute analysis times
- Autoloader allows for unattended analysis with an optional capacity up to 120 samples



### Moisture and Ash Determination

- Automated batch thermogravimetric analysis for 19 simultaneous samples
- Integrated 0.0001 g balance using macro sample mass (1 g nominal)
- Both moisture and ash results from a single sample

See how we can help you at [www.leco.com](http://www.leco.com)

**LECO**  
Delivering the Right Results

Phone: 1-800-292-6141 | [info@leco.com](mailto:info@leco.com)  
[www.leco.com](http://www.leco.com) | © 2017 LECO Corporation

Perhaps the most unprecedented aspect to the start-up challenge was the need to qualify 22 different computerized laboratory systems to the requirements of 21CFR Part 11, *Electronic Records*. The team followed strict quality system guidance to satisfy these federal requirements. Doing this for so many systems in such a short time period called for an intensive team effort with a detailed plan for each system.

Each computerized system had to go through a multi-stage series of assessments, from design qualification to user requirement specifications to risk assessment. Each then required qualifications for installation, operation, and performance. Typically, a fully functioning laboratory would consider it a success to complete these requirements for one new computerized system in a period of six months. The start-up of the Shire Georgia laboratories required qualification of 22 computerized systems in approximately nine months.

“The start-up of the Shire Georgia laboratories required qualification of 22 computerized systems in approximately nine months.”

### Lessons learned

Overall, the laboratory building start-up was an unprecedented effort, and lessons were learned that warrant sharing with the laboratory management community, including the following:

- When a laboratory start-up is part of an overall facility start-up, it is important for planners to realize the broad impact of laboratory operations. In order to support critical utilities like water and air supplies or environmental monitoring for the facility, the laboratory must be prioritized in the sequence of implementation.
- Laboratory representatives must closely coordinate with construction contractors to finish construction, including all punch list items. This coordination should include agreement on ownership of qualification and training tasks for all contractor-furnished equipment such as glass washers, fume hoods, sterility isolators, and autoclaves.
- Building design should be reviewed for changes in regulatory requirements as the project proceeds, because facility usage can be impacted. For example, rooms that were originally designed for waste accumulation might no longer meet the requirements at time of occupation, and late-stage room or process modifications may be needed.
- Contractors for commissioning and qualification are beneficial in cases where highly specific expertise is needed. However, the plan for how employees and contractors work together should be carefully considered, given inherent differences in business objectives. Contractors should never lead the project, and should have clearly outlined deliverables.
- Weekly sanitization of the building's RO water loop involves an automated cycle that closes valves at all points of use while super-heated water passes through for a period of hours. The parameters of the sanitization cycle must be carefully considered with respect to the operation of water polishing units installed at the points of use. Incorrect usage can cause malfunction of the polishers.
- Any equipment, no matter how simple, can pose difficulties in installation and qualification if care is not taken to review manufacturer's recommendations for use. Temperature mapping of laboratory refrigerators that operate via forced air circulation, for example, can present challenges with set point configurations and probe placements.
- Risk assessments for computerized systems that do not meet all 21CFR Part 11 requirements off the shelf must drive mitigation actions. For example, when a system does not have electronic signature capability, result records should be printed and signed by the analyst and reviewer, and such mitigations need to be captured in operational procedures.
- To reduce the number of software systems used, a chromatography data system (CDS) was chosen to operate five different instrument types: GC, HPLC, ion chromatography, capillary electrophoresis, and LC-MS (TQD). The team quickly learned that implementation of the CDS for third-party instruments marketed as

compatible was a challenge, as neither the CDS supplier nor the instrument supplier was prepared to take responsibility for making the combination work. Details of the lessons learned in this regard could be very valuable to laboratory managers in similar situations.

- Automated workstations that control operation of multiple analytical instruments in sequence can be difficult to bring on line and operate reliably. Workstations focused on ELISA or endotoxin methods include software and robotics that control automated liquid handling, bar code reading, sample dilutions, plate washing, and plate reading. Although careful coordination with the supplier can make it all work together, qualification of the system and associated methods requires extensive time and labor. In such cases, use of an experienced contractor helps.

Shire strives to develop best-in-class products for patients living with rare diseases, and to do so requires high-functioning, state-of-the-art laboratories. The Covington, Georgia, laboratories provide an excellent work environment, both functionally and esthetically. Successful implementation has resulted in quality control functions that put the new manufacturing plant in a good position to supply patients with much-needed protein therapies. Sharing the experiences and lessons learned with other laboratory professionals is another step toward helping patients worldwide.

*Kevin Ryan, senior manager, Quality Labs, Shire, can be reached at [kevin.ryan@shire.com](mailto:kevin.ryan@shire.com) or 678-212-3934.*

**Chemglass**  
Life Sciences

**Huber**

Chemglass, Huber  
and You.  
Magic together.

CG-17002

Contact us for your free quote.  
Toll-free 1-800-843-1794 • [www.cglifesciences.com](http://www.cglifesciences.com) • [sales@cglifesciences.com](mailto:sales@cglifesciences.com)

# Science & Architecture

How an old brick masonry warehouse became a lab for testing sustainability systems and methods

By Randy Kreie and David Godfroy



**E**xperimentation is the heart of science. The knowledge and understanding gained from testing and analysis are crucial in forming theories for real-life applications. And many scientists are better able to form insights using hands-on methods, seeing and touching their ideas and creations.

Such is the case in architecture as well. Technological blueprints, sketches, and systems all have their place, but being able to apply knowledge to a working building allows for testing and analysis in real time and in a real setting.

This vision became possible due to a special partnership program that allows engineers and architects to create a space to explore product testing for sustainable energy and building research. These structures are essentially living laboratories, intended to change over time and to research, develop, and test innovations in solar power, climate control, environmental barriers, and thermal insulation.

This project was created by Fraunhofer USA, a not-for-profit research organization that develops and validates scientific applications. Fraunhofer's research centers include the Center for Sustainable Energy Systems CSE. Looking to relocate from its original location in Cambridge, MA, the company chose to renovate an old abandoned building in South Boston by upgrading it to modern sustainability standards. Leaders chose a six-story brick masonry warehouse located in Fort Point Channel in the Boston Innovation District that was designed and built in 1913 and is considered historically representative of the area.

The renovation project's goal was to create a laboratory setting where various sustainable energy technologies, including solar panels, radiant cooling, phase change materials, and vacuum insulation panels could be implemented and carefully monitored over time for their efficacy and value. Flexibility was a key consideration, as the workflow is constantly in motion, novel equipment and materials move in and out, wall sections are replaced, and mechanical systems adapt as well. Innovations also included trying multiple HVAC systems for the best solution and researching various insulation options to enhance thermal performance while minimizing negative impacts, such as condensation, on the building.

## Lab accommodations

One challenge during the renovation was to create space for two lab areas with specific dimensions required to accommodate Fraunhofer's test labs. A floor needed to be removed to open up the space for a 20-foot high-bay lab to house tall solar manufacturing equipment, including bulky laminators. The lower floor was chosen for the high-bay lab to house equipment that was too heavy to lift to an upper level. The high bay also was needed to accommodate large climate chambers that can run 24/7 to repeatedly expose solar panels and thermal insulations to extreme conditions and simulate accelerated aging. This allows the evaluation of the impact on panel



2.



3.



4.

1. The six-story brick masonry building, designed and constructed in 1913, is considered historically representative of the Fort Point District, where it is located. 2. The first-floor reception and lobby space includes a technology showcase where the products of nearly 50 manufacturers are on display. 3. Labs in the building implement various energy-saving technologies, including solar panels, radiant cooling, and innovative HVAC designs, which are monitored and tested within the facility. 4. A floor of the building was removed to create the 20-foot-high bay lab, which needed the extra height to accommodate large equipment used for solar panel manufacturing and testing.

All images courtesy of DiMella Shaffer, Photographer: Trent Bell

performance and the insulation's long-term durability. Solar panel research focuses on improving performance, making the product more accessible and easy to install, and lowering costs for residents and homeowners.

The high-bay lab includes a loading dock leading directly to the outside. The lab extends up behind the reception area, allowing visitors to look down through a window to view activities without disturbing research efforts. The goal for the first-floor reception and lobby space was to highlight industry research—by Fraunhofer and others. The space includes a sustainable building technology showcase developed via a partnership program with manufacturers, giving them an opportunity to demonstrate new and emerging products. In total, nearly 50 suppliers donated products, some brand-new and not available on the market, to test and use in real-time operations and to promote to visitors.

The upper-floor layouts include enclosed lab spaces on the sides of the building; an open office with glass walls in the middle of the third floor allows more natural lighting as far into the building as possible. The sixth

floor contains advance material testing laboratories for thermal and hygrothermal testing of opaque building envelope materials and fenestration components, performance analysis of heat storage materials, and development and testing of nano insulations.

In addition, the building offers the flexibility to field-test materials other than the masonry envelopes. For example, novel curtain wall assemblies, insulated metal panels using high-performance core insulation, dynamic fenestration technologies, and the like can be installed and tested in full-scale, instrumented, highly controlled conditions in the South Boston climate.

### HVAC decisions for lobby

The first-floor reception area employs the concept of low-lift cooling, which uses a significantly higher chilled water temperature than that of traditional systems, reducing the temperature “lift” of the chiller and improving its efficiency. Humidity is a challenge in low-lift cooling systems, where radiant heating and cooling can cause condensation to form on the floor or ceiling sur-

faces, creating slippery conditions. A six-pipe HVAC distribution system is used throughout the building to offer flexibility. The six-pipe system includes two pipes for heating, two for low-temperature cooling loops, and two pipes for higher-temperature cooling loops. The standard cooling loop runs at 40 to 45 degrees in most buildings, and the higher-temperature cooling loops vary from 50 to 60 degrees, based on the humidity. A dual cooling loop allows facilities to use radiant cooling when they choose to or to turn it off when necessary.

The first HVAC system used for the lobby is a floor-based radiant heating and cooling system embedded in a 2" lightweight concrete topping slab that uses the fluctuating temperature cooling loop. A displacement air system is the second type used in the reception area. It delivers quiet, comfortable low-velocity air at the floor level to provide conditioned air specifically to the areas where occupants are, rather than conditioning the entire space (as a traditional air-based system does). To incorporate this design, large diffusers feature perforated metal panels below chair-rail height.

Chilled sails, the third system installed in the reception area, feature metal panels located in the ceiling, with cool water running over the back. Generally used during low-load conditions,

they provide radiant cooling and perform via natural convection as cool air descends from the panels to the space below. These large panels were incorporated into the architecture by sizing them to fit within the exposed wood beams, allowing the cooling system to be an integral part of the aesthetic feel of the room.

### Insulation dilemmas

Load-bearing masonry walls made of brick are difficult to insulate. Installing insulation on the interior wall can make bricks colder and wetter during the winter—this condition is driven by both climate and material. In addition to rain and snow passing from the outside surface of the brick to the inner wythes, moisture will pass through the brick from the inside and condense when it reaches a certain point. The point within the wall at which condensation occurs is important. The outer layer of brick can withstand freeze/thaw cycles, but when interior insulation prevents heat inside the building from warming the wall, condensation can occur in the softer, inner layers of bricks, allowing them to break down and eventually weaken the wall system.

Condensation was top of mind for project leaders as they applied advanced testing and numerical methods and strategies to assess the vulnerability of the brick to determine how best to insulate. A state-of-the-art WUFI hygrothermal analysis uses climatic data to perform dynamic simulations of flows of heat and mass (air, water, and vapor) through building assemblies. The software uses standard material properties, moisture storage, and liquid transport functions to model the performance of the brick over time and to assess its durability.

Project leaders tested all six types of brick from the building to characterize the actual material properties and used them later in hygrothermal simulations to determine how various insulation methods would perform over a long period. The structural analysis showed that the end walls of hard-fired brick were in relatively good condition, but party or long side walls were made of weak, soft brick. In theory,

**Miele**  
PROFESSIONAL

## EXPERIENCE THE MIELE DIFFERENCE

- New Flex Series Washers & ProCare Lab cleaning agents
  - Unmatched application expertise
- Guaranteed cleaning results & 5 Year Limited Warranty



the party wall should have had another building against it, or it should have been an interior wall. This occurrence is common in Boston-area construction, where most older buildings feature hard face brick on the front and back walls and a softer, less-valuable, and weaker brick on the sides. If these soft brick walls are not directly attached to other structures, sealed, or covered by other, more durable materials, they may deteriorate quickly. That is why it was crucial to carefully characterize the existing wall materials and later perform a series of thermal and hygrothermal simulations with different insulation and sealing strategies for different parts of the building.

This simulation work allowed a use of several unique retrofit configurations, such as vacuum insulation panels (VIPs) on the interior wall surface of the southern elevation. VIPs are high-performing insulation panels that are R-40 per inch. The project experimented with methods of installing the VIPs to understand the strengths and limitations of the product in a real-world application.

Likewise, the findings from numerical analysis led the project team to choose blown cellulose insulation with a vapor barrier on the front and back façades, allowing some air movement on the back face of the brick. On the party wall side, architects used an experimental wall unit to test mineral fiber insulation and an internal gutter system to address condensation. The small copper gutter and drain system is flashed on the inside face of the brick at the floor line to protect the interior wood structure from potential damage.

### Leave it to the professionals

Safety concerns surfaced regarding the removable wall sections on the top floor that were built to allow for testing different wall types. The project team initially thought they could replace the test wall sections themselves using moveable structural frames. However, the process was eventually considered too risky for personnel to perform in-house. It could be difficult to safely pull a test wall out and drop it 50 to 60 feet to the sidewalk below. After a thorough review, the team found the cost of the moveable structural frame was substantially more than the cost of bringing in a lift each time the panels needed to be changed. Therefore, they hired a professional rigging crew with the proper equipment and methods for walling off and putting up guardrails on the inside before removing wall sections.

The unique nature of this project-within-a-project made good communication and flexibility essential for the success of both the working laboratory and the exterior building renovation. The project team had to keep long-term goals and benefits in line while also focusing on current issues, such as the installation of solar panels, HVAC equipment, and insulation. Continued evolution is planned as well, with built-in evolving conditions that will open pathways to future knowledge and rewarding applications, all while working within the experiment.

*Randy Kreie, AIA, is principal/president with DiMella Shaffer and can be reached at [RKreie@dimellashaffer.com](mailto:RKreie@dimellashaffer.com).*

*David A. Godfroy, AIA, is associate principal, LEED AP, with DiMella Shaffer and can be reached at [DGodfroy@dimellashaffer.com](mailto:DGodfroy@dimellashaffer.com).*



**Anton Paar**

Simplify Synthesis

**Monowave 50  
Synthesis Reactor**

Conducting sealed-tube reactions has never been easier... or more affordable. Safely run reactions at temperatures up to 250°C and 20 bar in an ultra-compact system.

Expand the scope of chemistry in your lab today!

[www.anton-paar.com](http://www.anton-paar.com) | [info.us@anton-paar.com](mailto:info.us@anton-paar.com)

labs less ordinary

## Michigan Tech's Cloud Chamber

UNIQUE PIECE OF EQUIPMENT SHINES A LIGHT ON THE INNER WORKINGS AND FORMATION OF CLOUDS by Rachel Muenz

While you might think clouds weigh next to nothing, the average cumulus cloud with a volume of 1 cubic kilometer located 2 kilometers above Earth weighs around 551 tons, according to the US Geological Survey. And though they weigh far less than that average cloud, cloud chambers—the main instrument used to study cloud formation in the laboratory—are also pretty hefty.

For example, Michigan Technological University's (MTU) cloud chamber, including its associated equipment, weighs in at 15 tons. However, it's how the unit creates clouds that makes it unique among its fellow chambers. Most chambers, explains Michigan Tech physics professor Will Cantrell, are expansion chambers.

"You close [the chamber] up, you start pumping air out of the chamber really quickly, and that causes the air to cool quickly enough for the cloud to form," Cantrell says. "The drawback to that is the cloud lasts only as long as you pump, so if you go from atmospheric pressure to half an atmosphere of pressure, you just can't pump very much longer, and so the cloud dissipates."

Michigan Tech's chamber, located on the ground floor of MTU's Dow Environmental Sciences and Engineering Building in Houghton, can also make clouds in this manner, but usually creates them through mixing. The air next to the chamber's floor is hot, wet, and positively buoyant, while what's next to the ceiling is cold, wet, and negatively buoyant, explains Cantrell, who is also

director of MTU's Earth, Planetary, and Space Sciences Institute. When those two parcels of air meet and mix together, they create the conditions for cloud formation, similar to how hot breath creates clouds when it meets cold outdoor air in the winter.

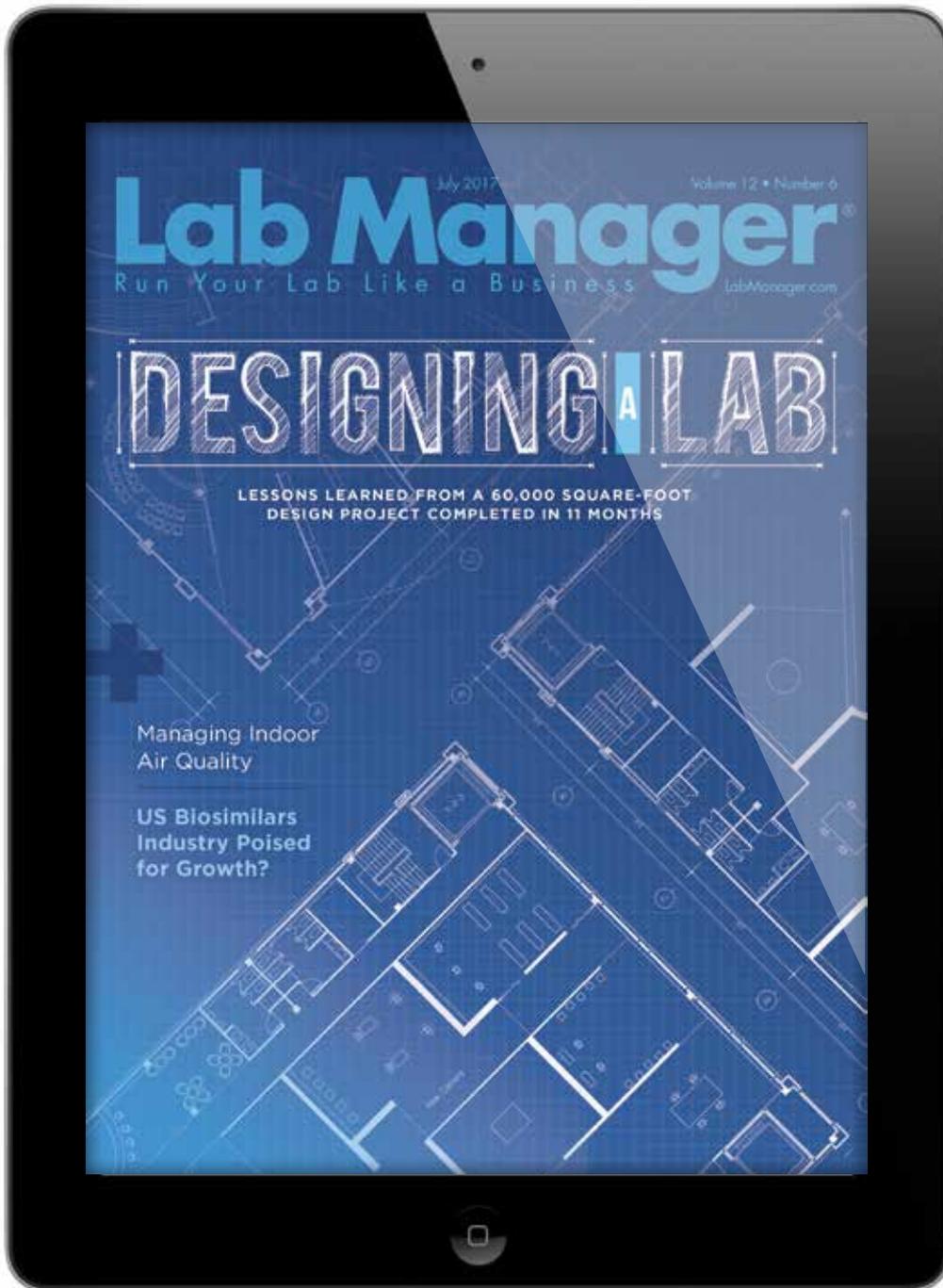
"The nice thing about that is it just keeps doing that as long as you keep that temperature difference," Cantrell says. "We've had a cloud in the chamber for basically a day, which I'm pretty sure is a world record, but I'm also pretty sure *Guinness* doesn't keep track of such things."

Funded by the National Science Foundation and built by Russells Technical Products (Holland, MI), the chamber is nicknamed the Pi Chamber because it was delivered to MTU on Pi Day—March 14, 2014—and its internal volume with the cylindrical insert in place is 3.14 cubic meters.

While the cloud created in that space weighs only a few grams, those few grams of water have provided many fascinating insights into cloud formation.

Recent research in the chamber, published in November 2016 and involving Cantrell and his colleague Raymond Shaw, centered on the way turbulence influences the growth of cloud droplets and how that changes in a big way between clean and polluted clouds. Experiments in the chamber showed there are two regimes: a polluted cloud regime in which the droplets are almost all the same size and a clean cloud regime in which the droplets experience a wide variety of growth conditions and therefore have very different sizes—small droplets that happened to

"There's no other chamber like this in the world."



Get **Lab Manager** on the go.  
Download a pdf at [labmanager.com](http://labmanager.com)

**Lab Manager**  
Run Your Lab Like a Business



**1.** Inspection of the main body of the cloud chamber as it came off the delivery truck. Photo credit: Claudio Mazzole-  
ni. **2.** Discussion of possible projects in the newly installed Michigan Tech cloud chamber. **3.** Ongoing experiments are discussed in the cloud chamber lab. Photos 2 and 3 credit: University Market-  
ing and Communications, Michigan Tech.



not find a high relative humidity or had lots of competi-  
tion when they did and then some lucky, big droplets that  
found their own patches of high humidity, Shaw says.

“The work that was described in that article was for  
liquid water clouds,” Cantrell adds. “All of this was at  
temperatures above zero. We’re also quite interested in  
ice phase processes in the cloud, and that adds another  
layer of complexity.”

He says figuring out how many ice crystals there are  
in cloud droplets is much more difficult than figuring out  
how many cloud droplets there are within the chamber.  
Currently, the researchers are improving their measure-  
ment of ice crystal concentration within the chamber and  
starting some experiments to explore ice phase processes

further, aiming to have those completed by summer’s end.  
Further work depends on what their data tells them.

“If we find surprises, it could be another four or five  
years of follow-on experiments and explorations of dif-  
ferent things that we find in the data,” Cantrell says. “All  
of this is of course contingent on funding.”

Funding, in fact, is one of the key challenges they face  
with the chamber, he adds.

“One of the challenges that Raymond and I have  
talked about from the beginning is to not only get fund-  
ing but [to get] continuous funding, because we want  
to make sure that we have funding to pay our research  
engineer,” Cantrell says, adding that the engineer is the  
only dedicated staff member for the chamber.

However, the uniqueness of the chamber helps. “I think we’re in a pretty good position because there’s no other chamber like this in the world,” Cantrell explains. “We can do things that other people can’t, so that gives us some substantial advantages for a lot of the kinds of things that we want to do.”

The custom nature of the chamber brings its own issues, though, as many factors need to go right for it to work properly, meaning there are many things that can go wrong. Overall, the system has worked well and the researchers are happy with what they received from Russells, which also does annual routine maintenance on the chamber to keep it in top shape and sometimes more than routine work if needed. In addition, the filter paper and water the researchers use to keep the chamber wet require regular changing about every three weeks, a process that takes around a day and a half. Instrumentation surrounding the chamber also requires regular maintenance and calibration.

Working with the numerous researchers and students involved in the chamber can also be a challenge, but one Cantrell finds more enjoyable than bothersome.

“It still just amazes me that we can sit there and watch this process.”

“The kinds of questions that we want to get at require lots of different approaches, so we have to have lots of different people working on different aspects of an experiment; coordinating all of that is a challenge, but it’s also exciting because it enables us to address some questions that we wouldn’t otherwise be able to get at,” he says.

Another plus is simply watching the clouds.

“One of the things that’s really amazing is that when we have a cloud in the chamber in the mixing mode, we have a laser sheet that will illuminate the inside of the chamber, just a thin slice of it, so that you can see the cloud droplets. You can look in the window and watch that thing, and it’s mesmerizing,” Cantrell says. “I know what clouds are supposed to look like. I know they’re turbulent, and it still just amazes me that we can sit there and watch this process. I love that part of it.”

Research involving the chamber isn’t going to slow down anytime soon, with several other projects lined up for the near future involving cloud chemistry and the optical properties of clouds.

“It’s a pretty unique facility, so we’re very pleased that people have lots of good ideas for how to use it,” Cantrell says.

*Rachel Muenz, associate editor for Lab Manager, can be reached at [rachelm@labmanager.com](mailto:rachelm@labmanager.com) or by phone at 888-781-0328 x233.*

# BVC

## FLUID ASPIRATION SYSTEMS

**Compact, powerful and quiet solutions for cell culture work**

- **Power & Control:** Suitable for two users
- **Robust:** Models designed for in bottle bleach decontamination
- **Safe:** Self contained systems for collection and disposal of biological waste, plus 0.2µm biofilter



**Special promotions at**  
[www.brandtech.com](http://www.brandtech.com)



Lab Rats Trust BrandTech®!

**BRANDTECH**<sup>®</sup>  
SCIENTIFIC, INC.

Toll Free (888) 522-2726

# MANAGING INDOOR AIR QUALITY

STUDY LOOKS AT IEQ CONDITIONS USING DYNAMIC CONTROL OF AIR CHANGE RATES

By Gordon P. Sharp



Lab research facilities are energy-intensive building types due to the vast amounts of 100 percent outside air required. With today's concerns over high energy expenses, reducing carbon footprints, and efforts to make facilities green and provide better indoor environments, reducing both new and existing lab and vivarium facility energy expenses has become a critical challenge. The primary reason behind many labs' high energy expenses is the minimum ventilation or air change requirements that often dominate the amount of outside air required by these facilities. To date, very little objective data has been available on the environmental and energy savings impact of both reducing and varying air change rates. To address this gap, a major research study was conducted that generated a significant amount of objective data on the indoor environmental quality (IEQ) conditions of labs and vivariums that are using the dynamic control of air change rate.

## Opportunity for optimization

In a large majority of labs (particularly life sciences labs) and vivariums, airflow is often dictated by the minimum air change rate (ACH) for the space, which might be six to 12 ACH in a lab room or 12 to 20 ACH in a vivarium. If the air in these rooms is "clean," or free of any harmful or irritating contaminants, then a high air change rate is not needed, at least when the air is clean.

