January | February 2016 Volume 11 • Number 1

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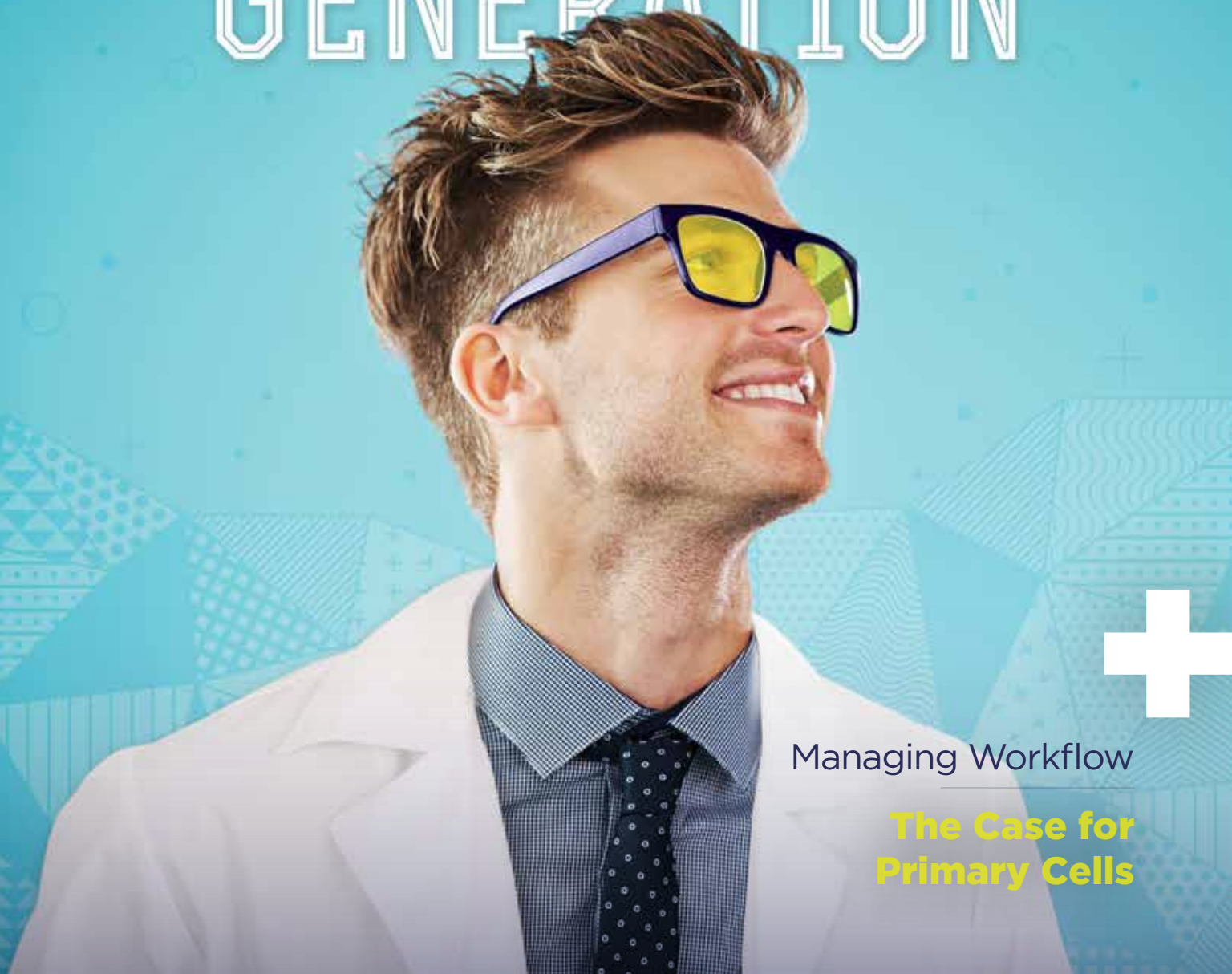
A NEW GENERATION

• RETOOLING YOUR MANAGEMENT STYLE FOR MILLENNIALS •



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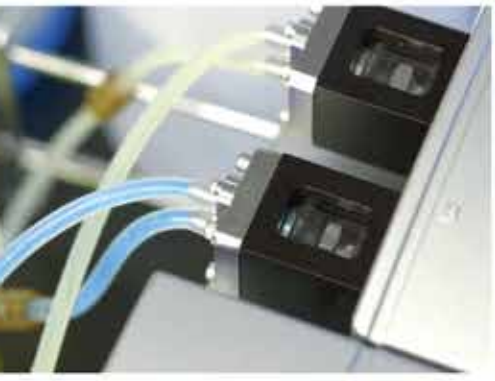

