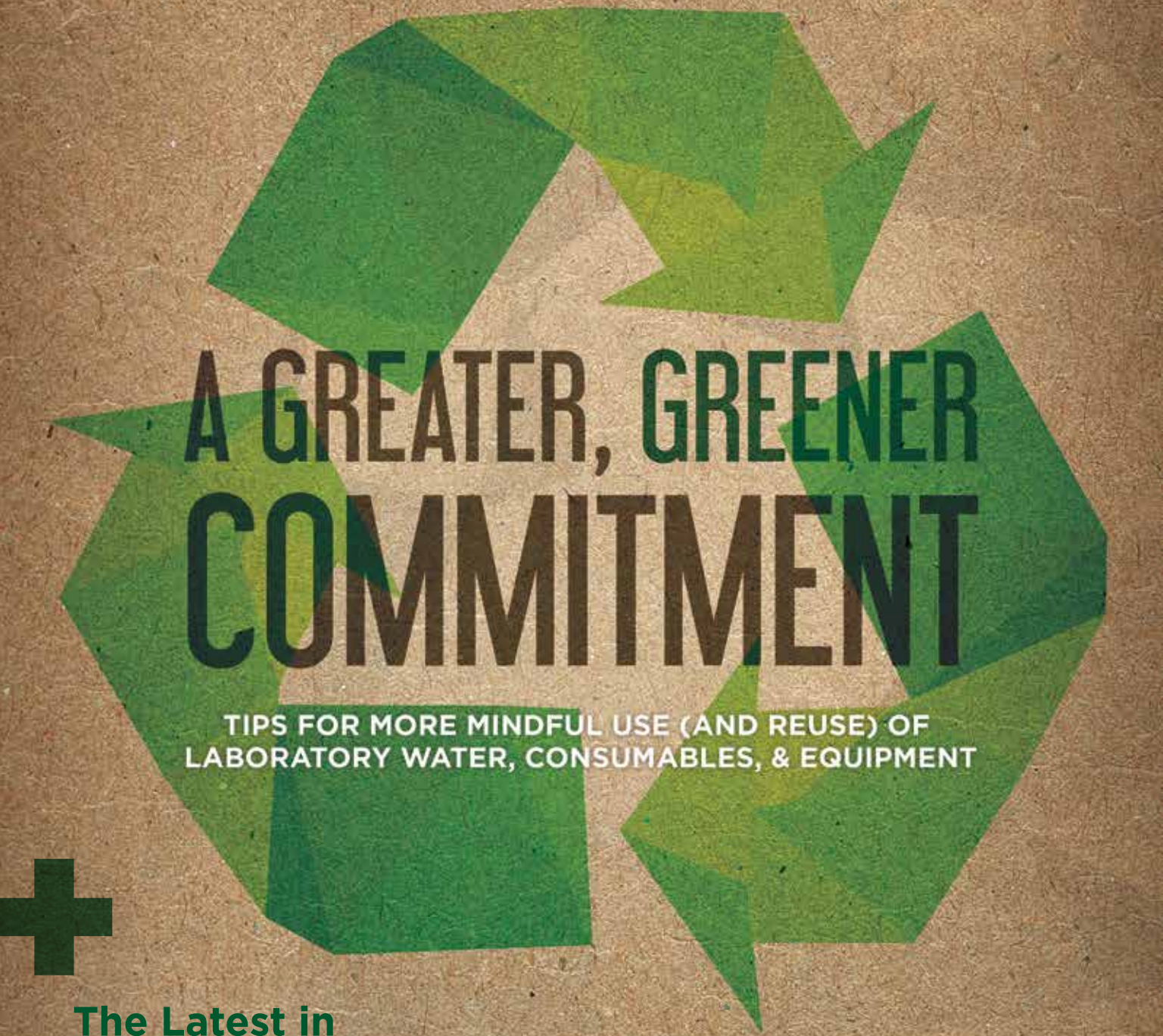
April 2016
Volume 11 • Number 3

Lab Manager®

Run Your Lab Like a Business

LabManager.com



A GREATER, GREENER COMMITMENT

TIPS FOR MORE MINDFUL USE (AND REUSE) OF LABORATORY WATER, CONSUMABLES, & EQUIPMENT

The Latest in Field-Worthy Instruments

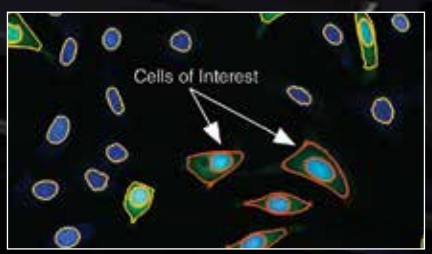
Insights on 3D Cell Culture and Organs-on-Chips

LIONHEART FX

automated live cell imager

Augmented Microscopy™

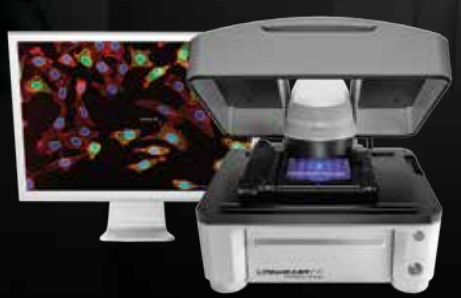
capture ▶ analyze ▶ annotate ▶ video



Cellular compartments are automatically segmented and analyzed. Annotation tools are available.

Includes temperature, gas, humidity control and a movie maker for live cell time-lapse imaging.

Lionheart™ FX Automated Live Cell Imager enables superior digital microscopy with high resolution images up to 100x. From simple fixed cell assays and slide scanning to advanced, environmentally controlled time-lapse movies and 3D spheroid formation imaging, Lionheart FX and Gen5 3.0 Software provide qualitative and quantitative data in a compact automated microscopy system.
Visit **www.lionheartfx.com**



Think Possible

BioTek®

www.biotek.com

STARLINE®
PLUG-IN RACEWAY

Your facility plans were finalized 10 months ago.

But your power needs just changed 10 minutes ago.

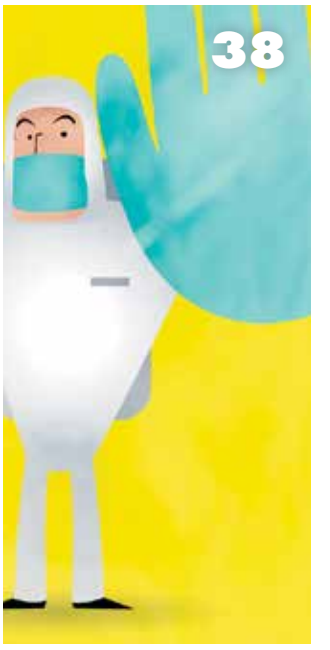
The only certainty for your facility is that your power requirements are going to change. That's why STARLINE Plug-In Raceway has created a flexible system that can change just as quickly. STARLINE Plug-In Raceway enables you to easily add or relocate plug-in modules anywhere on the raceway in seconds, with multiple options for outlets, datacom channels and real-time monitoring. **To learn more, visit StarlinePower.com.**

Lab Manager®
Run Your Lab Like a Business

April 2016

contents

LabManager.com



STARLIMS

Abbott

5 WAYS TO TRANSFORM YOUR LABORATORY

Information is your lab's greatest asset. Put it to work with a powerful LIMS that guarantees data integrity, drives innovation and growth for lab excellence.

STARLIMS solution provides the flexibility and configuration you need to take on the challenges of today and seize the opportunities of tomorrow.

CHOOSE TRANSFORMATION™ abbottinformatics.com

USA
Tel: +1 954 964 8663

GERMANY
Tel: +49 2302 915 244

UNITED KINGDOM
Tel: +44 (0) 161 711 0340

FRANCE
+33 1 61 37 02 00

NETHERLANDS
Tel: +31 72 511 8100

SPAIN
Tel: +34 91 663 67 64

AUSTRALIA
Tel: +61 3 9670 0678

ASIA PACIFIC
Tel: +852 2793 0699

LATIN AMERICA
Tel: +1 954 964 8663

CANADA
Tel: +1 888 455 5467

4000 Hollywood Blvd, Suite 333 South, Hollywood, FL 33021-6755 USA

April 2016
laboratory product reports
LabManager.com

Lab Manager
Run Your Lab Like a Business

A MORE INTERACTIVE PRINT EXPERIENCE

This month, you'll notice something different in some of our articles—the addition of QR codes. These link you to additional content on our website that we think will complement what you're reading in our print issue, so if you happen to have your phone or mobile device handy, you can give the QR code a quick scan for extra information on the topic. Just download your favorite free QR code scanner (if you don't have one on your device already) and get scanning for videos, articles, and other LabManager.com media related to the print article you're reading.

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.

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.

BPA WORLDWIDE BUSINESS

DEPARTMENTS

IT'S MORE THAN A CENTRIFUGE

IT'S AN EXCELLENT CUSTOMER SUPPORT EXPERIENCE

Beckman Coulter delivers support, training, and world-class service when you need it. Highly knowledgeable service professionals solve your problems quickly and efficiently—so you can focus on critical tasks.

Learn more about the Beckman Coulter Service team at
Info.beckmancoulter.com/CentrifugeService

**Image is actual Beckman Coulter customer support center*

BECKMAN COULTER
Life Sciences

think again

Having discussed "green" laboratory initiatives in every April issue of *Lab Manager* for the past four years, one might think there would be nothing new to say on the subject. But think again. Beyond obvious environmentally conscious practices such as turning off lights and electrical devices when not in use, exploring more sustainable lab design, choosing more energy efficient equipment, and better educating your staff about good "green" practices, this month's cover story goes even farther. According to author Allison Paradise, executive director of My Green Lab, there has recently been a rise in "innovative, cost-effective solutions for improved laboratory sustainability, solidifying a permanent and much-needed shift in how scientists think about their labs as well as their labs' impact on the planet." This year we look more closely at the use and reuse of laboratory plasticware, ways to further improve water usage and conservation, and the push toward laboratory equipment and instrumentation sharing. Turn to page 10 to find out more.

This April Earth Month issue also looks at the role that a well-designed water purification system can play in reducing a lab's environmental footprint. "Choosing more sustainable water purification technologies and solutions will ensure long-term conservation of resources, less environmental waste, and long-term cost savings," say the authors of this month's Business Management article, "Make Every Drop Count." Turn to page 22 for the details.

Another sort of environmental issue is addressed in our Health & Safety article this month, that being your lab's indoor air quality. In "Is This Building Making Me Sick?" (page 38), author Vince McLeod offers up guidelines for avoiding and minimizing the negative impact of poor indoor air quality often caused by building renovation projects or adjacent new construction.

For researchers involved in environmental analysis—be it water, soil, or air— the use of field instruments has become essential to their work. Tools such as environmental meters, portable GCs, and NIR spectroradiometers find welcomed application in those areas. However, these tools and others are now making their way into industrial and clinical applications as well. For all the latest in handheld analytical instruments, check out "Out Here in the Field" on page 34.

At the far opposite end of the environmental research equipment spectrum is this month's "Labs Less Ordinary" (page 18), which showcases the Gulfstream-V HIAPER atmospheric research jet. As opposed to lightweight and portable, this "lab" can carry 5,600 pounds of scientific payload and analyze ambient air at flight level in real time, depending on what techniques are being used.

In addition to all of our "green" topics this month, there is a wealth of technological and instrumentation information as well. Please take a few minutes to explore the issue to find what best suits your research and management needs.

Here's to spring.

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
Trevor Henderson
thenderson@labmanager.com
888.781.0328 x291

assistant technology editor
Ryan Ackerman
rackerman@labmanager.com
888.781.0328 x297

contributors
Angelo DePalma, PhD
Sara Goudarzi
Tanuja Koppal, PhD
F. Key Kidder
Vince McLeod, CIH
Bernard Tulsi
Mike May, PhD

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
info@labmanager.com

advertising account managers
June Kafato
Key Accounts
junek@labmanager.com
705.812.2332

Larry Frey
Southeast, Midwest & West
larry@labmanager.com
845.735.5548

Alyssa Moore
Mid-Atlantic/International
amoore@labmanager.com
610.321.2599

Stephanie McFadden
Northeast/Canada
smcfadden@labmanager.com
888.781.0328 x300

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

PolyScience®
Temperature Control Solutions

Delivering the ultimate in Temperature Control Solutions® since 1963.

For five decades, PolyScience has responded to the needs of customers by providing innovative Temperature Control Solutions®. The award-winning product line includes circulating baths, immersion circulators, non-stirred water baths, recirculating chillers and coolers. Find the perfect product for your application with our interactive Product Finder, available at:

www.polyscience.com

A GREATER, GREENER COMMITMENT

TIPS FOR MORE MINDFUL USE (AND REUSE) OF LABORATORY WATER, CONSUMABLES, & EQUIPMENT

by Allison Paradise

Laboratories present one of the greatest challenges and opportunities in sustainability. Due to energy-intensive equipment, round-the-clock operations, and unique ventilation requirements, they consume as much as five times more energy per square foot than typical offices do. On a university campus, laboratory buildings are often the largest consumers of water, the biggest producers of hazardous and nonhazardous waste, and the largest proportionate consumers of energy.

Over the past few years, scientists, facility managers, and many others have increasingly realized that it is possible to dramatically reduce the environmental impact of laboratories without compromising the integrity of research. This has propelled the rise of innovative, cost-effective solutions for improved laboratory sustainability, solidifying a permanent and much-needed shift in how scientists think about their labs as well as their labs' impact on the planet.

Plastics and recycling

In 2015, the nonprofit organization My Green Lab surveyed scientists at two international conferences about how they felt they could make their labs more "green." Nearly 80 percent of the over 1,000 respondents mentioned reduced plastic use and/or improved recycling as potential areas for improvement. While plastics are a highly visible component of laboratory research, the sheer volume of plastics used in labs is likely larger than most scientists would imagine. A December 2015 Correspondence letter published in *Nature* last year reported that biological research accounts for an estimated 1.8 percent of total global plastic consumption. This is not insignificant; in fact, it is staggering. Yet in spite of these numbers and the huge potential to improve on them, laboratories have been largely absent from the ubiquitous campaigns promoting reduced plastic use and increased recycling.

Reducing plastic use

The best way to address the pervasive plastic laboratory waste is to simply reduce the amount of plastic labs consume. A 2013 study published in *Lab Manager* showed that laboratories spend between 60 percent and 200 percent more on plasticware than glassware annually. The trend toward using plastic instead of glass can be reversed, and may even save the lab money. Using glass graduated cylinders instead of 50 mL conical tubes whenever possible is a simple way to reduce plastic use. Glass pipette tips and petri dishes can also be used in many cases, instead of their plastic counterparts. Viewing laboratory supplies as permanent, and not consumables, has several results that improve laboratory sustainability generally.

Another way to curtail plastic use is to purchase products that are produced with fewer resources. Several companies have redesigned their products to contain less plastic, including Eppendorf and LabCon. LabCon in particular now operates a zero-net plastic waste facility where scrap from tip and tube manufacturing is used to make their packaging. Though not a component of the consumables themselves, packaging is a reducible source overall of plastic waste for labs. Purchasing

Caution: Flood Free Zone

Turn off the Tap

Findenser™

Super Air Condenser

Patented

- No risk of flooding from running water
- Eliminate water purchase and disposal costs
- Helps meet sustainable water reduction targets

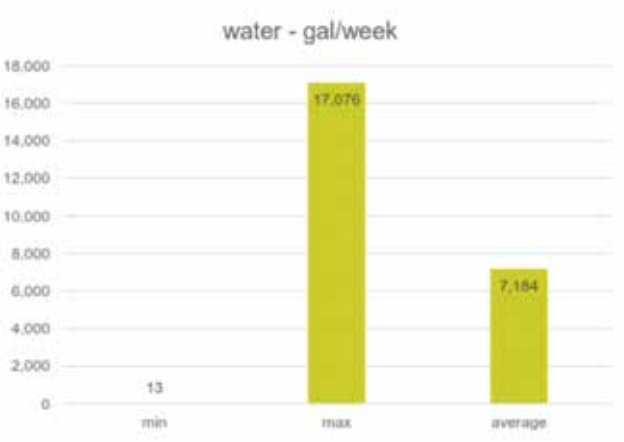
heidolph

research made easy

(224) 265-9600 • Findenser@heidolph.com

HeidolphNA.com

products whose packaging is minimized or made from recycled sources will reduce plastic consumption. Talking to vendors about ways to minimize or even eliminate difficult-to-recycle plastics like film and Styrofoam is also a good strategy for addressing plastic packaging waste.



▲ *Data from UC Riverside Genomics Dept. Data from one autoclave showing the amount of water used per week. On average, ~7,000 gallons of water per week are used to run the autoclave.*

Reusing plasticware

Although viable alternatives for some plasticware do exist, there are still many tubes, tips, and dishes for which there are no alternatives. In these instances, it is best to reuse products whenever possible, being mindful of potential issues with contamination and biohazards. For example, it is not advisable to use a single plastic pipette tip to load ten different samples into a gel, but it might be possible to reuse plastic pipette tips that are used to add buffer solutions to a DNA extraction column (after thoroughly washing them). In fact, there is little to no evidence correlating reuse with contamination, and many labs with limited budgets reuse their plasticware in order to reduce their consumption of consumables.

Reusing other types of plastic materials, such as Styrofoam, is usually easier for the lab and is a widely unheralded practice that already occurs in many facilities. Take-back programs for Styrofoam coolers, such as those offered by New England Biolabs and Sigma-Aldrich, may also be utilized as a means of reusing material.

Recycling plastic

For labs that are sensitive to issues of contamination, the next best option is to recycle. Any plastic that is not characterized as a biohazard or radioactive hazard may potentially be recycled. Several large biotech and pharmaceutical companies have large-scale waste diversion programs, including Thermo Fisher in Pleasanton, California, and Genentech in South San Francisco. Many university campuses are also diverting laboratory plastics, usually Types 1 and 2, in partnership with vendors and waste haulers.

Unfortunately most organizations do not have the infrastructure to divert laboratory plastics from their landfill waste. More often than not, this is due to a lack of communication between custodial staff, EHS, laboratories, and the waste haulers. Laboratory personnel are key to bridging these gaps, and have proven to be instrumental in bringing much-needed programs to their organizations.

Water usage and conservation

Water is so deeply embedded in standard laboratory operations that the extent of its use is often unnoticed. Unlike single-use plastics, there is often little transparency into how much water is consumed in each process. A study conducted by S-Labs in the UK found that laboratory processes account for approximately 25 percent of all water consumed in a laboratory building. Independent audits of life science research buildings at a US university revealed that each building used around 12 mega-gallons per year, which is equivalent to the water use of 82 US households.

"The trend toward using plastic instead of glass can be reversed, and may even save the lab money."

Therefore, even for facilities that are not located in drought-impacted areas, improving water efficiency is a smart idea. Distilled water use, single-pass cooling, and autoclave management all represent potential opportunities for water conservation. By simply rethinking how these resources are consumed, laboratories can conserve millions of gallons of water annually.

Distilled water

Distilled water should be used only when it is required for experiments, and not regularly as a substitute for tap water. The process of making distilled water is highly inefficient, with nearly three gallons of water required to make one gallon of distilled water.

Single-pass cooling

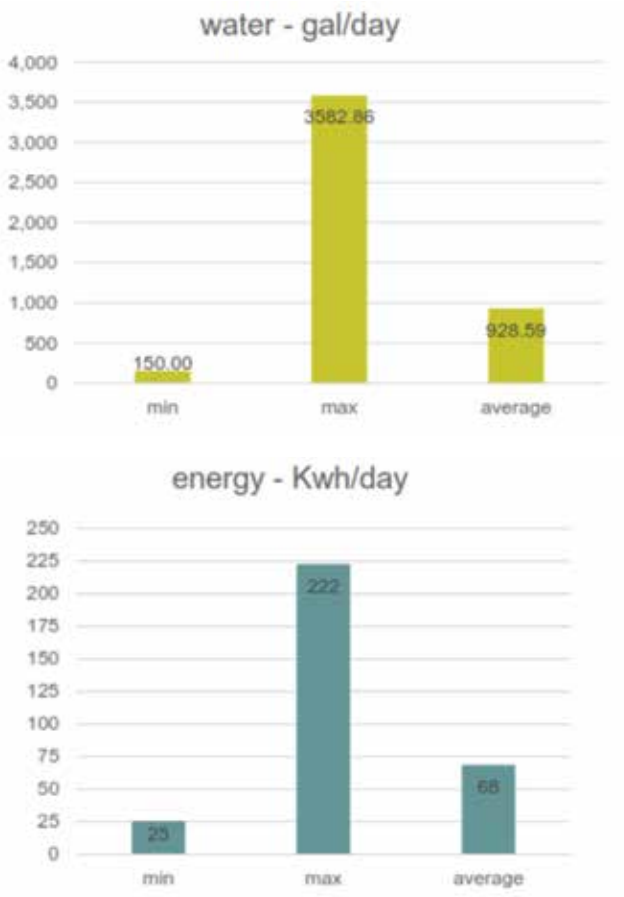
Traditional chemistry labs often use single-pass cooling to cool down reactions. Single-pass cooling refers to a continuous flow of water that is circulated once through a system before being disposed of down the drain. Water running at between one and two gallons per minute can result in over 1,000 gallons of water per day being sent down the drain. Simply recirculating the water, or using air condensers, can conserve hundreds of thousands of gallons of water annually.

In an effort to conserve water, some labs have reconsidered their standard practices and begun using closed-loop systems, such as an ice bucket with a fish pump to recirculate chilled water. Others are using air condensers, such as Findensers, instead of single-pass cooling. In fact, many institutions have provided funding to laboratories willing to switch to an alternative method, as the water savings alone are sufficient to pay for the new equipment.

Autoclaves

Autoclaves, or sterilizers, are another source of significant water use in labs. A recent study conducted by the University of California, Riverside, showed that a standard autoclave can consume at least 1,000 gallons/day. This is partially because autoclaves are often on single-pass systems like those described above, where the cold tap water used to cool down the hot water draining from the autoclave runs continuously. Putting autoclaves on closed-loop systems and installing water-saving devices known as Water Mizers can reduce the water consumption of autoclaves by up to 70 percent. Water Mizers work by sensing the temperature of the hot water effluent and allowing cold water to be released only when it is needed, thereby significantly reducing the amount of water being used.

New water-efficient and energy-efficient autoclaves are also now available for laboratories, and they may be a great alternative solution to the standard, larger autoclaves.



▲*Data from UC Riverside Etymology Dept. Data from one autoclave showing the amount of water and energy used per day. On average, this autoclave uses ~900 gallons of water and 68 kWh per day.*

Sharing resources

Despite the growing trend toward open lab areas and communal lab spaces, resources are often not commonly shared among labs. Resource sharing is perhaps one of the easiest ways for labs to reduce their environmental impact, and it brings the many benefits of increased collaboration.

Chemical and reagent sharing can result in significant savings, both for laboratories and institutions. Many EH&S departments have the infrastructure in place for labs to share chemicals, but few labs take advantage of it. If an organization does not have a mechanism in place to post and request extra chemicals, creating a departmental email list is a relatively simple way to achieve the same result.