One approach that has been shown to vary air change rates effectively and safely in labs and vivariums is to sense the quality of the air for such contaminants as volatile

organic compounds (VOCs) and ammonia, plus some other chemical vapors and odors as well as particulates. When the room air is free of these contaminants, then the air change rates can possibly be reduced to four, or in some cases two, ACH in a lab, and four to six ACH in a vivarium.

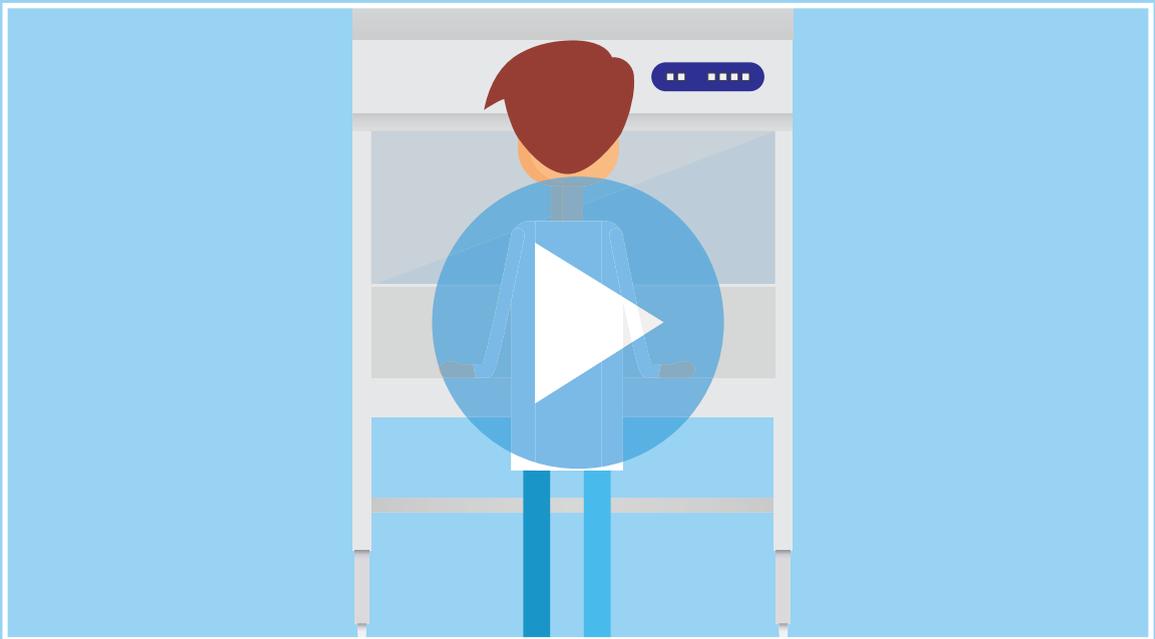
## Study methodology

The study is believed to be the largest one done of laboratory and vivarium IEQ conditions, covering over 1.5 million hours of lab operation from over 300 lab areas at 18 different facilities. In total, over 20 million sensor values were collected and analyzed, including data on total VOCs (TVOCs), particles of a size range of 0.3 to 2.5 microns, carbon dioxide, and dew point (absolute humidity). These sites consisted primarily of life sciences- and biology-related areas, as well as a smaller amount of chemistry and physical sciences lab areas.

"Labs are typically 'clean' of most chemical contaminants about 99.2 percent of the time."

In order to accomplish this sensing of environmental conditions economically and reliably, multiplexed sensing was used in many labs and vivarium rooms within one facility. With this approach, one central set of sensors is used in a multiplexed fashion to sense many different rooms or areas. Every 40 to 50 seconds, a sample of air from a different area is routed through a common air sampling backbone consisting of a hollow structured cable to the centralized set of sensors, known as a sensor suite, for measurement. These sequential measurements are then "demultiplexed" for each sampled area to create distinct sensor signals used for traditional monitoring

# ARE YOU IN THE MARKET FOR A NEW BSC?



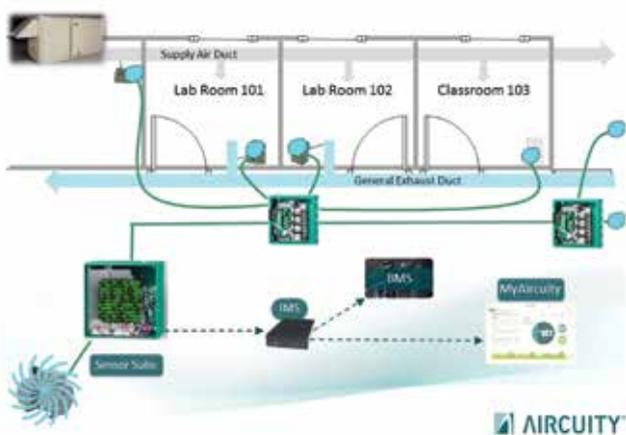
## **Volatile Chemicals in a Recirculated BSC: How Much is Safe?**

Choosing what type of primary engineering controls or ventilated enclosure is right for your lab can sometimes be confusing. When working with chemicals, typically you would use a fume hood—and if your work involves biohazardous materials, you would use a biological safety cabinet. But what if your research includes both biohazardous agents and volatile chemicals?

[LabManager.com/volatile-chemicals-bsc](https://www.labmanager.com/volatile-chemicals-bsc)

and control. Typically, 20 to 30 areas can be sampled with one set of sensors approximately every 15 minutes, depending on the requirements for those spaces. A variety of different types of sensors can be used to analyze the air samples for multiple air parameters. Figure 1 shows an example of the architecture of the multiplexed sensing system used to implement the study.

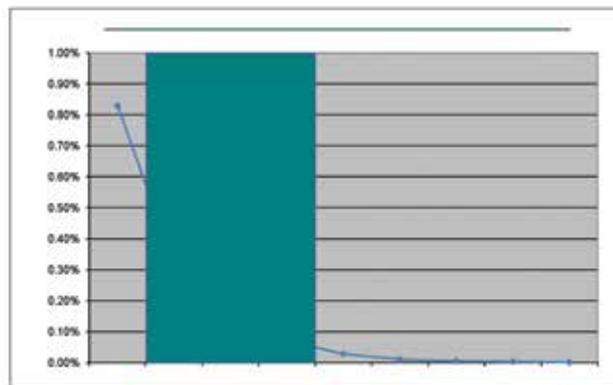
In addition to dramatically reducing the number of sensors needed to implement this concept by a factor of nearly 30, this multiplexed sensing concept can measure different contaminant or parameter levels much more accurately. Typically, for controlling the lab room space airflow and IEQ, it is best to look at the contaminant levels in the room differentially—subtracting the contaminants in the supply airflow from the exhaust or room levels. Any offset drift error of the sensor will be the same for both measurements, since the sensor is the same for both measurements and the offset drift error of each is cancelled out.



▲ Figure 1. Multiplexed sensing architecture for demand-based control.

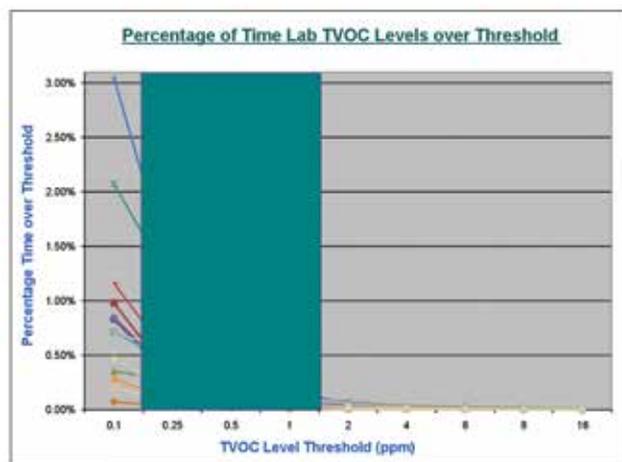
## Results

Figure 2 shows a cumulative graph of the average TVOC levels over all the lab locations, representing about 1.5 million hours of operating data. It demonstrates that labs are typically “clean” of most chemical contaminants about 99.2 percent of the time! Based on this, energy can be saved by operating at reduced minimum air change rates the majority of the time with respect to the TVOC sensor. When looking at each site separately (Figure 3), even at the site with the greatest amount of TVOC activity, the dynamic control concept can still save energy about 97 percent of the time.



▲ Figure 2. Average TVOC level percentages over threshold (1.5 million hours of lab operation).

Another parameter that can cause an increase in the minimum air change rate is particles in the lab. This could be due to a reaction that goes out of control, or an acid spill that causes an evolution of smoke, or an aerosol in the lab room. Figure 3 shows a graph of the average level of 0.3- to 2.5-micron particle counts (PM2.5) that exceeded a background level of the lab room’s supply air for all the different sites of the study.

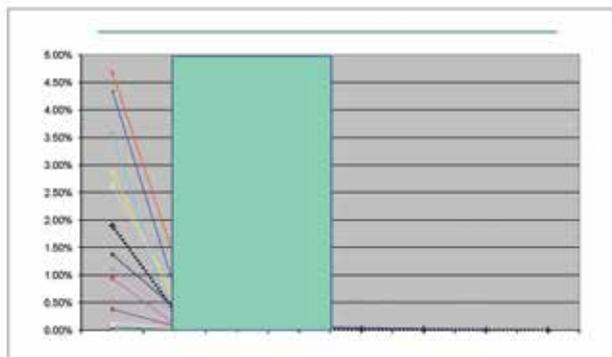


▲ Figure 3. Average TVOC level percentages for multiple lab sites.

The fourth figure depicts that the average lab room (dotted black line) is above the 1 million per cubic foot threshold almost 0.5 percent of the time, or about 30 minutes a week, on average. The individual sites show a range of values from near zero up to about 1.5 percent of the time that airflow should be increased based on a particle event. If this amount of time is added to the time that TVOCs are above the control threshold, this adds up to *only 1.2 percent of the time*, on average. In other



words, minimum air change rates of between two and four ACH can be achieved from 97 percent to in excess of 99 percent of the time due to the presence of either TVOC or particle events occurring up to about five hours a week, on average.



▲ Figure 4. Percentage of time that small particle levels exceed threshold.

### Conclusion

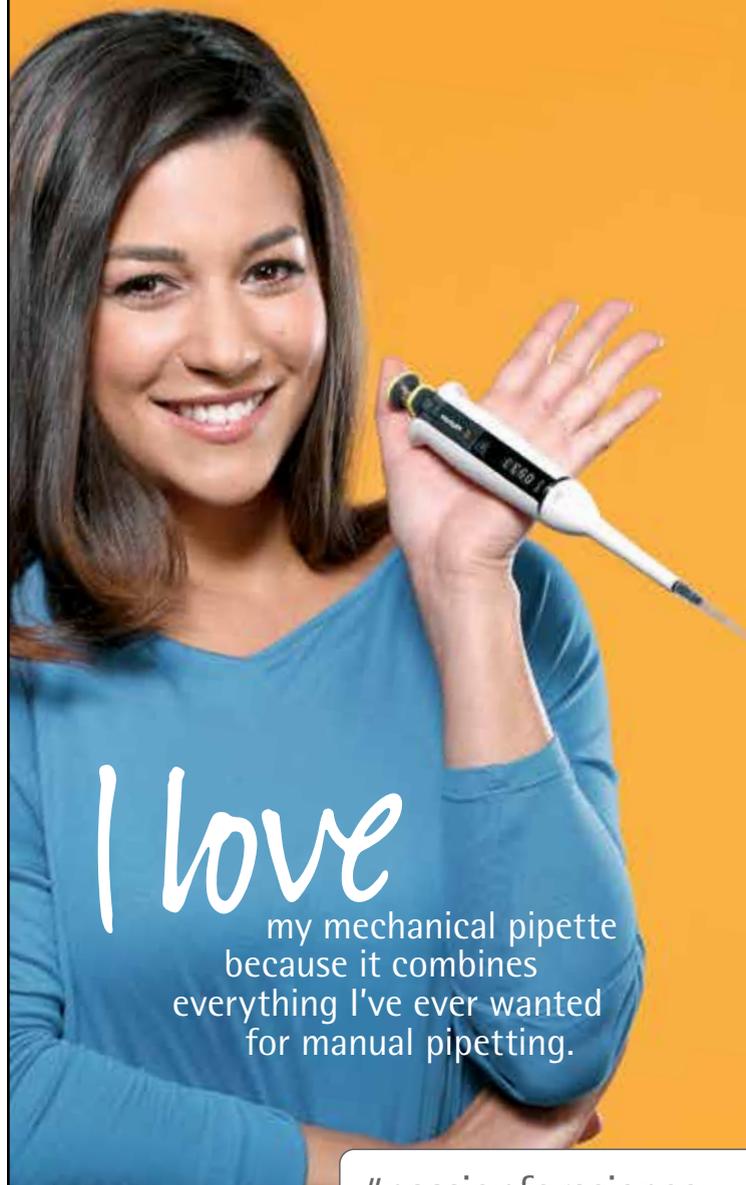
The study showed that particle and TVOC events occur only a few hours a week and require high ventilation rates; however, much lower flow rates can be utilized with an automatic ACH rate control system for well over 97 percent of the time. With the current challenges many organizations are facing concerning reducing their carbon footprints and usage of energy, this research and the case study provide evidence of the significant contribution that the demand-based control of lab air change rates can make toward safely meeting these goals and creating measurably better environments.

### References

American Industrial Hygiene Association (AIHA). 2012. Laboratory ventilation. ANSI/AIHA Standard Z9.5-2012. American Industrial Hygiene Association, Fairfax, VA.

American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE). (2011). ASHRAE handbook - HVAC applications, Chapter 16, Laboratories (pp. 16.1 to 16.22), Atlanta, GA: ASHRAE, Inc.

**Gordon P. Sharp**, Founder, Aircuity Inc., can be reached at 866-602-0700 or [info@aircuity.com](mailto:info@aircuity.com).



#passionforscience

## Tacta. The new perfectly balanced mechanical pipette.

Enjoy the ultimate pipetting experience: Feel the comfort of superb ergonomics, stay safe from contamination and achieve reliable results time after time.

Share your #passionforscience on [www.passionforscience.com](http://www.passionforscience.com)





# LET'S MAKE A DEAL

## NEGOTIATING ON USED LAB EQUIPMENT

By Erica Tennenhouse, PhD

Those selling pre-owned equipment have heard it all when it comes to negotiation attempts. Customers will point out that they can get the same item on eBay or from a broker for half price, offer \$5,000 on a \$20,000 system, or accuse the company of price gouging—and the list goes on. Yet these sorts of negotiating tactics rarely, if ever, hit the mark.

So how can customers who are in the market for used equipment effectively negotiate?

### Do your homework

When customers enter into a conversation about a piece of equipment, having done some background research can make a world of difference.

Speaking with others who have purchased used equipment is a good place to start. “Get references, get references, get references,” advises Richard Tula, lead product specialist at Biodirect (Taunton, MA). “Then you will see why some resellers sell their products for more than others.”

Reputable companies don't simply price their products on a whim. “Our team puts a tremendous amount of effort into properly pricing equipment at what we believe the market value is,” says Reid Hjalmarson, director of marketing at BioSurplus (San Diego, CA). Customers

should get on the same page as the vendors by finding out what the market value of a given product is before trying to negotiate.

One should also be aware that there are a variety of vendor types out there with different business models that can have important implications for a buyer. For instance, “there is a major difference between buying from certified equipment resellers and used equipment brokers,” Tula stresses.

### Work together

For Bill VanDeWeghe, president and CEO at BioSurplus, it is particularly helpful when customers commu-

nicate their needs, whether they relate to budgets, timelines, or applications. “Once we know their needs, we can figure out what we can do to help them,” he says.

“We want repeat customers,” says Hjalmarson. “So we want to find solutions to their needs. We're in it for the long haul with our customers.”

Tula believes negotiations are all about give and take. “Working together to make everyone feel like they got a good deal makes for a successful transaction and a long-standing relationship,” he says.

Hjalmarson adds, “I think that respect goes a long way in those negotiations.”

“When customers enter into a conversation about a piece of equipment, having done some background research can make a world of difference.”



**BioSurplus™**

Advancing Your Science

- **Sell Your Equipment**

Whether you need to empty a lab containing hundreds of pieces of equipment or to sell one mass spectrometer, we can make the process simple, quick and easy. Maximize your ROI by selling your equipment to a new user.

- **Buy Used Equipment**

Browse our catalog of more than 2,000 high-quality, used laboratory equipment. We carry a wide variety of equipment from top manufacturers in the business including BD, Thermo, Perkin Elmer, Agilent, Eppendorf and many more.

- **Repurpose Your Lab Equipment**

BioSurplus provides effective disposition services for used lab equipment. Whether you want to monetize unneeded assets or move them to another area of your business, we can provide a turnkey solution so that you can focus on your next project.

**[www.BioSurplus.com](http://www.BioSurplus.com)**

Visit our website to learn more about how you can get the best solution for your lab equipment needs

### Think beyond price

Although tight budgets are often the driving force behind a used equipment purchase, customers may consider other components that might be open for negotiation.

“Negotiating is just one of many ways for customers to get a deal on a piece of used equipment.”

Aside from price, Hjalmarson notes that customers sometimes want to discuss the terms of the sale, get assistance with installation, or store their purchased equipment until their lab is up and running.

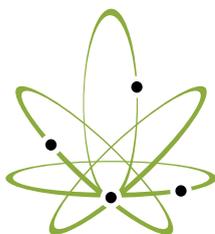
“Make sure to look for the added-value aspect of the vendor; don’t base your decision solely on price. Best price doesn’t always equate to best value,” Tula says.

### Negotiations aside

Negotiating is just one of many ways for customers to get a deal on a piece of used equipment. Joining an association like Biocom can pay off, according to VanDeWeghe, as members are often entitled to discounts on products from preferred vendors. Giving a company repeat business can earn a customer discounts as well. Purchasing equipment through auctions may be a good option for those looking to pay less than market price. Finally, with new equipment arriving each week, VanDeWeghe encourages customers to check in frequently to find out about new deals.

*Erica Temmenhouse, technology editor for Lab Manager, can be reached at [etenmenhouse@labmanager.com](mailto:etenmenhouse@labmanager.com) or by phone at 647-500-7039.*

JOIN US! Use Promo Code **JCANNA25** for 25% Off Registration!!!



CANNABIS  
SCIENCE  
CONFERENCE



August 28-30, 2017



Portland, Oregon



OREGON Oregon  
Convention  
Center



[CannabisScienceConference.com](http://CannabisScienceConference.com)

Contact [josh@jcanna.com](mailto:josh@jcanna.com)

Hosted by





# The **real** difference between new & refurbished lab equipment?



## Price.

[www.RefurbishedLabEquipment.com](http://www.RefurbishedLabEquipment.com)

- 50-75% savings vs. OEM
- Mass Specs | NMR | HPLC | Biotech
- Warranty, Installation & Chemist Support
- Proudly serving laboratories worldwide since 1979

Refurbished equipment from IET is tested to meet original manufacturer's specifications. And we have more equipment in-stock than any other lab equipment reseller in the world. Schedule a visit to see our inventory in person!



INTERNATIONAL EQUIPMENT TRADING LTD.  
955 Campus Drive, Mundelein, Illinois 60060  
Toll Free: 1.800.IET.4LAB | Phone: 847.913.0777  
Fax: 847.913.0785

Site: [www.ietltd.com](http://www.ietltd.com) | Email: [sales@ietltd.com](mailto:sales@ietltd.com)

REFURBISHED & CERTIFIED LAB EQUIPMENT SINCE 1979

# POSITIVE MENTORING

TRAINING SCIENTISTS TO DO GOOD SCIENCE FROM THE START **by Donna Kridelbaugh**



The value of effective mentorship in the sciences is increasingly being recognized. Mentoring is tied to many benefits for a mentee (e.g., increased research productivity and career satisfaction, which also benefits the lab overall.) Anyone can learn to be an effective mentor with the right training and practice. However, mentoring is not an isolated endeavor, and a team-based approach (e.g., peer-mentoring groups) can provide a holistic support system to ensure an individualized mentoring experience.

## Why mentoring in the lab matters

Research shows that the presence of effective mentoring relationships in the lives of early-career scientists is a strong indicator for career success. According to Christine Pfund, an associate scientist in the Wisconsin Center for Education Research at the University of Wisconsin-Madison who has extensively researched mentoring in the sciences, “In short, good mentorship impacts who does science, how productive they are, and how satisfied they are on a science career path.”

While technical skills and scientific theory can be taught in the classroom, Suzanne E. Barbour, professor of biochemistry and molecular biology and dean of the graduate school at the University of Georgia, says that much of what it means to be a professional scientist is just too nuanced to learn in that setting. Thus, a mentor is needed to serve as a role model to show trainees what is expected of a “card-carrying member of the profession.”

Mentoring support is especially important in the laboratory-based sciences, where the tedious nature of bench work and an isolating lab environment can quickly burn out a new scientist. As Joshua Morgan, postdoctoral researcher in the Department of Biomedical Engineering at the University of Delaware, and recipient of the

2016 Proteintech Best Postdoc Mentor Award, explains, “Research is uniquely frustrating, and without positive mentoring, it can drive good scientists away from the lab, or worse, to ethically questionable choices.”

Mentoring also provides reciprocal benefits for the mentor and collective benefits for science. Joanne Kamens, executive director of Addgene, explains, “Good mentoring increases job satisfaction by making sure scientists are always learning and growing. Happier people work better.” Additionally, she says, “Mentorship does more than increase scientific output—it makes it possible for good science to happen at all.”

And Morgan agrees, “Honestly, mentoring is one of those things that just keeps paying dividends. In addition to the emotional rewards of helping fellow scientists achieve, surrounding yourself with capable scientists enables good science.” Therefore, it is critical for mentors to train scientists proactively in how to do good science from the start.

## Cultivating effective mentoring relationships

Pfund defines mentoring as “engaging in a collaborative learning relationship that proceeds through purposeful stages over time and has the primary goal of helping mentees acquire the essential competencies needed for success in their chosen career.” Therefore, mentoring as a collaborative process requires shared responsibility between mentor and mentee to make it work.

Kamens advises that in this relationship, the mentor’s role is to help set concrete goals to which the mentee is held accountable, give honest and regular feedback, and make the most of a mentee’s strengths, while being careful not to micromanage or be demeaning. In turn, she says, the mentee needs to be prepared for meetings, not be afraid to ask questions, and always be coachable.

When starting a new mentoring relationship, it is imperative to set expectations from the start. Pfund advises that a lab manager openly acknowledge what roles he or she can play as a mentor, and address how any conflicts will be resolved. Likewise, Morgan says that honesty is key in the relationship: mentors need to be honest about what support they can provide and mentees about what they need.

Effective mentoring is also dependent on regular and open communications. Kamens suggests, “For starters, have regular meetings and keep these appointments. Absentee managers result in trainees taking wrong turns that can waste time and resources.” During the initial meetings, she advises that mentors focus on asking questions instead of giving answers, in order to understand how best to support the mentee.

Barbour emphasizes that both parties in the mentoring relationship need to take into account each other’s personality types and communication styles to determine the best way to work together. She also recommends developing a mentoring compact to ensure expectations are aligned, because it “provides an opportunity for the mentor and mentee to agree on a plan of action, milestones, and expected outcomes of their relationship.” Other useful tools include individual or professional development plans to track a mentee’s progress toward career goals.

Overall, an effective mentoring relationship is built upon mutual respect. Morgan emphasizes the importance of treating everyone as a collaborator and understanding the perspective of the mentee. He explains, “Being a repository of knowledge is probably the biggest advantage as a mentor, but it’s important to keep perspective that these were things you didn’t know once. Remember, it’s not what they do (or do not) know that makes them good scientists, but it’s whether or not they are willing to learn.”

Barbour also warns mentors to be cognizant of implicit biases and stereotype threats that can sabotage the relationship. She remarks, “Sometimes, even the most thoughtful mentors say and do things that hurt their mentees and come from a place of ignorance or inability to perceive a stereotype threat.” In the end, she says, “The most successful mentoring relationships evolve into colleague-colleague relationships.”

### Mentoring is a team-based effort

Mentoring often works best with a team-based approach. As Morgan emphasizes, a single mentor “can’t be everything to everybody,” and so being a good mentor is also about connecting mentees to other people to talk to or other relevant resources.

Additionally, mentoring should not take a one-size-fits-all approach, but rather be tailored to the individual mentee based on his or her skills, interests, and values. Therefore, having a team of mentors who provide guidance in different aspects of science is important for individualized professional development.

A team approach also expands the capacity for mentoring within an organization. This team can be composed of other lab members, especially senior lab staff or trainees for whom being a mentor is important for their own professional development.

Morgan mentions that as a postdoctoral researcher and mentor, he may be more in touch with understanding the frustrations of junior lab members

# PTFE Solenoid-Operated Isolation & Pinch Valves



Ideal for use with sensitive or corrosive media, this line is an excellent alternative to traditional mechanical valves when media contamination is a concern, as they interact with tubing or PTFE, and never touch the material being dispensed! Many sizes, styles and options available.

- small and hygienic
- low power
- zero dead volume
- made in the U.S.A.



## Clippard

Miniature Pneumatic Products & Solutions

877-245-6247 | [clippard.com](http://clippard.com)



because he remembers what it's like to juggle classes and long, often non-rewarding hours of research. As he explains, "I try to offer a slightly longer perspective that research success takes months and years, which can be hard to see when the day-to-day seems to be going nowhere."

Another team mentoring approach is through the use of peer mentoring groups. Kamens has had much success in implementing peer mentoring within numerous professional organizations and her own company. She states that peer mentoring provides multiple benefits for those involved, including a diversity of input and perspectives, increased accountability, and an expanded professional network.

The peer mentoring group structure includes five to eight colleagues who may share a common characteristic (e.g., similar career stage) and may include one or two assigned senior mentors. The group meets regularly and has a focused agenda; an assigned leader—who covers an identified topic of interest to the group—attends each meeting. This structure allows participants to both learn and gain valuable skills (e.g., leadership, communications) during the process.

Ultimately, the laboratory director or principal investigator has the primary responsibility for ensuring lab members receive the resources and support they need to be successful. Kamens points out that institutions and funding agencies will likely hold these individuals even more accountable in the future. For example, many funding agencies now require grant recipients to show proof of mentoring plans for science trainees.

Thus, mentoring is increasingly being recognized as an integral component of the research training process, and institutions can help promote its value among staff. Pfund explains that institutions can do this by creating a culture of mentorship in which mentoring is acknowledged as a valued activity and counted toward promotion.

### Training and practice are key to becoming an effective mentor

Mentoring is a skill that can be learned and improved upon over time with training and practice. In fact, Pfund and her colleagues have spent over a decade researching and developing evidence-based practices and training curricula for research mentors and trainees. Many of these resources are available online for free to the science community through several initiatives.