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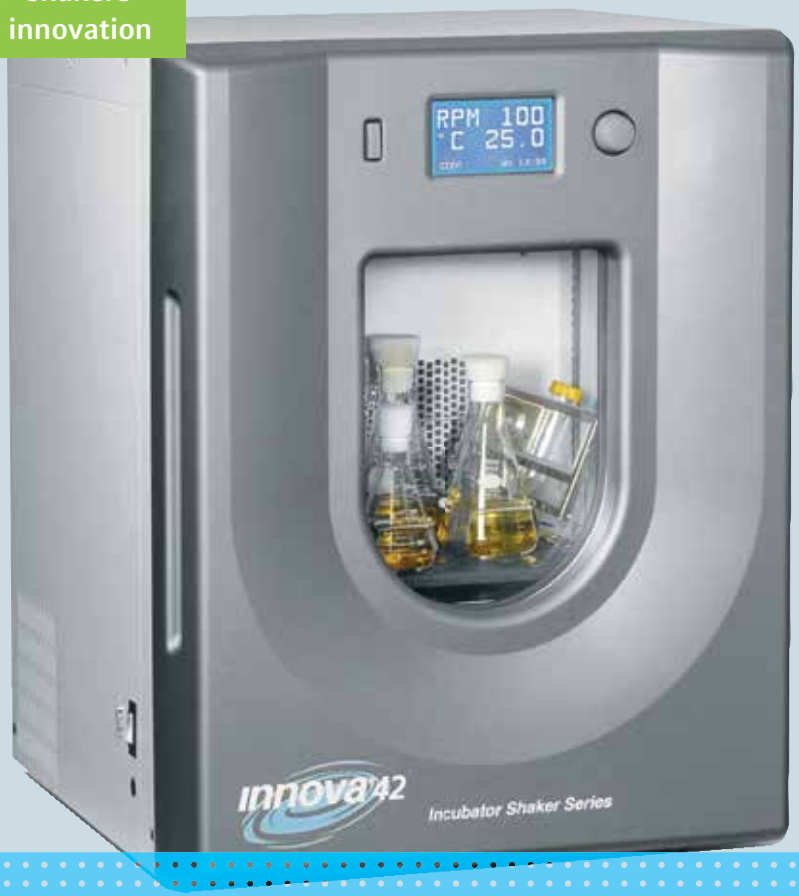

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Following the success of our quiz at last year's show, we'll be bringing it back to Pittcon 2016 in Atlanta. This year's "Are You Smarter Than *Lab Manager*" quiz can be taken either in-person at Booth 539 or online. Like last year, the first 250 participants at the show will get a free T-shirt and top scorers will have a chance to win an Amazon gift card. Also, if you'd just like to stop by our booth to chat, our entire editorial and sales team will be at the show, along with our fellow LabX Media Group brands.

ARE YOU SMARTER THAN LabManager?

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new game plans

Welcome to *Lab Manager*'s first issue of 2016, in which we look at a number of challenges and changes facing today's lab managers. Beginning with our cover story, where we examine some of the management adjustments required to attract and retain early-career millennials. The good news is their technology savviness. "Steps to understand and accommodate the technology-related needs of younger workers could result in better outcomes and benefit the lab enterprise overall," believes Rich Durand, director, material and characterization science at Sun Chemical Corporation. The challenge is accommodating their desire for flexible work arrangements, recognizing the value they place on an organization's social and environmental commitments, and creating a healthier, more holistic work environment.

These tech-fearless millennials are also expected to embrace the trend toward digital experiments. "With the new generation coming out of school, they like to have modernized modeling and simulation in the labs—they don't want to only have instrumentation connected to a PC. They want a new world. I think that will increase the value and the interest of new generations to be part of that community," says Dassault Systèmes CEO Bernard Charlès in "A New World of Experimentation" on page 36.

Another change for lab managers is the greater impact of global regulations as they relate to cross-nation concerns, such as food safety. In our "Insights on Food and Beverage Screening" (page 56), author Mike May tells us, "It takes different kinds of technology to make the right analyses and to do it fast enough to meet the requirements of governments around the world."

Echoing that message is our Leadership & Staffing article, "High Standards" (page 26)," in which Jason Poore, client development coordinator at the American Association for Laboratory Accreditation says, "As more regulators lean on accreditation as a means of establishing competency, more and more organizations will seek it, whether voluntarily or involuntarily. It is very likely an area that will see continued growth, especially as accreditation becomes more widely mandated and accepted in the global marketplace and by government entities."

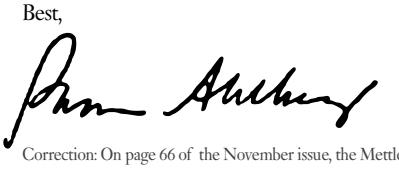
So whether it be managing millennials or considering your laboratory practices within a global context, both may require a bit of retooling on your part.

One more change. In this issue we introduce a new Industry Insights section to the magazine, wherein we address instrumentation challenges facing the clinical, drug discovery, environmental, food science, forensics, and life science markets. Relevant content related to these same markets can also be found on our website by clicking "Industries" in the navigation bar.

Lastly, don't forget to check out our Pittcon Technology News section on page 80 for a peek at what will be showcased in Atlanta in March.

Here's to a promising 2016.

Best,



Pamela Ahlberg
Editor-in-Chief

Correction: On page 66 of the November issue, the Mettler Toledo Product Spotlight contained an error. Where we wrote, "The UV5Nano only requires 1 mL of sample," the correct quantity was 1uL of sample. We apologize for the error.

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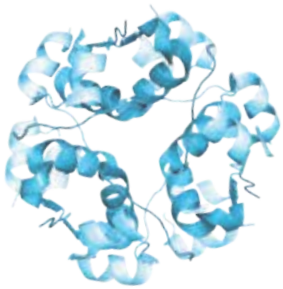

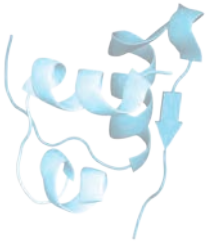

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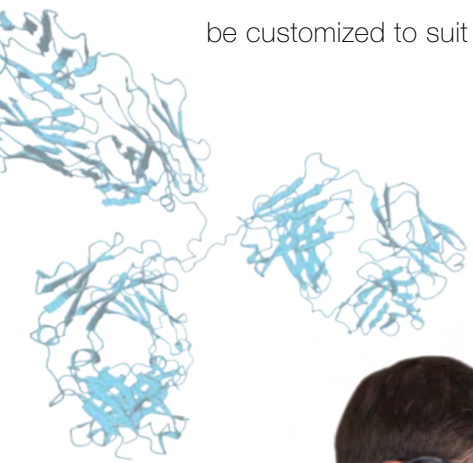

A NEW GENERATION

• RETOOLING YOUR MANAGEMENT STYLE FOR MILLENNIALS •

"This is not your grandfather's or grandmother's national lab system anymore," says Devin Hodge, deputy director of the Joint Center for Energy Storage Research (JCESR) at Argonne National Laboratory, in an apt interpretation of today's changing laboratory landscape.