Laboratory equipment and instrumentation sharing can be more complicated. With the exception of core facilities, these resources are rarely publicized. However, researchers stand to save hundreds of thousands of dollars in up-front and maintenance costs by sharing existing and underutilized equipment with their colleagues. Institutions also benefit from this type of resource sharing, as a reduction in total equipment leads to a reduction in energy consumption, and a further reduction in waste when the equipment is no longer useful. UC Santa Barbara saw the potential of a campus wide equipment sharing program and now hosts a website that lists over 300 pieces of shared equipment. For more information, visit www.sharedinstrumentation.ucsb.edu. In addition, in the UK, over 50 percent of universities use an online platform called Warp It that allows staff in labs to get, give, and loan surplus or underused assets on the same campus, or between organizations. Warp It has recently launched in the US in order to assist US organizations with sharing equipment.

It's time to start rethinking laboratory practices and being smart about laboratory operations. This Earth Month, make the commitment to be more mindful about the use of energy and water in the lab, and take steps to reduce and reuse laboratory supplies and equipment. Individual actions can have profound effects, and together the scientific community can set the example for what it means to live sustainably.

***Allison Paradise**, executive director of My Green Lab, can be reached at allison@mygreenlab.org or 424-354-1494.*

My Green Lab is a 501c3 nonprofit dedicated to building a culture of sustainability through science. For more information about My Green Lab, including information about how to certify your lab as a "green lab," visit www.mygreenlab.org.

WANT TO FIND OUT HOW YOUR LAB RATES IN THE AREA OF "GREEN" LAB PRACTICES?

Go to this green laboratory self-evaluation checklist to find out.

www.labmanager.com/Self-Evaluation

MANAGING ENERGY IN YOUR LAB

According to the U.S. Department of Energy's Office of Energy Efficiency & Renewable Energy, U.S. laboratories use much more water and energy per square foot than other facilities and office buildings. That higher energy use is due to labs' stricter health safety requirements and energy-intensive activities. The Federal Energy Management Program (FEMP) encourages labs to become more energy efficient by improving the efficiency of the entire facility, rather than just making specific lab components more efficient.

FEMP's Climate Neutral Research Campuses initiative provides a five-step process to help labs become more efficient:

1. **Determine Baseline Energy Consumption**—To get started, labs figure out their current energy consumption and the greenhouse emissions that result. They can then break down those emissions by sector.

2. **Analyze Technology Options**—Labs evaluate the technology available that would fit into a climate action plan. These technologies could fall under people and policy, buildings, transportation, energy sources, and offsets and certificates.

3. **Prepare a Plan and Set Priorities**—In this stage, labs pick their specific greenhouse gas reduction goals, set dates for achievement, and figure out their financial constraints and opportunities. The resulting plan can be either goal- or finance-driven.

4. **Implement the Climate Action Plan**—This step of the initiative involves asking two key questions. How will the lab pay for the climate action plan? And, who will manage and oversee the plan's implementation? A portfolio approach in which a wide variety of options are considered, is recommended for this stage.

5. **Measure & Evaluate Progress**— The American College and University Presidents Climate Commitment (ACUPCC) and the Association for the Advancement of Sustainability in Higher Education have put together a reporting system for colleges and universities that signed the ACUPCC commitment. Labs can use this system for reporting their progress in achieving their energy efficiency goals.

For more information, visit http://www.nrel.gov/tech_deployment/climate_neutral/ or, http://energy.gov/eere/femp/energy-efficiency-laboratories

PerkinElmer For the Better | OneSource Laboratory Services

GMP COMPLIANCE MADE EASY

By Joy L. McElroy

It's clear from the number of Good Manufacturing Practice (GMP) warning letters related to laboratory compliance that the Food and Drug Administration (FDA) considers laboratory controls to be vital to the safety, quality, and efficacy of drug products. The laboratory is critical in developing and manufacturing drug products, from the approval of submission documents to the release of the final product. Choosing the best services and supplies for your lab is a key part of meeting the requirements of the GMP standards.

"It's important for managers to know a few of the basics of auditing suppliers and vendors."

The various regulatory agencies have expectations that suppliers and vendors will demonstrate control over their manufacturing processes, validations, and documentation. Quality auditing is the process of checking whether these organizations have implemented what they have stated in written procedures and whether their people are doing what the organization's procedures state they will do. To be able to choose the highest quality supplies and services for their laboratories, it's important for managers to know a few of the basics of auditing suppliers and vendors.

Analytical instruments should be qualified and systems should be validated to demonstrate suitability for the intended use. Also helpful to lab managers is an overview of the regulatory background and getting guidance through the process from planning and writing requirement specifications to vendor assessment, installation and operational qualification, and ongoing testing during routine use. Finally, understanding the instrument qualification and system validation processes and gaining an idea of how to prepare for FDA audits and how to become 21 CFR part 11 compliant will all help make the GMP process smooth for lab managers.

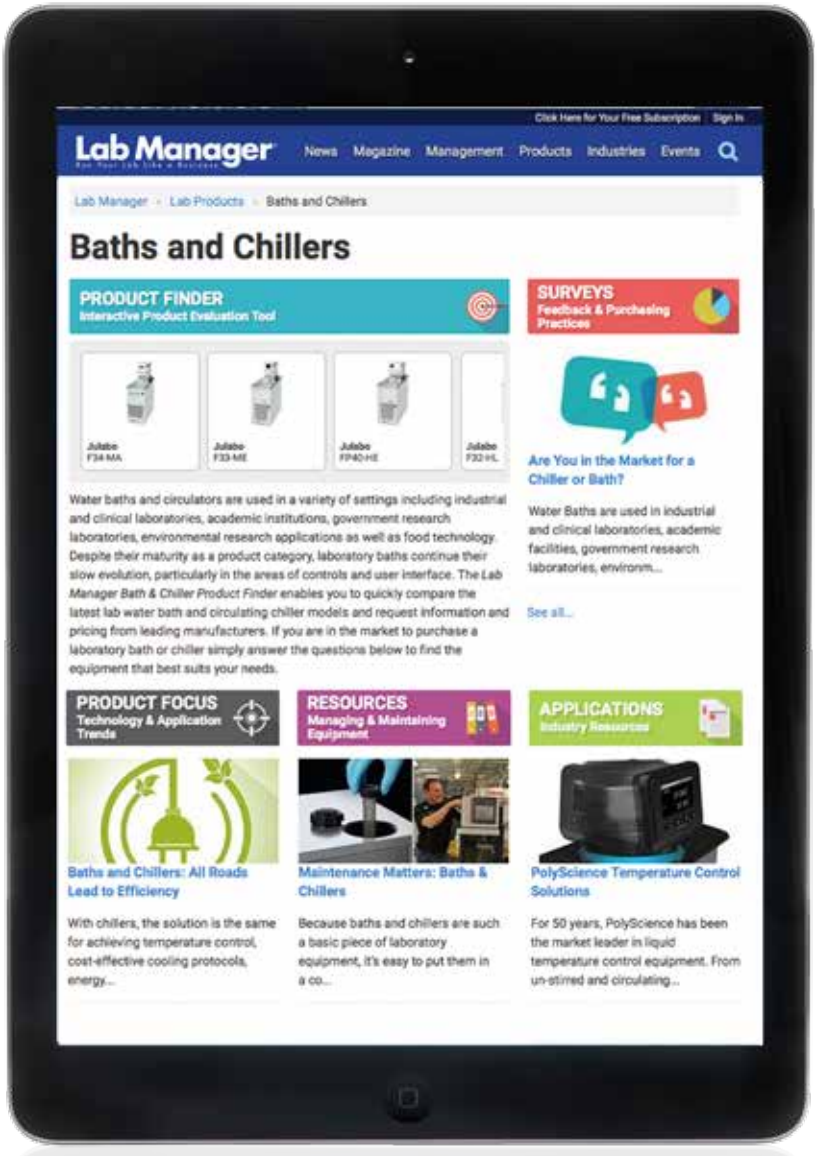
When asking themselves what controls they should implement in an FDA regulated environment, laboratories should do a thorough review of GMP/GLP [Good Laboratory Practice] requirements. A look at current industry practice for labs which support clinical trials as well as those who provide quality control testing for commercial products, is also a good place to start when answering this question. In addition, calibration programs, analytical method validation, equipment qualification, control of standards and reagents, SOPs, documentation practices, outsourcing, training programs, and change control are all areas that need to be looked at when managers are choosing which controls to implement in their laboratories.

***Joy McElroy** is co-owner of Maynard Consulting Company. Upon earning a degree in Zoology at North Carolina State University, Joy made her debut in the pharmaceutical industry in 1992 at Pharmacia & UpJohn, performing environmental monitoring and sterility testing. She then moved into a supervisory role at Abbott Laboratories where she oversaw their quality control lab. From there she moved into auditing clinical and GMP laboratories and manufacturing facilities, then into validation engineering.*

Now with 14 years' experience as a consultant, and over 20 years total experience in the pharmaceutical and biotech industries, Joy has gained extensive knowledge of quality assurance, process and cleaning validation, equipment qualification, auditing, and GMP and GLP training.

LABCAST

Be sure to attend Joy McElroy's Lab Manager Academy webinar, "Auditing Suppliers and Vendors/Qualifying Analytical Equipment," on Wednesday, May 4th, or afterward at www.labmanager.com/auditingsuppliers to watch the archived video.



LabManager.com/lab-products

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

Lab Manager®
Run Your Lab Like a Business

1.

GV HIAPER RESEARCH JET

A LAB ON A PLANE

Rachel Muenz

For environmental researchers, the Gulfstream-V (GV) HIAPER research jet is like Red Bull—it gives them wings. Essentially a flying lab, the research aircraft, which is owned by the National Science Foundation and managed and operated by the National Center for Atmospheric Research's (NCAR's) Earth Observing Laboratory (EOL), based in Boulder, Colorado, allows scientists to literally reach great heights in a variety of atmospheric research.

While research aircraft are nothing new, there are several things that make the HIAPER unique. Just how high it can go is one. Without scientific payload and carrying minimal fuel, it can reach a maximum altitude of 51,000 feet, but EOL director Dr. Vanda Grubišić says that with a typical payload and full fuel load for a long-distance flight, the maximum altitude is closer to 45,000 feet, reaching easily into the upper troposphere/lower stratosphere of the Earth's atmosphere. With a range of about 7,000 mi (11,265 km), the jet can also make longer flights than the typical research jet, up to ten hours in duration.

"Essentially one can fly from Boulder, Colorado, down to Punta Arenas [Chile] almost in a single flight," Dr. Grubišić explains.

The jet can also carry 5,600 pounds of scientific payload, and though that seems like a lot, it's not as much as other research aircraft can carry.

1. [Bottom right corner] The Ultra-High Sensitivity Aerosol Spectrometer (UHSAS) [left] and Closed Path Laser Hygrometer (CLH-2) [right] instruments flying high near Antarctica on the wing of the NSF/NCAR HIAPER during the ORCAS campaign. Photo by Jonathan Bent.

"There are research aircraft that can carry much more, but combined with the long range and unique high vertical reach of this aircraft, we go with very specialized scientific instrumentation, [such as] for chemistry and aerosol studies," Dr. Grubišić says.

Typically used as a business jet, this particular GV was purchased new and then modified in house and in close collaboration with Gulfstream from the get-go to serve as a research aircraft. Instead of the comfortable leather seats you'd find in a regular GV, the HIAPER is packed with instruments in racks, though a few seats remain for the scientists and instrument operators.

> "This is the first Gulfstream in the world that has wing-mounting points."

The racks house the portion of the instrumentation that receives data from the sensors mounted predominately on the fuselage and wings of the aircraft, Dr. Grubišić says. With chemistry instruments specifically, there are inlets on the aircraft that take the ambient air at the flight level of the aircraft into the cabin, and then the instrumentation in the racks analyzes that air in real time, depending on what techniques are being used. For other research, they simply store that air in canisters for post-analysis, she explains.

FreezerPRO CLOUD

NEW

Sample Management Software Service

Give your lab accurate and secure sample information management

Laboratory modernization is calling...

Access starts at $75 a month*

Start your free 30 day trial today at www.FreezerPro.com

Basic

$900
year

- 99.99% Uptime
- SSL Data Encryption
- All Software Updates
- All Software Licensing
- Daily backups
- Gold Customer Support
- 3 User Seats

Standard

$79
user/month

- 99.99% Uptime
- SSL Data Encryption
- All Software Updates
- All Software Licensing
- Daily backups
- Gold Customer Support

Enterprise

$149
user/month

- 99.99% Uptime
- SSL Data Encryption
- All Software Updates
- All Software Licensing
- Daily backups
- Gold Customer Support
- Private Cloud option
- Test / Validation option
- Supports HIPAA Compliance

* FreezerPro Cloud utlizes the Concurrent Access model. Customers are allowed an unlimited number of logins and are only limited by the number of those simultaneously logged in.

** All editions include a choice of datacenter (East Coast, West Coast, Europe, Asia)

RuRo
Laboratory Information Bliss™

The aircraft's wings are another unique feature.

"This is the first Gulfstream in the world that has wing-mounting points," Dr. Grubišić says. "It's no longer the only one, but it is the first one."

Those wing-mounting points allow the jet to carry underwing pods, containers that house specialized instrumentation and sensors. Those pods were also designed and fabricated in house. The HIAPER is one of only two jets to carry such pods; the other is HALO, a Gulfstream 550 managed and operated by the German Aerospace Center.

As far as challenges go, because the HIAPER's scientific payload capacity is smaller than other research aircraft, there's a need for smaller instruments. "For example, for chemistry researchers, their instrumentation is not very compact so they have to work on reducing it in size," Dr. Grubišić says.

Another challenge is the speed of the aircraft, moving twice as fast as the typical turboprop research aircraft, which moves at about 100 meters per second.

"In terms of making real-time decisions, [researchers] need to make them faster," Dr. Grubišić says. "In order to help scientists with that, we do have a position on the aircraft [that] we call a mission coordinator, one of our Research Aviation Facility team members who is there to act as an interface between the mission scientist for that particular research flight and our pilots."

That mission coordinator will also keep on top of the weather forecast and satellite data uploaded to the aircraft, to ensure that the plane avoids any unsafe weather, something the researchers might put by the wayside in their eagerness to collect the best data set possible, Dr. Grubišić says.

Collection of that data is much different from research flights of the past.

2. The NSF/NCAR HIAPER sits on the tarmac in Anchorage, Alaska during the HIPPO campaign. **3.** Valeria Donets, Department of Atmospheric Sciences, University of Miami, pulls Advanced Whole Air Sampler (AWAS) canisters filled with air samples taken during ORCAS RF09. Photo by Carlye Calvin. **4.** Ed Ringleman, pilot with the Earth Observing Laboratory, does an external inspection of the NSF/NCAR HIAPER prior to take off. Photo by Carlye Calvin. **5.** The Cloud Droplet Probe (CDP) [left] and the Two-Dimensional Optical Array Cloud Probe (2-DC) [right] on the wing of the NSF/NCAR HIAPER during an intercomparison flight with the ARSV L.M. Gould during the ORCAS field campaign on the Southern Ocean. Photo by Jonathan Bent. **6.** The NSF/NCAR HIAPER returns to Colorado after the ORCAS field campaign based in Punta, Arenas, Chile.

"Quite a few decades back, the scientists would hop on the plane and follow their planned mission almost strictly without knowing what data they were collecting," Dr. Grubišić says. "These days we do have sophisticated data systems and displays on board the aircraft."

Those displays allow researchers to see data in real time as it's being collected, giving them a much better idea of whether or not their hypothesis is confirmed. "I want to allow scientists to be able to come from a research mission with a first draft of their research paper," Dr. Grubišić says. NCAR quality controls the data collected by HIAPER research flights and, after a year of exclusive use by the original research team, the data sets are opened up for use by anyone in the world who requests them.

Having served the scientific community since 2005, flying its first official scientific mission in 2006 with Dr. Grubišić as the science lead, the HIAPER recently completed the ORCAS field campaign over the Southern Ocean in late February. The data collected by the series of flights will give researchers a better idea of the role the ocean plays in absorbing excess carbon dioxide emitted by humans.

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

"I want to allow scientists to be able to come from a research mission with a first draft of their research paper."

MAKE EVERY DROP COUNT

MINIMIZING THE ENVIRONMENTAL IMPACT OF YOUR LAB'S WATER PURIFICATION SYSTEM

by Joseph Plurad, Estelle Riche, and Stephane Mabic

According to an analysis published in 2012 by an architectural and engineering firm that specializes in lab design, a laboratory will consume five times more energy and water per square foot than a similarly sized office building.[1] Harvard University, for example, has found that while laboratories occupy 20 percent of its physical property, they are consuming 44 percent of the total energy used.[2]

Water is a commonly used reagent in the laboratory, and its quality is of paramount importance, as impurities may compromise experimental results. For this reason, water purification systems, either centralized or localized, are among the most common pieces of equipment found in a laboratory facility.

The choices made in selecting a water purification system can have an impact on the environmental footprint of an organization or facility. The environmental impact can become meaningful when the total number of systems that are in operation in a lab, in a building, or across the entire organization are taken into consideration. However, many solutions exist that can mitigate or minimize this environmental impact. In addition to reducing waste of resources, there is an economic benefit in behaving in a more sustainable manner, and absolute costs can be quantified for a lab or a department. Additionally, many organizations also have individual and departmental mandates to contribute to the conservation of resources and/or the reduction of their environmental footprint.

Environmental impact of purification technologies

Water may be purified by distillation, deionization, reverse osmosis, or using water purification systems combining several purification technologies. (Figure 1)

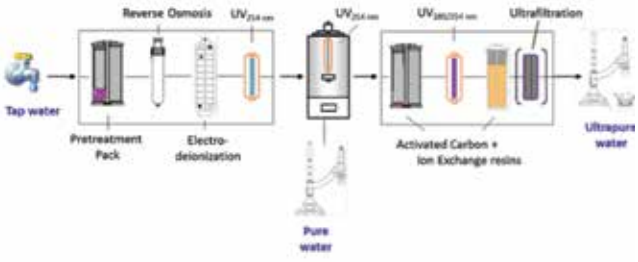


Figure 1. Schematics of a water purification system.

- **Distillation**

Water distillation is one of the oldest and most commonly used purification techniques. It entails heating the water, usually with electricity, and then condensing the vapors obtained, usually by cooling with tap water.

One three-liter-per-hour distillation consumes almost five kilowatt hours of electricity; thus, one hour of distillation uses as much electricity as using a hair dryer for ten minutes every day for a month or running a coffee machine for an entire month. In addition, nine liters of water are consumed for every liter of purified water produced (11 percent recovery). In a laboratory using 20 liters per day of distilled water, the still will consume almost 45,000 liters of water in one year, which is the amount of water needed to fill a regulation-size professional ice hockey rink.[3]

- **Reverse osmosis**

In reverse osmosis (RO), pressure is applied to the water, forcing it through a semipermeable membrane. Pure water passes through the membrane, while water impurities remain on the other side of the membrane.

Depending on the design, most RO systems will reject upwards of 50 to 80 percent of feed water, which is sent directly to the drain. In larger RO-based systems that service whole

buildings, the amount of water wasted can become quite substantial. Larger 100-L/hour systems can consume 200 to 500 liters of water per hour, whereas smaller 24-L/hour systems can consume 48 to 120 liters of water per hour.

Another environmental consideration is that RO is a temperature-dependent process, which means that for every degree Celsius drop in temperature, the flow rate through the RO membrane decreases by three percent. A ten-degree decrease in water temperature between summer and winter, for example, will result in a 30 percent decrease in efficacy of the water system. Many manufacturers will combat this challenge by adding a booster pump to ensure efficient flow; however, these pumps consume more electricity and actually waste more water. Other manufacturers may oversize the RO system to account for the lowest flow rate that can be expected throughout the year. In warmer months, however, the consumption will increase, and once again more water will be wasted.

Many centralized RO and RO DI (deionized) systems operate on a distribution loop, which means that the water is generated in one location, pumped to all the lab locations, and then returned to a central collection tank. This pump is constantly recirculating, resulting in additional electrical consumption. The size of the pump required for effective distribution—and the resulting amount of electricity also needed—are dependent on the size of the facility.

- **Ultrafiltration**

This purification technique is used to remove both endotoxins and nucleases. It relies on a membrane functioning as a molecular sieve.

Typically, water purification systems come with optional internal ultrafilters, which work like reverse osmosis in that these filters employ a tangential flow scheme. Up to 25 percent of the ultrapure water that is flushed through this filter, or 500 mL for every 1.5 L produced, will be sent to the drain as part of this ultrafiltration/purification step.

Magnifying this waste potential is the fact that the water going through the ultrafilter is already ultrapure. Approximately 25 percent of the water that has already been purified is therefore wasted, which drives up the cost of consumables, as more frequent cartridge exchange is needed. In total, a life science lab using approximately ten liters of water a day from an ultrapure water system that has a built-in ultrafilter could be wasting at least three liters of water every single day.

- **Additional considerations**

There are additional environmental considerations, including UV lamps, pumps, and cartridges and filters, to keep in mind when purifying lab water. Current UV technology utilizes mercury to generate radiation, and mercury waste handling should therefore be taken into consideration when building a water purification system. Some complete water purification installations may have up to four UV lamps in their system. Mercury must be disposed of in accordance with the facility's mercury policies or placed in the same containers/waste stream as fluorescent bulbs.

In water purification systems, pumps drive most of the water. Booster pumps, distribution pumps, and polisher recirculation pumps all vary in their electrical consumption. In many cases, these pumps consume

electricity all the time, even when the purification system is not being used, because they must continuously recirculate or distribute the water.

Water purification systems also utilize consumable products, including filters and ultrapure purification cartridges, that can significantly contribute to laboratory waste. Some organizations may generate tons of waste products that end up in a landfill or an incinerator. Unfortunately, many of these waste products are plastics and resins that take a significant amount of time to ultimately decompose. Additionally, many of these products are one-time-use materials, virgin plastics and virgin resins, resulting in a considerable waste stream.

Finally, every purification process has reject streams or condensation streams where water is being sent to the drain. Some water purification systems are designed to flush or purge up to 20 liters of water a day directly from the system to ensure that it is clean of microbial contamination. When all these sources are summed up, the waste may be hundreds of liters a month, and sometimes this waste is ultrapure water that is being sent down the drain.

Selecting sustainable solutions

Improvements have been made to commercially available technologies to reduce the environmental impact of purifying water. Some of these alternatives completely change the purification technologies, whereas others simply optimize existing techniques (Table 1). Selecting the most appropriate water purification system, as well as observing sustainable practices, will have significant impact on the lab's overall environmental footprint.