The National Research Mentoring Network, an NIH-funded program with the goal of increasing diversity in the biomedical sciences, provides a number of valuable mentoring resources that include an online research mentor training certificate and virtual mentoring network. Also, the website of the Center for the Improvement of Mentored Experiences in Research contains a collection of mentor training curricula across a range of scientific disciplines, and the center provides consulting and evaluation services to help organizations successfully implement mentor training programs.

Another way to learn best mentoring practices is from observation. Barbour says to identify an outstanding mentor and seek out advice on what works. But the most practical strategy for learning how to mentor effectively may simply be trial and error, as there is no substitute for real experience.

As Morgan explains, "Everything is theory until you put it into practice: work with students, get feedback from them about what helps and what doesn't, and be self-critical! If you've had a tough conversation with a student, ask yourself what you could have done differently. If a student isn't learning, don't throw up your hands and say they are unreachable, but figure out a different strategy to reach them. I think the best training is doing it and questioning yourself as you do."

## Have you ever seen such a Long Tip for 1000µL?

No more worries about contamination !!

Long tip for 250µL is also available. Please check it on our web site.



System Rack



**805**  
1200µL  
Full-size

Free sample available  
info@watsonbiolab.com

All products made-in-Kobe/Japan of assured quality and reliability!!

Something Different.



**Watson Bio Lab USA**  
http://www.watsonbiolab.com  
6540 Lusk Blvd, Suite C158A, San Diego, CA 92121

## Resources

- Center for the Improvement of Mentored Experiences in Research. (online). *Complete Mentor Curricula*. Retrieved from <http://cimerproject.org/#/completeCurricula>
- Howard Hughes Medical Institute. (2006). Chapter 5: Mentoring and Being Mentored. In *Making the Right Moves: A Practical Guide to Scientific Management for Postdocs and New Faculty, Second Edition*. Retrieved from <http://www.hhmi.org/developing-scientists/making-right-moves>
- Kamens, J. (2014). Form Your Own Peer Mentoring Group: A How-To Guide for Scientists [blog post]. Retrieved from <http://blog.addgene.org/form-your-own-peer-mentoring-circle-a-how-to-guide-for-scientists>
- Kuhn, C. and Z. Castano. (2016). Boosting the Career Development of Postdocs with a Peer-to-Peer Mentor Circles Program. *Nature Biotechnology*, 34, 781-783. Retrieved from <https://doi.org/10.1038/nbt.3631>
- National Research Mentoring Network. (online). *Research Mentor Training*. Retrieved from <https://nrmnet.net/mentorship-training-programs/>
- Olds, W. (2016). Interview with Josh Morgan, University of Delaware [podcast]. *The Incubator Podcast*. Retrieved from <http://theincubator.libsyn.com/bonus-interview-with-josh-morgan-u-of-delaware>
- Pfund, C. et al. (2015). *Entering Mentoring, Revised Edition*. New York, NY: W.H. Freeman.
- Pfund, C. et al. (2016). Defining Attributes and Metrics of Effective Research Mentoring Relationships. *AIDS and Behavior*, 20(Supp 2), 238-248. <https://doi.org/10.1007/s10461-016-1384-z>
- Science Careers. (online). *myIDP: Individual Development Plan*. Retrieved from <http://myidp.sciencecareers.org/>
- University of Wisconsin-Madison Institute for Clinical and Translational Research. (online). *Mentoring*. Retrieved from <https://ictr.wisc.edu/mentoring/>

*Donna Kridelbaugh holds an advanced degree in microbiology and is a former lab manager. Connect with her on Twitter (@science\_mentor) and visit her website at <http://ScienceMentor.Me>.*

# INTEGRA

## MULTICHANNEL PIPETTING ARE YOUR TIPS ON THE SAME LEVEL?

### PERFECTLY ALIGNED GRIPTIPS FOR SUPERIOR RESULTS



Schedule a free demo at your laboratory now!  
[www.integra-biosciences.com/multichanneldemo](http://www.integra-biosciences.com/multichanneldemo)



**EVOLVE**  
Manual Pipettes



**VIAFLO II**  
Electronic Pipettes



**VOYAGER II**  
Tip Spacing Pipettes

Visit us at  
**AACC 2017**  
Booth #1046,  
August 1 - 3  
San Diego, CA

[www.integra-biosciences.com](http://www.integra-biosciences.com)

# LABORATORY ROBOTICS

IMPROVED IMAGING AND TOUCH SENSORS CAN PROVIDE A VALUABLE OPTION IN LAB SETTINGS

by Mike May, PhD

A sort of humanlike hand swipes lightly over three tomatoes sitting in a row on a surface. Then, using its index finger, the robotic hand lightly taps the first, then the second and the third tomatoes. Finally, with a gentle yet precise right-to-left swipe, the hand pushes the middle tomato out of the line. In another demonstration, the same robotic hand locates a tomato sitting on top of a stack of two sugar cube-like objects and tenderly lifts the tomato without tumbling the cubes. It takes advanced sensors to make lab robotics work so precisely and carefully.



▲ At Cornell University's Organic Robotics Lab, a human-like hand feeling its way through a row of tomatoes will open new approaches to automating tasks in a laboratory. (Image courtesy of Huicban Zhao.)

This robotic hand comes from Robert Shepherd, assistant professor of mechanical and aerospace engineering at Cornell University (Ithaca, NY), and his colleagues in the Organic Robotics Lab. Soft sensors make up part of the

research in this lab. For example, dielectric elastomer sensors allow a haptic interface, like the one used in the robotic hand. Shepherd's team 3-D prints capacitors on soft materials to build sensors that can "feel" even as they bend.

Building sensors that resemble the ones in our fingers seems almost like science fiction. Nonetheless, some of the sensors that end up in laboratory robotics in the future might come from equally surprising places.

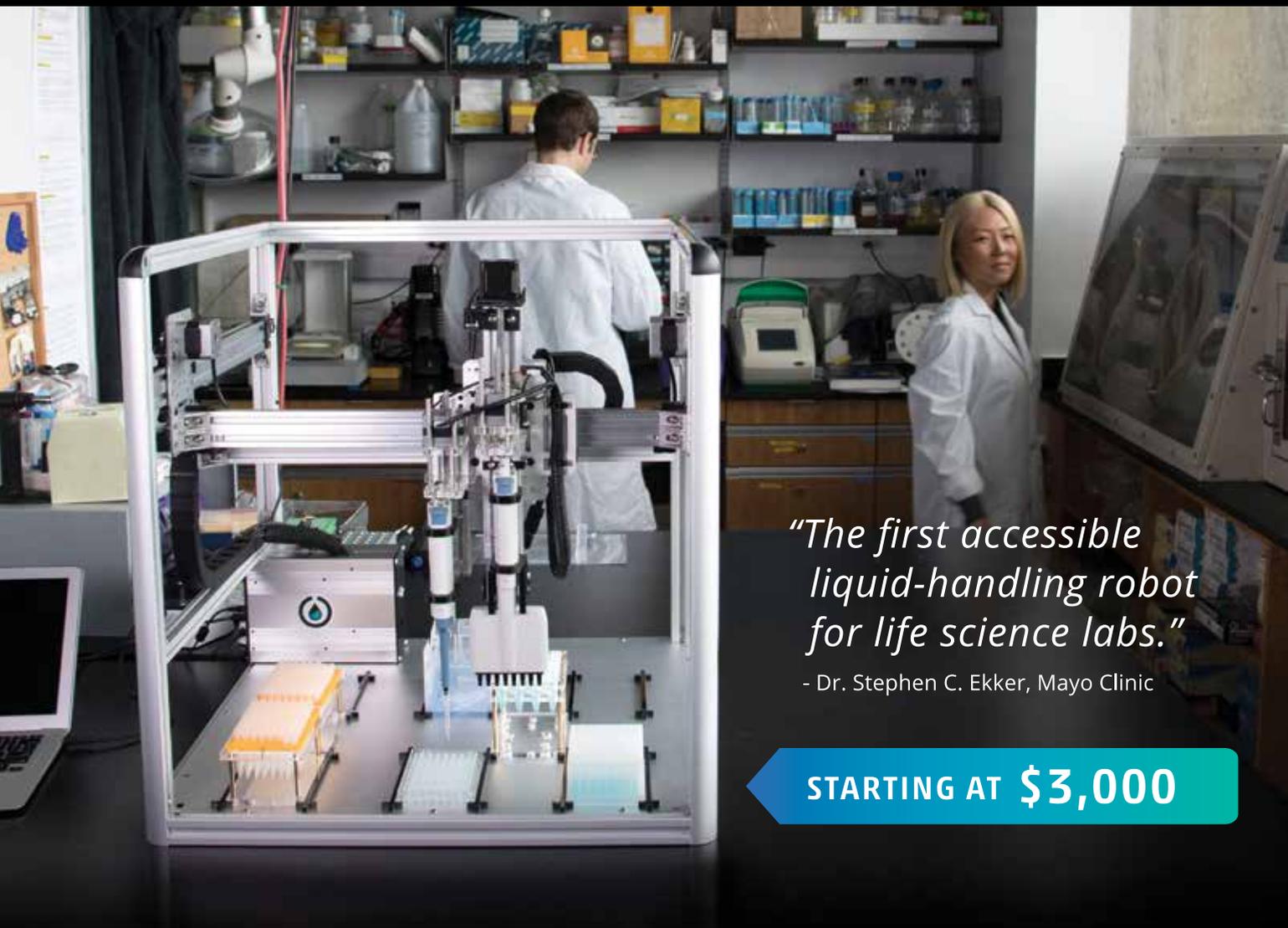
## The sense of sight

"Vision processing is a hot topic for lab robotics," says Kynan Eng, cofounder and president of Switzerland-based iniLabs. "Ongoing advances in sensor performance, algorithms, and computer performance have opened up new possibilities for automation to achieve increased experimental throughput and greater adaptability of lab equipment."

In thinking of how to control robotics, some sort of imaging might be one of the first ideas that come to mind to create a sensor. But anyone who knows even a bit about how an eye works and all of the associated neural image processing—at least the parts that are known—is unlikely to suggest mimicking biology. Instead, collecting a series of images with a camera might sound simpler, but it just changes the trouble spots. "A major challenge in the field is in dealing with the huge amounts of data that are generated by modern high-resolution, high-speed vision sensors," Eng explains.

To battle these challenges, researchers at the Institute of Neuroinformatics of the University of Zurich and ETH Zurich developed the dynamic vision sensor (DVS), which Eng describes as "the first fundamental change in how computer vision is done since the invention of the camera." Conventional technologies use a series of frames to capture images, but one frame and the next include lots of the same information, which eats

# Run more experiments with the Opentrons personal pipetting robot.



*"The first accessible liquid-handling robot for life science labs."*

- Dr. Stephen C. Ekker, Mayo Clinic

**STARTING AT \$3,000**

PCR PREP | TRANSFORMATIONS | MAGBEAD SEPARATION | DILUTIONS | GENE EDITING | & MORE



Used in 35 countries around the world, including labs at Stanford, Harvard, MIT, and the Mayo Clinic.

**LEARN MORE AT [www.opentrons.com](http://www.opentrons.com)**

up memory, processing power, and time. The frames also use the same exposure on each pixel, which reduces the quality of an image in very dark or very bright areas.



▲ A dynamic vision sensor in imaging devices from iniLabs uses eye-like processing to make smaller and more powerful capabilities for sensing. (Image courtesy of iniLabs.)

Instead, the DVS actually mimics some of the methods used by eyes for vision. For example, it works fully asynchronously—without frames—and processes only pixel-level changes, which are created by movements in the image being captured. That, Eng explains, “allows the sensors to provide data at microsecond time resolution, and that is as good or better than conventional high-speed vision sensors running at thousands of frames per second.” In addition to providing better temporal resolution, the sparse DVS data stream requires far less storage and computing power. Eng adds that the sensor’s “dynamic range is increased by orders of magnitude due to the local processing.”

iniLabs recommends this sensor for various applications, including real-time robotics. In a case where a robot requires visual input and fast reactions, the DVS makes a great choice. It works even better where space, power, and weight matter, because it requires much less of all three than traditional imaging solutions do. In addition, the DVS can process the image on the same board that includes the sensor.



## Rotary Evaporators



**2L SolventVap**  
Rotary Evaporator  
Desktop model



**10L SolventVap**  
Rotary Evaporator



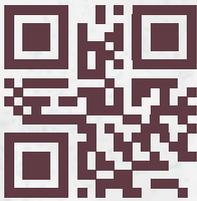
**50L SolventVap**  
Rotary Evaporator

Lab Manager .....

# CO<sub>2</sub> INCUBATOR CARE: BEST PRACTICES

## DOWNLOAD THE FULL INFOGRAPHIC

LABMANAGER.COM/CO2-INCUBATOR-CARE



### Lab Manager .....

## CO<sub>2</sub> INCUBATOR CARE: BEST PRACTICES

### HOW TO MAKE A HAPPY HOME FOR YOUR CELL AND TISSUE CULTURE

CO<sub>2</sub> incubators are designed to replicate in vivo conditions for optimal growth of cells and tissues. The device controls the levels of carbon dioxide, humidity, and temperature in a contamination-free environment. Cells and tissues are highly sensitive to changes in their environment, so it is important to keep your CO<sub>2</sub> incubator functioning properly.

#### AVOID CONTAMINATION



Always wear gloves when using the incubator and keep the inner glass door closed as much as possible. Change the water in the humidity pan weekly; regularly clean the pan, shelves, chamber, and any passages into the incubator; and occasionally wipe down the door handle.

#### MAINTAIN OPTIMAL TEMPERATURE



CO<sub>2</sub> incubators are typically maintained at 37°C. Attach a calibrated thermometer to the inside of the glass door to enable temperature readings from the outside when the door is closed. Check periodically that the temperature sensor matches the thermometer reading, and recalibrate the sensor if the readings differ.

#### MONITOR CO<sub>2</sub>

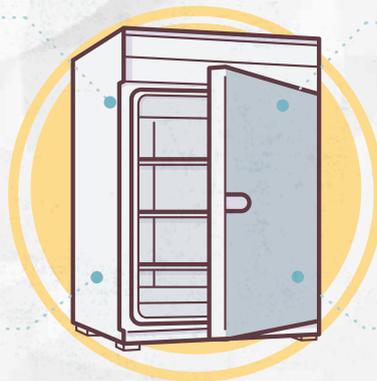


The CO<sub>2</sub> concentration should be kept around 5% to match physiological conditions and to maintain a constant pH. While most CO<sub>2</sub> incubators are equipped with a CO<sub>2</sub> sensor, an external gas analyzer will help to ensure the readings are accurate.

#### KEEP HUMIDITY HIGH



If the humidity inside of the incubator falls too low, the cell culture can evaporate or growth media can become too concentrated. To keep humidity around 95%, make sure that there is always water in the tray under the incubator.



Sponsored by



Sponsored by



**ThermoFisher**  
SCIENTIFIC

## Get to Know Metrohm



Titration



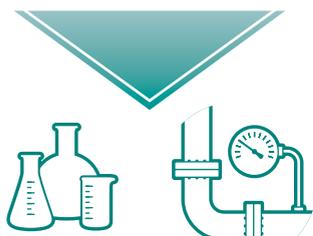
Ion Chromatography



Electrochemistry



Spectroscopy



Laboratory

Process

Find out more at  
[www.metrohmusa.com/technology](http://www.metrohmusa.com/technology)

 **Metrohm**

[www.metrohm.com](http://www.metrohm.com)

### Linking LiDAR to labs

In some cases, sensors for laboratory robotics start in other areas. In Morgan Hill, CA, scientists at Velodyne LiDAR use light detection and ranging (LiDAR) to create sensors for various applications, including autonomous cars, where LiDAR is used to navigate streets and highways. “It’s also been used to guide manipulator arms or actuators in manufacturing,” says Jeff Wuendry, marketing manager at Velodyne.

The 3-D LiDAR sensors built 10 years ago were specialized, physically larger, and prohibitively expensive. The key to Velodyne’s technology is size. “The unique part is miniaturizing a lot of the subcomponents to make the sensor smaller and smaller,” Wuendry explains. The company, working with Efficient Power Conversion (El Segundo, CA), did that by creating a solid-state LiDAR sensor from a monolithic gallium nitride integrated circuit (IC), which measures just 4 square millimeters. The smaller sensor size and the trend toward a solid-state design make 3-D LiDAR sensing feasible for new applications.



◀ *A tiny, solid-state sensor made of gallium arsenide and used in Velodyne’s LiDAR devices reveals how shrinking sensors could add improved imaging to lab automation. (Image courtesy of Velodyne.)*

Beyond manufacturing applications, this device could be used in drones. The small size of the IC-based sensor plus the lack of moving parts make it an effective choice in drone applications.

In corporate literature about this advance, Anand Gopalan, vice president of research and development at Velodyne LiDAR, stated, “This technology really opens the door to miniaturization and gives Velodyne the ability to build LiDARs in various form factors for many diverse applications. We will soon have a portfolio of integrated circuits to address various aspects of LiDAR functionality, paving the way to a whole new generation of reliable, miniaturized, and cost-competitive LiDAR products.”

This technology relies on 3-D laser scanning. Laser diodes on the IC, Wuendry explains, “provide depth perception, like your eyes do.” Multiple laser diodes spinning at 20 hertz collect data on objects in 360 degrees around the IC and 30 degrees up and down—all out to a distance of 200 meters. To do that, it processes from 300,000 to 1 million data points per second. That is a lot of data to process, but newer controller algorithms are designed to reduce the need to use all the data all the time. By using the same sensing technology, the controller can focus on data-point changes and ignore static data points.

The information collected by the IC goes to a controller for off-chip processing. One available version of this technology, called the Puck, is about the size of two hockey pucks stacked on top of each other.

The miniaturization of this sensor plus advances in its capabilities expand the likely applications. “As the sensor becomes smaller and more powerful, you can put it in more locations,” Wuendry says. “Making it less expensive will also lead to more possible uses.” Some of those uses will probably be in tomorrow’s lab robotics. Certainly scientists who want to collect data from drones could use this technology today. The simplicity of an IC-based sensor that is small and collects data from a wide range could make it useful in many field studies.

## Fine-tuning techniques

Rather than flying over sites to collect data, most lab robotics need finer control to move samples and instruments. Like other advances, improvements there could come from unexpected spots, and one could be industry. Hungary-based OptoForce, for instance, makes a six-axis force torque sensor.

“Our sensor gives the sense of touch to robots so more tasks can be automated and time can be saved,” says Nora Berezcki, marketing manager at OptoForce. “With our sensor, the robot will be more precise and human touch-needed tasks can be automated.”

In labs, that touch is often required. In fact, some lab applications could use robots working as a team. “What we see is that collaborative robots are gaining space during manufacturing,” Berezcki says. “There is a big market need for this kind of solution.” As examples, she mentions repetitive, monotonous human tasks. The same kind of needs exist in labs, and the OptoForce sensor could eventually help scientists too.



▲ To control articulated arms, OptoForce incorporates a torque sensor that could play a role in robots working in teams to automate lab research. (Image courtesy of OptoForce.)

In addition, the OptoForce sensor provides high resolution—sensitive to just 0.1 newtons—and it’s robust. “Even if the sensor falls down on the floor, it won’t break,” Berezcki notes.

The fine touch, sensitivity, and robust build of this sensor make it a valuable option in lab robotics. As Berezcki says, “We are developing applications continuously according to the market needs.” Although most of those needs come from industry today, the expanding use of robotics in scientific labs could be one of tomorrow’s key applications of this technology.

Watching a robotic hand sort tomatoes or seeing a machine find and move pallets in an industrial plant might not fit your idea of how to automate your lab, but keep an open mind. You never know when a piece of technology will improve just enough to fit a specific sensing need in your lab. A robotic hand that can locate and lift a tomato can gingerly move labware. If you work with hazardous samples or reagents, even more applications of these sensors could keep your team safe as machines take over some once-human tasks.

*Mike May is a freelance writer and editor living in Texas. You may reach him at [mike@techtyper.com](mailto:mike@techtyper.com).*

## Sky-High Value for your laboratory



Learn more at  
[adamequipment.com](http://adamequipment.com)

# HANDLING & STORING CHEMICALS

TIPS FOR SAFELY MOVING, STORING, AND PROTECTING YOURSELF FROM LABORATORY CHEMICALS by Vince McLeod



Let's face it: most laboratories use chemicals. Depending on the lab's focus—research synthesis, compound production, basic acid digestions, etc.—the types and amounts of chemicals used can vary greatly. Unfortunately, reports of accidents and incidents involving the use and storage of chemicals are far too frequent. We must remain diligent in properly handling and storing these hazardous materials, or problems will arise. So, in this column we provide general safety rules of thumb for handling and storing chemicals in the laboratory.

“Never move visibly degrading chemicals and containers.”

Before we get into the details, it is important to take stock of the many federal, state, and local regulations that may include specific requirements for handling and storing chemicals in labs and stockrooms. For example, controlled substances and consumable alcohols are regulated by the Food and Drug Administration and the Drug Enforcement Agency, radioactive substances are regulated by the Nuclear Regulatory Commission, and hazardous wastes are governed by the Environmental Protection Agency. These specific requirements can range from simple locked storage cabinets and specific waste containers to controlled access for regulated areas. If any of your labs are using or generating potentially hazardous substances, determine which regulations apply and the specific requirements they impose. State or local building and fire codes are very common, and applicability is becoming more demanding each year.

Another hurdle frequently encountered is the fact that labs evolve and change over time. We need to focus awareness on our lab facilities and implement a regular (annual) review process to ensure our overall laboratory safety stays up to date.

## First—The right personal protective equipment (PPE)

The focus of this article is safe storage of chemicals. But before we start rounding up bottles of chemicals and reorganizing our labs, we need to make sure we have the proper PPE. At a minimum, this should include appropriate chemical-resistant gloves and eye protection, closed-toe shoes (essential for working in the laboratory), and lab coats and/or chemical aprons (used when needed or when required by your laboratory safety policy).

Once we have collected our PPE, there are just a couple more things to gather before we begin moving those chemical containers around. Survey your surroundings, and take notice of any potential trip hazards and locations of work stations where others are busy. Make sure exits, passageways, and emergency equipment areas (i.e., eyewash and safety showers) are clear and free of stored materials. Locate and have close at hand a full spill kit with appropriate absorbent materials, neutralizing agents, cleanup utensils, and waste containers. Finally, check that all chemical containers have complete labels in good condition and that safety data sheets (SDS) are readily available. Consult OSHA's *Hazard Communication Standard*<sup>1</sup> for guidance. Another good resource for this is the *Standard System for the Identification of the Hazards of Materials for Emergency Response*.<sup>2</sup>

**Next—Safe transport**

Here are our pointers for moving chemicals safely:

- Never move visibly degrading chemicals and containers. Report these to your lab supervisor or principle investigator.
- Whenever transporting chemicals, place bottles in appropriate, leak-proof secondary containers to protect against breakage and spillage. A good example is using a special plastic tote for carrying four-liter glass bottles of corrosives or solvents.
- When moving multiple, large, or heavy containers, use sturdy carts. Ensure cart wheels are large enough to roll over uneven surfaces without tipping or stopping suddenly. If carts are used for secondary containment make sure the trays are liquid-tight and have sufficient lips on all four sides.

- Do not transport chemicals during busy times such as break times or (for those academic laboratories) lunch periods or class changes.
- Use freight elevators for moving hazardous chemicals whenever possible to avoid potential incidents on crowded passenger elevators. Remember to remove gloves when pushing elevator buttons or opening doors.
- Never leave chemicals unattended.

**Rules for chemical storage**

Safely storing chemicals in a laboratory or stockroom requires diligence and careful consideration. Correct use of containers and common lab equipment is critical. To store chemicals safely, DO the following;

- Label all chemical containers fully. We recommend including the owner's or user's name along with the date received.



# Proven, Robust, Reliable Thermal Analysis Solutions

## DSC • DTG • TMA • DTA • TGA

Shimadzu Thermal Analysis Systems offer flexibility in material characterization with either complete stand-alone functionality or multi-system operation for up to four units. All analyzers can be equipped with a vast array of sample pans and cooling accessories to **meet the most rigorous experimental routines.**

- Complete stand-alone functionality or multi-system operation for up to four units
- Vast array of sample pans and cooling accessories
- Easy-to-use software features:
  - Multi-channel control
  - GLP/GMP compliance
  - Wide variety of data analysis features
  - Intuitive operation
  - Advanced applications packages

Learn more. Call (800) 477-1227 or visit us online at

**[www.ssi.shimadzu.com/thermal](http://www.ssi.shimadzu.com/thermal)**

Shimadzu Scientific Instruments Inc., 7102 Riverwood Dr., Columbia, MD 21046, U.S.A.



- Provide a specific storage space for each chemical, and ensure return after each use.
- Store volatile toxics and odoriferous chemicals in ventilated cabinets. Please check with your environmental health and safety personnel for specific guidance.
- Store flammable liquids in approved flammable liquid storage cabinets. Small amounts of flammable liquids may be stored in the open room. Check with your local authority (e.g., fire marshal, EH&S personnel) for allowable limits.

- Separate all chemicals, especially liquids, according to compatible groups. Follow all precautions regarding storage of incompatible materials. Post a chemical compatibility chart for reference, both in the lab and next to chemical storage rooms.
- Use appropriate resistant secondary containers for corrosive materials. This protects the cabinets and will catch any leaks or spills due to breakage.
- Seal containers tightly to prevent the escape of vapors.
- Use designated refrigerators for storing chemicals. Label these refrigerators CHEMICAL STORAGE ONLY—NO FOOD. Never store flammable liquids in a refrigerator unless it is specifically designed and approved for such storage. Use only explosion-proof (spark-free) refrigerators for storing flammables.

And AVOID doing the following:

- Storing large, heavy containers or liquids on high shelves or in high cabinets. Instead store these at shoulder level or below.
- Storing bottles on the floor unless they are in some type of secondary containment.
- Storing chemicals near heat sources or in direct sunlight.
- Storing chemicals in fume hoods. Excessive containers interfere with air flow and hood performance. Only chemicals in actual use should be in the hood.
- Storing anything on top of cabinets. Ensure at least 18 inches of clearance around all sprinkler heads to avoid interference with the fire suppression system.
- Using bench tops for storage. These work spaces should contain only chemicals currently in use.
- Storing chemicals indefinitely. Humidity causes powders to cake or harden. Liquid chemicals evaporate. We strongly recommend all containers be dated when they arrive in the lab. Ensure all manufacturers' expiration dates are strictly followed. Pay special attention to reactive or dangerous compounds. Dispose of all outdated, hardened, evaporated, or degraded materials promptly.



## ANOTHER YEAR WITHOUT A BREAK

The KNF LABOPORT® series of oil-free diaphragm vacuum pumps offer exceptional reliability, portability, and adaptability for a wide range of laboratory applications. Our compact pumps are chemically resistant for maximum durability and extended performance.

To find the perfect pump for your applications, visit [knfusa.com/laboport](http://knfusa.com/laboport).