Hodge's depiction points to a reset—designing and operating highly functional scientific workplaces equipped with smart ways to find, motivate, and retain scarce talented staff. It signals an advance toward more flexibility for workers, opportunities to work remotely, better work-life balance, and greater cultural awareness, and it addresses expectations of early-career millennials, an increasingly dominant segment of the workforce, who embrace a more pervasive role for technology.

"My generation is very much electronically driven," says Paola Guevara Riveros, president of the Association of Lab Managers (ALMA), who is also an early-career millennial lab manager. In meetings with vendors' representatives, she typically inquires, "Do you have an app for this?" Apps allow her to place orders via a mobile device while on an elevator or showing a rep around rather than waiting to get back to her desktop. Riveros, who is eager to "make things go faster," says although apps seem ubiquitous, many vendors don't have them to support their products. "[That's] a mind-boggling challenge, because there's an app for almost everything else."

Cursory observations suggest a strong commitment by millennials to faster, more efficient technology with smaller physical and energy footprints. Riveros says that from all appearances, her generation espouses "sustainability and environmentally friendly technologies."

Erik Lustgarten, director, life sciences practice area at Gensler, says explorations by his architecture and design firm on millennials' approach to the workplace indicate how conversant they are with technology. "This is the first generation that has grown up with the computer as a normal part of everyday life, giving them a fluidity with technology that prior generations have had to adapt to."

Rich Durand, director, material, and characterization science at Sun Chemical Corporation, agrees that early-career workers "expect to be able to use their cell phones and mobile devices to communicate and access social media," noting the potential for tension in lab environments set in older workplace cultures. He believes that steps to understand and accommodate the technology-related needs of younger workers could result in better outcomes and benefit the lab enterprise overall.

Millennials tend to make choices based on socially responsible factors, says Lustgarten. This translates into choosing to work for companies with good reputations in these areas. "Healthy workplaces with real connections to social missions are important to the millennial generation," says Lustgarten.

He says that labs seem headed toward the "mixed-use scientific community" that incorporates wellness and lifestyle components—including, in some cases, organic gardens on campus that grow healthy food for on-site restaurants—right alongside spaces for scientific endeavors, all aimed at helping scientists access a healthier lifestyle. "That is a distinguishing factor for the generation coming into the workforce now—the lab is just a part of an overall work environment."

Furthermore, with lab workers now having greater flexibility to work wherever and whenever they want, including from home, Scott Hanton, laboratory operations manager for Intertek Analytical Sciences America, says, "What matters is

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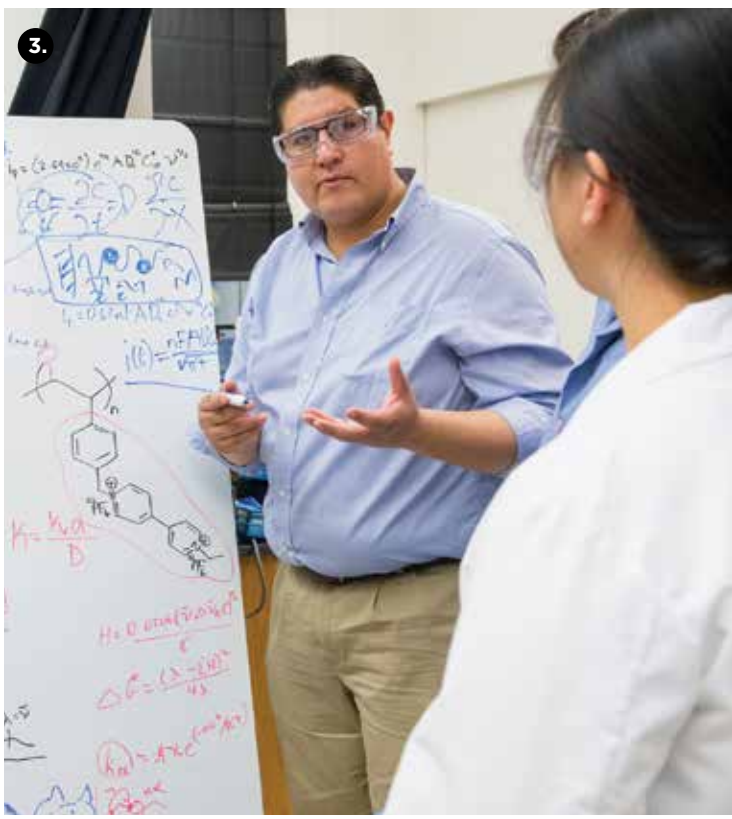
that the job gets done; you have flexibility about where and when you do it."

"I care a lot less about when someone clocks in or out, but I pay a lot of attention to whether they got the job done by the time it was due and with sufficient quality. For example, I don't ask people to schedule dentist appointments in advance. You have a dentist appointment, go, but still get your job done." Such flexibility helps workers better handle other important activities in their lives, such as caring for older family members or attending to children's needs and activities. "They can fulfill family obligations and still be successful at their work," he says.

Hanton says that his lab's remote and work-at-home arrangements do not introduce any undue burdens. "Chemists spend about 50 percent of their time with data rather than chemicals. We provide them with tools to access data remotely, and they can be equally effective working somewhere other than in the lab." He says that for entry-level chemists who mostly do bench work, "We have broader, more convenient working hours that they can tailor to their needs."

While Hanton acknowledges the importance of keeping up with technology and increasing opportunities to work anywhere and anytime, he says, "As labs become more digital, we have to take advantage of the flexibility that digital features provide without stretching the bounds of community too far. We still have to find opportunities for face-to-face and accidental conversations. My worry for the future is that we stretch the flexibility too far and lose something from the face-to-face community."