RO-EDI Vs Distillation	Reverse Osmosis: water-saving techniques	Ultrafiltration: technical improvements
Consumes 1/10 of the electricity of similarly-sized stills	Reject-stages RO modules	Zero-reject ultrafilters available at the point-of-use
Uses about 40% less water than similarly-sized stills	RO recovery loops	UV and purification media optimization
Realize significant cost savings on operation	Temperature-controlled booster pumps: constant flow	Reduced need to flush liters of water daily prior to use
	Optimized feed and RO control can result in up to 80% recovery	

▲ *Table 1. Alternative, sustainable solutions.*

- **Replacing distillation with reverse osmosis and electrodeionization**

Choosing a combination of reverse osmosis and electrodeionization (EDI) over distillation would considerably improve the environmental footprint of a laboratory, as it uses significantly less electricity and water than similarly sized stills.[3]

- **New generation of reverse osmosis**

There have been several technical improvements in reverse osmosis over the past 20 to 30 years that are designed to send less water down the drain. For example, a relatively new technology called E.R.A.™, or Evolutive Reject Adjustment, completely flips the waste paradigm in RO systems, moving from 20 percent recovery to 80 percent recovery with tap water sources that are well managed and well maintained prior to going to the reverse osmosis step.

- **Ultrafiltration at the point of use**

In ultrafiltration, simply moving from an internal inline ultrafilter, which has a built-in reject flow, to a point-of-use filter that processes 100 percent of the ultrapure water will save about half a liter for every two liters that are processed. These savings can quickly multiply, based on the volumes of water that are produced every day.

- **Recycling and other sustainable practices**

As facilities are developed or renovated, a gray water recovery system should be considered where feasible. As these systems are typically tap water driven, the quality is very good for typical gray water uses, including flushing toilets or irrigating the grass or plants at a particular site. Organizations should also select manufacturers that are actively engaged in sustainability practices, and systems, packaging, and water purification cartridges should be recycled where supported by organizational policy. For example, in one manufacturer's existing U.S. program for spent water purification cartridges, a life cycle assessment showed that collection and recycling of these cartridges could reduce their environmental impact by ten to 15 percent. Customers are able to send their used cartridges to a specialized waste management company for recycling, thus avoiding landfill dumping or incineration.[4] And finally, the water system should be sized according to usage and application.

Conclusion

Water is an important resource, not only in the everyday world but also in the laboratory. Well-designed water purification systems using the proper combination of purification technologies will ensure that the water produced is suitable for the specific applications for which it is needed. Choosing more sustainable water purification technologies and solutions will ensure long-term conservation of resources, less environmental waste, and long-term cost savings.

References:

1. https://www.wbdg.org/resources/sustainablelab.php
2. http://green.harvard.edu/programs/green-labs
3. "Comparison of the environmental impact of an Elix® 3 water purification system with a distillation apparatus"—Application note. www.emdmillipore.com/elix-vs-distillation
4. http://www.emdmillipore.com/US/en/responsibility/products/recycling-end-of-life/1gyb.qB.QxgAAAFAo-TI.1ZZu,nav
5. Link to the webinar on the same topic, May 28, 2015: "Water Purification in Your Lab—How It Can Impact Your Environmental Footprint." http://www.labmanager.com/green-water-purification

Joseph Plurad *is North America field marketing manager, lab water, at MilliporeSigma, the life science business of Merck KGaA, Darmstadt, Germany.*

Dr. Estelle Riche *is a senior scientist in the lab water application group at the life science business of Merck KGaA, Darmstadt, Germany, and Dr. Stephane Mabic is the lab water application manager and worldwide training manager at the life science business of Merck KGaA, Darmstadt, Germany.*

AVOIDING BUYER'S REMORSE

DOING THE PROPER RESEARCH CAN ALLEVIATE THE STRESS OF BUYING PRE-OWNED EQUIPMENT

by Ryan Ackerman

The process of outfitting a laboratory with equipment can be a daunting and expensive task. It's no wonder that over the past few years more and more laboratories—whether a small research laboratory or full-scale production facility—have begun to realize the benefits of purchasing pre-owned equipment. When the decision to do so can enable a researcher to save upward of 70 percent on their costs for name-brand equipment, it's easy to see why this trend is becoming so popular. That being said, there are still many questions to be asked and research to do when considering buying pre-owned equipment.

Navigating the landscape of pre-owned lab equipment can be intimidating, but doing proper research into the supplier one has decided to purchase from will help ease this stress. A sound warranty, proper documentation, and a shipping guarantee are enough to put most minds at ease.

One of the most important considerations in the purchasing process is proof that the equipment still meets the manufacturer's specifications. Many pre-owned suppliers will sell equipment that is "refurbished" or "reconditioned." This indicates that the supplier has repaired or replaced any faulty components in order to bring it back up to the manufacturer's specifications, and will be able to provide proof thereof.

On the other hand, equipment advertised as being in "as-is" condition may not have received the same treatment. While it will likely carry a more attractive price tag, the risk associated with purchasing as-is equipment is far greater. The condition of the equipment could be unknown and a solid warranty may be unavailable, not to mention that the equipment may be faulty to begin with.

"That's something else to look for in a company when you are doing research. Is the company just selling equipment, or do they have staff to be able to service it, install it, warranty it, help with tech support, and help with questions," says Tracie Brombos of GenTech Scientific (Arcade, NY). "If you're buying on eBay, you don't really know who that company is."

No two labs are the same, and the sample type can vary enormously as a result. If you are planning on purchasing an ICP-MS for trace analysis with silver as an analyte of interest, it would be helpful to know whether the instrument was previously used in a lab that was analyzing impurities in silver samples. Alternatively, an instrument could have come from a laboratory that works with radioactive materials, biological samples, or other pathogens. While all laboratories follow stringent protocols on how lab equipment must be decontaminated or decommissioned prior to removal, having proof of this from the supplier can help ease any worry.

When purchasing pre-owned lab equipment, taking the proper steps in advance can help prevent the risk of running into unforeseen downtime or monetary costs. By choosing a reputable supplier and performing some research beforehand, purchasing equipment that is reliable, robust, and fit for the purpose of the laboratory can be a seamless and enjoyable experience.

Ryan Ackerman, *assistant technology editor for* Lab Manager, *can be reached at rackerman@labmanager.com or by phone at 888-781-0328 x297.*

Why Choose GenTech?

Why Buy New When You Don't Have To? Our refurbished analytical instruments have been expertly restored to meet OEM standards. GenTech's knowledgeable engineers perform installations, repairs, training and method development. Our inventory is constantly changing with new shipments coming in daily.

20 YEARS OF EXPERIENCE

Our service has been exceeding customers' expectations since 1996.

FINANCING OPTIONS

Why Buy New When You Don't Have To? Purchase, lease or rent depending on your budget.

1-5 YEAR WARRANTY

Extend your peace of mind! All parts, travel and labor are included.

TECHNICAL SUPPORT

Our highly skilled service engineers and chemists will provide you with installation, training, repair and remote support.

HUGE INVENTORY

We have a 60,000 square foot facility to house our inventory. GenTech is not a broker. We own what we sell!

MEETS OEM STANDARDS

Expertly restored to meet OEM standards. Internal testing is done prior to release and test data is included with the instrument.

GenTechScientific.com • (585) 492-1068 • Sales@GenTechScientific.com

SKILL TRAINING

A DATA-DRIVEN APPROACH TO MANAGING SKILL SETS TO MEET CHANGING BUSINESS NEEDS

By Scott D. Hanton and Todd M. McEvoy

People are the key assets of any business. Their skills define what the business can offer to its customers, how it can develop new capabilities, and how it can address problems and opportunities. Since most businesses require a broad set of skills, the business will require a diverse team of people to deliver them. The needs of a business are constantly changing, which means that the skills of the people within the business need to change over time. To address the skills required by the business, leadership needs to identify:

- The current skills possessed by the people
- The skills required by the business
- Skills at risk
- New skills required to grow the business
- An approach to close any gaps

We will present our approach to skill planning, inventory, and staffing. Our approach is data-driven and has the advantage of Intertek Allentown (Pennsylvania) being an independent profit-and-loss unit within the broad Intertek network. The global Intertek Group is a contract services provider in the testing, inspection, and certification market. Intertek Allentown specializes in analytical testing, characterization, and problem solving in the chemicals and materials areas.

Skills analysis

Skills analysis is a study of complex and competing needs. It contains both an analysis of the skills currently available and estimates of what new skills need to be developed and what existing skills may be at risk to leave the business. These skill needs also must be addressed with a finite amount of resources, so prioritization is critical.

Skills analysis involves a series of questions to probe the existing skills and changes to the skill sets required by the business. Examples of these questions include:

- What specific skills do individuals possess now?
- What is the risk of any of these individuals leaving the business?
- Which skills does the business need to increase?
- Which skills can the business afford to decrease?
- Who has the interest and ability to train in additional skills?
- Does the business have capable teachers to complete internal training?
- What is the performance level of the current staff?

Fortunately, data are available to help address many of these questions. Good sources of data about existing skills of the employees can be found in both human resources (HR) and quality management system (QMS) files. Both HR and QMS may have copies of resumes or CVs that will include degrees and previous work experience that show different kinds of skills in employees. Laboratory information management systems can provide information about the current activities of both individuals and laboratories to see the existing demand on the staff and provide information about trends to help with estimates about future skills needs. Sales and revenue data (for a stand-alone business) or budget data (for an internal department) can provide indications of the value of the skills to the various customer groups. Together, these data can be analyzed to build a more informed image of the existing skills and the future demands on the staff skill sets.

HUMAN HEALTH

ENVIRONMENTAL HEALTH

EMPOWERING YOUR SCIENCE DRIVING YOUR BUSINESS

OneSource® Laboratory Services

- Laboratory Efficiency
- Asset Management & Repair
- Information Services
- Laboratory Relocation
- Qualification & Validation

PerkinElmer OneSource® Laboratory Services brings the most advanced solutions to bear on the asset management and operational challenges faced by today's labs. Our added laboratory efficiency consulting continue to redefine and revolutionize the role of a services provider. Expect more and discover the most comprehensive set of tools to help empower your science and drive your business.

http://go.perkinelmer.com/EfficiencyByDesign

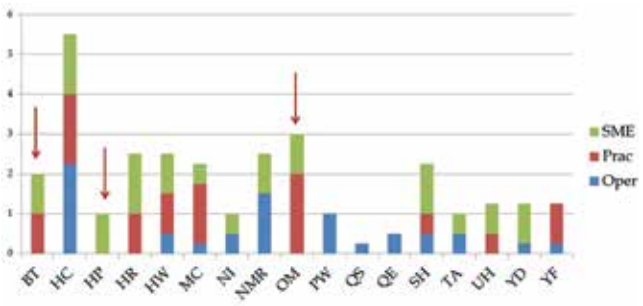
PerkinElmer
For the Better

For our internal skills analysis process, we complete the following sets of analyses across our internal laboratories:

- Skill level distribution
- Age distribution
- Skill risk
- Workload distribution
- Profitability distribution

Figure 1 shows our skill level analysis across all our internal laboratories at Intertek Allentown. We have three different skill levels in our laboratories:

- Subject matter experts (SMEs)—local and world experts in their area; key problem solvers responsible for developing new methods and capabilities
- Practitioners—solid, midlevel contributors who modify methods, analyze data, write customer reports, and address customer inquiries
- Operators—junior scientists and technicians who are responsible for keeping the instruments operating properly and creating high-quality data



▲ *Figure 1. Skill level analysis across each of the labs (arbitrary lab labels)*

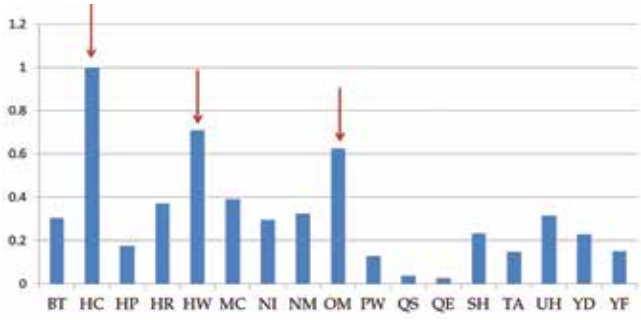
Typically, our skill level distribution is around one-third in each category. Right now, we have a little over one-third (40 percent) as SMEs and a little less than one-third (27 percent) as operators. By analyzing these data, we can see opportunities for improvement. For example, three different labs—BT, HP, and OM—have no operator support. Each of these labs still has technician-level work to be accomplished. Part of our team development plan for 2016 is to develop partial full-time equivalents of technical support to enable the more experienced scientists to work to their skill levels more often.

Like many businesses, we developed an imbalance in the age distribution over time. Having too much knowledge in a single cohort who all may leave in a narrow time window, the business carried too much risk of losing critical knowledge. Through significant hiring in the 1980s and limited hiring through 2010, we developed a staff that had a significant majority with ages above fifty. Since 2010, our business has grown, and we've had the opportunity to do some hiring. Between the new hiring and some retirements, we've been able to gain more balance in our age distribution, reducing our percentage of staff over fifty from two-thirds to almost one-third.

Our current age distribution analysis still shows some opportunities to improve. We still have two laboratories that have nearly all the staff aged over fifty. One of these labs has a consistently growing customer load. That lab will need additional cross-training of some younger staff in 2016 to share critical knowledge. The other lab has a consistently declining customer load. With limited resources, the skill risk posed by the aging staff in this lab will simply be acknowledged in 2016.

The best way we have found to address skill risk is the prioritization tool developed by the Tennessee Valley Authority.[1] Our approach to skill risk and prioritization was previously described in *Lab Manager* in an article on knowledge retention and transfer.[2] In our current skill risk analysis, we have identified four labs with critical knowledge that may become a risk in the three-to-five-year time period. We are now including cross-training and succession planning, starting in 2016, to start to address these risks.

Figure 2 shows the workload analysis across all our internal laboratories. The workload is normalized for the HC lab, which has the highest lab workload. The workload analysis can be very beneficial to our prioritization process for skill planning and skill building. We want to further invest with new people, additional training, and new equipment in the labs where we get the greatest benefit. For Intertek Allentown, the greatest benefit can be seen as the labs with the highest workloads for our customers. Figure 2 shows a wide diversity of workload levels across our internal laboratories. Three labs—HC, HW, and OM—have significantly higher workloads than the others, and we are including additional training plans in 2016 for these laboratories.

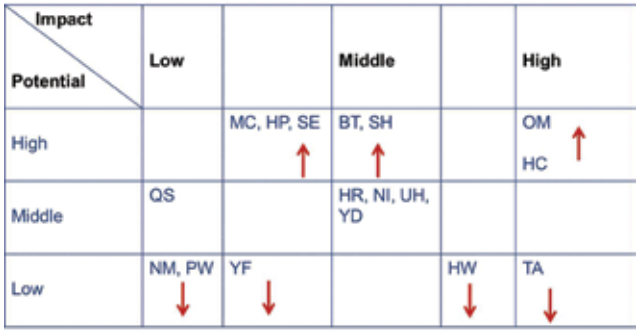


▲ *Figure 2. Workload analysis across each of the labs*

The workload analysis can be augmented with additional information, including normalizing to the number and skill level of staff in the labs and the profitability of the labs. As a business, we are concerned with both the workload, or the quantity of the business, and the profitability, or the quality of the business. By including these additional data in our analysis, we can more easily identify the best and most important labs in which to invest.

Figure 3 provides a summary of the workload and profitability data across our individual labs. The columns identify impact, which is a measure of the current contribution to

the business from each lab. The rows identify potential, or our estimates (based on trend data) of future contributions to the business. Our 2016 skills plan will focus on labs that have medium and high impact with high potential. Despite some skills needs, labs with low potential are unlikely to be key participants in the 2016 skills plan.



▲ *Figure 3. Business impact and growth potential for each of the individual labs*

Skill building

At Intertek Allentown, we take a three-pronged approach to skill building:

- Performance management
- Cross-training plans
- New hires

Performance management is a critical process. We need to clearly understand who the high performers are and work carefully to involve them in new skill-building opportunities to ensure they reach their potential. To ensure we have effective performance reviews, we have a simple process:

- Interim review halfway through the year—We provide clarity on objectives and expectations and have the opportunity to provide direction and guidance.
- A one-page performance review that highlights accomplishments and key opportunities for improvement.
- A clear conversation at the annual performance review—The conversation is far more important than the written document.
- Annual objectives that have contributions from both the employees and leaders and focus on accomplishments, not activities.
- We focus on growing strengths:
  - We hire people due to their strengths.
  - People develop strengths from a combination of interest and ability.
  - Growing strengths can lead to excellence, while growing weaknesses can, at best, yield mediocrity.
  - We focus on a weakness only if that weakness prevents the employee from finding success.

Performance management also is critical to either reshaping or removing poorly performing staff. We want to spend our time and resources improving the skills of the good and high performers, not extending the tenure of poor performers.

Cross-training plans are first built strategically for the business. They are the output of the skills analysis. The overall cross-training plan is directed at specific individuals to accomplish specific goals. Individual cross-training plans need to include:

- Specific scope
- Time expectations
- Depth of knowledge expectations
- Mode of training (internal or external)
- Metrics to identify success

"Having too much knowledge in a single cohort who all may leave in a narrow time window, the business carried too much risk of losing critical knowledge."

Individual cross-training plans are included in an employee's annual objectives, and if the training is done internally, also included in the teacher's objectives. We have a variety of cross-training tools that have been used successfully in our business. They focus on the mode of information to transfer either tacit knowledge or concrete knowledge. The tools were previously described in Reference 2.

Summary

By developing and using a defined skills analysis process, we have improved our organization and enabled our business to grow. By using the lab and business data available, we have been able to make data-directed decisions to optimize scarce resources. Our performance review and cross-training processes have enabled us to shift skills to meet new business opportunities. The outcomes have included key improvements:

- More balanced age distribution across the labs
- More balanced skill level distribution across the labs
- Effective metrics for business impact and growth potential
- Effective cross-training process
- Strong and flexible lab staff

References

1. Critical knowledge grid shared by the Tennessee Valley Authority during a KRT sharing event sponsored by APQC.
2. Hanton, Scott, "Retaining Business Critical Knowledge," *Lab Manager*, November 2013, 28.

***Scott Hanton**, general manager at Intertek Allentown, can be reached at scott.hanton@intertek.com or 610-295-0112.*

***Todd McEvoy,** operations manager at Intertek Allentown, can be reached at todd.mcevoy@intertek.com or 610-295-0120.*

TIPS FOR RETAINING BUSINESS-CRITICAL KNOWLEDGE.

By using KRT (knowledge retention and transfer) effectively, one can manage the risk to their business of losing critical knowledge.

www.labmanager.com/KRT

OUT HERE IN THE FIELD

RECENT PORTABLE INSTRUMENT RELEASES BENEFIT THOSE IN MANUFACTURING, ENVIRONMENTAL TESTING, AND CLINICAL MARKETS

By Rachel Muenz

As usual, the majority of recent field instrument releases since we covered this topic last year will benefit the environmental testing and manufacturing fields. However, there were also several releases that will help those in the clinical market. Specifically, the latest portable offerings will help those involved in soil and water testing, plant health and identification, sample management, and testing of raw materials, components, and finished products.

Released early last March, SPECTRO Analytical Instruments' family of handheld energy dispersive X-ray fluorescence (EDXRF) spectrometers will help those doing spectrochemical testing, either in the plant or in the field. The instruments deliver "repeatable, laboratory-quality results in a matter of seconds" and feature a fatigue-free design. The new spectrometers come in three versions: the xSORT Alloy, for affordable metals identification; the xSORT AlloyPlus, for advanced metals analysis; and the xSORT NonAlloy that includes a silicon drift detector, for fast element screening. In June, the company released its portable SPECTROSCOUT X-ray fluorescence spectrometer, bringing lab-grade quality control testing and elemental composition monitoring to at-line analysis. There's also a version for testing offsite or in the field.

Another option released in early March 2015 is Oxford Instruments' X-MET8000CG handheld X-ray fluorescence (XRF) analyzer for the consumer goods industry. The new instrument allows users to quickly and easily test materials using a large screen and simple interface.

"Our aim was to enable manufacturing companies, retailers, and importers alike to readily establish reasonable testing programs (RTPs), consolidate operational costs and controls, and avoid duplication of effort or activity," said Oxford Instruments product manager Christelle Petiot. "The X-MET8000CG provides the ideal means to implement these compliance screening processes, not only through the speed, convenience, and accuracy of the analysis, but also [through] the X-MET's powerful data management, with up

▲ *SPECTRO Analytical Instruments' xSORT can be used either in the plant or in the field.*

▲ *Oxford Instruments' X-MET8000CG handheld XRF analyzer for the consumer goods industry.*

▲ *B&W Tek's NanoLIBS LIBS analyzer for the pure materials testing market.*

▲ *OMEGA's HHC200 Series of portable rugged environmental meters.*

to 100,000 results including spectra and camera images being stored, plus the flexible report-building functions—requiring no additional software on a PC."

Another new tool for the pure materials testing market is B&W Tek's NanoLIBS LIBS analyzer, shown at Pittcon this year in Atlanta, Georgia. The instrument features a matchbox-sized advanced microLIBS laser with a high repetition rate and a compact spectrometer for "real-time spectroscopy." Customization options are also available. For those looking for handheld Raman options for raw materials verification, Bruker's BRAVO handheld Raman spectrometer is another recent release featured at Pittcon 2016. It's quick with a straightforward workflow and supports 17 different languages.

Air, water, and earth

As for the environmental side, OMEGA recently launched its HHC200 Series of portable rugged environmental meters for temperature, pressure, RPM/light intensity, airflow, humidity, dew point, and wet bulb measurement. For those concerned with testing pH, dissolved oxygen (DO), conductivity, total dissolved solids (TDS), and salinity, Hanna Instruments' new edge meters—including the HI2002 pH/ORP, HI2003 EC/TDS/Salinity, and HI2004 DO—are thin and lightweight and can be used both as portable and benchtop meters.

Other relatively recent options for this field include offerings from Xylem Analytics' YSI brand of handheld meters. The Pro1020 measures dissolved oxygen and temperature along with either pH or ORP (redox) and is EPA-approved for wastewater and drinking water compliance reporting. Xylem's YSI Pro10 handheld provides the same abilities, minus dissolved oxygen measurements, for those who are only worried about pH or ORP. Another fairly recent addition to the YSI brand is its EcoSense ODO200 handheld, which as the name suggests, is an optical-based dissolved oxygen meter for DO sampling. Like the other instruments, it also offers one-hand operation and is simple to use.

In terms of field-portable GCs, Falcon Analytical recently launched the GS model of its CALIDUS micro gas chromatograph, which can be used both in the lab and in the field for a variety of environmental and industrial applications. The GS model in particular is designed for measuring environmental gas samples such as ambient greenhouse air, stack gas, process ventilation, tank car headspace, and other low-pressure applications.

Other recent field instrument releases will help those interested in soils. For example, Spectral Evolution's PSR+ field portable NIR spectroradiometer provides a quick and easy option for measuring total organic carbon (TOC) in soil, giving users fast, full-spectrum 350nm-2500nm measurement with one scan. The device also includes a number of features that makes it easy for anyone to use, such as one-touch operation and a small, lightweight design. And the system's DARWin SP Data Acquisition software automatically saves spectra and data to ASCII file format for use with other analysis software. The system can be used for a number of other soil-related applications as well, including identifying clays in soils and soil mapping, and in vegetation studies for plant species identification.