Following these simple guidelines will get you well on the way to an efficient, organized, and safely operating laboratory. Ignore them, or become cavalier in their application, and you may be picking through ashes or rubble one day. Spend a few minutes going through the lab with this list on a regular basis, and you should avoid any major incidents with chemical storage. As always, safety first.

### References:

1. *OSHA Hazard Communication Standard* - [http://www.osha.gov/pls/oshaweb/owadisp.show\\_document?p\\_table=STANDARDS&p\\_id=10099](http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10099)
2. *Standard System for the Identification of the Hazards of Materials for Emergency Response*, National Fire Protection Association, Publication 704. <http://www.nfpa.org/aboutthecodes/AboutTheCodes.asp?DocNum=704>

### Additional resources

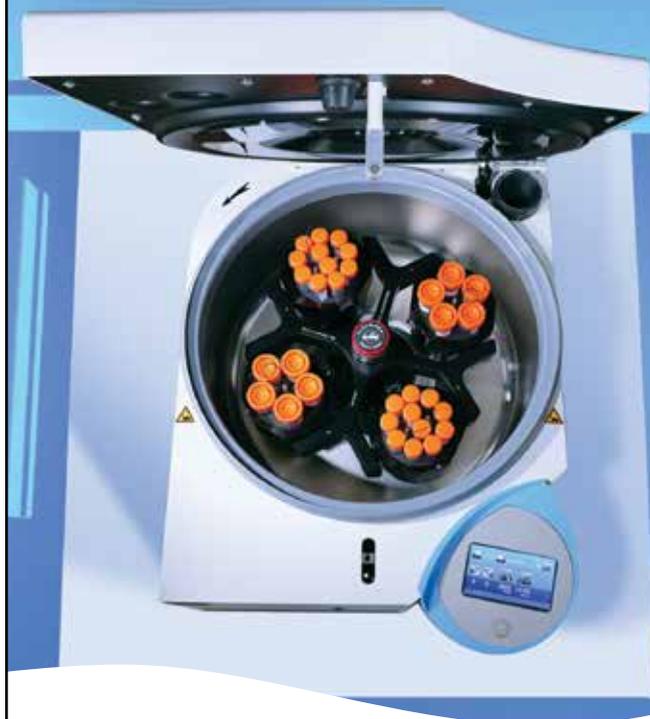
*NIOSH Pocket Guide to Chemical Hazards*. National Institute of Occupational Safety and Health. Publication 2005-149. <http://www.cdc.gov/niosh/npg/>

*The Merck Index: An Encyclopedia of Chemicals, Drugs and Biologicals*. 14th edition. Merck & Company, Inc. Rahway, NJ. Latest edition.

*Prudent Practices in the Laboratory: Handling and Disposal of Chemicals*. National Research Council. National Academy Press. Washington, D.C. Latest edition.

*Vince McLeod is an American Board of Industrial Hygiene-certified industrial hygienist (CIH) and the senior IH with Ascend Environmental + Health Hygiene, LLC, in Winter Garden, Florida. He has more than 35 years' experience in industrial hygiene and environmental engineering services, including 28 years with the University of Florida's Environmental Health & Safety Division. His consulting experience includes comprehensive industrial hygiene assessments for major power-generation, manufacturing, production, and distribution facilities. Vince can be reached at vmcleodcib@gmail.com.*

# Mighty. Small.



**LARGE CAPACITY.  
SMALL FOOTPRINT.**

NuWind centrifuges by NuAire.



**LEARN MORE AT**  
[www2.nuaire.com/16158](http://www2.nuaire.com/16158)

# US BIOSIMILARS INDUSTRY POISED FOR GROWTH?

**BATTLING OVER THE PATENT DANCE**  
by Angelo DePalma, PhD



The 1984 Hatch-Waxman Act, which created the US generic pharmaceutical industry, has succeeded in lowering costs and improving access to hundreds of drugs. The law provides a framework for competitors to copy the molecular formula of off-patent molecules, perform perfunctory tests to guarantee safety, demonstrate Good Manufacturing Practices, and sell the medicines as generics. Some exceptions and nuances exist, but owners of the original drugs have limited legal recourse for preventing the approval and marketing of generics: when the patent is up so is the jig, so to speak. Overnight, the price of the original branded medicine falls 50 percent, 70 percent, or in some instances 90 percent. Some brands disappear altogether.

When Hatch-Waxman passed, the biotech industry was in its infancy, so the act did not cover the monoclonal antibodies and therapeutic proteins whose approvals would come years later. That was both good and bad. It was good because biotech drugs deserved better. Complex proteins, like small-molecule drugs, cannot be reverse engineered and duplicated atom for atom in a few days by any competent medicinal chemist.

Where small-molecule drugs are defined by a single structure, proteins have three (sequence, bridging, folding), plus post-translational modifications (glycosylation, etc.), which may profoundly influence the drug's efficacy and safety. Expression system, growth medium, manufacturing method (batch, fed batch, continuous), purification train, and formulation may similarly affect the product. Thus, biomanufacturers have developed a saying—to a degree but not entirely self-serving and self-fulfilling—that the process is the product.

Hatch-Waxman did not anticipate therapeutic biotech at all, much less the potential of “biogenerics” or *biosimilars*. In the past 33 years, therapeutic biotech has grown to a \$300 billion global market. As molecules come off patent, biosimilars are expected to reach \$41.7 billion in sales by

2024, according to a report by Grand View Research (San Francisco, CA). The United States is now playing catch-up with Europe and Asia in terms of approvals, but with about 50 biosimilar molecules in development, pipelines' stateside growth is expected to dominate.

With this kind of money at stake, it comes as no surprise that owners of original biomedicines are fighting tooth and nail to prevent biosimilar approvals, with patents being the principal battleground.

## INFORMATION SWAP

US regulators struggled for nearly a decade in deciding what to call post-patent-expiration knockoffs of successful biotech drugs. They used “biogeneric” for a short while, but that was dropped because copycat molecules could never be chemically identical to the original. “Follow-on biologics” was tried but considered too vague. Eventually, the US

Food and Drug Administration (FDA) settled on “biosimilar,” a term that conveys similarity without suggesting identity.

Several years passed before an appropriate regulatory framework would exist in the United States for approving biosimilars. That occurred in 2010 with the passage of the Affordable Care Act. While

the law finally gave the FDA authority to license biosimilars, it did not fully anticipate how strongly super-blockbuster sales numbers would influence originator companies to protect their intellectual property.

“Generics have their FDA Orange Book—which actually used to be an orange book but is now online—containing all patents relevant to the original drug,” notes Courtenay C. Brinckerhoff, partner at Foley & Lardner LLP, a Washington, DC, law firm. “No similar resource exists for biosimilars. Each developer must perform their own research to determine which patents might cover the approved product.”

“It comes as no surprise that owners of original biomedicines are fighting tooth and nail to prevent biosimilar approvals.”

Originator companies have indeed come down hard, exploiting any potential infringement from amino acid sequence to manufacturing process. Any of the aforementioned factors contributing to product yield, safety, efficacy, or quality are fair game for litigation provided they are mentioned in a patent.

“The owner may also hold licenses for relevant patents that are not in their name, which would not show up in a typical patent search,” Brinckerhoff adds; for example, an expression system licensed from a university or a particular sequence of chromatography and filtration steps.

Originator and biosimilar aspirants thus go back and forth proposing and disputing which patents are relevant and which aspects of the developer’s commercialization program will infringe on the originator’s intellectual property. This process, referred to as the “patent dance,” is mandated by a special provision in the Affordable Care Act; specifically, when the exchange of information about a product’s manufacturing processes must be exchanged.

The Sandoz division of Novartis decided not to dance around the data exchange. Its biosimilar version of Amgen’s bone marrow stimulant Neupogen hit the market in 2015, before the company initiated the patent dance with Amgen. Since the law provided a 180-day sales moratorium during which that communication was to occur, Amgen sued. An appeals court ruled in Amgen’s favor, but Novartis appealed further to the US Supreme Court, which is expected to rule on the case this month.

## TANGLED WEB

Observers have long commented that for many US litigants “the process is the punishment,” which sounds an awful lot like the biotech industry’s “the product is the process.” Readers can judge for themselves the relevance for biosimilars, of which just five have been approved in the United States compared with 28 in the European Union.

Ron Rader, senior director for technical research at BioPlan Associates (Rockville, MD), notes a climate of uncertainty. “Several biosimilar projects are on hold or progressing very slowly as companies seek to avoid being the first to market these products in the United States. Despite first-to-market products having

clear marketing advantages, many developers are content to let large pharma-type companies battle among themselves to resolve patent issues.” Once this occurs, he says, biosimilars will be, like generic drugs were, a growing niche for many years, and many prospective players will be happy to enter the market.

Blaming the legal system is probably unfair given the limited time frame and dataset, says Julia Pike, VP for intellectual property at Sandoz. “It is too early to conclude whether it is easier to gain approval in Europe or the United States. We are pleased the FDA approved three biosimilars in 2016, including etanercept, as biosimilars offer patients and healthcare providers more treatment options and help bring savings to our healthcare system.”

Brinckerhoff’s perspective is similarly cognizant of the issues and significance of the upcoming Supreme Court ruling. “They may decide that the patent dance is unnecessary, that patent disputes don’t get resolved before approval. Or they may place the burden of monitoring for patent infringement on the originator. However, as complex as the patent disputes are, they almost certainly do not explain why we have fewer biosimilars than the EU. That is more likely due to the fact that the US biosimilar approval pathway is much newer than Europe’s.”

*Angelo DePalma is a freelance writer living in Newton, New Jersey. You can reach him at [angelo@adepalma.com](mailto:angelo@adepalma.com).*

**discover**

**solve**

**assure**

What did you do today?

FTIR • NIR • RAMAN

Find out more at [thermofisher.com/assure-in5](http://thermofisher.com/assure-in5)

**ThermoFisher**  
SCIENTIFIC

# GATHERING DATA IN EXTREME ENVIRONMENTS

TESTING EQUIPMENT FOR OR IN TRICKY ENVIRONMENTS DEPENDS ON ADVENTURESOME SCIENTISTS AND ENGINEERS by Mike May, PhD

In science, the idea of “extreme environments” covers a broad range of harsh physical conditions that complicate the process of making measurements. Some of those conditions exist on Earth, and some are created in labs. One of the latter exists in the world’s strongest magnet, which is the 45-tesla system at the National High Magnetic Field Laboratory (NHMFL; Tallahassee, FL). This magnet is often used to study the quantum mechanical properties of a variety of materials such as superconductors and graphene. “High magnetic fields give scientists a thermodynamic parameter—magnetic field—with an infinitely tunable control knob that allows them

“The challenge in a nutshell is we have to be able to hear a whisper in the front row of a rock concert.”

to tune the spin, orbital, and correlation energy scales of the electrons in the material, thus allowing access to new quantum mechanical phases,” says Tim Murphy, director of the DC field facility at the NHMFL.

To study quantum mechanical states, Murphy and his colleagues need to create, among other things, a very low-temperature environment of about 30 milliKelvin—close to absolute zero. Maintaining that temperature depends on measurement methods that require very little power. For example, to measure a material’s resistance, the scientists use an excitation current of a few nanoamps, which produces a signal of a few microvolts. Making that even more difficult, this measurement takes place 20 millimeters from a coil of the magnet that is carrying 37,000 amps at 500 volts, not to mention cooling water—10 degrees Celsius at 500 pounds per square inch (psi)—flowing through the magnet at 4,000 gallons per minute. “The

challenge in a nutshell,” Murphy says, “is we have to be able to hear a whisper in the front row of a rock concert.”

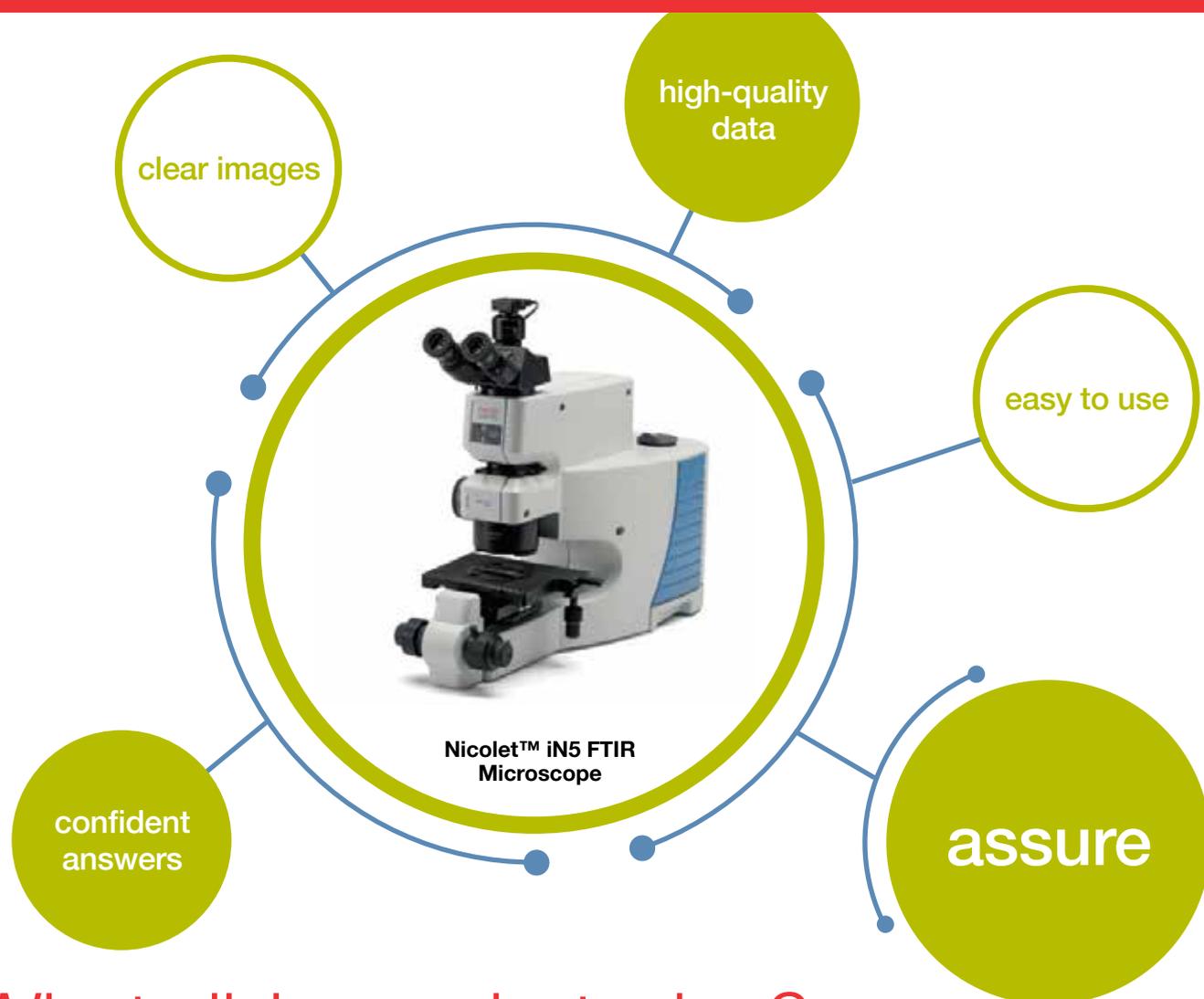
Murphy and his colleagues aren’t stopping with research on materials. They are working on a 36-tesla magnet for nuclear magnetic resonance (NMR) studies of chemical and biological samples. He points out that this “magnet allows scientists using NMR to access a much larger portion of the periodic table than has ever been possible.”

## CONDUCTING COASTAL RESEARCH

In nature, water creates one of the trickiest places for making measurements with electronic devices. At Florida International University Applied Research Center (Miami), research scientist Yew Teck Tan and his colleagues develop systems for environmental sensing and monitoring in coastal waters. In these circumstances, says Tan, “the main challenges are the safety of the operators and scientists and the logistics of deploying and retrieving sensors and robotic systems.”

When asked about the center’s latest advance, Tan points out the deployment of heterogeneous robotic systems, including an autonomous underwater vehicle (AUV), an unmanned surface vehicle (USV), and an unmanned aerial vehicle (UAV). “The AUV was sent for collecting data underwater, the USV collected data on the subsurface region as well as providing a communications relay from the operator on the shoreline, and the UAV took aerial pictures of the survey area and performed sparse point-based sampling on the water surface,” Tan explains.

Among the many challenges of such field research, the biggest one turns out to be communication between the networked robotic systems and the operators on the shore. “Wireless communication degrades significantly when operating in an extreme environment,” Tan notes. “The intermittent communication channel between the systems and the operators may cause unexpected behaviors in the robotic system and eventually jeopardize the robots’ safety.”



## What did you do today?

Whether you're discovering new materials, solving analytical problems or assuring product quality, your spectrometer needs to deliver the definitive answers you're looking for — fast! Thermo Fisher Scientific goes beyond your expectations with a full line of FTIR, NIR and Raman spectroscopy systems, to help you move from sample to answer ... faster than ever before.

The Thermo Scientific™ Nicolet™ iN5 FTIR Microscope enables rapid identification of contaminants that could put your products at risk. With simple point-and-shoot operation, it is designed for users at varying skill levels and ideally suited for the busiest quality control labs.

See it, scan it, solve it with the Nicolet iN5 FTIR Microscope.

Discover. Solve. Assure. [thermofisher.com/assure-in5](http://thermofisher.com/assure-in5)

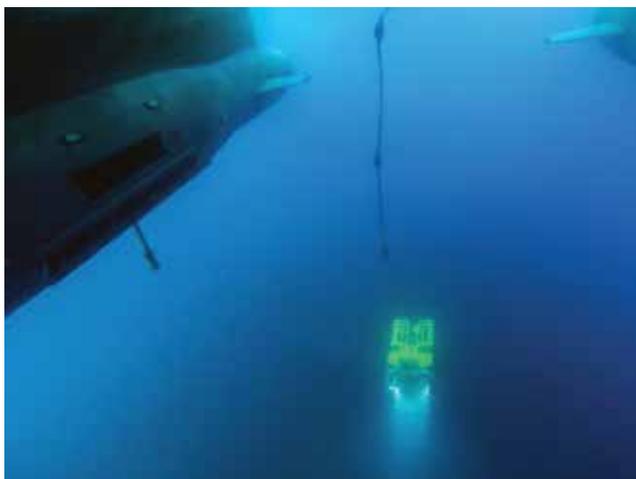
**ThermoFisher**  
SCIENTIFIC

In some other environments, communication disappears almost entirely.

## EXTREME DEPTHS

When asked what an extreme environment means for his work, Paul McGill, an electrical engineer at the Monterey Bay Aquarium Research Institute (MBARI; Moss Landing, CA), says, "The bottom of the ocean." That's a cold, high-pressure, saltwater environment.

The institute's remotely operated vehicle (ROV) goes to 4,000 meters below the surface, where the pressure approaches 6,000 psi. That's a bit more than the weight of a Chevy Suburban applied to an area about the size of a postage stamp—and then you cover the ROV with stamps, each with a Suburban pressing down on it.



▲ *The Monterey Bay Aquarium Research Institute's remotely operated vehicle Doc Ricketts descending below its host vessel, the Western Flyer, in the clear waters of the Gulf of Mexico. (Image © 2015 MBARI.)*

The temperature is also tricky, but mostly because of range. At 4,000 meters below the surface, it's about 2 degrees Celsius. The water gets below 0 degrees Celsius without freezing only in the Arctic or Antarctic, but even then it's not much below 0. The real extremes take place on the deck of the ship that transports the instruments. "On a sunny day in California, the deck can get up to 40 degrees Celsius and then drop well below freezing if the boat sails to the Arctic," McGill says. "So, we have to cover that range."

In facing these varied conditions, McGill and his colleagues tend to a fleet of vehicles and equipment, including autonomous vehicles, ROVs, and moored platforms that are anchored to the bottom and float, plus

time-lapse cameras and more. To do the job of making the best measurements in the right spots, it takes teamwork. "The whole point of MBARI," McGill explains, "is scientists and engineers working together to figure out what needs to be built and how data will be analyzed."

## CREATING THE CONDITIONS

To develop instruments that accurately measure the desired parameters, survive deployment to the testing site, and work where intended, MBARI engineers and scientists try to re-create the conditions in the lab, but they can do it only one at a time. The team can put an instrument in saltwater to see whether that causes any electrical problems. They also use an oil-filled system that can generate pressure up to 10,000 psi to check the strength of a housing and the integrity of its seals. A cold room is used to put a device in a 2-degree environment to make sure that the electronics and batteries function properly. "It's all just one extreme at a time," McGill explains. "That is necessary but not sufficient." To ensure that an instrument will work in saltwater, high pressure and cold are applied at the same time; "that requires field testing," McGill says.

"To ensure that an instrument will work in saltwater, high pressure and cold are applied at the same time."

In the past, field-testing an instrument at the bottom of the ocean meant attaching a weight to it and throwing it over the rail of a ship. Later, an acoustic signal released the instrument from the weight, and the researchers would try to locate the device when it floated to the surface. "We still do some of that," McGill says, but now they can send down an ROV to attach a data connection to an instrument for testing, turn valves, or do whatever is needed. "That's very helpful when developing something new," McGill points out. Nonetheless, it's expensive. "The biggest limitation with ROVs is that you can only be there a limited time," McGill explains, because ship time costs \$20,000 to \$30,000 a day.

Now MBARI's Monterey Accelerated Research System (MARS) has an observatory 900 meters under the ocean's surface. A 52-kilometer cable carries power and data to a science node on the seafloor in Monterey Bay. An instrument can be taken down to the observatory, plugged in,



▲ Launching the remotely operated vehicle *Doc Ricketts* through the ‘moonpool’ on its host vessel, the *Western Flyer*. (Image: Todd Walsb © 2009 MBARI.)

and monitored and controlled from shore. “We can do this in real time for as long as we want,” McGill says.

Some new devices don’t need any help once they are released. For example, McGill and his colleagues developed a benthic rover that ran on its own for one year and two days. “It broke the world’s record for autonomous, bottom-roving vehicles,” he says. “We were successful largely due to the extensive field-testing we did during the rover’s development.”

## SAILING THE SURFACE

Other groups develop unmanned vehicles. For instance, Sairdron (Alameda, CA) makes an unmanned surface vehicle with the same name. The wind and sun power the Sairdron, which is about the size of a Hobie Cat sailboat—23 feet long, 20 feet tall. “It’s definitely big,” says Jessica Cross, oceanographer at the U.S. National Oceanic and Atmospheric Administration’s (NOAA) Pacific Marine Environmental Laboratory (Seattle, WA), where she and her colleagues use a Sairdron. The Sairdron’s size, Cross explains, provides a significant advantage because it “increases its power and payload capacity, meaning that we can send it farther, leave it out longer, and take more sensors with us along the way.”

NOAA partnered with Sairdron through a cooperative research and development agreement (CRADA) to take on some of the challenges of integrating and adapting sensors for use on the platform. “One of the challenges we were concerned with at the beginning was sensor biofouling,” Cross notes. “For example, our team has been



▲ A Sairdron can carry many sensors and instruments and be dispatched at any time. (Image courtesy of Sairdron.)

working in the Bering Sea.” The productivity of this area—from phytoplankton blooms and commercial fisheries to expanding populations of jellyfish—creates conditions that can reduce the performance of sensors. “With a few simple adaptations and the Sairdron’s speed, biofouling has been a surprisingly small concern for us,” Cross explains. “We’ve been very successful so far in developing both passive and active acoustic sensing capabilities, which have never before been adapted for autonomous vehicles, and we are starting to branch into even more sensitive instrumentation that measures gas fluxes and ocean currents.” Those sensors expect a stable environment, so the scientists must account for the effects on the data of wave action caused by the Sairdron’s natural motion.

The Sairdron provides many benefits, including the ability to be launched from shore rather than from a ship. “This means that we can freely schedule launches as they are needed,” Cross explains. “That’s not flexibility we generally have with research vessels, which are often scheduled more than a year in advance.” That means that scientists can send the Sairdron to places as interest in them arises.

One day, Cross hopes to have “a set of subsurface platforms and instrumentation that is as powerful as the Sairdron.” Nonetheless, she adds, “The scientific and engineering community still has a long way to go with those kinds of efforts, ranging from navigation to power supplies.”

*Mike May is a freelance writer and editor living in Texas. You may reach him at [mike@techttyper.com](mailto:mike@techttyper.com).*



Dwight Stoll

# ASK THE EXPERT

## TRENDS IN 2D LIQUID CHROMATOGRAPHY

by Rachel Muenz

**Dwight Stoll** is an associate professor in the Chemistry Department at Gustavus Adolphus College in St. Peter, Minnesota, where he teaches quantitative and instrumental analysis courses in addition to directing a vibrant research program involving mainly undergraduate students. He holds bachelor of science degrees in plant biology and biochemistry from Minnesota State University, Mankato. Professor Stoll is the author or co-author of 49 peer-reviewed publications and two book chapters in the area of separation science, is a named co-inventor on four patents, and has instructed numerous short courses in two-dimensional liquid chromatography (2D-LC).

**Q:** What do you use 2D-LC for in your work?

**A:** In my laboratory, we use 2D-LC for separating both complex materials and [for] mixtures that are not complex per se but contain pairs or groups of molecules that are inherently difficult to resolve. Examples of complex mixtures include tryptic digests of proteins, plant extracts, and natural water samples. Samples in the difficult-to-resolve category often contain isomers—regioisomers and stereoisomers. I believe that conventional liquid chromatography, 1D-LC, will continue to be a dominant technique for a long time. But it has limitations, and in most cases 2D-LC can be an effective and efficient way to solve problems that cannot be easily addressed by 1D-LC.

**Q:** How many people work in your lab?

**A:** We don't have a graduate program at my institution so I work exclusively with undergraduates and postdocs. Typically, on average, I have about six undergraduates working with me and then one postdoc or technician.

**Q:** What are some of the recent trends in 2D-LC?

**A:** Right now there is a lot of growth in the adoption of 2D-LC in a variety of industries, but probably the most notable

one is in the pharmaceutical industry. Researchers in pharma and biopharma today can buy commercially available instruments for 2D-LC that simply weren't available five years ago. These instruments are both sophisticated and relatively easy to use compared with where the technology was at five and certainly ten years ago. Even more exciting at the moment is the fact that some groups in pharma are pushing methods involving 2D-LC separations into QC labs where the methods are highly regulated and must be very reliable. This means that the community is becoming increasingly confident in the technology and is committed to it for the long run.

**Q:** What have the changes in 2D-LC meant for your work?

**A:** Ten years ago most of my work on 2D-LC was perceived as being pretty "far out," meaning that people could not imagine our results having an immediate impact on their work. Today, with so many more users of 2D-LC, the community is much more interested in the research going on in academic laboratories. My group is very collaborative, and we have been establishing productive collaborations with different groups in pharma to focus our work on problems that will have an immediate impact in the use of 2D-LC for pharma applications.