Hodge says the goal is to "allow people to be successful when and where they want to [be]." JCESR's 20 partnering institutions across different disciplines and cultures work collaboratively to develop next-generation battery technology. The organization uses strategies like scientific sprints, often led by early-career people, along with cutting-edge communication and information-sharing tools. Partners are spread across the country, but innovative approaches help overcome potential barriers.



"WHAT MATTERS IS THAT THE JOB GETS DONE; YOU HAVE FLEXIBILITY ABOUT WHERE AND WHEN YOU DO IT."

1. The workplace has a variety of space types throughout each floor to enhance the work environment. Multiple workspaces provide greater choices in where and how to work to support focus and collaboration. Photo credit: Andrew Bordwin Studio, Inc. **2.** The interior space at Mylan's Robert J. Coury Global Center is organized around a five-story lobby, which serves as a central hub of social and collaborative spaces for the entire organization. Photo credit: Andrew Bordwin Studio, Inc. **3.** Joaquín Rodríguez-López, assistant professor of chemistry at University of Illinois at Urbana-Champaign, discusses next-generation battery research with postdoctoral research associates and graduate students in the laboratories at the University of Illinois at Urbana-Champaign. Image courtesy of Argonne National Laboratory. **4.** ingshu Hui and Elena Montoto, graduate students at the University of Illinois at Urbana-Champaign, conduct JCESR next-generation battery research in the laboratories at the University of Illinois at Urbana-Champaign. Image courtesy of Argonne National Laboratory.

"If you want to communicate, the best way is for the parties to be able to see each other. This helps you to read the situation better and know whether everyone is engaged. Our easy-to-use communication system allows us to engage people quickly in ad hoc meetings across the country." Hodge says this approach relies on trust and transparency, noting JCESR's considerable effort to build trust, starting at onboarding.

Hodge says, "At JCESR, we are all about giving people the tools to work wherever and whenever they want. We just have to work that way, and it just so happens that our early-career people prefer it that way. They want to be able to work remotely, and we give them the tools to enable that."

He notes that while it hasn't happened completely yet, private offices with bookshelves and decorated walls are giving way to open collaborative spaces. "Millennials seem to want it that way. To stay competitive, labs have to respond by moving in the direction [that accommodates] where the talent wants to be." He notes that research has suggested that millennials don't want noisy spaces, but are interested in areas where they can collaborate and work together.

"They want the best of all of those worlds. What they don't want is to be anchored to a desk. They want freedom to move around and work someplace else, and we try to provide that.

"For lab work, you need to be where your experiments are conducted, but a decent amount of time is devoted to reading papers, crunching results, and other activities that can be done remotely. I am positive about this approach, especially for millennials, who prefer to work this way. If they are happy, they will be more creative and innovative. I believe that's true for anyone. There is more creative power in this freer, collaborative model, with people working side by side, taking on challenges together," says Hodge.

Leadership is crucial in such flexible, less formal arrangements. Riveros says, "We are lab managers, but no one reports to us. We do guide, direct, and manage large processes across campus. What's crucial is a culture of mutual respect that includes a willingness to listen to lab managers as persons with knowledge and experience because of their integral involvement in helping to design and create the laboratory workspace—as people who can provide information and guidance."

Riveros says it's challenging to be a lab manager when no one reports to you. "In a culture where people are unwilling to heed someone they don't report to, a lab manager would be ineffective. Lab managers need to be more leaders than managers in these situations to be truly effective," she says.

Hanton concurs, adding that the exercise of leadership should be encouraged at every level in the organization.

"Sometimes we expect leadership to come only from the top; however, if we expect ideas to come from a select few, we'll miss a lot. What's the next best idea? We need it from everybody, from the most junior person to the most senior; everybody has the ability to contribute, and everybody else will listen."

Turning to motivation and retention, Riveros says that training is essential not only for skill building, which is essential for early-career workers not specifically trained for laboratory duties, but also for retention of the workforce.

Hanton adds, "We are focusing on people and making sure that we make sound decisions about recruiting, hiring, retaining, developing, and performance review, because qualified staff are even more critical today than in the past.

"We have more resource constraints, so we have smaller staffs and less spending flexibility. Against greater staff mobility, we have to spend more time figuring out the best workers who will fit into and stay longer in our organizations."

Hanton identifies two key considerations for motivating and retaining lab staff. "One, we are placing more attention on individual development. As lab managers, we are tasked with developing a staff. In the past, we focused on skill building. Now we are paying more attention to the holistic individual. There's still skill building, that's a part of it, but lab managers are spending more of their time thinking about their whole development, not only what lab skills they bring but also the development of leadership, communication, influence, and negotiation skills—areas that are much more broadly useful than just their technical skills.

"Two, we need to have a lot more conversations about how the people are doing, how they are feeling. This is not natural for people in the technical fields, who are more comfortable with conversations on the science and projects they are working on. But I see myself and my peers spending more time talking to people about how they are doing, really working toward making the right decisions to keep them challenged and satisfied as part of retention and development."

On the question of collaboration and community building in the laboratory, Lustgarten points to notable areas of progress. "Twenty years ago, socialization was just in a little café-style room where workers stored their lunch. Socialization now [happens in] a place where they can do scientific work and analysis as well as a place where they can take a break from their workday.

"Now leaders want to be engaged in the lab, they want to be accessible for conversations. They do need privacy for sensitive discussions and administrative duties. Increasingly, those types of situations are accommodated by the availability of alternative, private spaces that are just as available to senior leaders as they are to workers who want to make a private call to their doctor."

Such settings significantly increase opportunities for unplanned, accidental conversations that often turn into serendipitous exchanges of information with future value, according to Lustgarten.