Spectral reflectance measurements from the company's PSR-1100 and PSR-1100F field spectroradiometers are other options for those who are literally out in the field doing agricultural testing. For example, these two devices can be used to assess the health of wheat "provid[ing] insights for physiological wheat trait selection, estimated crop yield for agricultural planning, monitoring of crop stress, irrigation and nutrient planning, and potential early diagnosis and control of crop pests," the company stated in a release.

Managing sample management

For those looking to improve their sample management, Ziath, a company that provides sample tracking solutions for use in laboratories and biobanks, released its DataPaq™ Handheld tube scanner in January. The product claims to be the first truly portable device on the market that allows users to immediately identify tubes and track samples when away from the lab.

> "Our aim was to enable manufacturing companies, retailers, and importers alike to readily establish reasonable testing programs."

"Our unique handheld scanner represents an innovative breakthrough for scanning 2D barcoded tubes," said David Anstee, commercial director at Ziath. "The single-handed operation simplifies a number of everyday applications for users, including fast tube handling in cold storage facilities or safety hoods [and] quickly storing samples in the field. Those customers that have beta-tested the new instrument are very excited about the flexibility it will offer and the time it will save them when searching for and collecting samples."

Another portable option released recently is Micronic's MINI handheld wireless scanner for reading 1D and 2D tube and rack codes. Its lithium polymer battery gives users a minimum of 15,000 2D scans and is easy to

▲ *Xylem Analytics' YSI Pro1020.*

▲ *Spectral Evolution's PSR+ field portable NIR spectroradiometer.*

▲ *Ziath's DataPaq™ Handheld tube scanner was released in January.*

▲ *Micronic's MINI handheld wireless scanner is another option for reading 1D and 2D tube and rack codes.*

▲ *Thermo Fisher Scientific's VisionMate wireless barcode reader is designed to lay flat so it doesn't need to be held during the scanning process.*

recharge through a USB connection. Similarly, JADAK's flexpoint HS-2R Bluetooth handheld HF RFID reader and barcode scanner for use in healthcare and medical environments can read all popular linear (1D) and matrix (2D) barcodes. This handheld also reads and writes to HF RFID tags (13.56MHz) and supports a wide range of HF standards. The HS-2R is suited to applications including surgical part tracking, reagent scanning, drug inventory, point of care, and blood tracking. Thermo Fisher Scientific's VisionMate wireless barcode reader, launched at SLAS2016 in San Diego, rounds out the recent handheld options for tube and rack scanning. It's designed to lay flat so users don't even need to hold it while scanning on a lab benchtop; it can also be used as a handheld where samples are stored and can read tubes in a cold environment.

"Precise sample tracking and identification is essential to protecting sample integrity and safeguarding sample information," said Chris Tsourides, senior business director, life science products at Thermo Fisher Scientific. "The enhanced portability of the wireless barcode reader [is] intended to instill user confidence, providing assurance that samples have been securely identified and tracked throughout the workflow."

Whether you're ensuring the safety of consumer goods, trekking through the backwoods analyzing the health of a stream, assessing the fertility of a farmer's field, measuring emissions from a factory, or keeping the samples in your biobank safe and organized, recent field instrument releases have got you covered. Of course, there are many more options than we've summarized here, but these are the ones we've come across since our last look at this important area of instrumentation.

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

IS THIS BUILDING MAKING ME SICK?

INDOOR ENVIRONMENTAL QUALITY BASICS

by Vince McLeod

You have probably lived through at least one scenario where you ask yourself, "Is this building making me sick?" Maybe upon investigation you found something that was obviously amiss and easily corrected. But a number of things likely went wrong, and the complaints were validated. In this month's column, we intend to help you avoid some common indoor air quality issues and proactively defuse the most common building-related illnesses and complaints.

We strive to maintain employee and occupant health; comfort and productivity are also essential in managing indoor environmental quality effectively. This month the Safety Guys provide a few guidelines for avoiding and minimizing negative impacts of poor indoor air quality, building renovation projects, or adjacent new construction.

We advise you to involve your environmental health and safety (EH&S) office at the outset. Today, most EH&S programs will have an indoor environmental quality (IEQ) policy and personnel familiar with solving IEQ problems. If given the opportunity, make sure to review renovation and construction projects in advance with all occupants of the impacted areas. If any of our recommendations given here vary from traditional or consensus guidelines or local codes, try to apply the more stringent of the two.

The most common indoor environmental quality concerns stem from construction and renovation projects and include transient smells, nuisance odors, noise, and dust. Building occupants can experience mucous membrane irritation and headaches as well as aggravated allergies or asthma-like symptoms from these contaminants, even at very low concentrations. In addition, excessive noise can have a definite effect on focus, concentration, and productivity. If contaminates are repeatedly introduced into the occupied areas, workers are going to let you know about it, and rightfully so. However, most of these conditions affecting indoor environmental quality and employee comfort, productivity, and health are preventable and reversible. Based on our many years of experience dealing with IEQ complaints in occupied spaces, the following tips can keep your employees happy, healthy, and productive.

> "Make sure enough fresh air is being brought in, supply volumes meet design, and filtering is adequate."

First, ensure the ventilation systems supporting the occupied complaint areas are consistent with all appropriate recommendations of the latest version of the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Standard 62, *Ventilation for Acceptable Indoor Air Quality*.[1] In other words, make sure enough fresh air is being brought in, supply volumes meet design, and filtering is adequate.

If the complaints are about musty odors or mold, look for obvious visible mold growth or excess moisture. Find out whether there has been a recent or prolonged water intrusion event. Fix the moisture issue, and clean off any visible mold with a soap-and-water solution.

Make sure any construction/renovation project areas are separated from adjacent occupied areas with full-height, hard wall barriers. This type of barrier will effectively block any transmission of dust, odors, or other contaminates. In addition, isolate any construction zones from the adjoining work areas to attenuate noise as much as possible.

Only Labconco serves up the best of both worlds.

Axiom™ ...it's a no-brainer.

Introducing the World's First Type C1* Biosafety Cabinet

Confused about what type of BSC you need? Should it be ducted or can it recirculate? What if your needs change later? Stop worrying about making the wrong BSC choice. With Axiom, you CAN have it all.

- **Flexible Exhaust** – re-circulates back into the room or vents outside
- **Convertible Sash** - programmable for 8 or 10" sash opening
- **Total Safety** - protects you, your samples and the lab

Find out more. Visit **www.BSCno-brainer.com.**

*Pending

Protecting your laboratory environment
LABCONCO

Kansas City, MO | 800.821.5525
www.labconco.com

Made in the USA

Maintain any construction/renovation areas at a slight negative air pressure relative to the adjacent occupied spaces. If these work areas go to positive pressure, then contaminates, dust, and odors might find their way into nearby offices and labs. Set up and maintain negative pressure by adjusting the HVAC system, or install additional exhaust ventilation to support the construction/renovation work. If local exhaust ventilation (LEV) is used, it should follow the recommendations of the American Conference of Governmental Industrial Hygienists (ACGIH) guidelines in *Industrial Ventilation, a Manual of Recommended Practice.*[2]

For any construction/renovation work, try to segregate all areas utilized for containment. Locate any odor- or contaminate-generating activities away from outside air intake systems, and ensure adequate exhaust air is provided. Alternatively, the return air vent in the construction/renovation area could be blocked off temporarily.

Make sure regular, daily housekeeping is performed to prevent construction workers from tracking dust and debris outside the work area and into occupied spaces. If possible, set up decontamination zones or antechambers so workers can wipe down and clean off before leaving the construction area. Use of sticky mats greatly reduces dust and debris being carried by worker footwear. Your facility housekeeping staff will also appreciate their use.

Request that facility maintenance personnel perform routine checking and replacing of HVAC system air filters. Use more efficient filters if dust loading in adjacent occupied areas becomes excessive. We recommend pleated, extended surface area filters with a minimum dust spot efficiency of 60 percent (MERV 11).

> "Maintain any construction/renovation areas at a slight negative air pressure relative to the adjacent occupied spaces."

Many construction and renovation projects use equipment that produces odors or contaminates, and often these are set up outside. Examples include roofing tar pots, spray equipment, pressure washers, portable gas- or diesel-powered engines or generators, and portable showers/lavatories. Any such equipment set up outside must be carefully located well away from any ventilation system air intakes and building entrances to prevent re-entrainment of contaminates.

Make sure that material safety data sheets (MSDS) are maintained on-site for all chemical products used during any construction or renovation process. When the inevitable calls start coming in, you will need to know what the contaminates are so appropriate actions can be initiated.

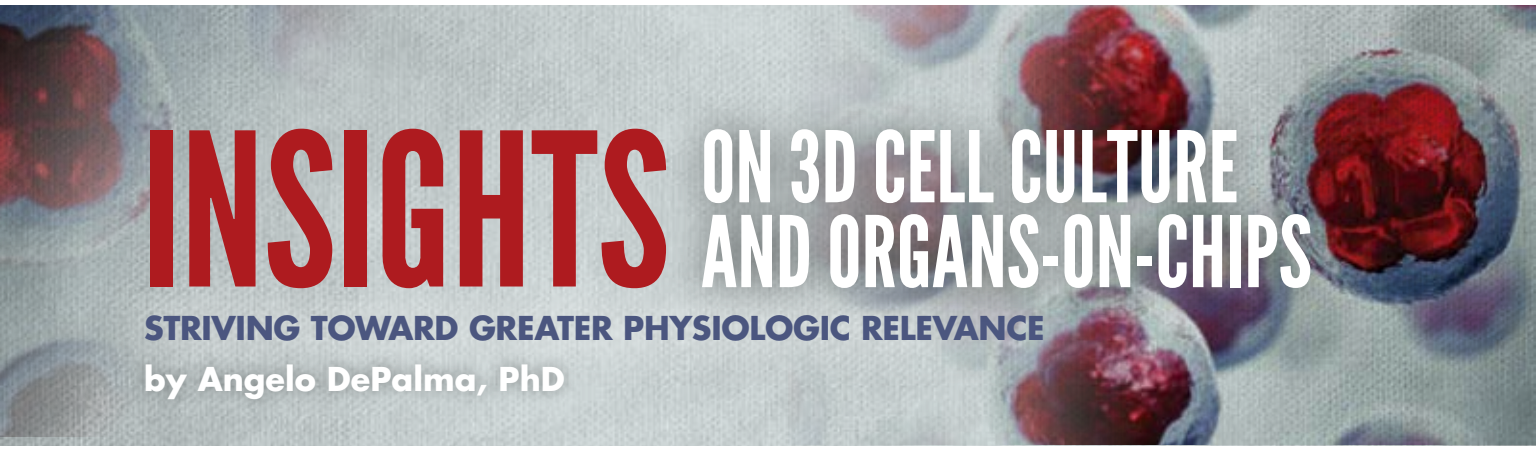
"Request that facility maintenance personnel perform routine checking and replacing of HVAC system air filters."

Even if you are extremely meticulous, chances are that something will upset the delicate indoor air quality balance at some point. There may be times when good IEQ just is not possible. When these cases arise, your only alternative may be to have a professional investigate. It is not often you run into these situations, but sometimes the issue is not obvious or easily found. Good luck with your next IEQ complaint, and remember—safety first!

References:

1. *Ventilation for Acceptable Indoor Air Quality.* American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Standard 62-2009. Atlanta, Georgia.
2. *Industrial Ventilation, a Manual of Recommended Practice.* American Conference of Governmental Industrial Hygienists (ACGIH). 27th Edition, 2010. Cincinnati, Ohio.

Vince McLeod *is an American Board of Industrial Hygiene–certified industrial hygienist and the senior IH with Ascend Environmental. Mr. McLeod 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 project experience includes comprehensive IH assessments for major power generation, manufacturing, production, and distribution facilities.*



INSIGHTS ON 3D CELL CULTURE AND ORGANS-ON-CHIPS

STRIVING TOWARD GREATER PHYSIOLOGIC RELEVANCE

by Angelo DePalma, PhD

Nothing short of post-marketing safety issues depresses pharmaceutical company shares more than drugs that fail in phase 2 or phase 3 clinical studies due to toxicity or lack of efficacy. "Fail early," before tens or hundreds of millions of dollars are wasted on human studies, has become a mantra.

Drug developers therefore seek to maximize preclinical study data obtained from biochemical assays, animal testing, and cell-based assays (CBAs).

Increasingly, two-dimensional CBAs are viewed as artificial constructs since cells occur naturally in 3D. Hence the rapid adoption of more physiologically relevant 3D cultures and organs-on-chips (OOCs).

"Industry is placing more of an emphasis on humanized [drug development] models," notes Richard Ladd, PhD, senior director for pharmaceutical business at Waters (Milford, MA). "Animal models are expensive, and [they] limit developers in terms of sample volumes."

In its 2015 report, *Global Market Study on 3D Cell Culture*, Persistence Market Research estimated that the global 3D cell culture market will grow to $2.7 billion in 2020 from $586 million today, an annual growth rate of nearly 30 percent.

"Limitations of 2D culture may well have contributed to the high attrition rates of molecules in clinical trials over the past two decades," says David Randle, PhD, applications development manager at Corning Life Sciences (Tewksbury, MA). "Continuing improvement in 3D culture systems, combined with availability of patient-specific primary cells, offers the prospect of generating higher-quality lead compounds and improved translation of preclinical assays into the clinic."

Corning's product portfolio covers a range of 3D culture applications, including the ubiquitous Corning® Matrigel® Matrix, a hydrogel suitable for 2D and 3D cultures. Breast tumor cells cultured in Matrigel assemble into 3D structures that recapitulate key aspects of in vivo breast tissue. Recent research has shown that stem cells cultured in Matrigel spontaneously self-assemble into small organoids that mimic the structure and function of intact organs. "This exciting development offers the possibility of personalized drug therapies tailored to a patient's specific tissues," Randle says.

ADAPTING ASSAYS

Three-dimensional cell cultures employ a natural or manmade matrix to retain cells within 3D structures. The interstices of the scaffold allow feeding, introduction of test compounds (e.g., drugs), and clearance of waste products and metabolites. Common matrix materials include fabricated polymers and natural proteins such as collagen, laminin, fibronectin, and gelatin. Protein matrices are believed to improve cell viability and support natural cell functioning.

Depending on the assay, 3D cultures may employ immortalized (tumor) cell lines, harvested and cultured primary cells, and primary cells derived from induced pluripotent stem cells (iPSCs). Immortalized cells are the hardiest and easiest to grow, but since they are "abnormal" their physiologic relevance is limited to testing cancer drugs.

Three-dimensional matrix cultures support co-culturing of two or more cell types, as well as "tissue" layering of several monocultures.

Adapting assays developed for 2D cultures to 3D formats is not always straightforward. Three-dimensional geometry creates gradients that affect how nutrients and test compounds enter the culture and are processed. "Sometimes it may be a matter of longer incubation times or agitation, or modifying cells or microtissues for compatibility with standard instrumentation," says Randy Strube, PhD, director of global marketing at InSphero (Schlieren, Switzerland). InSphero has worked closely with assay and reagent manufacturers to adapt conventional cell-based assays to 3D formats.

EXIT THE MATRIX

Scaffold- or matrix-free cultures consisting only of cells are considered a further step toward physiologic relevance. Matrix-free cultures also offer more options

for analysis, according to Strube. "It's possible to perform traditional histology, cell-based assays, enzyme-linked immunosorbant assays, proteomics, transcriptomics, and high-content imaging without interference or having to remove cells from the scaffold."

Two common methods for producing scaffold-free 3D cultures are the hanging drop method and ultra-low attachment plates. With hanging drop, scientists apply a droplet containing suspended cells onto a culture dish, invert the dish onto its lid, and expand the cells for several days in an incubator. Cells settle by gravity to the bottom of the drop and self-assemble into three-dimensional structures that are harvested and employed in assays.

InSphero's GravityPLUS™ Hanging Drop System adapts this technology to standard 96-well microplates, where drops are formed by pipetting cells into a narrow, hourglass-shaped channel from above. After spheroid formation, additional medium is added through the channel to transfer the drop and microtissue to a nonadherent trapping or harvest plate.

InSphero uses the hanging drop platform to produce standardized 3D microtissues derived from sources such as primary liver and pancreatic cells. The company ships these to customers along with an optimized culture medium most frequently used for toxicity and safety testing. The hanging drop method is ideal for primary cells and co-culture models, which are challenging to coax into forming solid tissues. InSphero offers both assay-ready tissues and products for customers who prefer using their own cells and media.

Similar scaffold-free microplate formats are also available, for example the Perfecta3D® Hanging Drop Plates from 3D Biomatrix (Ann Arbor, MI), and a number of ultra-low attachment formats from providers such as Corning and PerkinElmer.

Three-dimensional cell printing, a technique often associated with regenerative medicine, is another early-stage but noteworthy addition to 3D cultures. Three-dimensional cell printing uses inkjet-like nozzles to deposit cells into defined structures. The technique is under development at several universities and at the companies BioBots (Philadelphia, PA) and Organovo (San Diego, CA), which use 3D printing to produce organ models.

Cell printing's strength is the ability to precisely pattern matrix-free cells. "Our tissues are all cellular, with no foreign material present," says Organovo CEO Keith Murphy.

But like other 3D culture methods, bioprinted tissues lack true vasculature, so maintaining viability is a perennial issue.

ORGANS-ON-CHIPS

In addition to manufacturing assay-ready 3D microtissues and culture platforms, InSphero collaborates with groups developing OOCs, which take 3D cell culture to another level. OOCs interconnect 3D cultures on inert substrates using microfluidic channels to mimic the body's more complex integrated system of organs, and better model the multi-organ effects of drugs in vitro.

According to Dongeun (Dan) Huh, PhD, professor of bioengineering at the University of Pennsylvania (Philadelphia, PA), the ingredients for the success of OOCs are cells, materials, and validation.

Huh's notable accomplishment has been a breathing lung-on-a-chip that recapitulates lung physiology, including the mechanical stresses encountered during breathing.

Most scientists prefer primary human cells for toxicology or mechanism-of-action studies, but the supply and uniformity of such cells is unpredictable. Researchers can team with surgical or

pathology units, but isolating specific cells is time- and labor-intensive. Cell consistency depends on the harvesting technique, number of passages, if applicable, and patient health status at time of harvest. Thus many groups opt for iPSC-derived primary cells.

Material of construction for OOCs is an issue for screening small-molecule drugs. As Huh notes, the elastomer PDMS, a popular material for rapid prototyping organs and tissues on chips, is known to absorb small molecules. "Some of the drug compounds will not reach the cells due to this problem, so engineers are looking into alternative materials."

Ultimately, OOCs will be adopted but only if developers can validate the relevance of their models toward the resolution of specific scientific questions. Huh's original OOCs manuscript, submitted to *Science*, was unfavorably received. "The reviewers were intrigued by our model but were skeptical that we did not provide data to validate its physiologic relevance. To address this major concern, we needed to repeat some key experiments in an animal model to corroborate our in vitro findings from the lung-on-a-chip model."

RECENT SUCCESSES

Searching the newswires for organs-on-chips initiatives yields a wealth of information:

- Janssen Biotech (Horsham, PA) is collaborating with Emulate (Cambridge, MA) to apply Emulate's OOC platform across Janssen clinical research programs. The two products include a lung-on-a-chip to evaluate pulmonary thrombosis and a liver-on-a-chip to predict liver toxicity, a major cause of development-stage drug failures.
- The Defense Advanced Research Projects Agency (DARPA) has teamed with Harvard University's Wyss Institute for Biologically Inspired Engineering (Cambridge, MA) to develop a human body-on-a-chip integrating ten human "organs" to study complex human physiology in vitro. The deal could be worth $37 million to the institute.
- The National Institutes of Health and four grantee universities have developed a placenta-on-a-chip to study physiology and function of the human placenta

during pregnancy. The device imitates, on a micro-level, the structure and function of the placenta and models transfer of nutrients from mother to fetus.

- University of California, Berkeley, scientists have produced a heart-on-a-chip incorporating human heart tissue derived from adult stem cells. The system could replace some animal testing for drug safety screening.
- Among the successes of the Wyss Institute are a gut-on-a-chip that mimics the mechanical, structural, absorptive, transport, and pathophysiological properties of the human gut along with its crucial microbial symbionts.

DOUBTERS

Not every expert believes OOCs will solve the pharmaceutical industry's development problems. Cellular engineering pioneer Martin Yarmush, MD, PhD, director of the Center for Engineering in Medicine at Massachusetts General Hospital (Boston, MA), has produced a brain-on-a-chip, an allergy-on-a-chip, and a liver-on-a-chip, among others. Yet Yarmush remains skeptical about near-term real-world applications. "The field is overblown in what it can deliver reliably in the near future." He dismisses DARPA's human-on-a-chip, for example, as a "fairy tale."

Yarmush also disputes claims that OOCs will significantly reduce late drug failures, allowing developers to drop projects before spending millions of dollars on human studies. "Many drug failures occur not because we lack a human-on-a-chip platform, but due to idiosyncratic reactions or safety signals not appearing either in preclinical studies or during clinical phases 1 and 2, which enroll small numbers of subjects." The most dangerous side effects often arise only after thousands of subjects have been treated.

The pharmaceutical industry's reliance on in vitro models attests to their utility. The question is whether 3D cultures and OOCs have the potential to streamline drug development and lower costs. Three-dimensional cultures will succeed only to the extent that they predict in vivo behavior.

"I'd like to think we are already contributing to lowering R&D costs to a degree," says Organovo's Murphy. "We have seen quite a few drugs where our models could have predicted liver toxicology that was not observed until late-stage clinical trials."

In vitro models provide the greatest benefit for predicting efficacy for diseases that are difficult to duplicate in animal models, for example asthma and liver fibrosis.

The eventual success of 3D cell cultures and OOCs depends on developers and users applying these constructs to narrowly defined scientific questions.

Angelo DePalma *is a freelance writer living in Newton, New Jersey. You can reach him at angelo@adepalma.com.*

WHAT DIFFERENTIATES 3-D FROM 2-D CULTURES?

The discussion around 2-D or 3-D culture comes down to what is more realistic, which format better approximates physiologic conditions.

LabManager.com/cellculture-INSIGHTS-2015

INSIGHTS

ON THE GROWING FINGERPRINT CHALLENGE

THE FUTURE OF IDENTIFYING PEOPLE WILL REQUIRE MORE THAN ONE METHOD

by Mike May, PhD

Standing in the immigration line at the Indira Gandhi International Airport in Delhi, India, I watch person after person be fingerprinted. First, you put your left four fingers on a digital pad, then your right four, and finally both thumbs at once. If all goes smoothly, the Indian government collects all ten fingerprints for everyone entering the country. It's not as easy as it sounds, even from the start. More than one person is asked to try again and again. So obtaining a print can be as difficult as analyzing one.