**Q:** What are some of the applications you're working on with those groups?

**A:** The place where we're getting the most traction with those interactions is in the biopharma space, so antibodies, therapeutics, proteins—things like that. Historically, I've had a really hard time establishing those kinds of relationships, but not because there isn't interest. It mostly comes down to legal issues and the extent to which [biopharma companies] tend to be very secretive about their molecules, which is understandable. I think because in the biopharmaceutical spaces there's so much energy, so much interest in moving ahead quickly, there's been more willingness to figure out how to make [collaborations with academia] work.

**Q:** What are some of the most common challenges you encounter when working with 2D-LC?

**A:** Lately in my research talks and conversations with people, I have been referring to the second-dimension part of 2D-LC systems as a "strange place." It is strange in the sense that the conditions we use there and the kind of results we see are often very different from what we encounter in conventional liquid chromatography. For example, in some situations we are interested in doing extremely fast

gradient elution separations in the second dimension on the order of 15 seconds. Doing this effectively demands hardware that is sometimes difficult to find. For example, many HPLC columns are available only in lengths longer than 3 cm. If we want a 2-cm-long column in a particular chemistry, we are stuck.

**Q:** How do you handle those challenges?

**A:** We work collaboratively with instrument and consumable vendors to encourage them to expand the scope of their offerings to include items and product characteristics that might not be so valuable for conventional LC but are very valuable for 2D-LC. In this we have a classic chicken-egg problem—if users of 2D-LC cannot buy the equipment they need, they will not be able to develop the applications they need, and if they don't develop those applications, then there is no market for the vendors to sell to. So we see that it is a slow process, but at least it is moving now.

**Q:** What do you enjoy most about working with 2D-LC?

**A:** Good question. My educational path has involved elements of engineering, biology, and chemistry. I find that working on 2D-LC allows me to combine all of those interests in a way that helps us push the technology and the state of the art forward. And it is very rewarding to see the adoption of 2D-LC across different industries picking up speed now.

**Q:** What applications of 2D-LC do you find most interesting/promising?

**A:** In my laboratory we have made a pretty big shift over the past couple of years to focus a lot of our attention on applications in biopharma (e.g., antibodies, peptides). This is a research space where high-resolution separation methods are

badly needed, and the molecules often lend themselves to very effective 2D-LC separations. I believe great strides will be made in this area over the next few years.

**Q:** How do you expect 2D-LC to change in the future?

**A:** I think the trajectory will be similar to what we've observed with LC-MS. In the early days of LC-MS, the instruments were not very robust, users were experts, and the software was not well developed. Now, many LC-MS instruments are used by people we would not call expert mass spectrometrists, because the hardware has become more reliable and easier to use and the software has become smarter and taken a lot of decision-making burden off the analyst. I think we will see similar things with 2D-LC; the hardware will become more effective, more reliable, and easier to use. And the software will do more to help the user develop and use methods, rather than getting in the way of good ideas. I believe the future is bright.

**Q:** In your experience teaching courses in 2D-LC, what are some of the most common problems people encounter when they're first learning the technology?

**A:** I think the single biggest thing is that people new to 2D-LC can feel overwhelmed by the complexity of the technique. There are many more variables to consider in method development and I think people have a difficult time knowing where to start.

**Q:** How can they deal with those issues?

**A:** We have known for some time that this is a problem, and we are addressing it in two ways. First, we are constantly thinking about how to improve the hardware and software for 2D-LC to make it easier to use, and thinking about how to develop method development strategies that people

can apply broadly. Second, we know that education is very important, which is why we have developed the short courses and teach them every chance we get.

**Q:** What advice do you have for labs that are looking at adding 2D-LC?

**A:** Try to avoid reinventing the wheel. There are really great examples in the literature [from] the past five years or so of very high-performing 2D-LC methods in a variety of application areas. Try to learn from those methods and adapt them to your needs. Also reach out to experts in the community. The people I know who have a lot of experience with 2D-LC are generally very interested in talking with people about their applications—I know I would certainly be happy to talk with anyone interested in getting involved in 2D-LC.

**Q:** You recently won a Thought Leader Award from Agilent for your work with 2D-LC in biopharmaceutical analysis. How do you feel about that?

**A:** It's great. I think it really speaks to their interest as a company in terms of supporting research on 2D-LC generally. Obviously, the project that we've designed around that [award] is applications of 2D-LC in biopharma, but they're putting a lot of financial support behind [2D-LC research in general] and I think it speaks to their confidence in the future of the technology. For me personally, it's a huge win for my research program and will provide really great support, but, like I said earlier, it's rewarding to see the technique gather more and more interest, in a broad sense, across the industry.

*Rachel Muenz, associate editor for Lab Manager, can be reached at [rachelm@labmanager.com](mailto:rachelm@labmanager.com) or by phone at 888-781-0328 x233.*

## ICP-MS

## ICP-MS HELPS SCIENTISTS DIG DEEPER INTO THE WORLD AROUND US

by Mike May, PhD

The species of an element—based on its molecular form or valency state—determines how it behaves. Take a chemical like chromium. Its valency state impacts its toxicity and bioavailability. So to know how dangerous something might be, scientists must determine the species of the element. Through speciation analysis, researchers separate the species in a sample and quantify them. An integral tool for such analyses is inductively coupled plasma-mass spectrometry (ICP-MS).

The high-temperature ICP source turns a compound in a sample into its constituting elements. After ionization, the ions are separated and analyzed with MS. “Elemental speciation is a technique that is used to separate and quantify an element in terms of its chemical species, rather than the total element concentration,” says Shona McSheehy Ducos, ICP-MS product manager, chromatography and mass spectrometry at Thermo Fisher Scientific (Waltham, MA). ICP-MS can detect even trace species in a sample—down to sub-parts per billion.

“Scientists can easily integrate ICP-MS with common methods of separation.”

ICP-MS for speciation includes some upstream processing. “Because the plasma destroys all molecular information, a chromatographic technique is usually coupled to the ICP-MS,” says Brian Jackson, director of trace metal analysis at Dartmouth College’s (Hanover, NH) department of earth science. “The chromatography does the compound/species separation, the ICP-MS does the element-specific detection, and compounds are identified by retention-time matching.”

From Agilent (Santa Clara, CA), Sayuri Otaki, ICP-MS marketing manager, writes: “ICP-MS speciation is a common technique used to identify and quantify

trace levels of species/chemical compounds of metals in food chains, environmental substances, pharmaceuticals, and biological samples.”

### An array of advantages

Scientists can easily integrate ICP-MS with common methods of separation, including liquid and gas chromatography (LC and GC, respectively). As with other forms of MS, a separation stage can improve a setup’s sensitivity. LC-ICP-MS, for example, usually provides much lower detection limits than LC-MS.

In Jackson’s lab, the isotope specificity of ICP-MS really comes in handy for studying the speciation of mercury with GC-ICP-MS. “By spiking the samples with enriched stable isotopes of methylmercury and inorganic mercury,” Jackson explains, “we can quantify these two species by isotope dilution, which is a more accurate and precise method than external calibration and much more robust [when] changing instrumental conditions during an analytical run.”

Jackson and his colleagues also develop techniques for studying the speciation of arsenic. “We do a lot of arsenic speciation of food extracts and urine samples,” he says. When using traditional methods by anion chromatography-ICP-MS, it takes 10–20 minutes per sample. “When you have batches of one hundred samples and their associated calibration standards and quality control,” Jackson explains, “that adds up to a very long batch-analysis run.” So he and his team modified the method to use a short, five-centimeter anion exchange column, which decreases the run time for the five common arsenic species to less than four minutes. “It’s a simple thing but it’s made such a difference to sample throughput in my lab,” he says.

Getting the right chemistry in the separation stage also matters, because scientists often use ICP-MS to look for elements at trace levels. “With properly tailored column chemistry, a complicated sample matrix can be eluted separately from the analyte species, which removes a significant number of potential interferences,” McSheehy Ducos notes. The less interference getting to the detector, the higher the sensitivity of an analysis.

# NEW IsoMist XR

Improved Analytical Performance for any  
ICP-OES and ICP-MS Application



Improved thermodynamic design provides faster temperature equilibration and an extended temperature range of  $-25^{\circ}\text{C}$  to  $80^{\circ}\text{C}$ , settable in  $1^{\circ}\text{C}$  increments with an unmatched accuracy of  $\pm 0.1^{\circ}\text{C}$ .

[www.geicp.com/IsoMistXR](http://www.geicp.com/IsoMistXR)



**GLASS EXPANSION**  
Quality By Design

4 Barlows Landing Road Unit 2A, Pocasset, MA 02559  
Toll Free (US): 800 208 0097  
Email: [geusa@geicp.com](mailto:geusa@geicp.com)

## Testing for tin

Although scientists use ICP-MS to determine the species of elements in a range of samples, some of the most interesting recent ones involve environmental samples. For example, environmental samples can contain various forms of tin. “One of the most toxic species of tin, tributyltin, has persisted in the environment, following decades of use in commercially available boat hull antifouling paint,” McSheehy Ducos notes.

Tin’s toxic effects and common occurrence in environmental samples have driven regulatory legislation, including the European Union Water Framework Directive and the U.S. Environmental Protection Agency’s Ambient Aquatic Life Water Quality Criteria. These require sub-parts per billion measurements. Here, says McSheehy Ducos, “GC is often employed, as it will produce the most selective and efficient separation with excellent signal-to-noise ratios.” In this technique, a flexible transfer line maintains consistent temperature, which provides a complete integrated solution for the analysis of tin species.

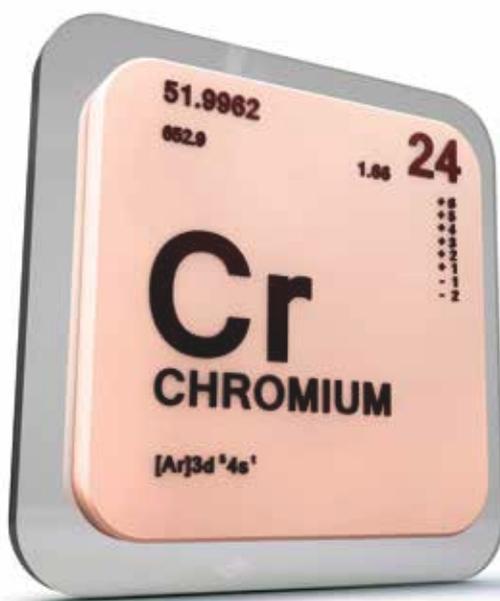
## Cruising with quad

To get even more out of a speciation system, some scientists use triple-quadrupole MS. According to Jackson, this is “opening new doors in terms of analysis of elements, such as phosphorous and sulfur, that now can be measured at very low concentrations.”

Agilent is an innovator of triple-quad systems. Agilent developed a fast arsenic-speciation analysis of rice and wines with LC-ICP-triple-quad MS. “This exciting project

is in collaboration with Courtney Tanabe and Susan Ebeler of the department of viticulture and enology at the University of California, Davis, as well as Patrick Gray from the U.S. Food and Drug Administration’s (FDA)

“When using traditional methods by anion chromatography-ICP-MS, it takes 10-20 minutes per sample.”



Center for Food Safety and Applied Nutrition,” writes Jenny Nelson, segment marketing application scientist. This separates inorganic arsenic from monomethylarsonic acid and dimethylarsinic acid DMA in under two minutes using a narrow-bore, small-particle chromatography column. The current FDA EAM 4.10 and 4.11 methods have an analysis time of approximately 20 minutes. “Furthermore, the use of oxygen as a reaction gas in the ICP-triple-quad allowed for a decrease in spectral interferences while increasing sensitivity,” Nelson adds.

Such advances are making ICP-MS faster and more sensitive. As Jackson says, “I think we’ll see more applications of multi-element speciation methods in the future.”

*Mike May is a freelance writer and editor living in Texas. You may reach him at [mike@techtyster.com](mailto:mike@techtyster.com).*

FOR ADDITIONAL RESOURCES ON ICP-MS, INCLUDING USEFUL ARTICLES AND A LIST OF MANUFACTURERS, VISIT [WWW.LABMANAGER.COM/TAG/ICPMS](http://WWW.LABMANAGER.COM/TAG/ICPMS)



# ARE YOU IN THE MARKET FOR A... THERMAL ANALYZER?

Thermal analysis is the broad category of at least 20 techniques that measure some fundamental property of matter as a result of adding heat. For example, dilatometry measures volume changes upon heating, thermomechanical analysis quantifies the change in dimension of a sample as a function of temperature, and thermo-optical analysis detects changes in optical properties upon heating or cooling.

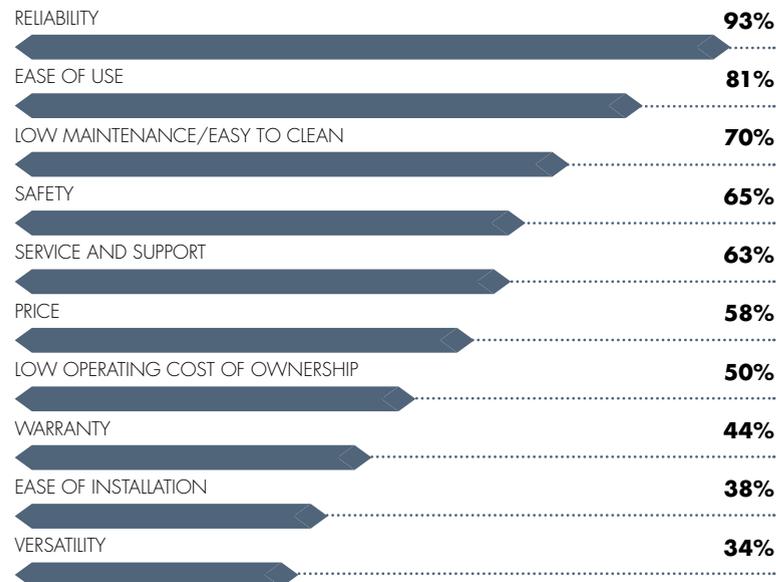
## TOP 6 QUESTIONS

You Should Ask When Buying a Thermal Analyzer

1. If you are going to be analyzing x,y,z properties, ask if the company has any customers conducting the same type of work and if you can talk to them.
2. Ask if you can submit a sample for a demo using specified conditions and, if so, how long this will take and whether a report will be provided.
3. What type of post-sale application and technical support does the company offer, and how much will it cost you?
4. What features distinguish the company's instrument from their competitors'?
5. What can the company tell you about the quality of the product, i.e., how it was manufactured and tested? This will help you determine the typical lifespan.
6. What can the vendor tell you about the total cost of ownership, including expected consumables, software upgrades, service, and warranty costs?

## TOP 10 FEATURES/FACTORS

Respondents Look for When Purchasing a Thermal Analyzer



Types of materials requiring thermal analysis used by survey respondents:

Polymers	56%
Organics such as lubricants, pharmaceuticals, paints, adhesives, etc.	42%
Minerals, inorganic chemicals, and other inorganics	29%
Ceramic / glass / building materials	17%
Metals / alloys	12%
Other	23%

Physical state of materials being measured by thermal analysis :

Liquid	50%
Powder	44%
Thin film	29%
Gel	21%
Fiber	19%
Foam	19%
Paste	15%
Other	35%

Nearly 45% of respondents are engaged in purchasing a new thermal analyzer. The reasons for these purchases are as follows:

Replacement of aging system	46%
Addition to existing systems, increase capacity	28%
First time purchase	10%
Other	9%
Setting up a new lab	7%



➔ For more information on thermal analyzers, including useful articles and a list of manufacturers, visit [www.labmanager.com/thermal-analyzers](http://www.labmanager.com/thermal-analyzers)



Wolfgang Peti, PhD

# ASK THE EXPERT

## IMPROVEMENTS IN LIQUID CHROMATOGRAPHY

by Tanuja Koppal, PhD

**Wolfgang Peti**, PhD, professor in the Department of Chemistry and Biochemistry at the University of Arizona, talks to contributing editor Tanuja Koppal, PhD, about the recent developments in chromatography techniques. He talks about how chromatography has now become more modular, automated, high throughput, and user friendly, which has allowed him to run samples for protein purification in an unattended, flexible setting. While innovations in instrumentation are important, integration and ease of use of the software tools and customer service remain important criteria in deciding which equipment to buy.

**Q:** What are some of the recent improvements you have seen in chromatography techniques?

**A:** We have been using chromatography for the past 25 years, and the main thrust of our work is to use the structure and dynamics of proteins to understand their biological function. For doing that work, we need pure proteins, peptides, or protein complexes. Chromatography gives us access to materials to perform experiments that can provide information on protein-protein and protein-nucleotide interactions, or to solve the structure of these proteins and understand the biology that is involved. In the past couple of years, chromatography has become much more user friendly and the software has improved greatly, which allow for higher throughput and automation. We can also do a lot of experiments unattended, at least the routine steps, by writing methods implemented in the modern software, setting up the workflow, and letting the system run unattended. There is a lot of routine work in protein purification, so this is an important feature that chromatography now offers. Automation has become much more powerful, and it is easier to program methods using the new software tools, which has, in turn, improved the throughput.

**Q:** Are there other alternatives to chromatography when it comes to protein separation and purification?

**A:** We use only liquid chromatography to purify proteins that can be expressed in *E. coli*, insect, or human cells. We lyse the cells and then extract and purify the protein of interest. Precipitation is a very crude way to purify proteins. [We] can purify the protein using affinity tags, which is a high-affinity, high-specificity method that is most commonly used. Or [we] can purify the protein away from other proteins and/or cellular components using liquid chromatography separation, based on intrinsic properties such as size, hydrophilicity, or the charge of the protein of interest. Liquid chromatography is really the workhorse for every molecular or structural biologist and biochemist looking to purify proteins.

**Q:** How do these improvements in chromatography translate to changes in the workflow?

**A:** The innovations in the instrumentation for chromatography lie in the modularity, which gives you the freedom to change things in the setup. Previously when you bought chromatography instruments, it was hard to change anything. Now it's easy to change, upgrade, and integrate instruments, which gives you a lot of flexibility. Furthermore, chromatography vendors realize that there are a

lot of companies that supply specialized detectors and other equipment that they cannot offer. Hence, they offer solutions that can integrate these different pieces of equipment easily and rapidly into the existing chromatography workflow. Modularity has made integration possible, and maintenance on these instruments has also become fast and easy. That's become an important feature because it minimizes downtime on these expensive instruments. It's become effortless to write methods with the software, which makes automation easy as well. Chromatography is no longer a technique that can be used efficiently by only specialists.

**Q:** Can you elaborate further on how you have increased throughput in protein purification using chromatography?

**A:** In protein purification, you can't run multiple samples at the same time since you have to purify one protein at a time. However, you can have many columns for purification set up back-to-back to run on the same system. Previously, the software for doing this would not allow for such a setup. But now, as long as you have the column-switching mode on your instrument and air sensors in your columns, [this] can be done very easily, and you can run the samples unattended overnight. When you come in the next morning, all the proteins are collected in fraction collectors. It's

not a fast technique, but with these new features, you can run two or three samples, instead of only one, in one day. Sometimes, when methods get very complicated with different columns to use and different buffers to mix, things don't always go right the first time. It's important not to get frustrated and to remember that once you get the method optimized, adapted, and ready to work, you have a protocol that can be repeated multiple times in a rigorous way.

**Q:** Can you explain more about the user friendliness of the chromatography software and how that has helped?

**A:** Chromatography software in the past was very painful to use, but now the software has become very intuitive and user friendly. It's not perfect, but I am hoping that in the next couple of years it will improve even more. In our case, the vendor, Bio-Rad (Hercules, CA), provided training on-site for two or three days and helped us understand the instrument and software. It also depends on your knowledge level. After 20 years of chromatography experience, as in our case, the training becomes more specific to the instrument and software and less about understanding the technique. For us, Bio-Rad provided good hands-on training and went over the entire purification procedure to give [us] the confidence that it works. [The trainers] are also quick to respond to any questions we now have regarding the system. One of the advantages of the Bio-Rad Chrom-Lab™ software is that it's freely available to people in academia, and we can install it on as many computers as we want and do all the modifications to the protocols off-line. All our computers are connected to a shared cloud environment, so you can change and optimize the methods using the software on any computer and put it back into the system and continue to modify it. You can also work on the software from a remote location. You can access the data

on a phone or tablet, but you need a large screen to scroll down to look at the various steps listed in the method and to view the details in the different chromatograms. There's a lot of information to look at.

**Q:** Have you been successful in coupling and integrating these chromatography systems with other systems?

**A:** Yes, but mostly off-line. What we are doing with these low-pressure chromatography systems is to get pure protein and do biophysical analysis, either online or off-line. The online detection uses [ultraviolet light] and conductivity. The off-line detection includes fluorescence and nuclear magnetic resonance to look at structural properties and protein interactions. With the chromatography systems that we have, you can perform biophysical characterizations, such as using size exclusion chromatography to look at protein interactions that correspond to the size changes of the proteins.

**Q:** Are there many challenges with sample preparation for this application?

**A:** When you perform soluble-protein purification, you start with a cell lysate, where you lyse your cells, mostly mechanically, and spin [them] down in a high-speed centrifuge. The pellet is discarded and the soluble proteins that are in the cell lysate are filtered and then loaded onto a purification column on the chromatography system. We can automate the loading process using sample pumps and load up to half a liter at 1-2 mL per minute in a robust manner. If you do it overnight, you can save a lot of time. Or we can start out with a protein that is semi-purified and load it onto the column to refine it further, to go from 80 to 90 percent purity to 95 to 98 percent purity. There is a lot of flexibility in how you load the samples onto the column using sample pumps or loops.

**Q:** Are there checks and balances in the system to prevent errors?

**A:** The system can't sense [when something] goes wrong, but it does guide you through the setup and protocols to make sure there are no errors. This is a new and important feature in chromatography systems, where it guides the user visually to make sure things are done right the first time. We have our chromatography system running on an uninterrupted power supply, so we don't worry about power outages. These systems are expensive, but if you need pure proteins, then you must have one.

**Wolfgang Peti is a professor in the Department of Chemistry and Biochemistry at the University of Arizona, the Homer C. and Emily Davis Weed Endowed Chair in Chemistry, and an American Diabetes Association Pathway to the Cure Fellow. In addition, he is an associate editor of the Journal of Biological Chemistry, a permanent member of the American Diabetes Association's Research Grant Review Committee, and a permanent member of the National Institutes of Health/Molecular and Integrative Signal Transduction study section. Dr. Peti received his PhD in chemistry from the University of Frankfurt, Germany, in 2001. He extended his research into structural biology at The Scripps Research Institute from 2001 to 2004 and then at Brown University from 2004 to 2016, where he rose through the ranks from assistant professor to professor. His current research efforts focus on enzyme function related to cancer, diabetes, and neurobiology as well as drug design. Dr. Peti is particularly interested in combining different molecular techniques to understand the function of kinases and phosphatases.**

*Tanuja Koppal, PhD, is a freelance science writer and consultant based in Randolph, New Jersey. She can be reached at tkoppal@gmail.com.*

## ACOUSTIC LIQUID HANDLING ENSURES HIGH ACCURACY AT LOW VOLUME

by Angelo DePalma, PhD

As biological assays shrink to sub-microliter volumes, dispensing and liquid handling based on air displacement become less accurate and predictable.

Acoustic liquid dispensing (ALD), the technology behind inkjet printing, is based on century-old technology. During the 1920s, scientists Robert Wood and Alfred Loomis discovered that sound projected through a fluid from below caused volcano-like structures at the surface, from which droplets emerged and shot upward. Fifty years later, Xerox and IBM exploited this principle to create inexpensive inkjet printers. Now two companies, Labcyte (Sunnyvale, CA) and EDC Biosystems (Fremont, CA), have applied ALD for ultra-precise, low-volume liquid handling.

Systems from both companies dispense nanoliter-sized droplets from a source plate, upward, into an inverted destination plate, at high speed and accuracy.

In Labcyte's Echo® Liquid Handler instruments, a sonic transducer first scans the source wells to measure fluid depth. After determining fluid depth, the transducer returns to the first source plate and applies bursts of acoustic energy whose strength depends on the meniscus level as determined in the initial survey step. A 2.5 nanoliter droplet emerges and sticks to the bottom of the inverted destination plate through surface tension. Larger fluid transfers require dispensing of multiple 2.5 nanoliter droplets.

### Variable volumes

EDC's ATS Acoustic Liquid Dispenser tunes the sound input to produce droplets ranging in volume from 1 nanoliter to 20 nanoliters. With tweaking, it is possible to dispense 25 or even 50 nanoliters reproducibly.

Accuracy becomes a concern at such small scale. According to Michael Forbush, PhD, a physicist at EDC, achievable accuracy and repeatability depend on the source plate. "Our system works best with film-bottom plates, which are available from many vendors. With those plates users can expect about two percent variability in dispensing volume."

Forbush explains that at low nanoliter scale, surface tension and static electricity become factors in ways they do not for microliter-scale assays. EDC's dispenser, for example, de-ionizes both source and destination plates before use, thus eliminating electrostatic events as a potential error source.

Fluid properties, particularly surface tension, also come into play. "Larger drops drag some of the liquid at the surface along, creating satellite droplets," Forbush says. "Solutions with lower surface tension and larger droplets tend to have more and larger satellites." One workaround is to adjust the droplet's escape velocity. "Some very enterprising customers have produced consistent 50 nanoliter drops, but it takes time. We don't want to promise customers they can do this with every fluid."

In the early days developers worried that solutes, for example surfactants, might affect surface tension sufficiently to require separate calibration or other adjustments to assure accurate dispensing. "This turned out to be a nonissue, since all dissolved compounds tended to affect droplet formation similarly," Forbush says.

### Lower volume limit

Acoustic dispensing is most suited to low-volume applications, up to about one microliter. "A fair number of acoustic dispensing applications exist for volumes between one and five microliters," says Jeff Lusén, field application specialist at BioSero (Langhorne, PA), "but above about five microliters it's rare."

Achieving larger volumes through multiple dispenses is also complicated by time. Liquid settling between drops for dimethyl sulfoxide takes about 12 milliseconds, so 10 drops involve 120 milliseconds of settling time, which is reasonable. "But dispensing a thousand drops to reach your volume takes twelve seconds per well, which times 384 wells is a long time," Lusén adds. Compressing the time between droplets is impossible since the liquid must come to mechanical equilibrium before the next drop ejects reliably.

Large-volume applications where acoustic dispensing is valuable are few but significant, mainly related to sequencing (both Sanger and next-gen) and PCR. Lusén recalls a customer with a seven microliter Sanger sequencing assay who, with the limitation of using only one tip, turned to acoustic dispensing because it was in the long run faster than dispensing protocols involving multiple tips. "And there was no cost for tips or wash solvents, and no carryover contamination."