Hanton says that increasing such opportunities for such "collisions is really important, because the resulting accidental conversations actually help to build community among staff. A simple coffee room can help to facilitate this. The value of these informal conversations is enormous, far outweighing the cost of the space … and the coffee."

Bernard Tulsi *is a freelance writer based in Newark, Delaware. He may be contacted by email at btulsi@comcast.net or by phone at 302-266-6420.*

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SNOLAB

DOING SCIENCE IN AN ACTIVE MINE

Rachel Muenz

While many lab professionals deal with a morning commute to the lab, few likely have to travel two kilometers through the earth to get to work. That's all part of a regular day at SNOLAB in Sudbury, Ontario, Canada, where lab staff start with a roughly five-minute elevator ride into the Vale Creighton Mine, then go for a kilometer-and-a-half walk to get to the SNOLAB facility, where they have to scrub as much mine dust off their boots as possible, shower, and change into cleanroom overalls before the science begins. The entire lab is a class 2000 clean room, so staff must ensure they're as clean as possible before entering.

"We also have to have someone walk through the lab to check that the air quality is acceptable," adds Dr. Nigel Smith, SNOLAB director. "So somebody clears the lab to make sure that there aren't any pockets of bad air that have developed, or anything like that."

The time staff leave the surface to the time they start working productively in the lab is about an hour, and the process needs to be completed on the way back, meaning the lab runs ten-hour shifts to ensure an eight-hour workday.

Along with the travel and cleaning requirements involved in working at SNOLAB, staff are also faced with the unique challenge of working in an active mine.

"Once you're in the lab, it's very difficult to recognize that you are two kilometers underground," Dr. Smith explains. "One has to maintain the level of awareness that you are in an active mine, and that has certain implications in terms of health and safety requirements."

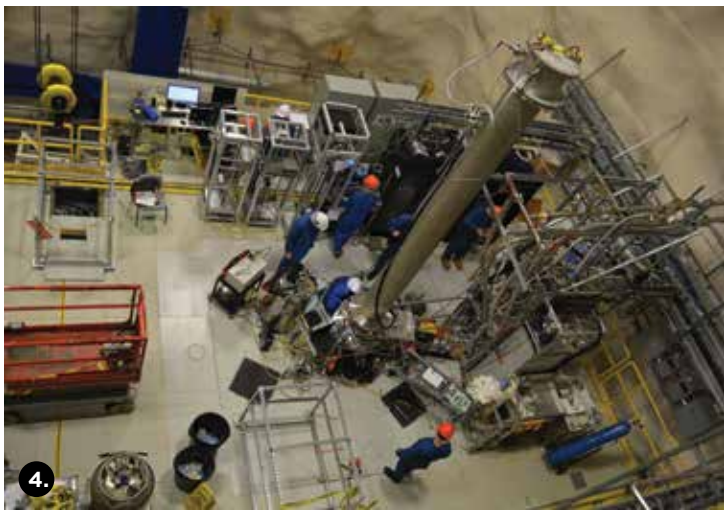
"Once you're in the lab, it's very difficult to recognize that you are two kilometers underground."

SNOLAB, an expansion of the existing facilities constructed for the Sudbury Neutrino Observatory (SNO) solar neutrino experiment, currently has two main tasks: looking for interactions of dark matter in its super-sensitive detectors and carrying on the work of the original SNO experiment dealing with neutrinos.

"We're looking for a very rare nuclear process called neutrinoless double beta decay which will give us more information about the mass of the neutrino, but we'll also be looking for solar neutrinos from the sun and what are known as geoneutrinos from the earth," Dr. Smith explains. SNOLAB will also be looking into neutrinos from supernovae.

Dr. Smith says the program is expanding beyond its original scope into several smaller projects related to genomics, in which researchers are exploring the effects of low-radiation environments on cell mutation. There's also a project looking at data from various mines around the area to see whether the rock mass characterization can be understood using the same data manipulation techniques used in particle physics.

"We're extending into other areas that we originally were not really thinking of," Dr. Smith says. "One of the great things about building a facility like SNOLAB is that people will then connect what we can provide to the



1. This is an internal view of the DEAP-3600 experiment. This is a dark matter detector that uses 3,600 kg of liquid argon to interact with dark matter particles and produce flashes of light that are detected by very sensitive light detectors. **2.** SNOLAB engineer working on cleaning the interior of pieces of the SNO+ scintillator plant. **3.** Student working on the electronics for the SNO+ experiment. This is a neutrino detector that uses 9,500 photo detectors and a million liters of scintillator to detect neutrinos and neutrinoless double beta decay. **4.** View of the DEAP-3600 experiment from above the deck.

research that they're interested in doing and come up with some other ideas."

In the next eighteen months to two years, SNOLAB will be home to a new $30 million dark matter experiment called SuperCDMS, a US-Canadian collaboration. This new dark matter experiment will add to the current dark matter program that includes DEAP-3600, MiniCLEAN, PICO, and DAMIC. The lab is also working with the double beta decay community to decide what the next project related to that area will be—it's expected to be a major $100 million to $150 million project that will take place in about four years.

"Coupled with that, we'll still be looking to broaden the support we're giving to the genomics and mining engineering areas so we can maximally exploit the facility that we're creating here and get the best science out of it that we can," Dr. Smith adds.

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

BUDGET PLANNING

TIPS FOR MANAGING AN ACADEMIC RESEARCH LAB BUDGET

by Kimberly A. Huey, PhD

Setting up a new lab can present many challenges, not least among them is managing your budget. Once you have chosen the techniques you plan to implement in your lab as well as the personnel to perform the experiments, you now face the challenge of developing a budget to fund your research goals. Fortunately, as a new faculty member, you will likely have received a start-up package that you negotiated to cover the majority of your expenditures. As the name implies, a start-up package should allow you to hit the ground running and begin collecting meaningful data. The information you used to negotiate your start-up package will allow you to lay out the basics of your initial budget.