Although some fingerprint analysis is new, the concept—using fingerprints for identification—started centuries ago. Thousands of years ago in Babylon, a fingerprint served as a signature of sorts on business papers. Finally, in 1880, British surgeon Henry Faulds described using fingerprints to identify people; he gets credit for the first use of this technology of lifting a print from an alcohol bottle. By 1946, the U.S. Federal Bureau of Investigation (FBI) maintained a collection of 100 million prints, all kept on cards and maintained manually. In 1999, the FBI launched its computer-based Integrated Automated Fingerprint Identification System (IAFIS). This unique and largely unchanging feature, a fingerprint, now gets used more than ever—from criminology to home computing.

For the field of criminology, Anil K. Jain—a computer scientist at Michigan State University in East Lansing and the creator of many tools for analyzing fingerprints, including AltFingID, which can detect altered prints—says, "Fingerprints are primarily for identifying repeat criminals." At a crime scene, this can be challenging because, as Jain notes, "They can be partial prints—maybe just one or two fingers and smudgy."

Fingerprints can be visible or invisible. The former could be a fingerprint left in blood, for example, and this can be captured with a high-resolution picture. Invisible or latent prints need to be found and made visible. For latent prints, Eberhard Schultheiß, manager of R&D at Germany-based EVISCAN, says, "A large collection of methods exists to accomplish this, and such methods have in common that they use one- or two-step processes based on the use of chemicals." He adds, "These chemicals are applied to either mask chemical substances left as latent traces, to stain such traces, or both." Then, the stains used can be imaged under visible or fluorescent light.

▲ *Even a latent fingerprint (left) can be captured and cropped (middle), and software can be used to analyze key features (right). (Image courtesy of Kai Cao.)*

A range of technologies is applied to obtaining and analyzing fingerprints. The capture, processing, and analysis all impact the final results. Likewise, the technologies involved range from imaging to computation. Moreover, the world's increasing population, easier access to travel and expanded use of fingerprints to identify users of personal electronic devices increase the need to identify fingerprints quickly and accurately for security reasons that range from public to personal safety.

IMPERFECT IDENTIFICATION

Although fingerprints do not change naturally with time, they can get worn, and that can make identification tricky. "Some people have poor-quality fingerprints for occupational reasons, like a mason doing brickwork," Jain says. "It can be more difficult to identify a person who works with lots of chemicals too." So there will always be some individuals who cannot be recognized with fingerprints.

Beyond the fingerprints themselves, the capture technology creates some challenges. "The biggest challenge is that not all fingerprints that are left on different materials or surfaces can

be developed easily," says Kok-Jhoon (KJ) Wong, national sales manager at Australia-based Pathtech. "Prints left on samples that are later wetted, [on] polymer currency notes, or [on] porous surfaces can be difficult to develop with conventional methods."

The EVISCAN technology combines heat imaging and infrared spectral properties of the material. "When a heat imaging device is aimed at an exhibit surface where trace material is present, it will see differences in reflected infrared intensity between trace and exhibit—a contrast [that] is not seen in visible light," Schultheiß explains. The EVISCAN excludes parts of the spectrum coming from the surface to detect latent traces without any need for contrasting chemicals or dyes.

Once you have a print, it can be imaged in many ways. For example, Pathtech's Foster + Freeman Crime-lite Imager has a full set of different wavelengths to capture fingerprints in different lighting conditions. This instrument is very easy to use and reduces the need for photographic expertise to capture a very good image.

Where the print gets left, also matters. "Getting prints off bullets is very difficult, because when you fire a gun, any print that was left on the cartridge degrades by the heat generated," Wong says. The CERA-LT, though, was designed specifically to recover fingerprints from bullet casings by using patented lighting and stitching software. "Normally bullets are loaded into the gun for a long time before its being fired. This gives sufficient time for the fingerprint residue—salt—to corrode the casing, leaving a mark. Hence it is possible to recover the print even after it is fired."

Other technologies also offer more options in the development of fingerprints. For example, vacuum metal deposition (VMD) uses metal ions, which can develop prints even on wetted samples. "In a wetted sample, only the oily residues of the fingerprint are left," Wong explains. "VMD takes advantage of this oil residue and develops a negative image of the fingerprint."

MILLIONS AND MORE

In analyzing fingerprints, quantity also matters. For example, the state of Michigan maintains a database of approximately three million, ten-finger sets of prints. So finding a criminal can mean trying to compare a partial print to 30 million possibilities.

Some databases contain huge numbers of fingerprints. For example, the Unique Identification Authority of India (Aadhaar) will include fingerprints—all ten—and two iris images for each of the country's 1.2 billion citizens.

Today's computer power, though, can run comparisons fast. If it's just one print being compared to a thousand or so, says Jain, a personal computer or even a smartphone can do it in about a second. Even when comparing one print to a million prints, parallel processors make quick work of the analysis. "At border crossings or immigration centers at airports, where they collect ten prints from each visitor, it only takes a second or so to compare that to a watch list, because they are using efficient algorithms and distributed computing," Jain explains.

SPOILING THE SPOOFS

With more and more countries adopting fingerprints for national identification programs and fingerprints being used to unlock mobile phones or to secure information, it raises the potential for a criminal finding a way around that. One of those methods is called spoofing, which is essentially mimicking a fingerprint. For example, one company made a fake fingerprint out of wood glue and easily tricked the fingerprint reader on a cell phone. In fact, a quick search online reveals more than one DIY spoofing video. Although this makes me feel less than secure as I open my new iPad with a touch of my thumbprint, experts are on the case.

When asked about some of today's biggest challenges with fingerprints, Stephanie Schuckers, director of the Center for Identification Technology Research (CITeR) at Clarkson University in Potsdam, New York, says, "People are committing fraud with fingerprints, faking a biometric device by trying to become someone else or to hide their own identity." She adds, "If you are on a watch list, you have some incentive to hide your fingerprint." Schuckers points out that commercial defenses against spoofing are emerging, but as she says, "the problem is not fully solved."

▲ *Fake fingerprints—spoofs—can be created from many materials, including the silicon used here. (Image courtesy of Stephanie Schuckers.)*

Schuckers works on ways to detect spoofed prints. "We do that through algorithms," she says. "You look at small details in the image." For example, an algorithm can look at grey-level information to try to distinguish a real from a fake fingerprint. Spoofers, though, create an ongoing battle: The software learns to identify a particular kind of spoof, the spoofers try to get around that, which drives the need for new or improved algorithms. Consequently, the details of many anti-spoofing algorithms remain proprietary.

The future of identifying people will probably include some combination of methods. For instance, Schuckers is part of the FIDO Alliance, which stands for "fast identity online" and aims to reduce our reliance on passwords. The plan is to combine cryptography, such as a public-private key code, with a biometric identifier, such as a fingerprint. "The biometric communication is local, at the device," she says, "and the cryptography is between the device and another party, such as a payer." She adds, "This might not make us completely free of passwords, but it might limit their use to things like identity recovery."

CUTTING THE COST

Seeing fingerprint readers showing up in mobile devices suggests the decreasing price of the technology. "The cost of the print reader in a mobile phone is only a couple of dollars," Jain says.

Inexpensive readers can mean lower quality. "Poor quality translates into poor performance in an algorithm," says Schuckers. "In mobile devices, the price of the scanner is under pressure to go down, and that impacts the quality and the amount of information that you are able to capture." For example, smaller scanners capture a portion of the print, and even that is at a lower resolution. "The sensor is being taken over by the consumer-device market," Schuckers says. "How can we capture the fingerprint in an inexpensive way to put it on a mobile device?" A lower price, though, is not always good. "If you spend more money to get a better quality scanner," says Schuckers, "the result is more robust."

Even though today's print readers remain imperfect, that's no reason to abandon them. As Schuckers says, "Even though whatever mechanism you put in place might not be perfect, like virus-protection software, you wouldn't want to go without it."

Mike May is a freelance writer and editor living in Ohio. You may reach him at mikemay1959@gmail.com.

VIDEO: REAL-LIFE CSI: AGE DATING FINGERPRINTS

Finding out how long a fingerprint has been at a crime scene has always been a challenge for investigators. Now a team at the National Institute of Standards and Technology (NIST) is working on a technique that would help law enforcement do just that.

LabManager.com/fingerprints

Terry G. Cain

Dr. Michael D. Wichman

ASK THE EXPERT

HPLC AND GC ENVIRONMENTAL TESTING TECHNIQUES

by Rachel Muenz

Terry G. Cain is a supervisor in the Environmental Health Division of the State Hygienic Laboratory (SHL) at the University of Iowa (UI). He received his degrees in chemistry and computer programming from Loras College, Dubuque, Iowa. He has worked in the areas of agricultural chemistry, radiochemistry, drugs of abuse testing, quality assurance, emergency response, laboratory information systems, and environmental monitoring with emphasis in gas chromatography in conjunction with mass spectrometry.

Dr. Michael D. Wichman has been with the SHL at UI since 1987 and currently is the director of the Environmental Health Division and the associate director of SHL. His education is in chemistry, with a doctorate in analytical chemistry from Kansas State University. His current research interests include simplifying sample preparation techniques, environmental monitoring for pesticide and industrial chemical degradates, and biomonitoring for human metabolites resulting from environmental exposure.

Q: What environmental work does the State Hygienic Laboratory at the University of Iowa do?

A: Wichman: We perform analytical testing to support numerous local and state agencies, including local county health departments, the Iowa Department of Natural Resources, the Iowa Department of Public Health, the Iowa Department of Inspections and Appeals, the Iowa Department of Homeland Security and Emergency Management, and others. We're involved in the testing of ambient air and surface water, groundwater, drinking water—both public and private water supplies—wastewater, plant materials, soils, sediment, and various other matrices. A lot of those tests are driven by various regulations like the Safe Drinking Water Act; Clean Water Act; Clean Air Act; Federal Insecticide, Fungicide, and Rodenticide Act; and the Resource Conservation and Recovery Act. We're also part of several emergency response networks at the federal level for the CDC [Centers for Disease Control and Prevention], EPA [US Environmental Protection Agency], and FDA [US Food and Drug Administration].

A: Cain: In addition, we consult with and perform testing for private citizens. So if a person has a private well and they have a problem or just want to check the integrity of their well, we can assist them. We also collaborate, usually on a project-by-project basis, with researchers from the University of Iowa, Iowa State University, and private colleges in the state.

Q: What specific things do you use HPLC and GC for?

A: Cain: Many people around the state know us for our drinking water testing. Part of that program includes testing for disinfection by-products formed when drinking water is chlorinated. We test for trihalomethanes by GC-MS, and we test for haloacetic acids, which are another set of disinfection by-products, by GC electron capture. Our robust air-testing program involves both LC and GC. We have a network of air-monitoring sites that we support, and we send canisters and cartridges out to those sites for collection of ambient air. The samples are returned to the laboratory for determination of tailpipe emission hydrocarbons and for toxic volatile organic compounds by GC-MS. The cartridge samples are used to determine carbonyl compounds by LC.

A: Wichman: We also look for other volatile components, such as things in gasoline—benzene, toluene, ethyl benzene, the xylenes (BTEX), and semivolatile organics such as polycyclic aromatic hydrocarbons, which were analytes of interest in the Gulf of Mexico oil spill. Our lab performs determination of pesticides and pesticide degradates, acid herbicides, nitrogen phosphorus herbicides, insecticides, rodenticides, fungicides, and other compounds such as personal care products and pharmaceuticals by both GC and LC technologies.

A: Cain: Often different pesticides require different methodologies, so we have numerous tests and procedures that we support. Different extraction procedures as well as different analytical procedures may be required, depending on the particular chemical class. Acid herbicides require a different procedure from the nitrogen phosphorous pesticides, for instance. So there's quite a variety. A lot of the pesticide work is surface water monitoring. Samples may be obtained from wetlands, rivers, lakes, streams, or groundwater.

Q: What challenges does your lab experience in HPLC and GC testing?

RuRo

Laboratory Information Bliss™

CERTIFIED ISO 9001 COMPANY

Limfinity

ISO 9001 quality LIMS solutions:
reliable deployment with customer objectives held paramount

Contact us at:

888-881-RURO (7876)
301-639-5546

sales@ruro.com

RuRo WWW.RURO.COM Laboratory Information Bliss™

Visit www.RURO.com for more information

Compliance:

FDA 21 CFR Parts 11, 21, 58, 210, 211, 820
cGLP/cGMP (Good Laboratory Practice and Good Manufacturing Practice)
Section 508 Accessibility Guidelines
HIPAA Accountability Act of 1996
HIPAA Patient Safety and Quality Improvement Act of 2005 (Patient Safety Act)

Browsers Supported:

A: Cain: Much of what we do is routine work—drinking water, for instance—but the challenging work comes with more complex matrices. The past couple of years we've been doing more fish analysis, so preparing a fish sample to be able to do the analysis can be difficult. Sometimes we'll get a whole fish that may be relatively large. We grind the fish, measure the fat content, figure out how to do the cleanup on the tissue, then do the extraction and the analytical work. We're looking for contaminants at parts-per-billion levels or even lower, so that's a challenge. Other tissue matrices are always a challenge too.

Q: How do you handle those challenges?

A: Cain: We have high expectations of our staff, and fortunately our staff has a lot of experience, so it's pretty unusual that we get something that we've never seen before. Usually we put our heads together and come up with a plan; sometimes it's on an individual sample basis. We try to figure out what's the best technique or what's the best way to go about problem-solving the difficult matrix. Another challenge is that we have different platforms that the instruments operate on. There are multiple software systems that analysts have to be familiar with, and then maintaining those different platforms is a challenge, but again I go back to our staff. They're experienced, and without that experience, we'd have a much more difficult time.

A: Wichman: Some of the other issues that we face are trying to maintain our current equipment and trying to obtain new technology with limited resources. It's a challenge to get some of the latest and greatest, like high-resolution mass spectrometers. That would be useful to us for things like the PCBs [polychlorinated biphenyls] and PBDEs [polybrominated diphenyl ethers] congeners, but we don't have that technology and really can't afford to purchase it. Service contracts are also getting more and more expensive. We do maintain a quality management system in our laboratory to ensure that staff completing tests have met their demonstration of capability. That's documented, and results are checked and validated. I won't say we never make mistakes, but we keep that to an absolute minimum.

Q: What changes do you expect to see in the future for your lab?

A: Cain: There's always going to be the need for new tests and new requirements and the need to detect lower and lower levels of contamination. I don't expect that's going to stop. There will also continue to be a need to respond to different environmental situations quickly—if there's a spill or a fire, for example, like the one we had at a nearby landfill a couple of years ago. To be able to respond to those unforeseen events more quickly will continue to be important.

A: Wichman: We've experienced a number of floods here, and of course, being able to see what people may or may not have been exposed to is important. So is a quick turnaround on those tests. During the 2008 flood, we were able to meet that demand, but it was a challenge. We had to implement an incident command structure to make sure we could keep things staffed and perform those tests in a timely manner. Some of the other changes I think we might see involve technology. A lot of things are moving to mass spec or tandem mass spec. MALDI-TOF is another emerging technology that we'd really like to look at.

Q: What key advice would you have for labs that are just getting into environmental testing and may be new to HPLC and GC?

A: Wichman: It depends on what program they're getting into. If they're getting into drinking water, for example, they should read through those methods and make sure they understand what the methods require. Then they should implement a quality management system based on either The NELAC Institute (TNI) or ISO 17025 standards, something to make sure that they have implemented a quality control system. That can save a lot of time. Our standard operating procedures are written, and methods are validated. Cross-training is important as well so you have some flexibility, depending on the size of the laboratory. With us—whether we're dealing with floods or a landfill fire—we have to be able to quickly shift our focus and address those issues.

A: Cain: With the quality assurance aspect, there's a cost to setting all that up, but it's really necessary. You really have to be thorough on that aspect and find good people who do good, careful work in a conscientious manner and train them well.

Q: Did you have anything more to add?

A: Cain: We've had a major effort here in developing and enhancing our laboratory information management system [LIMS]. I think a critical component for any lab is to have a good information management system that can be maintained. There are mountains of data that we produce, and keeping all of that organized in an information system is really, really important.

A: Wichman: Being able to track the quality control is essential so you can see [whether] something is off—whether it's the instruments drifting or whatever—you need to be able to track that. Something we've done here is interfacing our instruments directly into our LIMS, which saves a lot of manual data entry. That would be something that would be good for a new lab getting into this. It's expensive, but it would be a good thing for them to consider.

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

Get ***Lab Manager*** on the go.
Download a pdf at labmanager.com

Lab Manager®
Run Your Lab Like a Business

TROUBLESHOOTING A TITRATOR

KNOWING HOW TO LOOK FOR THE TROUBLE MAKES IT EASIER TO FIND

by Mike May, PhD

To find the concentration of an analyte in a solution, scientists turn to titration. Once a drop-by-drop-by-drop method, this can now be handled automatically with a titrator, but getting an accurate answer still takes some skill. Part of the needed skill depends on what is being tested. Nonetheless, some general information applies to virtually any titration situation.

"Titration issues are typically either systematic or random," says Matthew Eby, application and technical support manager for the Mettler-Toledo NA division in Columbus, Ohio. "Systematic errors generate the same results, although incorrect, every time; random errors generate no results or various incorrect results without consistency." Since systematic errors generate the same problems every time, they are the easiest to figure out. To see whether a problem is systematic, says Eby, "It is always advised before troubleshooting to run the sample or method with the issue multiple times to look for trends and to see the repeatability of the issue before attempting to address the problem."

Scientists in research and industry use titration in so many ways that variety alone creates a challenge. "Depending on the type of reaction, whether it's an acid-based, a redox, a complexometric, or a nonaqueous titration, using the right electrode can make all the difference," says Lori Carey, product manager for titration at Metrohm USA in Riverview, Florida. "Metrohm has fine-tuned the electrode design for even the most difficult samples, and referencing our Metrohm titration monograph is very helpful as an overview for many titrations."

> "When titration runs into trouble, history impacts the troubleshooting."

In search of the source

The goal of titration is finding the end point, but that can be elusive. "There are many different reasons why an end point may not be obvious," Carey says. "There are a few simple questions you can ask yourself to identify the cause."

The questions, says Carey, include, is the correct titrant at the proper concentration being used? Is the electrode fully submerged in the sample? Is the sample completely dissolved, and is the analyte of interest available for titration? Are the increments in the titration method set properly? And did the titration just stop too soon?

Other experts also see users struggling at times with the titration end point. According to Alicia Guardado, technical adviser at Hach Company in Loveland, Colorado, "For titrations in which the user is looking for a visual end point, the most common issue is probably going to be overshooting the end point." She adds, "This is usually caused

Get All You Need
In One Box…

… and stay flexible with new Titration Excellence!

Experience the New
Titration Excellence Modular Concept

The new Titration Excellence line offers full space-saving modularity regarding:

- Applications: Easily change and add new analyses whenever you need.
- Workflows: Choose from a number of accessories and adapt the system to your workflows.
- Compliance: Fulfill current and future regulations.
- Users: Individually customize your system to accommodate each user's work style.

Request a free demo today and experience it for yourself. We're so excited to show you the value of the new Titration Excellence that for a limited time, we're giving away a bluetooth speaker with every onsite demo* — for all the music you need in one box! To learn more and request a demo, visit ▸ www.mt.com/NewTitrationExcellence

*while supplies last

METTLER TOLEDO

ARE YOU SURE YOU'RE GETTING YOUR TITRATIONS RIGHT?

LabManager.com/titrationsspotlight

In this webinar, learn how you can evaluate the quality of titrations in your lab and uncover potential financial and productivity improvements.

For additional resources on Troubleshooting a Titrator, including useful articles and a list of manufacturers, visit

LabManager.com/titrators

by not completely mixing in each drop of titrant or dispensing drops that are too large." Even for titrations that require a pH-change end point, Guardado points out, it can easily be overshot if the pH probe being used does not have a fast enough response.

Also, when titration runs into trouble, history impacts the troubleshooting. "If a titration method and procedure have been used for some time with success," Eby says, "then that is the last thing one would want to modify; the fluctuations are most likely due to hardware, reagent, or sample inconsistencies."

Even the sample can contribute to the problem. "With sample fluctuations, users should try to pretreat samples in a way that minimizes effects of interference, temperature, pH, etc., so that the results are consistent," Guardado says. "Things like pH adjustment to a specified pH, dilution, and filtration are common pretreatment steps, and these will vary largely depending on the type of titration being performed."

Keep up the care

"The best way to deal with any fluctuations in system performance or sample results is to make sure you are taking care of your titration system," Carey says. "Making sure the electrode is stored in the correct solution and calibrated properly will help reduce fluctuations." In addition, she says, "Making sure that your dosing burettes are properly vented to the molecular sieve or ascarite will help protect the titrant concentration from degrading."

Diminished reproducibility can really destroy results over time. "When reproducibility starts to fade, it's time to verify a few things," Carey says. For one thing, inspect the electrode for wear or blockage. "Two key components of every electrode system are the measuring membrane and the reference diaphragm," she says. "If either of these areas becomes slightly blocked or scratched, the electrode won't be able to respond properly and will give irregular results."

Eby agrees that the electrode can often be the source of errors, and he points readers to Mettler-Toledo's GTP Sensor Use and Maintenance on-demand webinar (www.mt.com/gtp-sensor). He adds, "Seeing [whether] a new sensor addresses the issue is the quickest way to troubleshoot the sensor, and operators must remember that electrodes are consumable items and will eventually wear out."

The problem, though, might not be the device. "The other most common source of issues is the titrant or solvents used," Eby says. "Changing titrant strength due to varying temperature or contamination, improper storage and protection of titrants, or contamination of solvents are the typical issues regarding reagents." To find the source of this kind of problem, the user should exchange the reagents one by one and see whether that solves the problem.

It's also possible that the system that purifies the water used in titration needs maintenance.

To keep your automated titration running smoothly and accurately, Carey offers some valuable advice. "It's always good to refresh your mind with how the electrode system works, because understanding the key functioning areas of an electrode will often lead you to the proper troubleshooting techniques," she says. "Additionally, review the different modes of titration and how changes in titration parameters affect the shape of your titration curve." To develop new titration knowledge or refresh it, Metrohm hosts several Titration Bootcamp courses. Carey says, "I would always recommend [these courses] to anyone working in the field of titration, regardless of their years of experience."

So keeping up titration knowledge and the condition of the equipment go a long way toward preventing problems. Even an automated titrator needs care and skill to ensure ongoing accuracy in the results. The level of skill needed, however, depends on the task at hand.

Mike May is a freelance writer and editor living in Ohio. You may reach him at mikemay1959@gmail.com.