Many users rely on pin tools for dispensing very small volumes. Pin tools are slotted pins of inert construction that pick up and dispense nanoliter-sized droplets by direct contact. Due to their speed, pin tools are

popular in labs that conduct high-throughput screening with DMSO-based solutions. But the pins are nontunable. “Their downsides are fixed volumes, the need for solvent washes, and material carryover,” Lusén says.

Carryover is not much of a problem for bulk dispensing, but in assays of highly potent pharmaceuticals it can skew results when the compound does not completely wash off the pin tool surface. In his own experience (in his previous career) Lusén turned to acoustic dispensing for that very application.

Aside from supra-5-microliter dispensing—for which many applications still exist—Lusén sees no practical barriers from a system or reader perspective for adopting acoustic dispensing. “You might need a special reader if an assay requires it. Or if the destination plate is not a standard SBS (Society for Biomolecular Screening) device, you might require a custom gripper.”

He mentions as an example Bruker’s ground steel MALDI target plate for mass spectrometry sample preparation, typically used for proteins. Another possible hurdle arises when the destination plate falls out of the thickness range of conventional plate handlers and cannot be moved or stacked conveniently.

As mentioned, most plate manufacturers offer plates for inverted microscopy, and small sample droplets will stick through surface tension, upside down, to wells of most sizes in most assays. The exception, which Lusén also related by anecdote, involved a larger diameter well and 200 microliters of media, which did not stay fixed in the bottom of the well.

## Enabling smaller volumes

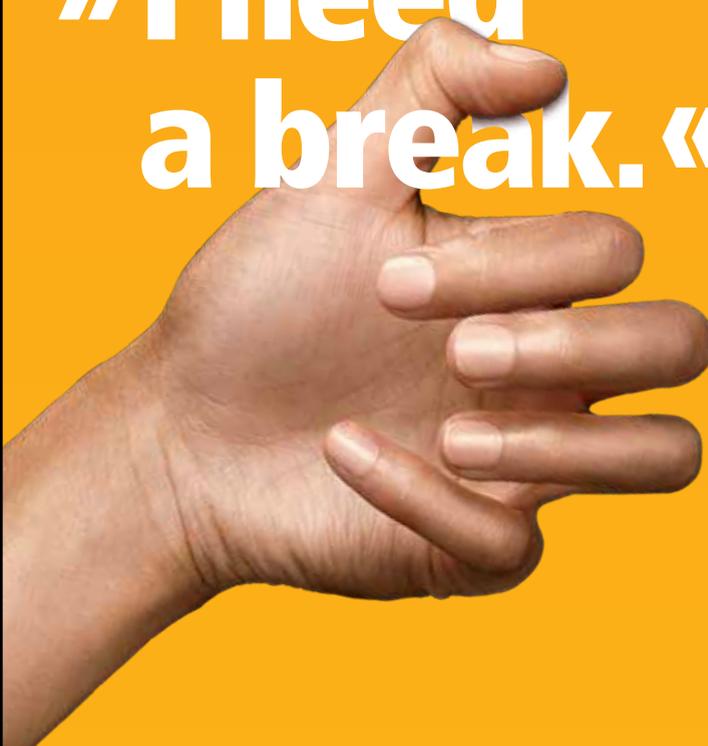
Old-school scientists marvel at the smallness of today’s naked-eye-invisible biological assays. Their value, says Chris Grimley, VP of marketing at Labcyte, extends beyond physical dimensions. “The reagent cost reduction associated with nanoliter-scale assays can be truly game changing. Published data demonstrates that assay volumes can be reduced up to a hundredfold for applications ranging from NGS library prep to DNA assembly for synthetic biology. Cost savings of that magnitude enable projects that previously would not have been feasible. Our Echo liquid handlers don’t just reduce costs, they facilitate new science and the future discoveries that result.”

*Angelo DePalma is a freelance writer living in Newton, NJ. You can reach him at [angelo@adepalma.com](mailto:angelo@adepalma.com).*

FOR ADDITIONAL RESOURCES ON LIQUID HANDLING, INCLUDING USEFUL ARTICLES AND A LIST OF ANUFACTURERS, VISIT [WWW.LABMANAGER.COM/LIQUID-HANDLING](http://WWW.LABMANAGER.COM/LIQUID-HANDLING)

Ergonomic pipettes.  
Listen to your hand.

» I need  
a break. «



**Break the bad habit before your hand's had it.** With ergonomic Sartorius pipettes, you can be sure your hand will make it through the day in good shape. All you need is minimum force to pipette the correct quantities for perfect results – your hand will love it.

**Your hand knows best:**  
**Request your free trial pipette now!**  
[www.sartorius.com/liquid-handling](http://www.sartorius.com/liquid-handling)

#passionforscience  
Discover it. Share it. Love it.



#### Most common problems users experience when using their electrophoresis systems:

Time to results (not quick enough)	<b>53%</b>
Inconsistency in gels	<b>34%</b>
Shelf life is too short for gels	<b>28%</b>
High labor costs	<b>13%</b>
Dangers in handling toxic chemicals to make gels	<b>11%</b>
Buffers heating up too much	<b>9%</b>
Not enough control options in the electrophoresis system	<b>9%</b>
Other	<b>9%</b>

#### Factors that would help users overcome their electrophoresis challenges:

Newer equipment	<b>40%</b>
Better technical support	<b>11%</b>
Better training	<b>9%</b>
Improved maintenance	<b>7%</b>
More staff	<b>5%</b>
Newer accessories	<b>5%</b>
More instruments	<b>5%</b>
Other	<b>16%</b>

## WHAT DO ELECTROPHORESIS USERS HAVE TO SAY?

Electrophoresis relies on a basic process—particles moving in an electric field. Known for more than 200 years, this phenomenon still drives fundamental techniques in many labs and its long history plays a role in the widespread use of the technology. Current interest lies in making the technology faster, more accurate, and more sensitive.

### TOP 9 QUESTIONS

You Should Ask When Buying Electrophoresis Equipment and Supplies

1. How many gels per experiment can you run at once in a single electrophoresis cell?
2. Can you run hand cast and precast gels with the same electrophoresis equipment?
3. Can you blot in the same tank as you run the gels?
4. How fast can you run a set of gels with optimal performance?
5. How fast can you visualize your proteins in the gel?
6. Do you need any special buffers or sample buffer to run your gel?
7. Does a precast gel give you the same separation as a hand cast gel?
8. How fast can you transfer proteins from your gel to a membrane?
9. How efficiently can you transfer your high molecular weight proteins from your gel to a membrane?

### SOME OF THE MOST EXCITING APPLICATIONS

for electrophoresis, as reported by users:

#### Vaccine Analysis

Several vaccines, including the influenza, hepatitis, and polio vaccines, have been purified, processed, and analyzed through electrophoresis. Capillary electrophoresis is an established technique for vaccine analysis, having replaced a variety of traditional methods because it offers greater precision, resolution, linearity, and ease-of-use, and it is also less costly.

#### Short Tandem Repeat Analysis

Short Tandem Repeat (STR) analysis involves amplification of certain regions of DNA by PCR followed by electrophoresis to determine the lengths of short tandem repeats. Forensic scientists commonly use STR analysis to distinguish DNA samples from each other.

➔ For more information on electrophoresis, visit [www.labmanager.com/electrophoresis](http://www.labmanager.com/electrophoresis)

Learn more at [www.labcyte.com](http://www.labcyte.com)

# MOVING LIQUIDS with SOUND

No contact, no tips, no contamination liquid handling

Labcyte Echo® Acoustic Liquid Handlers offer a powerful new way to transfer liquids for life science research. With unparalleled speed, precision, and accuracy, Echo acoustic liquid handling is providing highly efficient solutions for labs around the world in a wide range of applications including personalized medicine, genomics, synthetic biology, and drug discovery.

- Transfer 2.5 or 25 nL increments at hundreds of droplets per second
- Assay miniaturization reduces costs up to 100x
- Precise non-contact transfers increase data quality and reproducibility
- High-speed cherry-picking and transferring from any well to any well
- Significantly lower costs related to tips and consumables

**LABCYTE** ™  
The Future of Science is Sound

© 2017 LABCYTE INC. All rights reserved. Labcyte®, Echo®, and the Labcyte logo are registered trademarks or trademarks of Labcyte Inc., in the U.S. and/or other countries.

FOR RESEARCH USE ONLY. Not for use in diagnostic procedures.



Follow Us on Twitter:  @LabcyteInc

Email Us: [info-us@labcyte.com](mailto:info-us@labcyte.com)

## CHOICES, CHOICES, AND MORE CHOICES

by Angelo DePalma, PhD

Laboratories in the market for casework enjoy numerous options for materials of construction. Least expensive is polymer laminate, typically melamine—a melamine-formaldehyde copolymer used in kitchen tables and counters. Slightly more expensive is high-density polyethylene, which has moderate chemical resistance and is nonabsorbent.

Solid phenolic materials offer the highest chemical resistance, are nonabsorbent, and fall just below epoxy resin materials in cost. According to FORMASPACE (Austin, TX), chemical and temperature resistance are high and moderate for epoxies and phenolics, respectively. Applications for the former include “medical, clinical, and bioscience” whereas the latter are suitable for chemical and industrial use.

### The case for steel

Steel casework sits at the top in every performance and cost category. MultiLab (Spring Lake, MI) calls stainless the “holy grail of industrial aesthetic (sic)

and function” based on its durability, customizability, versatility, ease of cleaning, good looks, and value, but notes that the cost of such installations may be out of reach for some labs. Hence the argument for stainless lab furnishings as an “investment” (as opposed to a consumable purchase) for pharmaceuticals, biosafety work, surgical centers, hospital and animal research, autopsy labs, and food R&D.

Steel’s strength and amenability to specialty coatings is well-known in the kitchen appliance trades. Epoxy-coated stainless steel is easily sterilizable, impervious to most chemicals, and easily decontaminated for work with infectious or radioactive materials.

Since steel is easy to work, fabricators can create almost any design or shape. Seamless joints, rounded edges, and smoothness contribute to cleanability. From MultiLab: “For laboratories that require zero contamination and have to reduce all risk of infection, stainless steel is one of the best solutions out there.”

Lab managers may (or may not) appreciate how stainless steel surfaces blend in with almost any color decor, as well as surrounding equipment. Moreover powder coated steel, which is quite common, is available in many colors to match, for example, a lab’s decor.



FOR ADDITIONAL RESOURCES ON LABORATORY CASEWORK, INCLUDING USEFUL ARTICLES AND A LIST OF MANUFACTURERS, VISIT [WWW.LABMANAGER.COM/LAB-DESIGN-AND-FURNISHINGS](http://WWW.LABMANAGER.COM/LAB-DESIGN-AND-FURNISHINGS)

Ultimately MultiLab's case for stainless rests on cost-efficiency. Stainless steel, according to the company, "lasts longer than any product on the market, requires little to no repairs, and is 100 percent recyclable...[E]ven if a customer spends a bit more money upfront for stainless steel casework, they'll make back that money in what they save on replacement costs and repairs."

"Lab managers may (or may not) appreciate how stainless steel surfaces blend in with almost any color decor."

Note that for a good deal of life science work an easily cleanable epoxy or phenolic work surface sitting atop wooden or plastic cabinetry is perfectly adequate. This combination provides easy cleaning, sufficient resistance to typical biological buffers and reagents, and relatively low cost. In a pinch, surfaces can be further protected by laying down inexpensive plastic-lined absorbent sheets.

### A thing of the past

For decades, composite stone was the most popular chemical laboratory work surface for both open lab benches and fume hoods. Cabinetry was made of coated steel in research labs, and more classical wood in instructional settings. Furniture placement was permanent, and designs incorporated fixed openings for utilities like nitrogen, air, and water. Mario Di Fonte, VP of sales and marketing at Mott Manufacturing (Brantford, ON, Canada), provides a

succinct update and reality check: "Traditional cabinets and casework are a thing of the past. Benches are now more flexible, with suspended cabinetry and utilities feeding benches from above."

It should come as no surprise, therefore, that casework materials of construction should reflect the functional flexibility of modern lab workstations.

Dave Campbell, president of Hemco (Independence, MO), notes that stone work surfaces are rare these days. "Years ago one company sold a popular Portland cement composite material that contained asbestos fibers, but that has obviously gone out of fashion." Also rare are ceramic and soapstone work surfaces.

Flexible, movable casework has not affected trends in materials of construction, says Hemco's Campbell. "Stainless steel and wood are both capable of being modular."

*Angelo DePalma is a freelance writer living in Newton, NJ. You can reach him at [angelo@adepalma.com](mailto:angelo@adepalma.com).*

[www.hatfieldlabfurniture.com](http://www.hatfieldlabfurniture.com)

**HATFIELD**  
Laboratory Furniture

Toll Free  
800 739 9067

### Modular Laboratory Casework and Laboratory Tables

#### HATFIELD offers two series of Laboratory Cabinets.

Our **Premium Series** that feature, sound deadening doors and drawers, stainless steel pulls and hinges, removable back panel to access utilities and integrated toe base with leveling glides.

Drawers feature ball bearing slides.

Cupboards include adjustable shelves and removable pans.

We also offer our **Economy Series** who's items start with the prefix C.

These heavy duty cabinets are extra deep we offer them in both 26" and 30" depths.

They are offered with painted steel hinges and plastic pulls to keep your cost down.

The economy series does not offer the sound deadening design of the premium series.



Many specialty products, fittings and standard products are available

Please call with your requirement

Islands With Modular Uprights and Shelving



Traditional Casework and Wall Units shown with Resin Surfaces and Back Splash



Laboratory Tables including:  
- simple four leg design  
- cantilever design  
- hand crank or electric height adjustable

## WHAT TO CONSIDER WHEN CHOOSING AN ULTRACENTRIFUGE FOR YOUR LAB

by Erica Tennenhouse, PhD

Ultracentrifugation accomplishes faster separations and higher resolution of similarly sized particles than either standard or high-performance centrifugation. This ultrafast technology is ideally suited to a variety of exciting research applications. But with so many highly specialized options available, care must be taken when selecting the right ultracentrifuge for your lab.

### Many uses

“The vast majority of applications that an ultracentrifuge is used for are preparative in nature,” says Phil Hutcherson, global product manager for superspeed and ultracentrifuges at Thermo Fisher Scientific (Waltham, MA). Preparative ultracentrifugation is used to separate and purify small particles for some downstream process.

Hutcherson notes that there are a variety of applications that require preparative ultracentrifugation, from lipoprotein separation to nucleic acid purification and subcellular fractionation. “Modern ultracentrifuges are so advanced that they can also engage in virus particle separation and purification, and have been used in influenza vaccine production,” he says.

One new workflow that Beckman Coulter (Indianapolis, IN) has been focusing on lately is that of exosomes, says Chad Schwartz, the company’s global product manager of analytical ultracentrifugation. These vesicles were once thought to simply contain junk from the cell, but scientists now understand that exosomes are involved in cellular communication, which makes them far more interesting from a research perspective. “Ultracentrifugation is the gold standard method for purifying these exosomes,” he says.

Then there is analytical ultracentrifugation, which is considered an analytical technique because it reveals insights into characteristics like particle size, molecular weight, and stoichiometry. “It’s the exact same box as a preparative ultracentrifuge ... the difference is that it’s equipped with optical systems,” Schwartz explains.

### Think before you spin

When sifting through all of the ultracentrifuge options available, users would be wise to consider several factors, including rotational speed, rotor type, size, and consumables.

The types of particles being separated will dictate the speed required, says Hutcherson. “If, for example,

you need to separate very small particles, then an ultracentrifuge exceeding 100,000 x g will be needed.”

There are several types of rotors that can be used for ultracentrifugation, including fixed angle and swinging bucket, says Stephen Otts, Beckman’s global product manager of ultracentrifugation. While fixed-angle rotors contain openings for tubes at a fixed angle from the central axis, swinging bucket rotors allow tubes to swing outward while they spin.

Ultracentrifuge models come in different sizes. Though larger floor models are common, for labs that are limited on space, Hutcherson suggests that a compact benchtop design might be a better choice.

It is important to think about the consumables available as well. “We have tubes and bottles that support different workflows,” says Otts. Users should consider both how a particular tube will enable them to retrieve their sample and how well the tube is able to withstand high centrifugal forces, he says.

### Ultra-advanced technology

Although ultracentrifugation has been a widely used technology for some time, there have been recent innovations. For instance, Thermo Fisher Scientific has developed an alternative to the traditional metal rotors in the form of their Fiberlite carbon fiber rotors.

“The primary cause of failure of conventional rotors is the damage to their metal surface due to moisture, chemicals, or alkaline solutions that weakens the rotor’s structural integrity,” says Hutcherson. The Fiberlite carbon fiber rotors are corrosion-resistant, effectively removing this hazard. They are also designed to be fatigue-resistant, whereas high rotational speeds and repeat cycles can cause metal rotors to stretch and distort over time.

Beckman has recently come out with its Optima analytical ultracentrifuge, which provides higher resolution than previous instruments. The new technology also allows for multiwavelength analysis, enabling researchers to study complex systems in a single experiment.

Aware of the fact that a centrifuge of any speed is often a shared resource, Beckman has also introduced their Centrifuge Scheduler Software. With this software, users can schedule their time with the centrifuge and guarantee that no one else jumps the queue. The associated MobileFuge app can also be used to control and monitor centrifuges remotely.

*Erica Tennenhouse, technology editor for Lab Manager, can be reached at [etenmenhouse@labmanager.com](mailto:etenmenhouse@labmanager.com) or by phone at 647-500-7039.*

FOR ADDITIONAL RESOURCES ON ULTRACENTRIFUGES, INCLUDING USEFUL ARTICLES AND A LIST OF MANUFACTURERS, VISIT [WWW.LABMANAGER.COM/CENTRIFUGES](http://WWW.LABMANAGER.COM/CENTRIFUGES)

Lab Manager



**GENERICVS**

Many leading biologic medicines are slated to lose patent protection in the coming years, which will create considerable opportunity for both manufacturers and consumers. Like generic drugs, biosimilars can help lower drug costs. However, biosimilars differ from generics in a few key ways, at the most basic level, generics are identical to their reference drugs, whereas biosimilars are only similar to theirs.

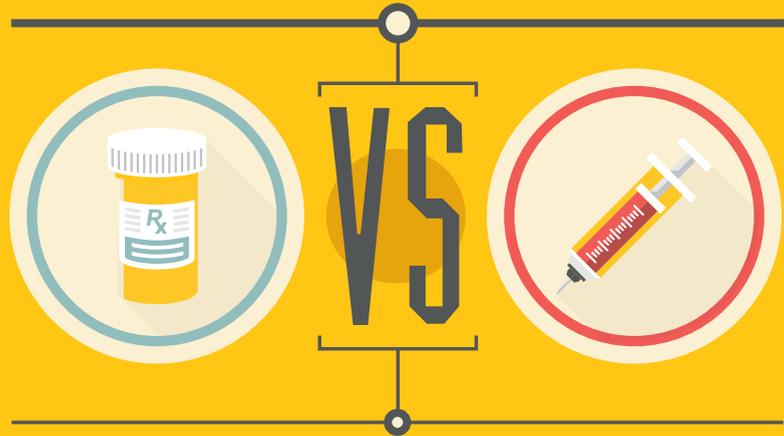
**Learn more about the differences between generics and biosimilars.**

**G** *Generic*: a small-molecule drug that is chemically identical to a brand name drug. **B** *Biosimilar*: a biologic drug that is highly similar to a licensed reference drug.

 <i>Generic</i> : Small	<b>SIZE</b> 	 <i>Biosimilar</i> : Large
 <i>Generic</i> : 150 Daltons	<b>MOLECULAR WEIGHT</b> 	 <i>Biosimilar</i> : 150,000 Daltons
 <i>Generic</i> : Relatively simple	<b>COMPLEXITY</b> 	 <i>Biosimilar</i> : Very complex
 <i>Generic</i> : Relatively stable	<b>STABILITY</b> 	 <i>Biosimilar</i> : Sensitive to handling conditions and storage
 <i>Generic</i> : Lower potential	<b>ADVERSE IMMUNE REACTIONS</b> 	 <i>Biosimilar</i> : Higher potential
 <i>Generic</i> : Produced by chemical synthesis	<b>MANUFACTURING</b> 	 <i>Biosimilar</i> : Produced in living cells
 <i>Generic</i> : Small clinical trials	<b>APPROVAL REQUIREMENTS</b> 	 <i>Biosimilar</i> : Large clinical trials
 <i>Generic</i> : 2-3 years	<b>DEVELOPMENT TIME</b> 	 <i>Biosimilar</i> : 8-10 years

Lab Manager

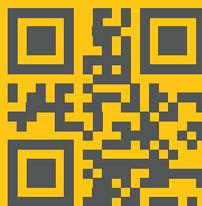
# GENERICVS

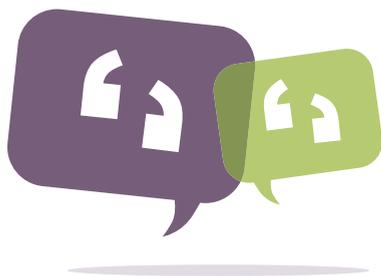


# BIOSIMILARS

DOWNLOAD THE FULL INFOGRAPHIC

[LABMANAGER.COM/GENERICVS-BIOSIMILARS](http://LABMANAGER.COM/GENERICVS-BIOSIMILARS)





Acid types used by survey respondents for microwave digestion:

Nitric Acid	84%
Hydrochloric Acid	76%
Sulfuric Acid	44%
Hydrofluoric Acid	12%
Perchloric Acid	8%
Phosphoric Acid	8%
Borofluoric Acid	4%

Microwave digestion applications as reported by survey respondents:

Analyzing metals	40%
Trace metal analysis	24%
Biological sample analysis	12%
Material analysis	4%
Soil analysis	4%
Oil and lubricant analysis	4%
Other	12%

Nearly 44% of respondents are engaged in purchasing a new microwave digester. The reasons for these purchases are as follows:

Replacement of aging system	36%
Addition to existing systems, increase capacity	24%
First time purchase	21%
Other	12%
Setting up a new lab	3%



# ARE YOU IN THE MARKET FOR A... MICROWAVE DIGESTER?

Microwave-acid digestion is a common sample preparation step for atomic absorption, atomic emission, or inductively coupled plasma analysis of metals. Microwave digestion takes minutes, compared with hours for conventional hot plate digestion. Because it uses high temperature and strong acids—commonly nitric and hydrofluoric—microwave digestion mineralizes any matrix. For example, EPA method 3052, based on microwave digestion, provides total metal analysis from soil, sediments, sludge, oils, plastics, and biological materials.

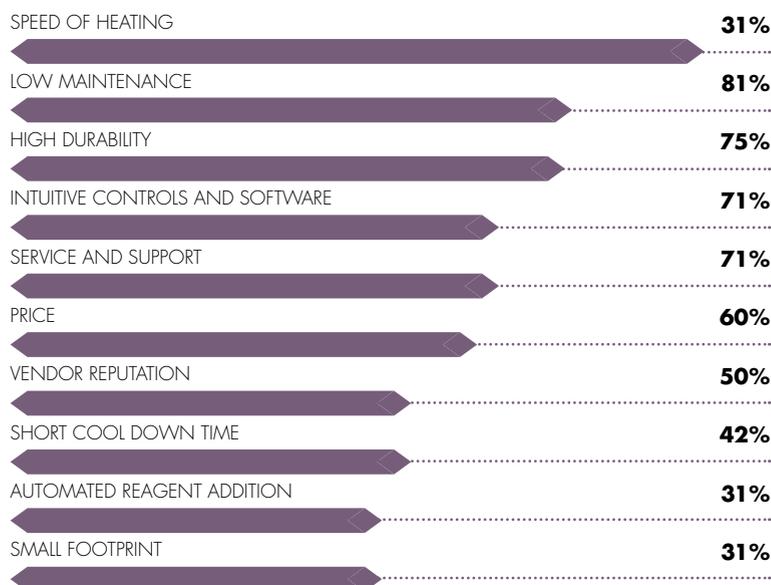
## TOP 5 QUESTIONS

### You Should Ask When Buying a Microwave Digester

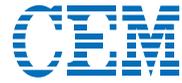
1. What is the system's maximum microwave power output? Microwave energy heats substances quickly to high temperatures. The higher the temperature, the faster and more completely substances are digested. Extractions also need sufficient power, as some solvents can act as a heat sink and are difficult to heat.
2. Can the system monitor and control every vessel? Temperature and pressure monitoring and control are extremely important. Inadequate safeguards can result in damaged vessels and equipment, and a lack of temperature and pressure control can pose a safety hazard to lab personnel.
3. How many samples can be processed per run? Though the number of samples processed is dependent upon your laboratory's needs, planning for growth is always a good idea.
4. Does the company offer free applications support? Do they offer dedicated, direct service support and local factory-trained field service technicians? Dependable applications and service support are essential since you never know what may go wrong.
5. How user-friendly is the system? As with many instruments, if a system is very complicated to operate, it generally becomes either a glorified shelf to store things on or a headache to those having to operate it. The easier a microwave system is to use, the better off you will be. Also make sure the vessels are easy to handle and set up.

## TOP 10 FEATURES/FACTORS

### Respondents Look for When Purchasing a Microwave Digester



➔ For more information on microwave digesters, including useful articles and a list of manufacturers, visit [www.labmanager.com/microwave-digesters](http://www.labmanager.com/microwave-digesters)



# The world's best digestion microwave is better than ever.

[www.cem.com/mars6](http://www.cem.com/mars6)



## iWave

Light Emitting Technology

True internal temperature control  
without probes.



## iPrep

Unmatched Vessel Performance

The highest performing vessel ever  
developed with dual-seal technology.





# WHAT DO **BALANCE** USERS HAVE TO SAY?

Choosing the correct balance for your application, or a series of balances that suit all of your application needs, is the first step in good lab weighing practices. If you choose the correct balance; calibrate it regularly, including any time the balance is moved to a new location; and keep it clean, your balance will reward you with many years of accurate operation.