There are three major components within a lab budget: 1) personnel (salary, benefits, meeting travel/registration), 2) major equipment, and 3) supplies/consumables.

"With respect to major equipment, your first step is to learn about core and/or shared facilities within your institution."

Personnel costs

Personnel can constitute a large majority of your budget once you have purchased the major equipment necessary to conduct your research. This is especially true as you move forward in your career and your lab continues to grow in size. However, as a new investigator, your hiring decisions will determine how much of your budget is allocated for personnel.

A new investigator has the opportunity to make the critical hires to begin a successful career, and these hires will likely fall into one of three categories: 1) full- or part-time laboratory technicians, 2) postdoctoral fellows, and 3) graduate or undergraduate students.

Some—but certainly not all—universities will include the salary for a technician in your start-up package. If this is the case, having a competent technician as you begin your research career can be very important to your future successes. A technician can work in the lab full time without the demands of teaching or service and may be able to provide technical expertise in an area that is new to you. In addition, a technician can help train graduate and undergraduate students. A good technician will also provide your lab with some continuity, as postdoctoral fellows and graduate students may be in your lab for only a few years. However, a full-time technician can consume a large portion of your initial budget, whereas postdoctoral fellows or graduate students can often be funded by outside sources.

A good postdoc can greatly improve your research productivity, as he or she is usually well-trained and is motivated to be productive in order to be competitive for a faculty position in several years. Similar to a technician, a postdoc can also help you train graduate and undergraduate students. Ideally, you would like to find a postdoc who has a fellowship from an institute such as the National Institutes of Health or the American Heart Association. Depending on the source of the fellowship, it will often cover the salary, benefits, and travel for the postdoc.

In a faculty position, you will also be expected to mentor graduate students, and they may comprise the largest portion of your personnel. There are numerous ways to fund graduate students, such as predoctoral

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grants, teaching assistantships, and/or research assistantships. Predoctoral grants and/or teaching assistantships would not contribute to your budgetary planning, whereas research assistantships are generally funded by your start-up financing and/or grants. Ideally, you would like to find postdocs or graduate students who have funding for at least one year, thereby giving you time to obtain grant funding to support them further in your laboratory.

Major equipment

Before you begin purchasing the major equipment for your laboratory, compile a list of equipment and supplies and divide it into resources that are expensive and resources that are essential to successful research. This will enable you to categorize your budget and thus use your funds in the most effective manner. For example, required equipment and supplies could include large/heavy equipment (refrigerators, hoods, lab shakers, centrifuges), microscopy, cellular/molecular biology equipment (PCR machines, plate readers), computing and printing equipment, general lab equipment (pipettors, microfuges, vortex), chemicals and reagents, and reference books.

With respect to major equipment, your first step is to learn about core and/or shared facilities within your institution. Most major research universities have core facilities that often include expensive equipment that is generally not within the budget of an individual investigator. For example, some universities have institutes that maintain state-of-the-art imaging equipment, such as electron and atomic force microscopes and functional MRIs. Core or shared facilities would also include equipment that you would not use on a regular basis. Consequently, it is not in your best interest to budget a significant amount of money on such equipment.

After determining the equipment that you definitely need to purchase for your independent laboratory, the first step is to receive quotes from several companies, especially when you do not need to purchase a specific model or brand. Many of the major scientific supply companies offer specialized new-lab start-up programs that provide discounts on all types of equipment and lab consumables. It is also important to develop a good working relationship with the local sales representatives for the

companies with which you will be conducting the majority of your business.

Second, you should ask colleagues if they have any spare equipment that they are no longer using and would be willing to donate to your laboratory. Oftentimes, well-funded, senior faculty will be happy to donate older equipment when they update to newer models. In most cases, this equipment works great and can save your budget thousands of dollars. It may also be helpful to develop relationships with investigators with similar research interests/techniques who have established laboratories. In these cases, you may be able to share certain equipment or reagents. Independent of budget issues, it is always important to begin developing collaborations within your department or university.

"It may also be helpful to develop relationships with investigators with similar research interests/techniques who have established laboratories."

Another nontraditional source of major equipment is companies that specialize in used laboratory equipment. Local appliance or big-box stores are excellent sources for purchasing basic appliances, lab furniture, tools, cleaning supplies, carts, etc. While these items can be purchased from lab supply companies, the prices are significantly higher for the same items.

An additional consideration if you purchase new equipment is whether to buy a service contract. A service contract can include many services beyond a general warranty, such as software updates, calibration, certification, preventive maintenance, priority service, and/or additional discounts on upgrades. Service contracts can be costly, and you can either discuss options with colleagues or make your own informed decisions. Several reasons why you may choose to purchase a service contract could include reduced inconvenience if your equipment breaks,

faster/priority repairs, and a predictable expense in your budget. If a piece of equipment is critical to your work, you use it frequently, and major repairs are very expensive, a service contract may be worthwhile. In terms of budget, you will know exactly what you are going to pay in advance and will not be blindsided with a major "surprise" expense. On the other hand, you may end up paying for services that you never use and therefore paid for "peace of mind," which would extend beyond the typical one-year warranty.

Supplies/Consumables

Once you have outfitted your lab with all the appropriate major equipment, the majority of your budget will likely be spent on personnel costs. However, the daily costs of running the lab must also be considered in your budget. While the daily costs will vary depending on the number of people in your lab, the types of assays you perform, etc., a general rule is that you can plan on spending ~$1,000/month on pipette tips, tubes, glassware, cell culture supplies, gloves, etc. Additional consumable supplies, such as antibodies, enzymes, ELISA kits, and PCR kits, will add to these costs; however, items like antibodies or enzymes—if correctly stored and handled—can last for months to years. After tracking your spending over a representative period of time, you will be able to get a good estimate of how much to budget for supplies and consumables.