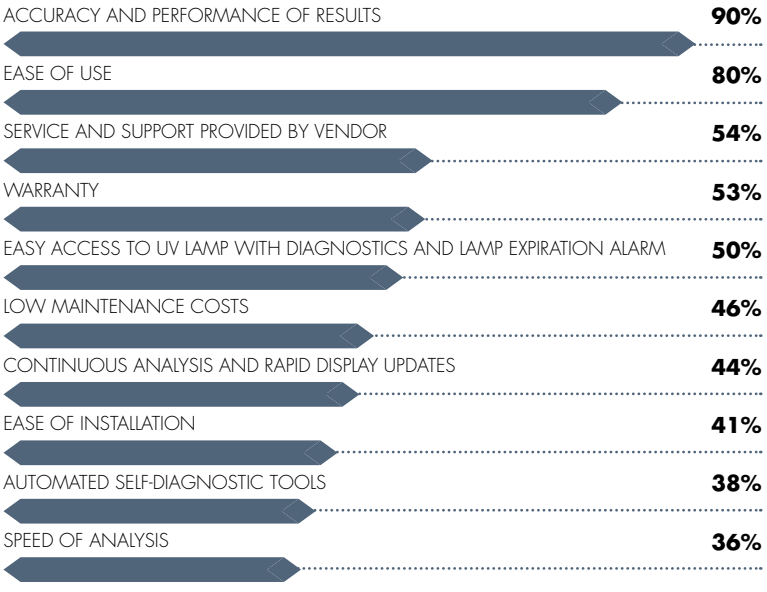
ARE YOU IN THE MARKET FOR A...
TOC ANALYZER?

Total Organic Carbon (TOC) analyzers are a mainstay of environmental and quality control chemistry. TOC, a crucial metric in many processes, may arise from a combination of living or dead organisms or chemical contamination. Its measurement can serve as a surrogate for more difficult measurements or a screen for further analysis.

TOP 5 QUESTIONS
You Should Ask When Buying a TOC Analyzer

1. Is the TOC technology suitable for your specific application or water conditions? Many TOC technologies may be suitable only for waters with a narrow range of organic or inorganic contaminants.
2. Are different models available to meet your current and future sampling needs (i.e. online, portable, laboratory)? Do these models use similar technology to simplify method transfer or data comparability from lab to online?
3. Does the company offer the documentation and support necessary to help meet applicable industry or government regulations?
4. What is the company's level of experience supporting sales of TOC analyzers in your specific industry? Do they understand the unique challenges specific to your application?
5. What type of service, applications, and technical support are available during and after the purchasing process?

TOP 10 FEATURES/FACTORS
Respondents Look For When Purchasing a TOC Analyzer



Types of TOC analyzers used by survey respondents:

Benchtop	**94%**
Portable	**12%**
Online	**12%**

Methods used by survey respondents to detect CO_2:

Non-Dispersive Infrared (NDIR)	**52%**
Direct Conductometric (Non-Selective Conductometric)	**27%**
Membrane Conductometric Detection (Selective Conductometric)	**19%**
Other	**10%**

Over 54% of respondents are engaged in purchasing a new TOC analyzer. The reasons for these purchases are as follows:

Replacement of an aging system	**41%**
Addition to existing systems, increase capacity	**16%**
Setting up a new lab	**13%**
First time purchase	**13%**
Other	**16%**

For more information on TOC analyzers, including useful articles and a list of manufacturers, visit www.labmanager.com/TOC-analyzers

George Weinstock, PhD

ASK THE EXPERT

GEARING UP FOR MICROBIOME RESEARCH

by Tanuja Koppal, PhD

George Weinstock, PhD, professor and director of microbial genomics at the Jackson Laboratory for Genomic Medicine, talks to contributing editor Tanuja Koppal, PhD, about the differences between microbiology and microbiome research. He talks about the big challenges facing the microbiome field and discusses ways in which lab managers can better equip their labs and build expertise to face those challenges.

Q: How does microbiome research differ from traditional microbiology?

A: Microbiology pays attention to individual species of a microorganism; for instance, studying species of bacteria like *Salmonella* or *Escherichia* coli. When doing a microbiome study, you are looking at many different species and microorganisms at the same time. It involves studying the community of microorganisms as a whole. It's not as easy as studying a single species, where you can isolate, purify, and culture the cells. Many of the species found in a microbiome may have never been grown in a culture. Traditional microbiology does have branches like environmental microbiology or microbial ecology where you study communities of microorganisms, but that is now amplified and expanded by microbiome research.

Q: How do the laboratories for microbiology and microbiome research differ in terms of their activities and setup?

A: Many of the microorganisms found in a community have never been cultured; hence, microbiome labs are driven by methods that are usually culture-independent. The most important of those methods is DNA sequencing. In a microbiome study, a nucleic acid preparation is done to isolate the DNA from the entire sample, which can be a saliva, nasal, or stool sample. The sequencing is not done on individual DNA separated from the various species seen in the sample. Then a bioinformatics analysis is done on the sequences obtained from the mixture to try to figure out what organisms may be present. So you gather a list of all the different organisms present in the mixture without trying to culture each of them separately. In microbiology you are often purifying and culturing species and trying to identify them separately. In microbiome research you rarely do that. Instead, you rely on DNA sequencing and the associated bioinformatics tools to convert mixtures of DNA sequences into a list of organisms that may be present.

Q: What types of microorganisms are typically studied?

A: The predominant microorganism in the human body is bacteria, and bacteria is mainly located in the intestinal tract. There are also fungi and eukaryotic microorganisms that are found in abundance in many different body sites. Fungi, for instance, are more abundant in the mouth and skin than in the gut. Most healthy people also carry viruses without showing any sign of disease or infection and, hence, viruses are also considered to be a part of the human microbiome. There are various types of DNA sequencing that need to be done in order to identify all these different types of microorganisms. For bacteria, you sequence the 16S ribosomal RNA gene. Similarly for fungi and eukaryotes, you sequence the 18S ribosomal gene or the internal transcribed spacer (ITS) region. Viruses do not have ribosomal RNA, so one has to do shotgun sequencing to look at the entire nucleic acid preparation of the sample and go through all the sequences to see which of them are viral in origin. Viruses can have both, DNA or RNA, so you have to make an RNA preparation in addition to the DNA prep, and then convert the RNA into cDNA in order to sequence it. Thus, in order to get an exhaustive view of the microbiome, one has to do many different types of sequencing—targeted sequencing of 16S, 18S, or the ITS region; shotgun sequencing; RNA sequencing; and much more.

Q: How can traditional microbiology labs start building an expertise in genomics and bioinformatics?

A: There are options for outsourcing some of the work to companies that already have the expertise to do that. Depending on the type of sample and how much you need to oversee the process, you can either send out the samples—or the DNA preparation from those samples—to outside labs.

Q: What are some of the big challenges in conducting microbiome research?

A: Generating the data using DNA sequencing is pretty straightforward. The parts that introduce variability and bias in the results are often associated with how the samples are handled initially. In microbiology there is some amount of tolerance associated with sample handling since, very often, you only want to know if a certain species exists in the sample. In microbiome research, you want to know

the types of organisms present in the microbial community along with their relative abundances. Since this work is quantitative, the handling of the samples becomes very critical. With some organisms being hardier than others are, the whole structure of the community can be affected during handling. Some samples, such as stool, saliva, or nasal samples, can be collected and frozen right away, but in some situations when that's not possible, the preservation and handling can affect the microbiome structure, and hence the results. Sample handling is always going to be a big challenge because you are looking at community structures and you want to preserve their relative stoichiometry. At the other end of the process, once you have a list of the organisms present in the community and their relative abundances, comparing different communities across samples becomes a challenge too. The statistical methods that are necessary to draw really strong conclusions get complicated and more advanced. That downstream analysis of the complex microbiome data becomes very tricky.

Q: What types of microbial work are you involved in?

A: The two things we are most interested in are comparing the microbiomes of different sets of people—healthy people versus those having a particular disease, old versus young people, or pregnant versus nonpregnant women, and others—to look at changes in the microbiome in different tissues. Once we identify the differences in the microbiomes, then we try to identify the species that have changed and whether their abundance has gone up or down. If there are some organisms found that have never been cultured, then we try to culture them. The idea is to identify the mechanism of diseases by understanding what specific species have changed in the microbiome and then to try to figure out how those changes have contributed to the disease. We study lots of different diseases and work with clinicians and hospitals to provide us with samples, and they work with us to study the mechanistic role of the microbiome in disease. The other area we are working on is geared toward improving the diagnosis of infectious diseases. Sometimes diagnostic labs at hospitals are only looking to identify common pathogens and are not able to identify the less-common organism that may be responsible for the infection. This is particularly true for patients who are immuno-suppressed, as they can get infected with pathogens that would not regularly infect a healthy individual. We would like to do a microbiome analysis of all those patients to figure out what microorganisms are present in them. We are working to make such general types of pathogen diagnosis faster, cheaper, and to be able to do this with a higher throughput.

Q: Will microbiome studies have an impact only on life sciences and medical applications?

A: Microbiome research is certainly ongoing everywhere. In agriculture, the animal microbiome can affect animal health and agricultural production. Plants have microbiomes too; they have an interesting microbiome around their roots, which is essentially like an inside-out human intestinal system. That's where nutrients are absorbed and waste products are released, and that microbiome interacts with the soil as well as with the plant. Microorganisms in the environment have been around far longer than plants and animals, and they have had a big impact on the geology and the processes taking place on Earth. There is an Earth Microbiome Project that looks at microbiomes present in different habitats. So microbiome research is a huge field that goes well beyond human health. There is a trend to set up microbiome centers in universities that will serve as more than just core facilities. These university-based microbiome centers bring together faculty who are involved in various types of microbiome research. There is a rich set of resources out there for anyone looking to study microbiomes to see how it's done.

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

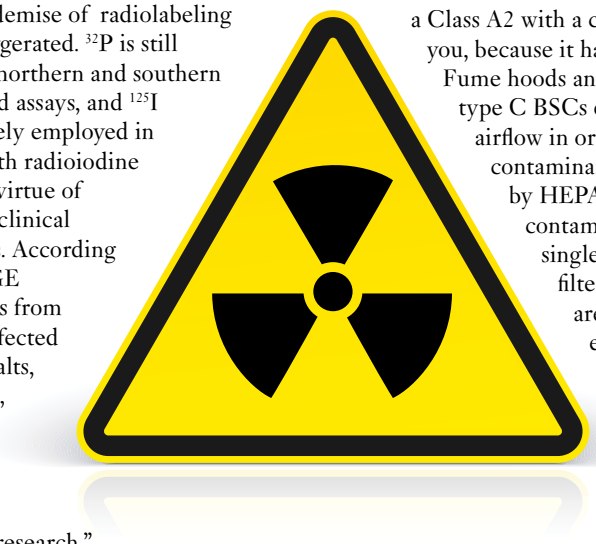
BIOLOGICAL SAFETY CABINETS

WORKING WITH RADIOLOGICAL HAZARDS

by Angelo DePalma, PhD

The emergence of fluorescence- and luminescence-based assays has significantly reduced the need for radioisotope labeling in the life sciences. Fluorescence assays are safer and generally less expensive, often come as kits, and are easier to run. Performing multi-labeling experiments with fluorescent tags is easier than with radioisotopes.

Yet rumors of the demise of radiolabeling are very much exaggerated. ^{32}P is still commonly used in northern and southern blotting nucleic acid assays, and ^{125}I and ^{35}S remain widely employed in protein analysis, with radioiodine heavily favored by virtue of its extensive use in clinical radioimmunoassays. According to literature from GE Healthcare, "Signals from ^{125}I and ^{35}S are unaffected by enzyme, metal salts, pH, or temperature, making them very useful for new and uncharacterized systems often used during life science research."



Select the right cabinet

This leads to the issue of how to handle radioactive materials and processes within the confines of a biosafety cabinet (BSC). Just as the choice of Class I, Class II, and Class III (and their several subtype) biosafety cabinets depends on the need to confer product or personnel protection, or both, the add-on features for protecting operators and the surrounding lab from isotopes is a function of the process and the isotope. Think of the isotope in this regard as a third element or variable in the specification of a BSC. "The amount and kind of protection required depends on the type of radioactive tag and its concentration," explains Brian Garrett, LEED Green Associate at Labconco (Kansas City, MO).

Some processes that natively do not require the protection of a BSC and that use low levels of low-energy isotopes such as tritium may be more easily carried out on a benchtop (although in this writer's experience, virtually all isotope work is carried out in a dedicated, preferably enclosed, workspace that might as well be a BSC).

According to Garrett, if a BSC is required, then all isotope or otherwise hazardous work should be conducted in ducted BSCs only. "At this level, a Class A2 with a canopy will not protect you, because it has internal recirculation. Fume hoods and type B and the new type C BSCs employ single-pass airflow in order to dilute and remove contaminants that cannot be trapped by HEPA filters. Radiological contaminants often require single-pass airflow so that the filters trapping the emitters are contained. You might even consider moving to a true fume hood or perhaps a Type B cabinet or one of the newer Type C units."

Add-ons and retrofits

Unfortunately, modifications for isotope work are the responsibility of the purchaser, with a little help from "body shops" that retrofit BSCs for every imaginable hazard or specialty application. Users should consult with health physics or plant safety personnel when specifying modifications. Stainless steel may provide sufficient shielding, even for some gamma-emitting isotopes, depending on the quantities used, but third-party vendors can line boxes with lead if necessary.

Simple protective equipment like Plexiglas for shielding the strong beta emitter ^{32}P is available from many suppliers. ^{32}P has a very short half-life, about two weeks, so cleanup, while desirable, is not as critical as it is for the gamma emitter ^{125}I, with a half-life of two months, or ^{35}S, another beta emitter with a three-month half-life. For most experiments, tritium and ^{14}C require no

"If a BSC is required, then all isotope or otherwise hazardous work should be conducted in ducted BSCs only."

special protection except for a good exhaust system, unless labeled materials are gaseous or easily airborne.

Prevention and cleaning are the keys

No matter how carefully one works within dedicated isotope workspaces, most eventually become chronically "hot." Disposable pads that are absorbent above and liquid-proof below are a must for work surfaces, and stainless steel surfaces are the easiest to clean. If you work regularly with isotopes, your site safety personnel have probably devised a monitoring protocol based on swiping the insides and outsides of the BSC and perhaps some random surrounding areas as well, and then checking the swipes in a liquid scintillation counter for beta emitters or a suitable gamma detector.

Since the air filter will probably become contaminated as well, Garrett advises changing it with care. "A bag-in-bag-out air filter allows for removing the exhaust filter without exposing nearby workers to isotopes. It's also possible to change the protective level of a BSC by swapping out the sash."

But retrofitters should be aware that many modifications will negate the NSF certification. "That's the reason OEMs don't do those mods in the first place," Garrett says. "It would invalidate the certification for safety under NSF/ANSI 49."

Good radiological practice within BSCs

"The first rule is to work with as low a dose as possible, and make sure you have the proper shielding in your work area regardless of whether it's in a BSC or on a benchtop," advises Kara Held, PhD, science director at The Baker Company (Sanford, ME). "Always do a dry run first before you unpackage the radioisotope, and make sure the BSC used for radioactive work is appropriately labeled."

Operators may use Class II A2 BSCs, the most common cabinet found in labs, for trace quantities of low-energy isotopes, but note that these systems use recirculated air. Beyond that, Held recommends Class II B2 BSCs, which are fully exhausted and hard-ducted to the laboratory ventilation system. "This way, you will not be exposing yourself or your process to recirculated isotopes."

Which raises the point of why not simply use a fume hood? Many labs actually do this. But keep in mind that a BSC offers significantly better protection for the worker and the experiment. "BSCs provide directional airflow through a HEPA filter that flows down onto your experiment, whereas a fume hood only intakes room air and vents it. Fume hoods provide good protection, but your best bet is a Class II B2."

Held also suggests implementing a directional workflow, working left to right or clean to dirty. Clean work materials would be on the left, work occurs in the center, and waste is kept on the right. "This minimizes the likelihood of cross-contamination and concentrates waste and contamination in one small area."

Held feels strongly about retrofits. "Always contact the BSC manufacturer before you cut large holes or make any other significant alteration, because those changes can alter the BSC function and level of protection."

Baker offers some retrofitting to accommodate radioisotope work. "We know these retrofits are safe. But speak to our customer support people before doing anything on your own. It's critical for your safety and the safety of your product that the cabinet remain within certification after physical changes," she says.

***Angelo DePalma** is a freelance writer living in Newton, New Jersey. You can reach him at angelo@adepalma.com.*

HOW TO AVOID MAKING A BSC BUYING MISTAKE

LabManager.com/BSC-video

This video guides you through the key questions you should ask before purchasing a BSC.

For additional resources on Biological Safety Cabinets, including useful articles and a list of manufacturers, visit

LabManager.com/biosafety-cabinets

ARE YOU IN THE MARKET FOR A... CO_2 INCUBATOR?

CO_2 incubators are designed to copy a cell's natural environment with a relative humidity of around 95 percent, a temperature of 37°C, and a pH of 7.2 to 7.5. They are most common in biology labs performing tissue or cell culture and are used in any process where cells need to be cultured for a few hours or up to many weeks, as well as where cells need to be expanded or maintained.

Types of CO_2 incubators used by survey respondents:

Water Jacketed	62%
Air Jacketed	37%
Direct Heat	20%
Gel Jacketed	1%
Other	1%

Primary purpose of CO_2 incubators as reported by survey respondents:

Research	67%
Clinical	22%
Quality Control	7%
In Vitro Fertilization (IVF)	2%
Other	6%

Nearly 59% of respondents are engaged in purchasing a new CO_2 incubator. The reasons for these purchases are as follows:

Replacement of an aging system	38%
Addition to existing systems, increase capacity	21%
Upgrading existing equipment	15%
Setting up a new lab	9%
First time purchase	6%
Other	11%

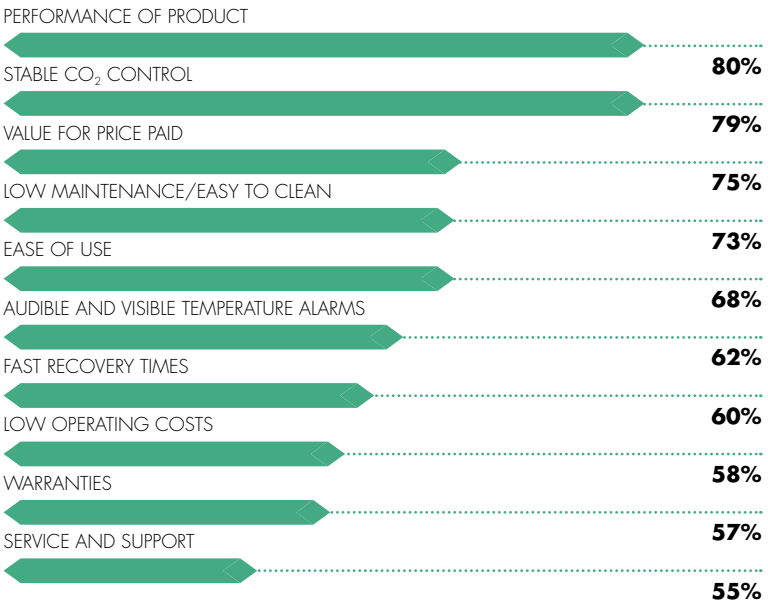
TOP 6 QUESTIONS

You Should Ask When Buying a CO_2 Incubator

1. What measures have been taken in the design to avoid contamination and what features are included to remove contamination?
2. How does the CO_2 sensor contribute to optimal cell growth?
3. How does the humidity contribute to optimal cell growth?
4. Ask for the uniformity and accuracy data versus asking for a water jacket or air jacket.
5. Do you need O_2 control to simulate the environment for your experiment accurately?
6. Calculate the total cost of ownership on the product over one year including product price, install, regular cleaning, labor, materials such as HEPA filters, etc.

TOP 10 FEATURES/FACTORS

Respondents Look For When Purchasing a CO_2 Incubator



For more information on CO_2 incubators, including useful articles and a list of manufacturers, visit www.labmanager.com/incubators

BEADS FOR BATHS

SWITCHING FROM ICE OR WATER MAKES LIFE IN THE LAB EASIER IN MANY CASES

by Mike May, PhD

Heating things in a lab makes most scientists think of a water bath, but the medium can be beads instead. For instance, metal beads can replace the water in a laboratory bath or ice bucket, and they perform the same job—just not in the same way. Sometimes going from water to beads makes a huge difference.

Both San Antonio-based Lab Armor and Chicago-based ThermoElectric Cooling America (TECA) offer beads that look like BBs. These can be poured into a bath or bucket instead of water or ice. And they can be used over and over.

Paul Kim, assistant professor of biology at Grambling State University in Louisiana, says, "I use a bead bath in place of a water bath to heat media and reagents, mainly for cell culture." On the plus side, he sees three big advantages. First, he says, "I can leave the bead bath on so it's always ready to use without monitoring and refilling." Second, a bead bath doesn't need water, which can support microbial growth. Third, he says, "You don't need floating racks or weighted collars, because things just stay put." Overall, Kim concludes that "these features make the bead bath tremendously convenient."

Of course, few changes in lab techniques bring only good, and bead baths come with some trade-offs. One—maybe the key one—is a slower transfer of heat. "A large vessel will take longer to heat," Kim says. He also points out that "procedures that depend on rapid heating, like heat shock," could be tricky.

The benefits of a bead bath, however, make this technology useful in life science research and a range of industries. Within an industry, bead baths can also be used in many stages of production, such as in research labs, production facilities, and quality control steps.

Keep your cool

In addition to heating, beads can be used for cooling, such as in most TECA tecaLAB products, like the ICE-4000 Electric Ice Bucket for general cooling and the ICE-301 for temperature-controlled cooling. According to Emily Hutensky, sales and marketing coordinator at TECA, this equipment can be used "in place of an ice bath in various laboratory applications." In fact, she says that it can be used "anywhere cooling of samples is needed—laboratory or industry." As an example, she mentions a customer in the dairy industry that uses this device to keep milk samples cool as part of its quality control process.

When using beads in these devices, Hutensky notes several benefits. One is low maintenance. She says, "Beads will require cleaning once in a while in a mild soap solution, but that is all." In addition, you save the time and money of using ice. As long as an ice bucket is filled with beads, turned on, and cooled down, it's ready to use. Hutensky adds, "There is no worry about ice melting, water evaporating, or replacing ice or water. It is simply always available and always cold."

Although this technology seems easy enough to use, there is a tiny learning curve. "For example, to get large vessels well immersed, you sometimes need to remove beads," Hutensky says. "For best results, samples must not sit atop beads."

This bead technology can also be used in multipurpose platforms. For instance, TECA's AHP-301MSP is a magnetic stirring plate that heats and cools. It uses the company's Thermal Lab Beads, which are aluminum. This bath's temperature can be adjusted from 0 to 50 degrees Celsius.

Whether an experiment or procedure requires heating or cooling, beads can be easier to use and more economical. In some cases, beads just plain do a better job.

***Mike May** is a freelance writer and editor living in Ohio. You may reach him at mikemay1959@gmail.com.*

SAVE TIME IN YOUR BATH OR CHILLER SEARCH

LabManager.com/ProductFinder/Baths-and-Chillers

Our Product Finder asks you questions about your application to help you figure out the best bath or chiller options for your lab.

For additional resources on water baths, including useful articles and a list of manufacturers, visit

LabManager.com/baths-chillers

ROTARY EVAPORATORS

MUST-HAVE FEATURES

by Angelo DePalma, PhD

Rotary evaporators are standard laboratory equipment found in nearly all laboratories. Chemical, pharmaceutical, food, and environmental industries are the most common users, but rotary evaporators, or "rotovaps," may be found wherever processes require sample concentration or solvent distillation.