## Weighing applications, according to survey respondents:

Dynamic Weighing	<b>65%</b>
Differential Weighing	<b>48%</b>
Filter Weighing	<b>34%</b>
Mass Comparison	<b>33%</b>
Pipette Calibration	<b>52%</b>
Other	<b>6%</b>

## Most common problems users experience when using their balance:

The unit does not respond to weight addition	<b>9%</b>
The unit is out of calibration	<b>13%</b>
Display problems	<b>12%</b>
Weight readings do not stabilize	<b>66%</b>
Readings moving only down	<b>7%</b>
Poor repeatability	<b>13%</b>
Cornerload errors	<b>6%</b>
Other	<b>16%</b>

## Factors that would help users overcome their weighing challenges:

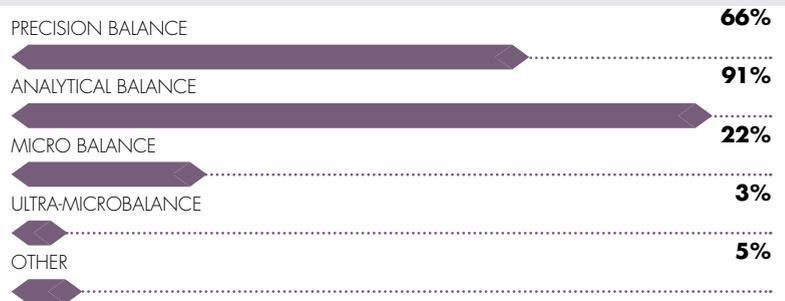
Newer equipment	<b>50%</b>
Newer accessories	<b>14%</b>
Improved maintenance	<b>46%</b>
Better technical support	<b>14%</b>
Better training	<b>31%</b>
Other	<b>17%</b>

## TOP 6 QUESTIONS

### You Should Ask When Buying a Balance

1. What are the heaviest and lightest samples you will weigh (including container weight)?
2. What is the required +/- tolerance of your lightest sample?
3. How many decimal places in grams do you require for the displayed weight?
4. What type of samples will you be weighing and do you need to take into consideration the size of the weighing surface or the securing of a tare container?
5. Is on-site service available from a factory-trained service technician?
6. Do you need to interface the balance to another device such as a computer, printer, or bar code reader?

## Types of laboratory balance used by survey respondents:



For more information on balances, including useful articles and a list of manufacturers, visit [www.labmanager.com/balances](http://www.labmanager.com/balances)





**It all started with an idea...** What if we took our powerful and sensitive ultra-weighing system and approached it with the familiarity and intuitiveness of modern touch-screen devices. And what if we made a balance so easy to use; you would never have to read the manual?

Well, we did.

**The Precisa H Series.** A semi-micro and analytical balance range with touch screen software built from the ground up.

Available exclusively through



Weighing Technology

Contact us at 866-920-3000

[sales@intelligentwt.com](mailto:sales@intelligentwt.com)

[www.intelligentwt.com](http://www.intelligentwt.com)

# TECHNOLOGY NEWS

## ANALYTICAL

### Mass Detector for Flash Chromatography

#### Isolera™ Dalton 2000

- Expands functionality through a wider detection range of ion masses, up to  $m/z$  2000, and new analysis features
- Seamlessly integrated with Isolera™ Spekra flash purification system via the Isolera™ Dalton Nanolink unit, an intelligent sampling device which handles all fluids and synchronization between the two instruments
- Identifies compounds in real time during purification



Biotage

[www.biotage.com](http://www.biotage.com)

### Light Source Lamps for Instrumentation

#### Shimadzu

- JM Science offers Shimadzu deuterium lamps for AA and LC instrumentation
- Designed for maximum, reliable performance
- Typical lifetime of a deuterium lamp is approximately 2,000 hours with a shelf life of up to two years
- JM has an extensive list of cross-references and part numbers from the various instruments designed for deuterium lamp usage



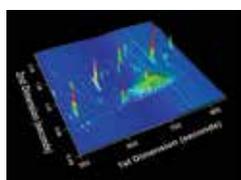
JM Science

[www.jmscience.com](http://www.jmscience.com)

### GCxGC Method Development Tool

#### Simply GCxGC™

- Designed for both the new user looking to get started with GCxGC, as well as for the experienced user who wants to streamline their analysis
- This free tool walks users through the necessary steps of creating a GCxGC method from scratch, or converting an existing 1D GC method to GCxGC
- Includes a helpful "Guide Me" menu



LECO

[www.leco.com/simply-gcxcg](http://www.leco.com/simply-gcxcg)

### Benchtop NMR Spectrometer

#### Spinsolve 80

- The system's higher field strength enables the largest chemical shift spread which, combined with the highest resolution (0.5 Hz/20 Hz), makes it possible to resolve close NMR peaks
- Provides high sensitivity (1% Ethyl Benzene > 200:1 dual channel)
- Through the system's intuitive software, users can perform multiple advanced 2D NMR methods such as COSY, HSQC-ME, HMBC, and more in a single click



Magritek

[www.magritek.com](http://www.magritek.com)

### Core Shell Columns

#### Kinetex 2.6 $\mu$ m Polar C18

- The ninth selectivity in the Kinetex core-shell family
- This stationary phase combines C18 ligands with a polar-modified surface to enable superior retention of polar and nonpolar compounds while ensuring 100 percent aqueous stability
- Provides high efficiency and performance on HPLC systems and potential increases in resolution, sensitivity, and separation speed



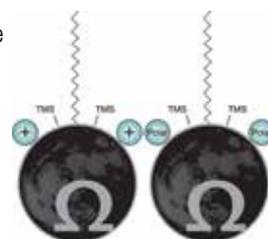
Phenomenex

[www.phenomenex.com](http://www.phenomenex.com)

### Fully Porous LC Columns

#### Luna Omega 3 $\mu$ m Polar C18 & 3 $\mu$ m PS C18

- The Luna Omega Polar C18 stationary phase is a unique, robust selectivity bonded to an innovative silica particle that delivers high loadability and retention for both polar and nonpolar analytes
- New 3  $\mu$ m particle joins the existing 1.6  $\mu$ m and 5  $\mu$ m sizes to provide full scalability from UHPLC to HPLC to preparative chromatography
- The PS C18 delivers two distinct and useful separation mechanisms



Phenomenex

[www.phenomenex.com/lunaomega](http://www.phenomenex.com/lunaomega)

## BASIC LAB

### Krebs Unit Viscometer

#### KU-3

- Offers continuous sensing and display in Krebs units, grams (weight), or centipoise
- Now features a magnetic spindle coupling providing rapid attachment and quick release of the KU spindles
- Provides a measurement range from 40 to 141 KU, 32 to 1099 gm, and 27 to 5274 cP, accuracy to  $\pm 1\%$  of full scale range, and reproducibility to  $\pm 0.5\%$  of full scale range



AMETEK Brookfield

[goo.gl/EVSOOJ](http://goo.gl/EVSOOJ)

### High Efficiency Ozone / UV Sterilizer

#### CoolCLAVE™ Plus

- Provides 20-25x more sterilization power than its popular predecessor (CoolCLAVE™) by using the power of combined UV and ozone cycles plus a new heating function
- Highly effective in keeping sterile, or sterilizing contaminated pipettes, pipette tips, gloves, plates, etc.
- Capable of eliminating more than 98% of common pathogenic organisms (bacteria, fungus, virus) in just 30 minutes



AMSBIO

[www.amsbio.com/CoolCLAVE.aspx](http://www.amsbio.com/CoolCLAVE.aspx)

## 8-Position Parallel Synthesizer

### DrySyn Octo

- An entry-level product for chemists wishing to conduct synthetic reactions under an inert atmosphere with temperature control, reflux, and powerful magnetic stirring
- Accommodates low cost consumable reaction tubes, each with a working volume of 5-6 ml
- The large surface area of these glass reaction tubes enables the DrySyn Octo to be used for air cooled gentle reflux reactions



Asynt

[www.asynt.com](http://www.asynt.com)

## Cutting Mills

### PULVERISETTE 19

- Ideal for size reduction of soft to medium-hard, tough-elastic, and fibrous materials as well as for heterogeneous mixtures
- The entire grinding chamber can be opened easily in seconds and both the rotor and the sieve can simply be removed, making the unit easy to clean
- Features a maximum feed size of 70 x 80 mm



FRITSCH

[www.fritsch-milling.com/cutting-mills](http://www.fritsch-milling.com/cutting-mills)

## Anaerobic Workstations

### Bugbox

- Features a small footprint with 200 x 90mm plate capacity at an affordable price
- Designed specifically to help microbiologists cope with rising workloads and provide the best primary isolation rates
- Interlock system allows simple and fast transfer of 10 x 90mm plates into the anaerobic chamber
- Offers quick and easy access via the Ezee Sleeve Glove port system



Baker Ruskinn

[www.bakerco.com](http://www.bakerco.com)

## Reaction Workstation

### Mya 4

- This 4-zone reaction station offers precise heating, active cooling, software control, and data logging for 24/7 unattended chemistry
- Allows for multiple experiments with individual control in a single compact benchtop system
- A touchscreen Control Pad means chemists can set experimental profiles for each individual zone, set safety limits, view real-time results, and much more
- Offered in partnership with Radleys



Heidolph North America

[www.HeidolphNA.com](http://www.HeidolphNA.com)

## Humidity Test Chamber

### KBF 1020

- Provides 36 cu. ft. of interior volume
- Stainless steel inner chamber is corrosion-free and specially designed to store large test samples efficiently
- Offers significant long-term storage advantages as well as time and cost savings for shelf-life and stability testing, especially in the pharmaceutical industry
- Ensures climatic condition uniformity and maximum unit reliability during continuous operation



BINDER

[www.binder-world.us](http://www.binder-world.us)

## Direct Write E-Beam Tool

### JBX-8100FS

- Introduces the capability of writing ultrafine patterns at a high rate of speed directly onto substrates with minimum idle time during the exposure process
- Maximum scanning speed has been increased to 125 MHz (the world's highest level) for high speed writing applications
- Features two exposure modes to support a range of patterning options, from ultra-fine processing to faster throughput for small-to-mid-size production



JEOL

[www.jeolusa.com](http://www.jeolusa.com)

## Dust Containment Bag

### COILPOD®

- Provides an environmentally-friendly solution for the indoor cleaning of self-contained condenser coil units in plug-in cooling appliances of all types
- Users simply place the bag over the coil structure and then simultaneously supply compressed air and vacuum, e.g., from a standard wet/dry vacuum, through two ports in the bag's surface to remove debris from the coils while vacuuming out of the bag
- Entraps the removed debris during the cleaning operation



CoilPod

[www.coilpod.com](http://www.coilpod.com)

## Portable Chillers

### Iceman SC Series ASL & WSL

- Feature an available fluid temperature range of 5°F to 30°F (-15°C to -1°C)
- Offers users a greater selection for their process cooling requirements
- Provide ½- to 40-Ton chilling capacities
- Offer air-cooled or water-cooled condensing and feature a scroll compressor and highly efficient brazed plate evaporator
- Include a microprocessor-based controller in easily accessible panel



Mokon

[www.mokon.com](http://www.mokon.com)

## Thermal Analysis Platform

### THEMYS

- Available in various platforms: Standard thermogravimetric analysis (TGA), high pressure TGA, simultaneous thermal analysis (STA) TG/DSC, and evolved gas analysis (EGA)
- Designed to provide better experimental control, quality results, versatility, and ease of use
- Offer operating temperatures up to 1750°C at atmospheric conditions or under vacuum, or up to 1200°C under pressures as high as 150 bar (2175 PSI)



Setaram

[www.setaram.com](http://www.setaram.com)

## Undercounter Refrigerators

### TSX Series

- Feature a redundant cooling technology designed to protect medical and research storage while delivering up to less energy, less noise, and more storage capacity
- Do not use a compressor—a variable speed control uses thermoelectric devices in place of compressors, providing ideal conditions for demanding storage applications
- Conditions are monitored and during periods of door openings, temperatures are kept stable without temperature fluctuation



Thermo Fisher Scientific

[www.thermofisher.com/cold](http://www.thermofisher.com/cold)

## Multimode Microplate Readers

### Infinite® 200 PRO

- Series has been updated to even better serve the life sciences market, with a number of new options and configurations designed to provide flexible and user-friendly solutions for entry level research applications
- Now available in six application-focused configurations, allowing researchers to choose the perfect solution for their specific needs and budget today, with the option to upgrade as requirements change



Tecan

[www.tecan.com/infinite200pro](http://www.tecan.com/infinite200pro)

## Dry PTFE Diaphragm Pumps

### DTC

- Used for evacuation of corrosive gases and solvent vapors down to 10 mbar
- Corrosion-resistant
- Chemically resistant—only parts made from PTFE and FPM contact the pumped gases
- Available in four sizes from 20 to 240 liters/min
- Easy to maintain and affordably priced



ULVAC

[www.ulvac.com](http://www.ulvac.com)

## DualBeam Microscope

### FEI Helios G4 DualBeam

- Now available with plasma focused ion beam (PFIB) technology for advanced materials research
- Faster milling capability of the PFIB enables the analysis of a relevant set of features that are too large for conventional gallium (Ga+) FIB
- Includes an advanced and wide range of gas chemistries
- Offers fast and easy guided TEM sample preparation for novice users



Thermo Fisher Scientific

[www.fei.com](http://www.fei.com)

## Carboy Mixers and Agitators

- Designed for high purity applications
- Available for use in buffer prep, media prep, filtration, diagnostics and reagents, and more complex mixing applications
- Offered in USP VI PP non-metallic, can be autoclaved, CIP, COP, magnetic drive agitator, or available as single use mixers
- A variety of materials and options are offered
- Compact and ergonomic



White Mountain Process

[www.wmprocess.com](http://www.wmprocess.com)

## Refrigerated Incubators

### RI-150 and RI-250

- Now available in Europe, Asia Pacific, emerging markets, and Latin America for temperature applications ranging from 4 to 60°C
- Utilize powerful compressor technology designed to provide optimal temperature conditions for applications that require thermal stability and uniformity above, around or below the usual ambient laboratory temperature
- Available in both a benchtop and a more spacious floor-standing unit



Thermo Fisher Scientific

[www.thermofisher.com](http://www.thermofisher.com)

## Focused Ion Beam Scanning Electron Microscopes

### Crossbeam 550

- Features a significant increase in resolution for imaging and material characterization and a speed gain in sample preparation
- Nanostructures such as composites, metals, biomaterials, or semiconductors can be investigated with analytical and imaging methods in parallel
- Allows simultaneous modification and monitoring of samples, resulting in fast sample preparation and high throughput e.g. for cross-sectioning, TEM lamella preparation, or nano-patterning



ZEISS

[www.zeiss.com/crossbeam](http://www.zeiss.com/crossbeam)

## CHEMICALS, KITS, & REAGENTS

### Assay Kit to Measure Mitochondrial Function

#### Mito Stress Test (ACU Format)

- Designed to measure oxygen consumption rate and extracellular acidification simultaneously and in real time under tightly controlled atmospheric conditions using open-flow respirometry
- Designed to work exclusively with microplate readers equipped with an Atmospheric Control Unit
- Optimized using BMG LABTECH's CLARIOstar® microplate reader
- Eliminates the often confounding hyperoxic conditions under which most commercially available, cell-based in vitro assays are conducted



Cayman Chemical

[www.caymanchem.com](http://www.caymanchem.com)

### Plasmid Mini-Prep Kit

- Requiring only 1-3mL of bacterial culture, the kit isolates high-quality plasmid or cosmid DNA for extraction up to 10 kb in length and yields up to 20 µg per preparation
- Features an integrated pH indicator within the lysis buffer, which indicates whether the pH level is optimal for DNA binding
- Also includes neutralization buffer, Rnase A, activation buffer, washing buffer, elution buffer, spin columns, and collection tubes



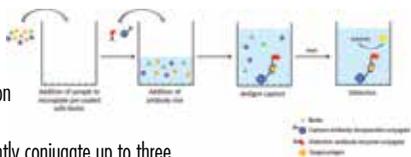
Empirical Bioscience

<http://empiricalbioscience.com>

### ELISA Kit

#### FlexLISA®

- Provides a flexible tool for development and optimization of sandwich ELISA assays
- Allows researchers to covalently conjugate up to three capture and three detection antibodies using Innova's Lightning-Link® technology, with any antibody of their choice
- As each Lightning-Link kit within the FlexLISA kit contains three reactions, multiple conjugation reactions can be run at the same time



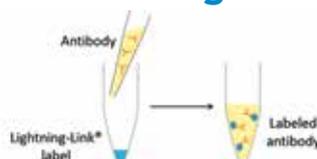
Innova Biosciences

[www.innovabiosciences.com](http://www.innovabiosciences.com)

### Antibody and Protein Labeling Kits

#### Lightning-Link®

- ALEXA Fluor® 488, one of the most popular fluorescent labels used by life science researchers, has now been added to Lightning-Link® kits
- The addition of ALEXA Fluor® 488 now enables easy, direct conjugation of the label to primary antibodies
- Allow for conjugation of antibodies and proteins in less than 20 minutes, using a simple protocol which is free of separation steps



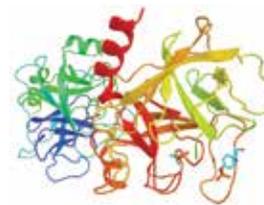
Innova Biosciences

[www.innovabiosciences.com](http://www.innovabiosciences.com)

### Solution Stable Enzyme for Mass Spectrometry

#### SOLu-Trypsin

- Designed to be stable in solution when refrigerated, SOLu-Trypsin can be used immediately without preparation
- Allows excess product to be saved for future use, thus eliminating unnecessary waste and cost
- Formulated with a high-purity recombinant trypsin, free of chymotryptic activity, to ensure high fidelity digestion
- Fits seamlessly into established workflow — no need to modify protocols



MilliporeSigma

[sigma.com/solu-trypsin](http://sigma.com/solu-trypsin)

### Reagents for Proteomics Research

#### ProteoSpec™

- Ensure high-resolution analysis for proteomics and large molecule research
- This line of reagents includes: protein crosslinkers, protein modifiers, LC-MS additives, GC derivatization and molecular biology buffers for high-resolution analysis
- Meet the tightest standards in the industry, resulting in low lot-to-lot variance, something that is crucial in protein testing



RICCA Chemical Company

[www.riccachemical.com](http://www.riccachemical.com)

## INFORMATICS

### Indoor Environmental Monitoring Software

#### Aircuity 2.0

- Ideal for research laboratory facilities looking to significantly reduce energy costs, monitor space conditions and occupant behavior, and achieve quantifiable savings that can be reinvested in research
- Includes the MyAircuity web and desktop apps that, out-of-the-box, deliver actionable insights, transparency, and accountability to building owners and facility managers implementing demand control ventilation
- Also includes physical system upgrades



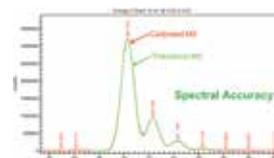
Aircuity

[www.aircuity.com](http://www.aircuity.com)

### Mass Spectrometry Software

#### MassWorks Version 5.0.

- New features and improvements extend the versatility of the software
- Enhancements include integration with NIST GC-MS library search and formula look-up as well as ChemSpider formula look-up to assist in identifying unknown compounds
- Accurate mass calibration (up to 0.005mDa for single quadrupoles) provided by MassWorks allows accurate mass library search filters to improve the confidence and selectivity of the NIST search



Cerno Bioscience

[www.cernobioscience.com](http://www.cernobioscience.com)

PRODUCT SPOTLIGHT

**SIMPLIFIED GENE EDITING**  
NEW ONLINE TOOLS MAKE SOPHISTICATED CRISPR GUIDE DESIGN FAST AND EASY FOR ALL RESEARCHERS

In mid-May of this year, Synthego, a leading provider of genome engineering solutions, announced online CRISPR tools that make accessible over 100,000 genomes for free, fast, and easy target design. The software consists of a guide designer and a design validator and addresses gaps in the CRISPR design process. It also allows both sophisticated and novice researchers to reduce the time it takes to create optimal designs from hours to minutes.



A well designed CRISPR guide is a critical factor in achieving high efficiency gene edits with minimal off-target effects, the company explains. However, to properly design a guide using today's tools requires a significant amount of effort and time. Current design tools are very limited in the number of genomes available, and require multiple time-consuming steps across a complex user experience. As a result, researchers often invest significant time into learning and setting up tools, understanding sophisticated methods for choosing CRISPR targets, and then manually curating CRISPR targets through multiple steps in a sub-optimal design process.

With Synthego's new CRISPR design tool, researchers are able to select a desired gene of interest from a curated list of more than 100,000 genomes, compared to the less than 100 provided by previous tools. The tool then uses several built-in algorithms to instantly generate guide designs and recommendations for the most efficient targets with low off-target effects and highest likelihood to knock out the function of a gene. Finally, the user experience has straightforward workflows for both advanced researchers as well as first-time CRISPR users.

**The new Synthego CRISPR tools are free to use and available at <http://design.synthego.com>**

**LAB AUTOMATION**

**Personal Pipetting Robots**

**OT-One S**

- Starting at \$3,000, the same price as the previous line-up of robots
- Allow users to execute experiments at two times the speed and cut the runtime of a protocol by 50%
- Can fill a 96 well-plate in less than 90 seconds
- Offers an affordable alternative to manually pipetting by hand and frees up scientists' time at the bench



Opentrons

<https://opentrons.com>

**Automated Blood Cell Washer**

**CW3 Cell Washer**

- Specifically designed to enable precise, thorough, reproducible, and rapid blood cell washing of up to 24 tubes in a three-minute run
- Engineered to combine the benefits of efficient performance with user-friendly design and safe operation
- Users can select one of the pre-set programs, allowing for time savings as well as ease of use and sample safety



Thermo Fisher Scientific

[thermofisher.com/cellwasher](http://thermofisher.com/cellwasher)

**LIFE SCIENCE**

**Human Apolipoprotein Panel**

**Bio-Plex Pro™**

- This 10-plex panel allows researchers to rapidly detect and quantify key human apolipoproteins associated with cardiovascular disease, especially within the statin pathway, as well as the widely used biomarker C-reactive protein
- Offers the largest number of apolipoproteins on the market
- Includes four targets (Apo C1, Apo D, Apo J, and Apo H) not found on other multiplex panels



Bio-Rad

[www.bio-rad.com](http://www.bio-rad.com)

**Flow Cytometer**

**ZE5 Cell Analyzer**

- The first expandable flow cytometer; comes with flexible configurations to meet a broad range of experimental complexities and throughput needs
- Can handle anything from low-complexity, two-parameter experiments to high-complexity, 28-parameter experiments
- Accessible for novice users yet powerful enough for the most experienced flow cytometry professionals
- Includes a fully integrated sample loader with the ability to handle tubes or plates without an instrument hardware change



Bio-Rad

[www.bio-rad.com](http://www.bio-rad.com)

**Advanced Flow Cytometry System**

**Aurora**

- Enables a 20+ color capability, using three excitation lasers and 50 channels
- An innovative system design allows for the implementation of more detection channels per laser than conventional flow cytometry systems
- Depending on the laser excitation wavelength, this design permits detection of any fluorescence emission in the 400-900nm range without having to change optical filters



Cytek Biosciences

[www.cytexbio.com](http://www.cytexbio.com)

**Micro-Catheter Pressure Transducers**

**FISO-LS**

- Designed as semi-disposable units for multi-use applications in the life sciences and small animal research
- More robust than disposable catheters in clinical applications
- Features a protected tip, and with proper use and care, the sensor can be used many times
- A complete system consists of a chassis, signal conditioner, and sensor

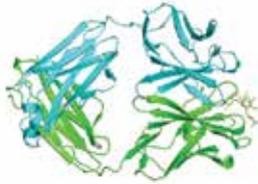


Harvard Apparatus

[www.harvardapparatus.com](http://www.harvardapparatus.com)

## Human Fab Antibody Fragment Library

- A fully synthetic antibody library
- Takes advantage of the most up to date understanding of the human antibody repertoire
- Combines massive sequence diversity and dispersity with high functionality and developability
- Offers the most efficient route to therapeutic antibody lead identification
- Provided in the industry standard phagemid display format to allow for immediate integration in licensees' existing workflows



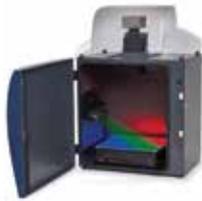
Isogenica

[www.isogenica.com](http://www.isogenica.com)

## Imaging Systems

### G:BOX

- Now utilize high intensity, "H-LED" lighting and updated image capture software
- Guarantee cost-effective imaging and faster workflow with a huge range of fluorescence gel and blot applications
- Feature the option to add a full spectrum of high intensity blue, green, red, and infra-red H-LEDs that are up to 200 times brighter than standard LEDs



Syngene

[www.syngene.com/g-box-chemi-xx6](http://www.syngene.com/g-box-chemi-xx6)

## Capillary Electrophoresis System

### Applied Biosystems™ SeqStudio™ Genetic Analyzer

- Designed to offer a low-throughput, cartridge-based system for Sanger sequencing and fragment analysis
- Supports the growing need for an affordable and easy-to-use CE platform
- Utilizes a unique all-in-one cartridge that combines the capillary array, polymer reservoir, and anode buffer, which vastly simplifies preparation and hands-on processing time
- Features a small footprint, with an onboard computer and integrated touchscreen

Thermo Fisher Scientific [www.thermofisher.com/seqstudio](http://www.thermofisher.com/seqstudio)

## 0.30ml Tube with External Thread

- Enables miniaturization of reaction volume required in genomic applications
- Cuts out intermediate (screening) plates and is more accessible for low volume liquid handlers
- This automation-friendly 0.30ml tube with a working volume of 210µl is ideal for RNA/DNA libraries, unique aliquoting, and storage capacity with multi access
- External thread reduces the chance of cross-contamination while improving sample integrity



Micronic

[www.micronic.com](http://www.micronic.com)

## 384-Well Filtration Plates

- Feature a unique drip geometry which provides unmatched sample recovery
- By re-shaping the drip director, and giving it a compound curve structure, the new filtration plates virtually eliminate the traditional "hanging filtrate" effect where excess filtrate clings by surface tension to the outside of the structure
- Available with four different membranes in a 140µL volume

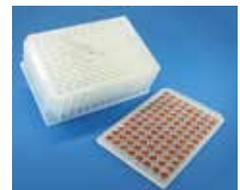


Porvair Sciences

[www.porvair-sciences.com](http://www.porvair-sciences.com)

## Glass Vial Deep-Well Plate

- Designed to ensure that absolutely no extractables or leachates are present in a withdrawn sample, thereby removing the risk of false peaks in sensitive UHPLC and MS applications
- Combines 96 x 1ml tapered or flat bottomed glass vials held firmly in each well of a 2ml 96 deep-well plate
- Less costly than solid glass plates



Porvair Sciences

[www.porvair-sciences.com](http://www.porvair-sciences.com)

## SUPPLIES & CONSUMABLES

### Filtration Plates

#### ISOLUTE® FILTER+

- Designed for the processing of samples prior to UPLC-MS/MS, alongside a diverse range of other filtration applications
- Offer high performance filtration of diverse biological samples, ideal for use with urine prepared by 'dilute and shoot', prior to UPLC-MS/MS analysis
- Each plate contains a 0.2 µm membrane filter for particulate removal, topped by a depth filter to prevent blocking of the membrane



Biotage

[www.biotage.com](http://www.biotage.com)

## Enhanced Validation Tubing Products

### ValPlus™

- Available with an enhanced level of validation documentation, including USP <788> for sub-visible particulates; USP <85> and USP <161> for endotoxin; and ISO 11737 for bioburden
- An annual testing program has been established to routinely monitor compliance to these test specifications
- Now available for select sizes and formulations of industry leading brands, including C-Flex® and Sani-Tech® tubing and hoses



Saint-Gobain

<http://biopharm.saint-gobain.com/en>

## OIL-FREE VACUUM PUMPS FOR GC-MS

**Problem:** A critical feature of every mass spectrometry system is its vacuum apparatus, which creates the vacuum in which ions get separated for counting. Most vacuum systems use oil-sealed vacuum pumps, however, having oil in the system can lead to problems. Pumps can be messy, they can leak and leave oil residues on the ground, and measurement quality can be affected if oil molecules migrate onto the instrument's internal surfaces. Additionally, the oil must be changed and disposed of whenever it becomes discolored—typically every six to 12 months. Furthermore, the cost of disposing the used oil can be more expensive per liter than the original purchase price. Rotary vane pumps also have a tendency to fail due to oil starvation, or from blocked internal lubrication passages, which can result in costly service calls—and hours of unexpected downtime.