Staying within budget/tracking spending

Following the development of an initial budget to run your laboratory, it is important to track your spending to ensure that you are working within the parameters of your budget. This can be accomplished using spreadsheet or database programs. A database program can be particularly helpful, as you can establish a database of your money sources (start-up, grants, etc.), suppliers, and a record of all your purchase orders. This can also save time with regard to purchasing supplies that you buy on a regular basis. For example, you can have a standing purchase order for pipette tips and microfuge tubes that you would just print out and give to the person in charge of ordering when you need additional supplies.

Conclusion

While developing and implementing a budget for your new laboratory may be as fun as balancing your checkbook, it is indispensable to initiating a successful career. Making the most of your start-up budget, in part, can be instrumental in obtaining future grant support. Specifically, budgeting for enough personnel and the necessary equipment is the only way you will be able to generate preliminary data for your subsequent grant applications. Unfortunately, budgeting and accounting strategies are generally not part of your training as a graduate student or postdoc, and thus you must take the initiative to learn from mentors and/or colleagues when it comes time to develop the best budgeting strategies. Remember that successful budgeting continues throughout your career, as all granting agencies expect you to present an accurate and well-documented budget for spending the money you obtain from your successful grant applications.

Kimberly A. Huey, *associate professor of Physiology at Drake University, can be reached at kimberly.huey@drake.edu or 515-271-4853.*

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WARRANTIES ON PRE-OWNED ANALYTICAL EQUIPMENT

GETTING THE COVERAGE YOU NEED

by Mike May, PhD

When it comes to running a lab, you need analytical equipment, but it's not always affordable unless you can find it used. Even then, it might not be the best choice unless it comes with the right warranty. Just being used doesn't make analytical equipment a good deal unless you can count on it. That means being sure that the seller stands behind the product with a warranty and fast responses to problems in order to keep your lab running.

> "It's one thing to offer a warranty; it's another to offer servicing."

At LabCentral in Cambridge, Massachusetts, lab manager Lyndsey York takes the used equipment approach for many devices, including minus-80 freezers, cryogenic freezers, CO2 incubators, biosafety cabinets, and centrifuges, as well as multiple plate readers and balances. She says, "Having a warranty included with the purchase of used analytical equipment is a critical deciding factor. We find that having support available during the install and initial operating period is extremely valuable." She adds, "Having a warranty included with the equipment reduces the impact of malfunctions and lessens the risk associated with buying used equipment."

But how long a warranty do you need? York says, "I would suggest seeking a warranty for a minimum of 90 days from receipt of the equipment, which should be enough time to install the system and operate it." The right warranty, though, depends on the equipment. If you are purchasing equipment that has a lot of moving parts, or parts that wear over time, York says, "it may be in your best interest to try extending the warranty up front if the option is available."

Company considerations

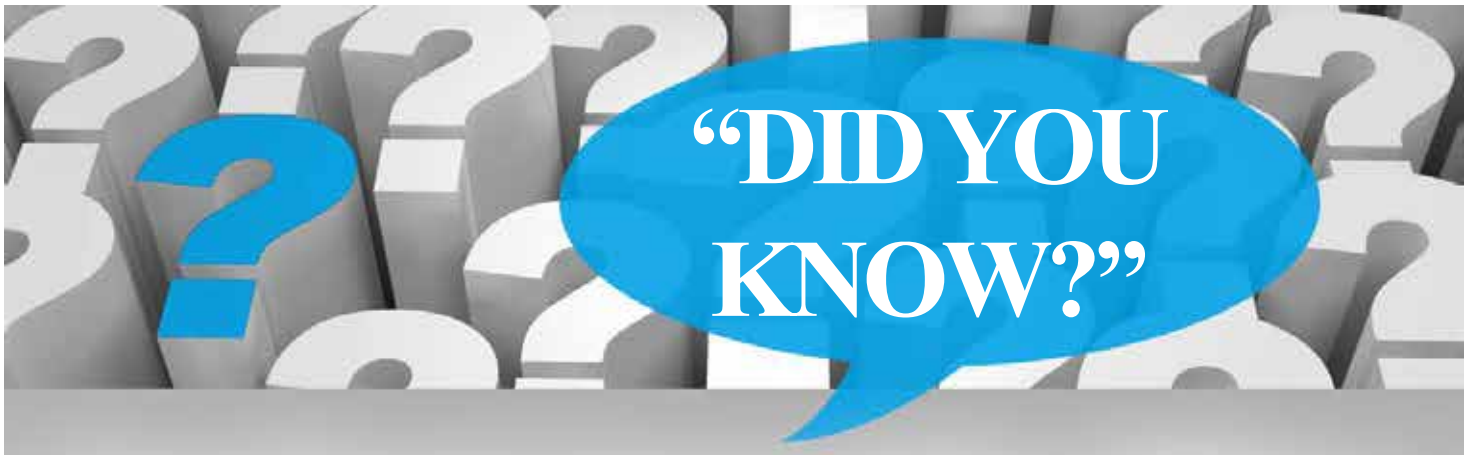
At American Laboratory Trading (ALT) in East Lyme, Connecticut, chief operating officer Jayson Bernstein says, "Everything in our building comes with a 90-day warranty—all parts, all labor." He adds, "We also offer an upgraded one-year warranty with all parts and labor included."

It's one thing to offer a warranty; it's another to offer servicing. That all starts with what you receive. Bernstein says, "Our equipment has to run at the manufacturer's specifications before it leaves the building." If a device ends up needing on-site service, ALT provides it.

A buyer should expect that. In some cases, a buyer can expect even more. As Bruce Jones, chief coordinating officer at GenTech Scientific in Arcade, New York, says, "If we install the instruments, we are able to offer a one-year warranty on most instruments, because we are confident in the expertise of the technician and the quality of our refurbished instruments." He adds, "For certain instruments, we may be able to extend the warranty up to five years with installation."