All rotary evaporators include a heating bath, condenser, collecting vessel, and rotating sample or distillation flask. BUCHI Corporation (New Castle, DE), a leading manufacturer of rotovaps, still sells a large number of those simple units to academic and even industrial labs. But another world of rotary evaporation exists for laboratories that value application versatility, automation, and connectivity.

"Our largest-volume market has been and remains pharmaceuticals, and they're willing to pay for a high degree of automation, for many features that go beyond simple rotovaps," says Jason Wagner, VP of marketing at BUCHI. "But there's still a big market for stripped-down, no-frills models."

A "full system" has a chiller to replace the use of cold tap water in the condenser unless dry ice is readily available. In place of the simple aspirator or house vacuum you may now be using, you could enjoy the benefits of a real vacuum pump, which is chemically inert and quiet. Worried about samples bumping into the condenser and collection vessel? A vacuum controller will solve that problem without the user having to give it a second thought.

Unlike with some laboratory products where purchasers must outsource upgrades and modifications, top rotovap vendors supply all the necessary components.

Since modern rotary evaporators operate at up to 5 L at benchtop scale and at 20 to 50 L for industrial models, general solvent recycling becomes an attractive alternative to dedicated distillation systems. Low-temperature condensation traps even volatile solvents like ether and methylene chloride, while high vacuum enables recycling of polar aprotic solvents like dimethylformamide or distillation of essential oils.

Every user of rotary evaporators has experienced bumping. Vacuum controllers virtually eliminate such mini-disasters by allowing a vacuum gradient. "That's where automation really comes in," Wagner says. "The controller and AutoDest sensor measure whether the condenser is heating and adjust vacuum accordingly." Similarly, a foaming sensor can tell whether the distillation is getting out of control. "And all the user has to do is say go."

The wide variation in features and price and the low potential dollar entry point for rotary evaporator acquisition are somewhat unusual in the world of laboratory equipment. Yet despite the lingering fondness for simple rotovaps, nearly every laboratory can benefit from automation, says Thomas Ketterer, head of application support at IKA Works (Staufen, Germany). "The reasons are enhanced safety, the capability for unattended operation, consistency of conditions, and results."

A call for simplicity?

Jim Dawson, president of Heidolph North America (Elk Grove Village, IL), believes that automation may be overhyped. "Researchers want to be able to run their processes uninterrupted but to get involved easily if the need arises. Chemists are hands-on, highly visual types of researchers. They may wish they could walk away from what they're doing completely and still achieve the desired result, but they don't do that in practice. They want simplistic automation, not something complicated. They want automated vacuum control and measurement, and want to know that when the evaporation is completed the flask will come out of the bath, but it has to be simple. And they don't want to spend a lot of money on it if they don't have to."

The ability to have many options at varying price points is a hallmark of rotary evaporators. "Chemists don't want to be boxed in to one level of sophistication; they want to pick and choose specific options and do that with an associated price as well," Dawson says.

Angelo DePalma *is a freelance writer living in Newton, New Jersey. You can reach him at angelo@adepalma.com.*

GREENING YOUR EVAPORATION

LabManager.com/green-evaporation

Find out about the recent environmentally-friendly advances in nitrogen evaporator technology.

For additional resources on Rotary Evaporators, including useful articles and a list of manufacturers, visit

LabManager.com/evaporators

The mission of NAOSMM is to promote the professional development of members who support and manage scientific laboratories in educational, research and community settings.

JOIN US AT OUR 43RD ANNUAL CONFERENCE AND TRADE SHOW

THE VINOY RENAISSANCE RESORT & GOLF CLUB ST. PETERSBURG, FL

JULY 25TH – 29TH, 2016

DON'T MISS OUT ON THIS YEAR'S CONFERENCE:

Over two full days of education and professional development to help you save time, money and help you enhance your career

Two half days exclusively for trade show and vendor interaction

Network with peers in academia, research and industry

Training opportunities by the Laboratory Safety Institute and much more..

FOR MORE INFORMATION, PLEASE VISIT US AT:
WWW.NAOSMM.ORG

WHO ARE WE?

The National Association of Scientific Materials Managers (**NAOSMM**) is a professional organization of approximately 500 individuals in the USA and beyond involved in purchasing, inventory management and control, and the safety and regulatory matters of laboratory chemicals, supplies, instrumentation and special services in academia, research and industry. With nearly 200 million dollars in buying power, members receive excellent discounts from many vendors. Join with us to help you run an efficient stockroom, provide great customer service, understand federal and local regulations and share best practices in running your laboratory and stockrooms.

NAOSMM
National Association of Scientific Materials Managers

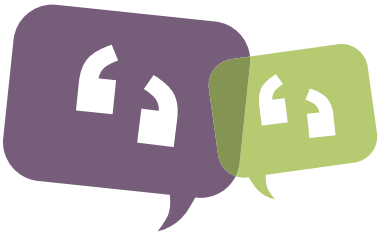
Supporting the professional development of scientific laboratory & materials managers

JOIN NOW TO TAKE ADVANTAGE OF:

- Networking with other members in the same field
- Exclusive promotions and savings from supporting corporate members
- Advance your career with education and cetrification programs
- Interaction with scientific supply companies at annual trade show
- Recognition of member volunteers
- Quarterly magazine "Newsline" with insightful articles and information
- **NAOSMM** Listserv and Forum enables members to interact 24/7
- Online membership directory makes contacting members easy

CORPORATE MEMBERSHIP AND SPONSORSHIP OPPORTUNITIES ARE AVAILABLE.

TO BECOME A MEMBER, GO TO WWW.NAOSMM.ORG



ARE YOU IN THE MARKET FOR AN... ELECTRONIC LAB NOTEBOOK?

Electronic laboratory notebooks (ELNs), one component of a lab's information infrastructure, help laboratories capture and manage knowledge, streamline data management, protect intellectual property, and foster collaboration. Both non-specific/generic ELNs (which compete directly against paper notebooks) and application/task-specific ELNs exist, each with their own enthusiasts.

Types of ELN installations used by survey respondents:

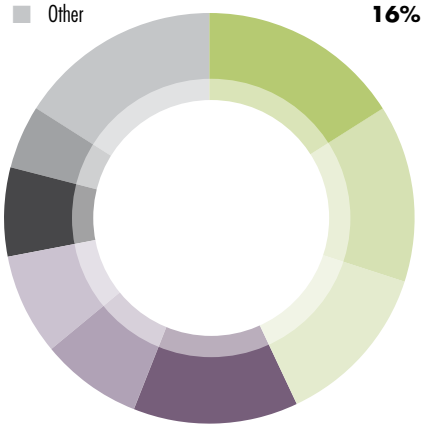
Web-based	36%
Client/Server	33%
Stand-alone	25%
Thin client/server	6%

Primary purpose for ELNs as reported by survey respondents:

Centralized data repositories	58%
Infrastructure for capturing, accessing, and sharing experimental information	53%
Accelerating the documentation and reporting of experimentation	50%
Improve productivity	47%
Intellectual property (IP) protection	36%
Improved communication between instruments and related software	31%
Streamlined regulatory compliance	28%
Enabling scientists to collaborate effectively on multi-stage projects	25%
Workflow coordination across geographic and business boundaries	19%
Patent evidence creation	19%
Other	6%

Nearly 37% of respondents have plans to purchase an ELN. The reasons for these purchases are as follows:

Upgrading existing ELNs	16%
Accelerating the documentation and reporting of experimentation	14%
Addition to existing systems, increase capacity	13%
Centralized data repositories	13%
Infrastructure for capturing, accessing, and sharing experimental information	8%
Web-based access	8%
Streamlined regulatory compliance	7%
Setting up a new lab	5%
Other	16%



TOP 6 QUESTIONS

You Should Ask When Buying an Electronic Lab Notebook

1. How local are resources and how available are resources for deployment, training, and extensions? What is the timeline for availability and cost?
2. How easy is it to extend the application? Does it require IT or super users? How long does training take to make modifications and how extensive is the API for modifications?
3. How easy is it to get data back out of the system? Is all information indexed and searchable? Can users query and combine data from multiple experiments, not just return a list of experiments?
4. What is the typical number of hours of admin time required to upgrade for a major release and a minor release?
5. What level of support is offered? How many support staff are there, where are they located and what language do they support? How is the support rated by other customers?
6. Is your IP system safe in their system? What is the chance the company will be around in five years? What is the chance that the company will switch technologies and force an expensive migration? What credibility does the company have in the past for delivering robust, scalable, secure, and 21 CFR Part 11 compliant systems?

TOP 10 FEATURES/FACTORS

Respondents Look For When Purchasing an ELN

For more information on electronic lab notebooks, including useful articles and a list of manufacturers, visit www.labmanager.com/ELN

ARE YOU IN THE MARKET FOR A...
WATER PURIFICATION SYSTEM?

Water is the most commonly used laboratory reagent; however, the importance of water quality is often overlooked. Because impurities can be a critical factor in many research experiments, water purity ranks high in importance. There are several types of impurities and contaminants in water such as particulates, organics, inorganics, microorganisms and pyrogens that can adversely affect results.

TOP 4 QUESTIONS
You Should Ask When Buying a Water Purification System

1. What do you need the water for? What is your application and what type of water is needed? What is the source of your current water? How much water is required per batch/day? Are there special requirements for delivery?
2. What is your budget? (This will determine the technology). What is the cost of ownership over five years?
3. Where do you need the system in the lab(s)? Consider: top of counter, under counter, or wall mounting the unit. What is the overall footprint/real estate of the system(s) and components?
4. What kind of warranty and service is provided? Is the system manufactured to quality standards and which ones? Is this a pharmaceutical application that needs to be validated?

TOP 10 FEATURES/FACTORS
Respondents Look For When Purchasing a Water Purification System

PERFORMANCE OF PRODUCT	87%
DURABILITY OF PRODUCT	81%
EASE OF USE	74%
VALUE FOR PRICE PAID	74%
LOW MAINTENANCE/EASY TO CLEAN	69%
AVAILABILITY OF SUPPLIES AND ACCESSORIES	69%
SERVICE AND SUPPORT	66%
LOW OPERATING COSTS	66%
TOTAL COST OF OWNERSHIP	64%
WARRANTIES	59%

ASTM standard water purity used by survey respondents:

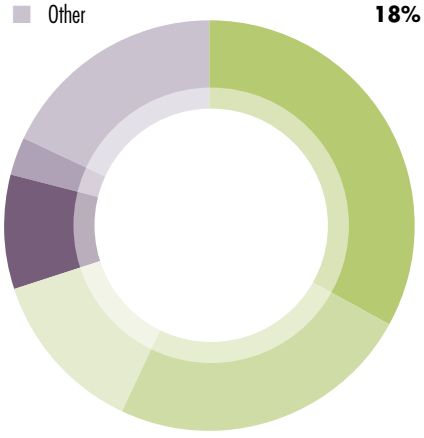
ASTM Type I	57%
ASTM Type II	36%
ASTM Type III	11%
Other	8%

Water purification system components used by survey respondents:

Water quality monitor	64%
Dispensing points	58%
Storage tank	57%
UV sterilizer	50%
Polisher	38%
Distiller	21%
Water softener	20%
Other	8%

Nearly 50% of respondents are engaged in purchasing a new water purification system. The reasons for these purchases are as follows:

Replacement of an aging system	33%
Upgrading existing equipment	24%
Addition to existing systems, increase capacity	13%
Setting up a new lab	9%
First time purchase	3%
Other	18%



For more information on water purification systems, including useful articles and a list of manufacturers, visit www.labmanager.com/water-purification

MEASURING CONDUCTIVITY OVER A WIDE RANGE

Problem: Conductivity measurements provide fast, continuous, inexpensive indications of changing electrical and material properties. In non-aqueous systems, conductivities may be very low and can easily swing over many decades with only relatively small changes in concentration of additives or impurities. The ability to cover a wide range with a single meter permits the user to follow parameters such as solvent purity, additive concentration, and total dissolved solids, as well as track processes, titrations or other experiments where the conductivity varies widely. From a practical point of view, a single meter that covers a wide range is less expensive than multiple meters each covering a limited range.

The electrodes of a system designed to measure conductivity in aqueous samples are often configured as two rings separated by an insulator mounted coaxially on a long thin cylindrical probe. The surface area of the electrodes and the distance between them are fixed. During measurement, a potential difference is applied to the electrodes and the current emerges from one electrode and follows a curved path to return to the other electrode. The length and shape of the current path are dependent not only on the configuration of the probe, but also on the electrical characteristics of the liquid. Clearly, sample dependent changes in path length will affect conductivity measurement accuracy. The effects of changes in path length can be reduced by configuring the electrodes as concentric cylinders, however fringing at the edges of the electrodes can still introduce unacceptable variability over a wide measurement range.

For measurements over a limited range, the variation in path length can be accommodated by calibrating the probe with an appropriate standard of known conductivity. The calibration procedure determines the cell constant (the effective ratio of path length to electrode area) for a particular probe. However, calibration becomes problematic at low conductivities since it depends on the availability of accurate standards. Good conductivity standards below 10 micro-Siemens/cm are notoriously difficult to obtain. At 10 micro-Siemens/cm, available standards have an accuracy of ± 2-3%. At 1 micro-Siemen/cm that accuracy degrades to ± 25%. For DI water in the nano-Siemen/cm range, no standard is available.

Solution: One example of a product that solves such problems is ILIUM's conductivity meter which uses adaptive wave forms, dynamic signal compensation, and adaptive noise suppression techniques to provide highly accurate measurements over a range of 12 decades from milli-Siemens/cm down to 1 femto-Siemen/cm. The smart probes use concentric cylinder electrodes and incorporate guard electrodes to completely eliminate the effects of sample dependent variations in current path length on measurement accuracy. The fully guarded probe design permits accurate measurements over the full design range of the probe without recalibration. Probes are calibrated using an NIST-traceable procedure at the factory. All calibration data is stored in the probe from where it can be immediately retrieved by the meter. Probes can be swapped as needed without recalibration. In addition, smart probes are extremely easy to clean. They can be disassembled and reassembled in seconds with no change in the calibration or cell constant, providing complete reproducibility.

For more information, visit http://www.iliumtechnology.com/

▲ *Figure 1. ILIUM 2100 Conductivity Meter with probe (left) and 1020 Smart Probe (right) disassembled to show guard electrodes and signal electrode.*

STANDARDIZED SOIL TESTING WITH A TOC/TNb ANALYZER

Problem: A lack of standardization in the methodology to better understand soil health and an instrument to properly analyze water with heavy particulates.

Solution: The Haney Soil Test, a standardized health test for soil developed by Rick Haney at the USDA-ARS, has made a big impact in the study of soils and now, with updated technology, is becoming easier and more accurate than ever. Samples of soil are dried and the available nutrients are extracted using standard optimized guidelines for consistency. The water-extracted total organic carbon (TOC) along with the water-extracted total nitrogen (TN) are measured to show the C:N ratio. The C:N ratio serves as an important indicator to predict microbial activity in the soil. These two parameters, TOC and TN, are now readily measured with greater precision by Mr. Haney using the Elementar vario TOC cube.

The Elementar vario TOC cube allows measurement of TOC and TN content of soil extracts in a single sample run even for samples of high particulates, with its specially designed particulate method. Furthermore, this mode of operation analyzing samples containing small amounts of particulates, like in soil extracts, is performed with nearly the same precision as particulate-free samples.

Automated sample dosing can be performed for up to 50 liquid samples (incl. stirring) and with an easily exchangeable automated sample feeding module for solid samples, soil labs can readily switch back and forth between solid and liquid analyses. The autosamplers are fully integrated in the basic unit and do not require additional bench space. Changing the sampling system from solids to liquids and vice-versa can be done within a few minutes.

The measuring principle for all modes of operation is the oxidation of bound carbon into CO_2. The liquid sample is directly injected into the combustion chamber at 850°C using zero air for the carrier gas stream. The gas is dried and the flow is stabilized and measured by means of a non-dispersive infrared detector (NDIR).

A connected PC calculates the total carbon concentration (TC) from the measured CO_2 signal and the injected sample volume. Inorganic carbon (TIC) can be measured automatically by acidifying the sample in a sparger, stripping and detecting the released CO_2. Total organic carbon (TOC) content is calculated from the difference of the TC and the TIC (TOC=TC-TIC). In addition, the total bound nitrogen (TNb) can be measured with the TOC, in the same analytical run, by means of an NO sensitive electrochemical (EC) detector.

All parameters such as TOC, NPOC, TC, TIC, DOC, POC, and TNb can be measured with the same basic unit. Detection of ppb level C for ultrapure water, undiluted samples to 100,000 ppm C, industrial wastewater, or up to 30 mg C absolute in solids represents a measuring range which cannot be met by any other instrument.

Using this method of analysis in conjunction with the vario TOC cube, the C:N ratio can be accurately determined and considered in any soil amendments.

For more information, visit http://www.elementaramericas.com/analyzers/vario-toc-cube/

▲ *The Elementar vario TOC cube.*

TECHNOLOGYNEWS

ANALYTICAL

3µm Amylose-1 Chiral Columns

Lux®

- These high-efficiency Lux polysaccharide columns are ideal for UHPLC, HPLC, and SFC chiral screening and analysis
- Now with two sizes—the new 3µm and existing 5µm particles—method scalability from analytical work to preparative purification is seamless
- Deliver increased separation power with their broad recognition and high efficiency levels
- 3µm-particle media is available in analytical columns

Phenomenex www.phenomenex.com

Silicon Drift Detector

SDD1000

- For the Thermo Scientific ARL QUANT'X ED-XRF spectrometer
- Designed to dramatically improve elemental analysis capabilities for a broad range of applications
- Utilizes a 1,000-micron silicon crystal, more than double the thickness of silicon drift detectors on the market, providing enhanced sensitivity for the detection of heavy elements
- Can be stopped overnight and re-started in less than three minutes

Thermo Fisher Scientific www.thermoscientific.com/quantx

UHPLC System

UltiMate 3000 RSLCnano

- Combines higher nano LC performance with versatility and ease-of-use
- New ProFlow technology increases retention time precision, resulting in high-quality data with accurate quantitation
- Offers reduced start-up time and simplified system operation so that researchers can focus more time on data acquisition and analysis
- Provides a wide flow range (nano-to-micro flow rates) in UHPLC mode, and more

Thermo Fisher Scientific www.thermoscientific.com/RSLCnano

Research System with iKnife Sampling

REIMS™

- Combines direct-from-sample ionization with high performance time-of-flight mass spectrometry and powerful, intuitive analytics
- Rapid Evaporative Ionization Mass Spectrometry™ (REIMS™ with iKnife™ Sampling System eliminates the need for sample preparation and chromatographic separation, providing food, microbiology, and tissue researchers with near-instantaneous data acquisition
- Allows researchers to quickly and easily differentiate samples from one another

Waters www.waters.com/reims

BASIC LAB

Analytical and Precision Balances

Eclipse

- Feature an advanced capacitive touch keypad and one of the largest LCD readouts in the industry
- Connectivity, whether it's basic data printing or advanced communication with a LIMS, is achieved with USB and RS-232 interfaces
- Come in three different body styles
- Offer a wide range of weighing units to facilitate numerous lab applications

Adam Equipment www.adamequipment.com

Biological Safety Cabinets

Purair BIO

- These Class II Type A2 biosafety cabinets minimize and contain Biosafety Level 1-3 agents
- Maintain negative pressure inside the cabinet during operation to prevent contaminants from escaping the work area
- HEPA filtration scours 70% of the incoming room air to protect the products, while the remaining 30% of the exhausted air is filtered by a second HEPA filter

Air Science USA www.airscience.com

Lab Safety Products

- Provide a complete solution for designing an integrated, reliable, and compliant gas delivery system for non-corrosive, high-purity, flammable gases
- Consist of high-purity zone-valve boxes, emergency shut-off valves, and safety monitors that work in combination with C Series gas cabinets and the 585 Series emergency shut off controller

CONCOA www.concoa.com

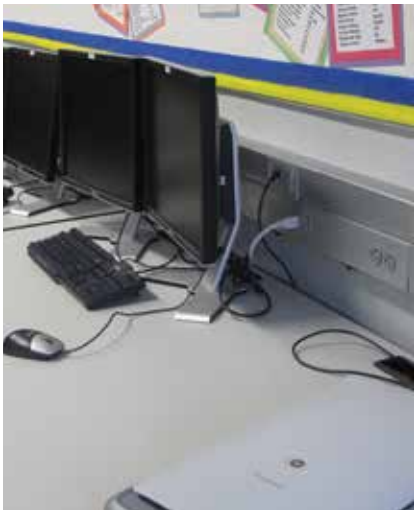
SEM Calibration Standards

EM-Tec MCS and M Series

- Specially developed for magnification calibration or critical dimension measurements in tabletop SEM, standard SEM, FEGSEM, FIB, Auger, SIMS, and reflected light microscope systems
- Made using the latest MEMS manufacturing techniques with high contrast chromium deposited lines for the larger features and gold over chromium for the smaller features below 2.5 µm

EM Resolutions www.emresolutions.com

STARLINE PLUG-IN RACEWAY®



STARLINE Plug-In Raceway® is the next generation in raceway systems created to meet the ever-changing power distribution and datacom 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 needed to reconfigure circuits, receptacles and wiring. Insulated copper bus bars are preinstalled in the raceway sections. 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 design criteria for all of our systems. This system is tested to meet NEC and UL standards and has the ETL mark. Joints and plug-in units require no maintenance.
- **Aesthetically appealing** – 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, metallic silver, or custom colors are also available.
- **Re-locatable and Scalable** – 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 "green" products on the market.
- **Reduced Installation 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 install, 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** - 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.
- **Higher 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.

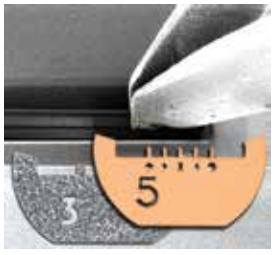
STARLINE® PLUG-IN RACEWAY

www.starlinepower.com/raceway

Focused Ion Beam Grids

EM-Tec

- Offer a secure way to attach TEM lamellas to the posts during lift-out procedures with FIB or SEM/FIB systems
- Available in multiple post configurations with a shape optimized for easy accessibility
- Compatible with all standard 3 mm TEM grid holders
- Come in three types: copper, molybdenum and unique, smooth-walled molybdenum



EM Resolutions www.emresolutions.com

High Definition Longwave Infrared Camera

FLIR T1030sc

- Delivers excellent thermal sensitivity, clarity, and high-speed streaming
- Couples an extraordinarily sensitive detector, with new FLIR OSXTM Precision HD-ready optics
- Routinely detects temperature differences of less than 20 mK at 30°C
- Functions as a standalone data collection and analysis system in the field or as a fixed-mount thermal measurement solution in the lab

FLIR Systems www.FLIR.com

PRODUCT SPOTLIGHT

TITAN OF TITRATION

NEW LINE OF INSTRUMENTS ALLOWS USERS TO CUSTOMIZE THEIR TITRATOR TO THEIR SPECIFIC NEEDS

Those using titration in the lab got a new tool in their arsenal with Mettler-Toledo's launch of its new generation of Titration Excellence instruments last month. While the launch of a new line of titration instruments may not seem exciting, the Titration Excellence line is unique in the modularity it offers, allowing the systems to be configured and adapted to a lab's existing and future needs.