**Solution:** Now there's a game-changing solution—a clean, compact, and cost-effective alternative to conventional oil-sealed pumps—the Agilent IDP-3 dry scroll pump. The IDP-3 dry scroll pump is an affordable way to make GC-MS productivity happen and avoid the hassles of oil-sealed pumps once and for all. Dry scroll pumps like this one are also quieter, cleaner, and cheaper to maintain.

This elegantly simple design offers many benefits including lower noise and vibration levels, simple, infrequent maintenance, and the elimination of catastrophic failure modes. In addition, dry pump technology is environmentally friendly, as it eliminates the need for oil disposal—and the risk of handling contaminated oil.

The compact IDP-3 uses scroll pump technology, whereby vacuum is created using a simple dual scroll mechanism—one nested scroll (a spiral-shaped compressor) orbits within the other, creating moving zones of captured gas. Gas enters the scroll pump at the perimeter and is displaced and compressed toward the center hub, where it is exhausted creating low ultimate pressure at high speed.

This unique solution eliminates the many issues surrounding oil pump maintenance such as leaks, disposal costs, mess, and safety concerns. The IDP-3 dry pump only requires replacement of two tip seals and a single O-ring. This simple maintenance procedure is clean and can be accomplished in less than 30 minutes by anyone with modest mechanical skills. The IDP-3 also has a small footprint and lightweight construction, ideal for any instrument configuration, even inside cabinets.

*For more information, visit <http://bit.ly/2lPFbtI>*



▲ Agilent IDP-3 dry scroll pump.

## CAPPLUGS EVERGREEN SPUTOCOL™ COLLECTION SYSTEM



The Sputocol™ sputum collection system from Caplugs Evergreen is a patented, self-contained device used for collecting, transporting and processing potentially infectious specimens. The innovative design allows for easy collection and minimal exposure, safeguarding hospital and lab personnel. Each unit includes a unique funnel-stand-base housing, a freestanding or conical 50 ml centrifuge tube and a patient ID label. Step-by-step instructions are also included.

The large polyethylene funnel on the Sputocol collection system provides a convenient collection area, and the resealable funnel lid allows lab personnel to prepare the specimen for transportation without ever coming in contact with a contaminated area. Sputocol is available with freestanding 50 ml tubes and conical 50 ml tubes. All Sputocol tubes are made from ultra clear polypropylene, which can withstand 6000 RCF and has raised graduation markings.

Use the Sputocol collection system to help minimize exposure to infectious specimen. The inside edge of the funnel brings the specimen directly into the centrifuge tube and prevents contact with the tube rim. The funnel's outside edge is extended to provide a safe area for handling and removing. Pinching the two sides of the forked stand

together holds the tube in place during funnel removal. The bottom lid detaches and functions as a capping device, so that personnel may avoid touching the tube until sealed. Extra-wide base prevents tipping and provides a sturdy, protective carrier for the tube during transit.

Evergreen labware products are now backed by the engineering and manufacturing expertise of Caplugs. Caplugs Evergreen offers more than 1,000 catalog single-use labware products designed for a variety of industries, including Clinical Chemistry, Microbiology, Histology and Life Sciences.

In addition to its catalog products, Caplugs Evergreen can also produce custom solutions with its Class 8 certified Clean Room, six different molding processes and thousands of available material options to meet medical requirements and specifications. A custom solution can specifically cater to medical and laboratory needs by providing traceability, record retention and strict process controls. And as a trusted supplier to more than 2,500 medical customers, Caplugs brings more than 65 years experience to the labware market.



2150 Elmwood Avenue  
Buffalo, NY 14207  
1.800.CAPPLUGS  
[www.evergreensci.com](http://www.evergreensci.com)

# DETERMINING END POINT DURING LABORATORY FREEZE DRYING

**Problem:** Freeze drying, or lyophilizing, is an ideal method for evaporating or drying a heat sensitive sample, but it can be difficult to determine when the freeze drying process has reached complete dryness, or “end point.” Freeze drying in flasks, which is very common in laboratories, can be the most challenging sample type in which to determine end point. The current method requires visual inspection to determine if a sample is fully lyophilized, which often requires a lot of guess work.

If a sample has not reached end point and is removed from the lyophilizer prematurely, the ice will melt and rehydrate the sample cake that has been dried. For many applications, this would require the entire cake to be resuspended and the process to begin all over. Because of the need to start over and the inability to determine when the freeze drying is complete, many freeze dry runs are extended beyond their end point. The unnecessary extension of the freeze dry run wastes precious time.

**Solution:** Fortunately, modern sensor technology can detect the end-point condition for optimum efficiency. The End-Zone™ End Point Detection System by Labconco takes the guess work out of determining when end point is reached during flask freeze drying. Utilizing two vacuum sensors, it detects the end point by comparing the vacuum level of a sample flask to the vacuum level of an empty freeze dryer valve. Because the presence of vapor molecules within the flask raises the vacuum level, the vacuum level inside of a flask that is undergoing lyophilization will be higher than the system’s vacuum level. Once lyophilization has completed, vapor molecules are not present to elevate the vacuum level within the flask, thus the vacuum level in the flask becomes equal to the system vacuum level.

The EndZone Starter Kit requires a freeze dryer with the Lyo-works™ operating system. Lyo-works OS will display an alert when end point has been reached. If the FreeZone is connected to a network, the FreeZone can send an email to notify its user that freeze drying is complete.

The EndZone Starter Kit includes everything needed for end point detection of one flask. For use with more than one flask, the End-Zone Add On Kit is required.

*For more information on the EndZone and FreeZone Freeze Dryers, visit [www.labconco.com](http://www.labconco.com).*



▲Labconco’s FreeZone Freeze Dryer with the End-Zone™ End Point Detection System.

## RAPID IDENTIFICATION WITH POINT-AND-SHOOT SIMPLICITY

Introducing the new Thermo Scientific Nicolet iN5 FTIR Microscope for QA/QC



Even the smallest of problems in your manufacturing can cost you time and money. Small contaminants and defects can lead to quality problems that may result in production line shut downs and expensive product recalls. When these issues arise, you need a tool to give you expert answers fast—without the need for an expert. The **Thermo Scientific™ Nicolet™ iN™5 FTIR microscope** is so intuitive and easy to use; you can get answers in minutes.

### Walk-up Simplicity

- **Easy**—as simple to use as a common stereo microscope
- **Fast**—point-and-shoot operation means you can get the answers you need in minutes
- **Reliable**—sophisticatedly simple design for maintenance-free operation

### See it. Scan it. Solve it.

- **See it**—permanently-aligned optics, high-powered LED illumination, and binocular and video viewing options provide you with a clear image of your sample.
- **Scan it**—multiple collection modes (transmission, reflection and ATR) allow you to quickly obtain high quality data from your sample.
- **Solve it**—with Thermo Scientific™ OMNIC™ software, you can identify your sample with extensive databases in real-time, for quick and confident answers.

### Applications

- **Food safety**—with its rapid, spot-check contaminant identification, the Nicolet iN5 FTIR microscope helps to ensure product quality and avoid production line downtime.
- **Manufacturing**—the reliable Nicolet iN5 microscope is built to handle the demands of the non-stop industrial production line to help meet quality standards and prevent costly product holds or recalls.
- **Academia**—designed for easy operation, the Nicolet iN5 FTIR microscope inspires confidence for first time users, helping prepare students for the technology they will encounter when they enter the workforce.

Designed with the busy lab technician in mind, the Nicolet iN5 FTIR microscope can begin solving everyday microscopic identification problems minutes after installation. With its walk-up and use simplicity and reliable design, the Nicolet iN5 microscope will allow users to get answers for years to come. In addition, you can rely on our world-class service and support programs to keep your maintenance costs low and your productivity high.

Learn more at [www.thermofisher.com/iN5](http://www.thermofisher.com/iN5)

**ThermoFisher**  
SCIENTIFIC  
[www.thermofisher.com/iN5](http://www.thermofisher.com/iN5)

## STARLINE PLUG-IN RACEWAY® – For Flexible Lab Power



**STARLINE Plug-In Raceway®** is the next generation in raceway systems, created to meet the ever-changing power distribution and data-comm needs of retail, labs, data center and higher education customers.

STARLINE's innovative design offers a flexibility that no other product on the market offers – the ability to add or relocate plug-in modules anywhere on the raceway quickly and easily, eliminating the time and cost needed to reconfigure circuits, receptacles and wiring. Insulated copper bus bars are preinstalled in the raceway sections. Then, with STARLINE Plug-In Raceway, you simply snap the pre-assembled plug-in modules into place on the raceway backplane and the connection to power is made automatically without having to interrupt power.

STARLINE Plug-In Raceway not only offers flexibility and low cost of ownership, additional benefits are:

**Reliability** – If you know the name STARLINE, you know that reliability is the backbone of design criteria for all of our systems. This system is tested to meet NEC, IEC and UL standards and has the ETL mark. Joints and plug-in units require no maintenance.

**Aesthetic Appeal** – The electrical raceway is built with a smooth aluminum finish and its compact design requires minimal space. STARLINE Plug-In Raceway is available in white, black or silver. Custom colors are available upon request.

**Flexibility and Scalability** – STARLINE Plug-In Raceway is an investment that allows you to expand, reconfigure or relocate the system anywhere you need power—improving your ability to meet future changing facility needs and making it one of today's most flexible products on the market.

**Reduced Overall Costs** – STARLINE Plug-In Raceway makes installation quick and easy, and lowers costs because it takes about one third less time to install, so labor costs are cut dramatically. Also, the modules are so easy to add, that an electrician is not needed.

**Safety and Convenience** – Allows the user to avoid large panel boards in a remote location and has greater flexibility without the confusion of determining what breaker corresponds to which outlet.

### STARLINE Plug-In Raceway Common Applications:

**Labs – Medical/Pharmaceutical** – Designed to provide reliability, STARLINE Plug-In Raceway helps labs and hospitals run at peak efficiency. And the flexibility of STARLINE Plug-In Raceway allows you to meet the constant changes a lab presents.

**Education** – STARLINE Plug-In Raceway has a role in facilities all over campus, from cafeterias, labs and vo-tech classrooms, to stadiums, auditoriums and theaters.

**Healthcare** – The flexibility of the Plug-In Raceway product, as well as the circuit protection each plug-in unit provides, makes it ideal for healthcare environments.

**Data Centers** – Downtime at data centers can be costly. That's why STARLINE Plug-In Raceway is preferred at data centers and mission critical facilities that need the ability to add power, without shutting off power.



To find out if STARLINE Plug-In Raceway is the right fit for your facility, visit [www.starlinepower.com/raceway](http://www.starlinepower.com/raceway).

## NEW IsoMist XR Provides Improved Analytical Performance for all ICP-OES and ICP-MS Applications

To meet the demand for a reliable and convenient temperature controlled cyclonic spray chamber Glass Expansion developed the IsoMist™ in 2007. On the 10th anniversary of the IsoMist release, Glass Expansion is proud to present the all-new IsoMist XR™.

The IsoMist XR incorporates an improved thermodynamic design, providing an extended temperature range and faster equilibration so that your target temperature is attained more quickly. The spray chamber temperature of the IsoMist XR is accurately controlled using a multi-stage Peltier device, with a range of -25 to +80 °C in increments of 1 °C and an unmatched accuracy of +/- 0.1°C.

### IMPROVED PERFORMANCE

The temperature of a sample introduction system has a profound effect on ICP-OES and ICP-MS performance. Adding the IsoMist XR guarantees optimum performance for any ICP-OES and ICP-MS application.

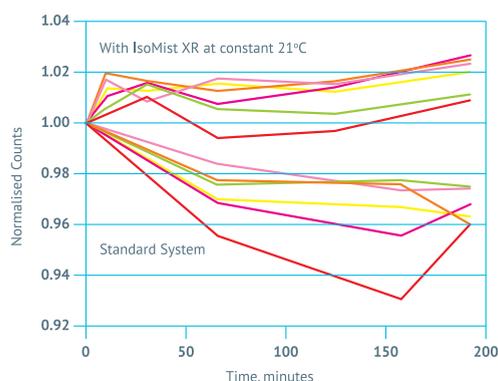


Figure 2. Effect of IsoMist XR on ICP stability at 21 °C.

Maintaining a constant temperature with the IsoMist XR improves analytical reproducibility and accuracy, enhances throughput and lowers operating costs by reducing the need to re-run samples due to instrument drift.

Using the IsoMist XR spray chamber at sub-ambient temperature reduces sample transport to the plasma. This results in lower oxide formation and reduced polyatomic interferences, improving accuracy and detection limits for ICP-MS applications.

The extended temperature range makes the IsoMist XR the perfect tool for analyzing volatile solvents. With the ability to maintain a temperature of -25 °C, the IsoMist XR allows for the



Figure 1. Glass Expansion IsoMist XR

direct analysis of naphtha without dilution resulting in higher intensities, better precision, and higher accuracy.

The sensitivity for many analyses can be enhanced by operating the spray chamber at elevated temperatures. For example, the IsoMist XR showed improved accuracy and signal intensity for precious metals at a temperature range of 30 to 45 °C. Heating the spray chamber also improves the analysis of viscous samples such as lubricants and edible oils, in addition to limited sample volumes.

### UNMATCHED HIGH QUALITY DESIGN

The IsoMist XR comes standard with Glass Expansion's proven Twister cyclonic spray chamber encapsulated with a temperature conductive resin to provide a uniform spray chamber temperature from top to bottom and an air tight fit within the module. These features allow for a stable temperature to be maintained with an unmatched accuracy.

Glass Expansion's proprietary Helix o-ring free nebulizer interface eliminates sample contamination and ensures easy nebulizer removal. This zero dead volume nebulizer interface reduces carry-over, improves washout between samples and a built-in positive stop ensures optimum and reproducible nebulizer insertion depth for consistent nebulizer to nebulizer performance.

The IsoMist XR is compatible with interchangeable glass, quartz and PFA cyclonic spray chambers, offering the utmost flexibility and optimum setup for any matrix. For maximum convenience, the IsoMist XR can be controlled via a USB cable or wirelessly with a Bluetooth interface kit.

The IsoMist XR is an elegant, compact, stand-alone system compatible with any ICP-OES or ICP-MS instrument. Learn more at [www.geicp.com/IsoMistXR](http://www.geicp.com/IsoMistXR)



4 Barlows Landing Road • Pocasset, Massachusetts • 02559

Phone: 508-563-1800 • Fax: 508-563-1802 • [geusa@geicp.com](mailto:geusa@geicp.com)

[www.geicp.com](http://www.geicp.com)



ASK LINDA

# GETTING NEW HIRES UP TO SPEED

**QUESTION:**

Dear Linda,

I am the managing director of a lab that specializes in food analysis. A number of recent university graduates entering our workforce are poorly prepared and even less motivated. There is also a fair amount of staff turnover within the first two years of hire because new recruits, many of whom are just exploring, typically use this period to decide whether they have chosen the right field.

Any suggestions for getting these new hires up to speed quickly and keeping them motivated?

Thanks.

Martin

**ANSWER:**

Dear Martin,

This is a problem that many lab managers face and the solution to which is not always straightforward. But I would begin by developing a good mentoring program. Match new hires with mentors who:

- Are subject matter experts in their given areas.
- Have strong people skills and are willing to provide constructive criticism and guidance.
- Understand how to motivate people, get to know their shortcomings, and help them with solutions.
- Will perform regular performance reviews in which there are mutually defined goals and open communication.
- Can help promote and encourage new hires' professional development.

Cheers,

Linda

## HAVE A QUESTION FOR LINDA?



**EMAIL HER AT:**  
*LINDA@labmanager.com*

To learn how Linda solves technological challenges in her lab, see our videos.



### IS IT TIME TO REPLACE YOUR WATER ASPIRATOR?

Find out the real costs of using a water aspirator for vacuum production.

[LabManager.com/water-aspirator](http://LabManager.com/water-aspirator)



### THE ADVANTAGES OF A GAS SUBSCRIPTION

Evaluating a gas subscription service for your lab.

[LabManager.com/gas-subscriptions](http://LabManager.com/gas-subscriptions)

## ADVERTISER INDEX

Company	URL	Page
Across International	www.acrossinternational.com	38
Adam Equipment Inc.	www.adamequipment.com	41, 85
Agilent Technologies	www.agilent.com	88
Anton Paar	www.anton-paar.com	19
Biosurplus	www.biosurplus.com	29
BrandTech Scientific, Inc.	www.brandtech.com	23
Cannabis Science Conference	CannabisScienceConference.com	28
CEM	www.cem.com	69
Clippard	www.clippard.com	33
Conquer Scientific	www.conquerscientific.com	85
Eppendorf	www.eppendorf.com	2
Federal Equipment Company	www.fedequip.com	85
Glass Expansion	www.geicp.com	55
Hamilton Company	www.hamiltoncompany.com	5
Hatfield Laboratory Furniture	www.hatfieldlabfurniture.com	65
Huber USA Inc.	www.huber-usa.com	9, 15
INTEGRA	www.integra-biosciences.com	35
Intelligent Weighing Technology	www.intelligentwt.com	71
International Equipment Trading, Ltd.	www.ietltd.com	31
KNF Neuberger Inc.	www.knfusa.com	44
Labconco	www.labconco.com	3
Labcyte Inc.	www.labcyte.com	63
LECO Corporation	www.leco.com	13
Metrohm USA Inc.	www.metrohmusa.com	40
Miele Inc.	www.miele-pro.com	18
NuAire Inc.	www.nuair.com	45
Opentrons	www.opentrons.com	37
Panasonic Healthcare	www.panasonic-healthcare.com	7
Sartorius AG	www.passionforscience.com	27, 61
Shimadzu Scientific	www.ssi.shimadzu.com	43
Summitmeasurement.net	www.summitmeasurement.net	70
Thermo Fisher Scientific Inc.	www.thermofisher.com	47, 49
Universal Electric	starlinepower.com	11
Velp Scientifica SRL	www.velp.com	85
Watson Bio Lab	www.watsonbiolab.com	34

The Advertisers Index is provided as a reader service. Although every attempt has been made to make this index as complete as possible, the accuracy of all listings cannot be guaranteed.

**Independence Deals**

CEM Microwave Peptide Synthesizer  
Dofiran Phoenix 8000 TOC Analyzer  
Dionex Ultimate 3000 HPLC

**877-9-CONSCI**      www.conquerscientific.com  
info@conquerscientific.com

**Federal Equipment Company**

PHARMA    CHEMICAL    PLASTICS / RUBBER    PACKAGING  
FOOD & BEVERAGE    UTILITIES    TRAINING

When you think equipment, Think **Federal Equipment**

216.271.3500  
fedequip.com

### BRILLIANT PRECISION

Eclipse lab balances from Adam Equipment bring distinction and performance to any lab.

- Large LCD readout ensures ultimate visibility
- Capacitive touch keypad provides uncomplicated navigation
- USB and RS-232 interfaces enable easy connectivity

To learn more about how Eclipse balances can enlighten your labwork, visit [www.adamequipment.com](http://www.adamequipment.com)



**Contact: Adam Equipment**  
[www.adamequipment.com](http://www.adamequipment.com)



### VELP SER 158 SERIES FULLY AUTOMATIC SOLVENT EXTRACTOR

Five-times faster than traditional Soxhlet

State-of-the-art technology, premium materials, intuitive UI for accurate and precise fat extraction and sample preparation in a wide range of applications.

- 3 or 6 positions available
- The ControlPad controls up to 4 SER 158 units independently
- Independent heaters switch on – off and final auto-lift of the cups
- Automatic results calculation and storage



**Contact: VELP Scientific, Inc.**  
[velpusa@velp.com](mailto:velpusa@velp.com) - phone +1 631 573 6002



# LAB MANAGER ONLINE

We look back at our web content since the June issue and look forward to what's in store for the upcoming August issue.

## 1 Salary & Job Satisfaction and Readership Surveys Are Now Live

With our annual Salary & Job Satisfaction and Frost & Sullivan readership surveys now open, this is your chance to let us know how you feel about your job as a lab professional, and how well we're doing in helping you run your lab like a business. Learn more about the benefits of these surveys and where you can take them on our website.

Read more at [LabManager.com/surveys-2017](http://LabManager.com/surveys-2017)

## 2 Trending on Social Media: Requirements for Eyewash and Safety Showers

As of June 15th, *Lab Manager's* top June issue article posted to social media was our Health & Safety article on eyewash and safety showers. This article shares the key steps to follow to keep this emergency equipment functioning properly in the laboratory, along with OSHA and ANSI requirements.

Read more at [LabManager.com/eyewash-safety-showers](http://LabManager.com/eyewash-safety-showers)

## 3 Most Popular Webinar

Last month's top webinar on LabManager.com with 310 registrants was "Complying with the New USP General Chapter on Analytical Instrument Qualification" presented by Paul Smith, global strategic compliance specialist at Agilent Technologies. As the title suggests, this webinar shared what the USP chapter contains and how to comply with the new requirements. Though it ran on May 11th, you can still catch it on demand at the link below.

Read more at [LabManager.com/USP-compliance](http://LabManager.com/USP-compliance)

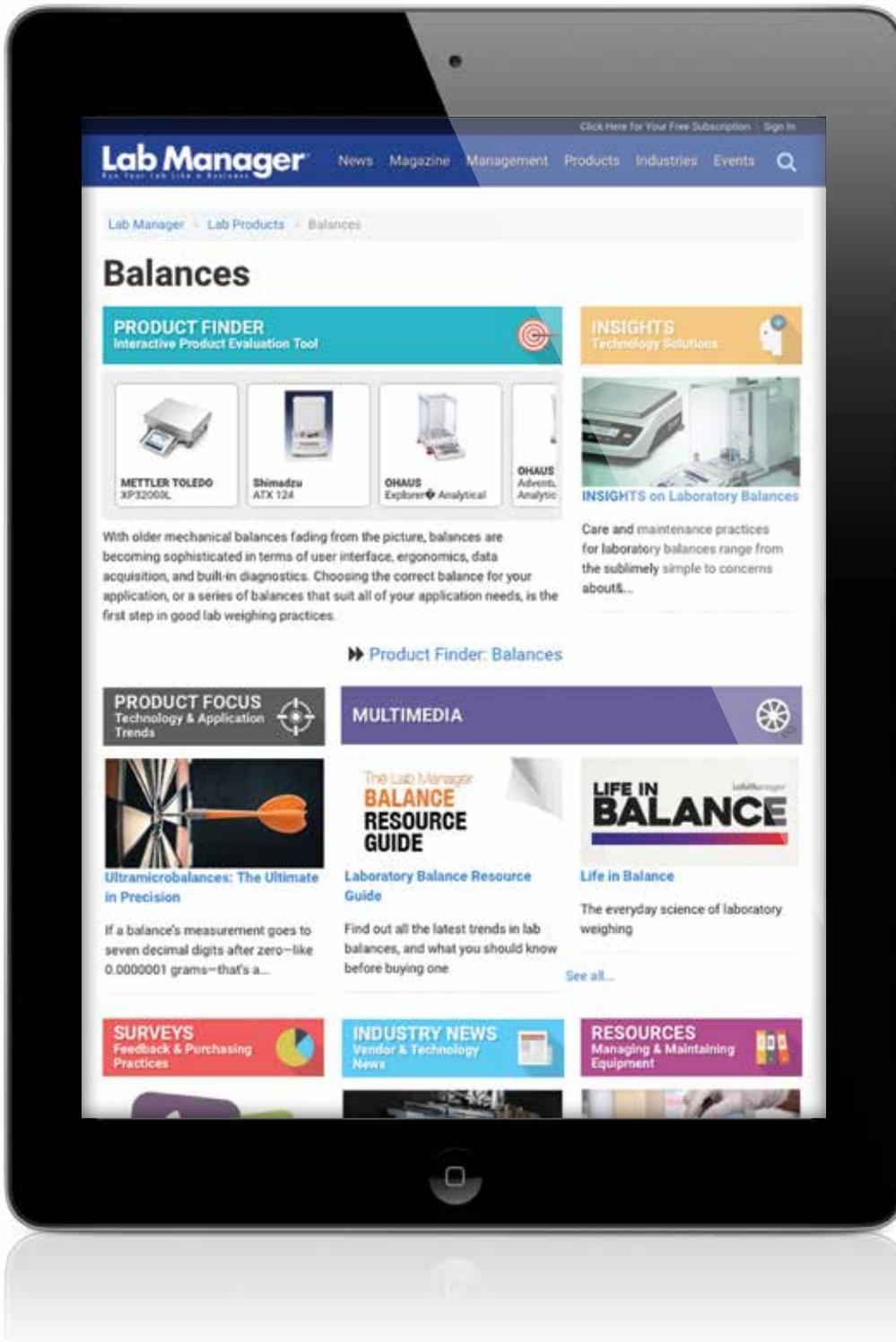
## NEXT ISSUE ➡

### Product Resource Guide 2018

This year's edition of the guide will bring back refreshed versions of our popular "Questions to Ask" lists for buying various types of lab equipment, safety tips for the 35 main product categories included in the guide, and helpful links to related content on our site, including our latest infographics and Linda videos. Also look for enhanced features online as we improve the digital version.



LabManager.com



From Autoclaves to Water Purification Systems,  
the NEW *Lab Manager* Product Pages have you covered.

**Lab Manager**  
Run Your Lab Like a Business



WE LIVE **EFFICIENCY**

# NEW **PURIFICATION TEAM**

Introducing the new Agilent InfinityLab LC Purification Solutions! A complete and scalable portfolio based on a single platform gives you the choice to tailor a system to meet your lab's current and future needs. Team up with Agilent and get on top of your analytical and preparative-scale LC purification challenges.

Live efficiency. Live purification.

[www.agilent.com/chem/livepreplc](http://www.agilent.com/chem/livepreplc)  
[#WeLiveEfficiency](#) [#EfficientUHPLC](#)



© Agilent Technologies, Inc. 2017