"The new Titration Excellence line combines the utmost modularity in device configuration with powerful and secure analysis to meet today's highly competitive environment," Mettler-Toledo said in a release. "The launch of the new generation offers compelling benefits that enhance efficiency in daily laboratory work."

The new systems also include all the benefits of older versions along with new features such as automated sodium determination, coulometric Karl Fischer titration, and an integrated SmartSample™ reader.

The fully-automated direct sodium determination allows the user to analyze an entire sample series, saving time and increasing daily analysis throughput, and the modularity of the system now enables coulometric Karl Fischer titration to be performed on all instruments, allowing analysis of water content down to 1ppm.

The SmartSample reader included on all Titration Excellence instruments provides users with wireless data transfer from balance to titrator on single samples, eliminating transcription errors and mix-ups. In addition, the new systems also feature Mettler-Toledo's easy-to-use One Click® user interface, making operation simple and safe.

"This truly powerful titration system meets regulatory compliance and is tailored exactly to customers' needs," the company concluded in its release.

For more information, visit www.mt.com/Titration-Excellence

Evaporator

Series 3 HT

- Features LyoSpeed™ Fast Lyophilisation technology, developed to provide a rapid, high-throughput alternative to freeze drying HPLC purification fractions
- Enables pharma labs to now routinely dry HPLC fraction samples to a powder form, such that the samples can then be accurately weighed, easily sub-sampled, and re-dissolved

Genevac www.evaporatorinfo.com/info5.html

Fume Hoods

UniFlow SE AirStream

- Constructed entirely of chemical resistant, flame retardant, non-metallic composite resin materials
- Features an exclusive "Unitized" construction that does not require screws, bolts, rivets, or metallic hardware to assemble
- UL 1805 certified and is offered in 48", 60", 72," and 96" widths in either constant air volume or restricted bypass models

HEMCO www.hemcocorp.com

Transmission Electron Microscope

JEM-F200 (F2)

- This high throughput 200kV S/TEM offers a cold field emission gun (Cold-FEG) and dual silicon drift detectors
- The high brightness/narrow energy spread of the Cold-FEG achieves high energy resolution electron energy loss spectroscopy (EELS) for rapid identification of chemical bonding states
- Dual silicon drift detectors offer high sensitivity and throughput for X-ray analysis

JEOL USA www.jeolusa.com

Wireless Barcode Reader

VisionMate

- Designed to lay flat, allowing users to set it directly on the benchtop and scan tubes or racks without holding it
- For samples that should not be exposed to ambient conditions, the reader can easily be used as a handheld instrument, reading samples while they remain safely in storage
- Can read tubes in a cold environment, capturing and sending data via Bluetooth to a paired computer

Thermo Fisher Scientific www.thermofisher.com

Gravity Oven

NCL LabStrong

- Offers industry leading temperature uniformity performance at an exceptional price point
- Gentle drying and heating, with low turbulence, protects delicate samples where a fan airflow would disturb them
- An advanced 4.3" display with touchscreen graphical control provides intuitive operation with precise temperature control
- This lightweight, compact oven conserves benchtop space and fits in most fume hoods

LabStrong www.labstrong.com

Handheld Tube Reader

DataPaq™ Handheld

- Provides users with the ability to immediately identify tubes and track samples when away from the lab
- Can be operated using one hand and incorporates a lightweight build and intuitive interface that's easy enough for anyone in the lab to use
- Since the scanner is battery-operated, users have the option to effortlessly enter data about specific samples as soon as they're scanned

Ziath www.ziath.com

Filtered Chemical Workstations

Isola™ Series

- Provide protection to the end user and environment from hazardous chemical fumes and vapors
- Feature a filtration matrix that is configured of three stages of filtration media that effectively adsorb and capture a wide range of contaminates
- Series consists of three models: Isola™ VUE, Isola™ PRO, and Isola™ EDGE
- Include the EverSafe™ III Touch Screen controller

Mystaire www.mystaire.com

Transit Time Ultrasonic Flow Meter

FDT7000 Series

- Boasts easy installation with its snap-clamp on pipe transducer body sensors that do not come in contact with the internal liquid
- The technology has inherent advantages over alternate ultrasonic devices including: low-cost, easy installation, no pressure head loss, no moving parts to maintain or replace, no fluid compatibility issue, and a wide measuring range that ensures reliable readings

OMEGA www.omega.com

Benchtop Liquid Chiller

TLC-900

- Has been upgraded with a pulse width modulating (PWM) controller incorporating four PID temperature ranges for improved temperature control over a wide temperature range
- USB communications, operational, and data logging software are standard
- New more physically rugged design lends the product increased durability for a wider variety of application environments such as truck beds, factory floors, and lab benches

TECA www.thermoelectric.com

Rack Reader

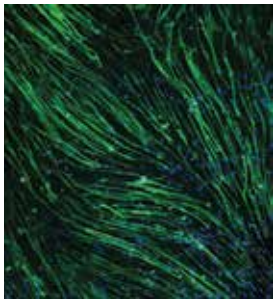
DataPaq™ Cube

- Utilizes a dual camera set-up and unique cuboid design
- Provides a flexible system for scanning 2D datamatrix coded tubes housed in all currently available rack formats and offers one of the fastest sample scanning and tracking solutions on the market
- Dual cameras combine to produce high quality images that eliminate the risk of edge effects and tracking errors

Ziath www.ziath.com

CHEMICALS, KITS, & REAGENTS

Skeletal Muscle Differentiation Kit



- Offers researchers a unique tool to rapidly differentiate donor stems into functional myotubes in a reproducible fashion
- Tested on a wide range of human embryonic and induced pluripotent stem cell lines
- Follows a simple three-step process of media changes and cell passaging
- The three step protocol generates a highly pure population of approximately 70 percent skeletal muscle myotubes in weeks

AMSBIO www.amsbio.com

Metal Scavenger Screening Kit

- Includes five 1 g pre-packed tubes of ISOLUTE® Si-TMT, ISOLUTE® SCX-2, ISOLUTE® Si-Trisamine, ISOLUTE® Si-Thiol, and Biotage® MP-TMT metal scavengers
- Features an easy-to-use format with detailed instructions that enable researchers to screen active pharmaceutical ingredient product mixtures and identify an optimum scavenger for their downstream metal removal process

Biotage www.biotage.com

INFORMATICS

Application Suite

EM Suite

- Aims to help scientists improve experimental reproducibility
- Includes Elemental Insights, an intuitive web-based software application that provides real-time visualizations and dashboards to pinpoint factors affecting outcomes
- Also features Elements, networks of distributed intelligent sensors that passively monitor the lab environment
- Includes Elemental Alerts, text and email notifications should any of the Elements encounter an anomaly

Elemental Machines www.elementalmachines.io

LIMS

LabVantage 8

- Includes a new user interface—developed with extensive customer input—that greatly enhances usability
- Features an improved design for viewing and managing critical data making it quicker to access and intuitive to use
- A new scheduler interface features a calendar view, schedule randomization, and local time zone support
- Boasts a new end-to-end formulations solution that manages compound recipes

LabVantage Solutions www.labvantage.com

Thermal Cycler Software

Alpha Cycler 4

- Allows users to monitor time until runs complete via the Alpha Track monitoring app
- App also reports error messages back to PCRmax, on system health and condition, thus allowing PCRmax to monitor each unit and spot problems before they occur
- Reporting feature acts similarly to a preventive maintenance check each time the report is sent back to the PCRmax technical support team

PCRmax www.pcrmax.com

LIFE SCIENCE

Denaturing Gradient Gel Electrophoresis System

OmniPAGE VS20WAVE-DGGE

- Features a modular design and can be simply adapted to perform most single-base pair mutation detection techniques that are used in DNA mutation analysis
- Fully equipped with temperature control unit, stirrer, and gradient mixer and casting accessories
- Able to perform heteroduplex analysis, parallel denaturing gradient gel electrophoresis, and constant denaturing gradient gel electrophoresis

Cleaver Scientific www.cleaverscientific.com

Multiplex DNA Assembly Technology

- Scales the manufacture of synthetic DNA by nearly two orders of magnitude
- Will be applied to Gen9's BioFab® next-generation DNA synthesis platform over the next ten months
- Increases the BioFab's manufacturing capacity and will decrease costs to a fraction of one penny per base pair when fully implemented

Gen9 www.gen9bio.com

Ultra Stable Microscope Platform

ZDeck Quick Adjust Platform

- This high quality, height adjustable platform is designed specifically for upright microscopes widely used in electrophysiology and neuroscience
- Compatible with most commercially available vibration isolation tables
- Offers an exceptionally stable platform, ensuring that your experimental area is as smooth and vibration-free as possible
- Top surface breadboard design (6mm holes on 25mm centers) is ideal for accurately and quickly mounting equipment

Prior Scientific www.prior.com

Targeted RNA Panels

QIAseq

- Over 170 new panels for gene expression profiling now available
- Enable researchers to select from over 20,000 human genes and lncRNA to survey expression fold changes and discover interactions between genes, cellular phenotypes, and disease processes
- Use innovative molecular barcode technology and built-in control assays to empower researchers with true digital RNA sequencing and accurate gene expression results

QIAGEN www.qiagen.com

Crossflow Filter Device

Sartocon® Slice 50

- Designed for use in biotechnological applications, especially for membrane screening and small-volume process development
- Offered as an encapsulated and ready-to-use crossflow module with a filter area of 50 cm^2 and a wide variety of molecular weight cutoffs
- Eliminates the need for a compression holder and is available in a choice of two polymers

Sartorius Stedim Biotech www.sartorius.com

Benchtop Crossflow Filtration System

SARTOFLOW® Smart

- Designed for optimized ultra- and diafiltration applications
- Can ideally be used in many downstream processes, such as purification of vaccines, monoclonal antibodies, and recombinant proteins
- Equipped with a low shear 4-piston membrane pump that enables highest product yields to be achieved
- Supplied with Sartorius' intuitive and easy-to-use DCU-4 control unit

Sartorius Stedim Biotech www.sartorius.com

High Capacity FISH Hybridization System

CytoBrite

- Consists of one CytoBrite slide incubation system for performing rapid probe denaturation on batches of 12 FISH slides and one CytoBritesSlide oven for overnight hybridizations of 60 slides
- Removable slide trays streamline slide set up and transfers between instruments
- The combined instruments replace six older generation ThermoBrite instruments at a fraction of the bench space and cost

SciGene www.scigene.com

Small Benchtop Centrifuge

Medifuge

- Features a unique 2-in-1 hybrid rotor that has interchangeable fixed-angle and swinging buckets to facilitate quick and convenient switching between applications
- Incorporates safety and environmental sustainability features such as an emergency lid-lock release, in case of power failure, and quiet operation at less than 56 dBA
- Designed for simple operation

Thermo Fisher Scientific www.thermofisher.com

Automated Affinity Purification Solution

MSIA Streptavidin EVO Microcolumns

- Designed to bring the novel mass spectrometric immunoassay (MSIA) affinity purification technology to Tecan's Freedom EVO series of robotic platforms that are equipped with a 96 multichannel arm (MCA96)
- When combined with Tecan robotic platform, columns enable fast and accurate isolation of target analytes from complex biological matrices
- Since this technology is incorporated into a pipette tip, users can analyze sample volumes as low as 10 µL

Thermo Fisher Scientific www.thermofisher.com

SUPPLIES & CONSUMABLES

Sorbent Tube for Hazardous Air Pollutants

PAH Tube

- Dedicated to the reliable analysis of polycyclic aromatic hydrocarbons (PAHs) in air
- Ensure the transfer of even the heaviest PAHs from the sorbent sampling tube into the GC
- Using the optimized sorbent tubes with Markes' UNITY or TD-100 instruments gives negligible carryover across the board, as well as excellent reproducibility

Markes International www.markes.com

4.00ml Sample Storage Tubes

- Now include non-coded, alphanumeric and 2D data matrix coded formats
- Offer a working volume of 2.70ml
- Provide a solution for storing larger volumes in a wide variety of short-term and long-term sample storage applications
- Incorporating an internal thread screw cap with silicon O-ring, these tubes provide optimal sealing, enabling high integrity storage at ultra-low temperatures

Micronic www.micronic.com

Black 96-Well Deep Well Plate

- Offers a working volume of 1ml per well, which in conjunction with black sealing films ensures that light sensitive assays and samples are not degraded by exposure to light
- Features excellent heat and solvent resistant qualities
- Using only ultra-pure grade polymer means that the black deep well plate has near zero leachates, ensuring long-term sample integrity

Porvair www.porvair-sciences.com

ONLINE EXCLUSIVES
LAB MANAGER'S UPCOMING WEBINAR SERIES

Lab Manager
Run Your Lab Like a Business

FORENSIC SCIENCE

THE USE OF NEAR-INFRARED REMOTE SENSING IN THE DETECTION OF CLANDESTINE HUMAN REMAINS

Tuesday April 12, 2016 | 12:00 – 1:00 pm EDT
www.labmanager.com/NIRforensics

TECH TRENDS

ANALYTICAL CHEMISTRY TECHNIQUES

Thursday April 14, 2016 | 12:00 – 1:30 pm EDT
www.labmanager.com/analyticalchemtrends

FORENSIC SCIENCE

THE MOVE TO FIELDABLE INSTRUMENTATION: MASS SPECTROMETRY AS THE INITIAL AND FINAL TEST IN FORENSIC CHEMICAL ANALYSIS

Tuesday April 19, 2016 | 12:00 – 1:00 pm EDT
www.labmanager.com/massspecforensics

TECH TRENDS

FORENSIC SCIENCE TOOLS & TECHNIQUES

Tuesday April 26, 2016 | 12:00 – 1:30 pm EDT
www.labmanager.com/forensictrends

FOR A COMPLETE LIST OF OUR UPCOMING AND ON DEMAND WEBINARS, PLEASE VISIT
www.labmanager.com/webinars

ADVERTISER INDEX

Company	URL	Page
Beckman Coulter Inc.	www.beckman.com	7
BINDER	www.co2-incubator.com	40
BioTek Instruments, Inc.	www.biotek.com	2
BrandTech Scientific, Inc.	www.brandtech.com	23
CARVER	www.carverpress.com	45
Conquer Scientific	ConquerScientific.com	77
Coy Laboratory Products, Inc.	coylab.com	31
Drummond Scientific Company	www.drummondsci.com	80
ELGA	www.elgalabwater.com	15
Eppendorf North America	www.eppendorfna.com	79
EquipNet, Inc.	www.EquipNet.com	25
Federal Equipment Company	www.fedequip.com	77
GenTech Scientific, Inc.	www.GenTechScientific.com	27,77
Glas-Col, LLC	glascol.com	21
Gulf Coast Conference	www.gulfcoastconference.com	44
Heidolph North America	www.heidolphNA.com	11,43
Huber USA Inc.	www.huber-usa.com	35
IKA Works	www.ika.com	59
INTEGRA	www.integra-biosciences.com	41
International Equipment Trading, Ltd.	www.ietltd.com	77
JM Science Inc.	www.jmscience.com	49
KNF Neuberger Inc.	www.knfusa.com	37
Labconco	www.labconco.com	39
Mettler Toledo Inc.	www.mt.com	55
Miele, Inc.	www.miele-pro.com	12
National Association of Scientific Materials Managers	www.naosmm.org	65
NuAire Inc.	www.nuaire.com	47
OI Analytical	www.oico.com	48
PerkinElmer	www.perkinelmer.com	29
PolyScience	www.polyscience.com	9
Ruro	www.ruro.com	19,51
SE International, Inc.	www.seintl.com	13
Sonntek, Inc.	www.sonntek.com	77
STARLIMS	www.abbottinformatics.com	5
TOMI Environmental Solutions	www.tomimist.com/pharmastudies	33
Universal Electric	starlinepower.com	3
Vacuubrand, Inc.	www.vacuu-lan.com	64
Vertere	www.vertere.com	30

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.

PRODUCT PROFILE

PRE-OWNED EQUIPMENT MARKETPLACE

MARKETPLACE

LAB MANAGER ONLINE

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

1 "Eggs-ellent" Research

Eggs aren't just great for Easter and eating, they're awesome for science as well. We take a look at four recent studies where eggs have made a splash, helping in the development of a treatment for celiac disease, bringing new insights into environmental change, developing a new flu vaccine, and better understanding neural stem cells.

Read more at **LabManager.com/research-eggs**

2 Trending on Social Media: INSIGHTS on Next-Generation Sequencing

As of March 22, *Lab Manager*'s top March issue article posted to Facebook and Twitter was our Clinical Industry INSIGHTS article on next generation sequencing (NGS). In this article, we shared the benefits that NGS is bringing to medical diagnostics.

Read more at **LabManager.com/NGS-INSIGHTS**

3 Most Popular Webinar

Last month's top webinar on LabManager.com with 505 registrants was "New Developments in Mass Spectrometry," presented by Beckman Coulter, Agilent Technologies, and Parker Balston. This presentation shared the latest advances in mass spec and where this technology is moving for the future. Though it ran Feb. 11, you can still catch it on demand at the link below.

Read more at **LabManager.com/Mass-Spec-2016**

LabManager.com

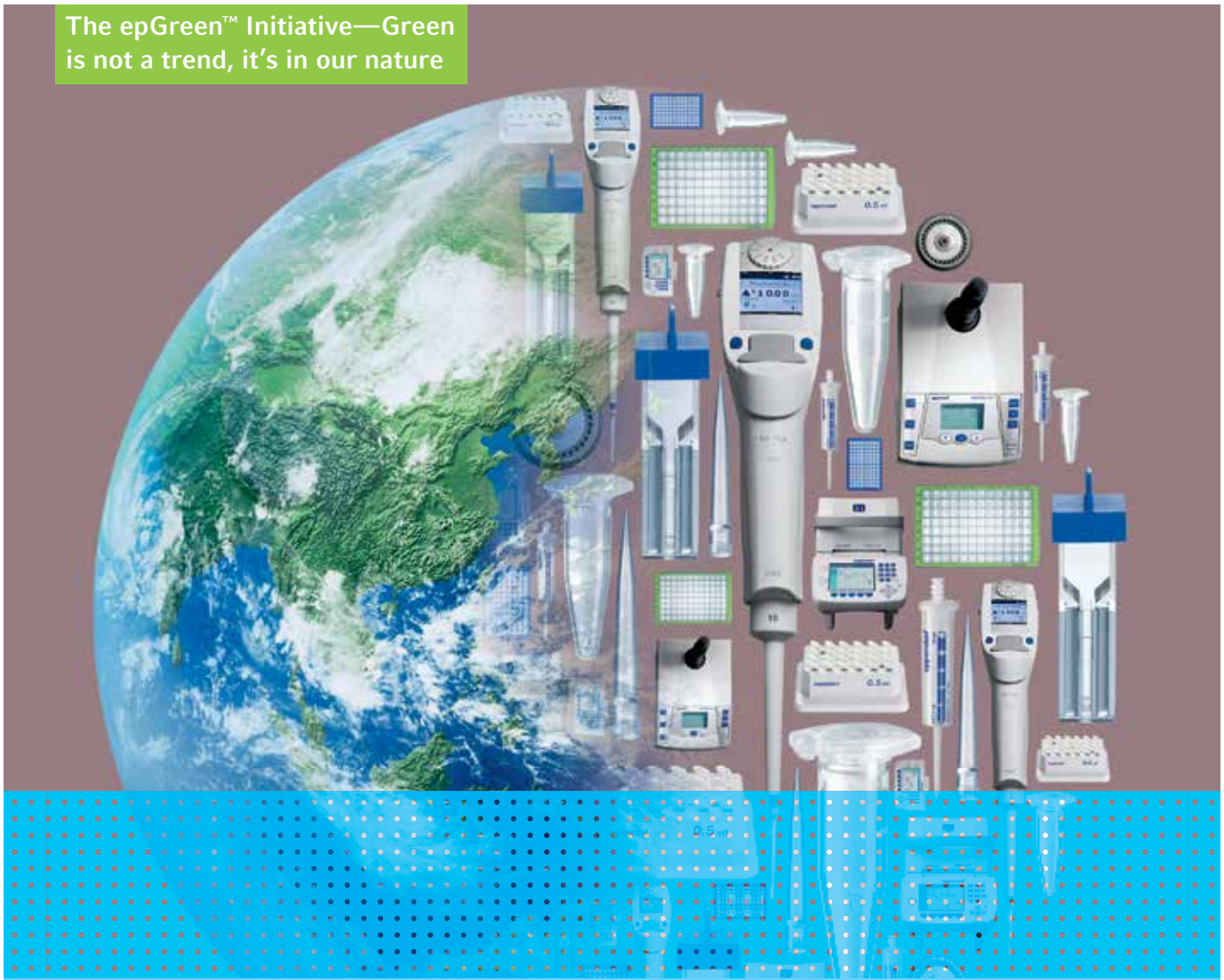
NEXT ISSUE ➡

Apps in the Lab and Beyond

Our May issue looks at the latest apps available for use in the laboratory. Our broader focus will include not only specialty applications from instrument vendors, but more general applications that are useful in the laboratory, no matter what its type.

eppendorf

The epGreen™ Initiative—Green is not a trend, it's in our nature



Less is More

The epGreen Initiative—Eppendorf's contribution to keep our blue planet green

Our goal with epGreen is to constantly reduce the environmental impact of our business operations and products. Get peace-of-mind with Eppendorf products that ensure the safety of your lab and your environment. Visit our website for more epGreen initiatives.

> Centrifuges designed to optimally cool, minimizing energy use
> ULT Freezers have high performance but low energy consumption
> Consumables are manufactured with sustainability in mind and can be recycled

www.eppendorfna.com/epgreen • 800-645-3050

Experiencing Arm or Shoulder Fatigue When Pipetting Under a Hood?

The Ergonomic Design of the Drummond Pipet-Aid® *XL* is Proven to Reduce Neck and Upper Arm Strain

The Longer, Lightweight Handle Enables a Lower, More Comfortable Arm Position

Pipetting under a hood doesn't need to be a pain in the neck. The longer handle of the Drummond Portable Pipet-Aid® *XL* reduces the amount of arm lift required to perform the same operation as with a conventional pipettor. The ergonomic design includes an adjustable sliding hand rest and a removable stand which enables the unit to be set down without contaminating the pipet.

See the Pipet-Aid® *XL* in Action

Scan the QR code or visit www.drummond sci.com/xl to view a video demonstration of the Pipet-Aid® *XL* in use.

From the Developers of the Original Pipet-Aid®

DRUMMOND SCIENTIFIC COMPANY

MADE IN USA

500 Parkway, Box 700, Broomall, PA 19008