To be sure that you get the warranty you desire, the key could be checking with your colleagues about their experiences buying used analytical equipment. Also, be sure to ask the crucial questions: What is the warranty, and how will it be serviced? Only then can you feel safe buying used analytical equipment. Otherwise, you're taking a financial and professional risk.

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



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HIGH STANDARDS

TRENDS IN LAB ACCREDITATION AND TRAINING AND TIPS FOR SUCCESS

By Rachel Muenz

With ever-tightening government regulations and a closer eye on laboratory tests, accreditation and training aren't likely to lose their importance in the laboratory world anytime soon. Jason Poore, client development coordinator at the American Association for Laboratory Accreditation, says that while accreditation generally doesn't change very often because it's tied to the standards against which organizations choose to be accredited, as tests and measurements are scrutinized more often or there's a desire for international acceptance of results, the need for accreditation becomes more pronounced.

"The concept of third-party accreditation is growing both domestically and internationally, and regulators are increasingly leaning on competent accrediting bodies to establish competency in organizations," he says.

As far as specific trends in lab training go, Poore says that many organizations are starting to realize that over the long term investing in lab training is much less costly than hiring consultants. "Finding an organization with enough knowledge to develop comprehensive training courses with enough substance to facilitate understanding of the content area is absolutely necessary, similar to finding the right consultant," he says.

While accreditation doesn't change very often, Poore says that standards are always being revised to keep up with industry changes and any challenges that come up over time. He adds that currently the major accreditation standard ISO 17025 is under revision, with a number of changes to the current version of the document proposed. The ISO 17011 standard that governs how accrediting bodies do business is also under review.

"Thankfully these standards will have a generous transition period to allow accrediting bodies to implement the changes along with their accredited organizations," Poore says.

Karen Breckenridge, director of quality systems at the Association of Public Health Laboratories (APHL), notes that a recent trend she's noticed from the public health lab side of things is that more labs are getting ISO 17025 accreditation.

"A lot of that is because they do a lot of environmental work as well, not just clinical testing," she says of public health labs.

> "The concept of third-party accreditation is growing both domestically and internationally."

Keys to successful accreditation

For Kathryn Wangsness, chief of the Office of Laboratory Services at the Arizona State Public Health Laboratory, the Food Safety Modernization Act of 2011 was a key reason her lab recently decided to become ISO 17025 accredited. Since Wangsness's lab is part of the nation's Food Emergency Response Network, the U.S. Food and Drug Administration (FDA) recommended completing the accreditation process.

"The FDA was encouraging us to … become ISO 17025 accredited so that during outbreaks and emergency responses or surveillance activities we would have this accreditation available that would show that we had a quality management system in place and that it had been reviewed by an external entity," she explains.

When it came to choosing an accrediting body, Wangsness's lab had to go out for bid, since it is a state lab. She recommends that other government labs that need to go out for bid start the process as soon as possible and be patient.

"It does take a while to go through the standard and figure out all the pieces and parts that are missing that need to be put in place," she says. "If you've got people [who] are dedicated to just doing that, then you could probably get it done fairly quickly, but if you've got limited resources and you're trying to do this, be patient."

For labs that don't need to go out for bid, choosing the right accreditation body is just as important, and, according to Poore, good communication is often the key determiner of which accreditation body to go with.

"All recognized accrediting bodies provide the same basic service: accreditation to a given standard," Poore says. "However, what often sets one accrediting body apart from another is having an open line of communication with knowledgeable staff [who] can help an organization understand the language in the standard and how best to meet the requirements."

Wangsness agrees that the knowledge and resources provided by her accreditation body made the ISO 17025 process easier. She adds that many accrediting bodies have a checklist related to the ISO standard that they use for their assessments, which is a helpful tool for any lab completing the accreditation process.

"Downloading that and going through it line by line will really help them in the long run," she says. "With our accreditation body, we're required to go through it every year."

Because the ISO standard involves certain requirements for the facilities and purchasing sides of labs, staff at Wangsness's lab who do not perform actual lab work and staff working in the lab had to adopt new systems.

"Everybody was supportive, but it was challenging for them to understand how that all worked and how it was going to fit together," Wangsness says. "They had their own processes in place, but now we had to figure out exactly what those processes were, have them available, and make sure that we were doing all the things we needed to do."

Meetings and good communication were key to how Wangsness's lab dealt with the challenges of switching to ISO 17025. She says that APHL was an important part of the process, as they helped connect her with other labs that had also gone through the accreditation process so she could get tips on and ideas for how to handle any difficulties. They were even able to get an APHL representative to come to their lab and do a walk-through and a one-hour introductory training session on ISO 17025 for all staff involved in the process.

> "It does take a while to go through the standard and figure out all the pieces and parts."

"We really used a lot of resources that APHL had available to us," she says, adding that she would recommend other labs get a similar pre-assessment done, whether through a consultant or their accrediting body. "Have an individual come through who's knowledgeable about the standard and will walk through the laboratory and let you know where you might still have gaps."

Poore notes that challenges to labs going through the accreditation process depend on the reasons they are becoming accredited.

"Customer requirements, regulatory requirements, and voluntary participation are all very different reasons to become accredited, and each carries its own set of challenges," he says. "For those organizations [that] must be accredited, getting buy-in from staff or upper management can be daunting. Sometimes assessment findings lead to a need for change, and facilitating that change can be difficult in an organization that is required to be accredited."

For Wangsness, getting that support from upper management right from the start was the key to making the ISO process as smooth as possible.

"We actually went all the way up to the top to make sure that the top individuals understood what their staff [who] actually worked directly with us would be doing, so that we weren't going to run into any issues there," she says, adding that they also had their accreditation body come in and do some on-site training for the entire lab management team. "Having the [whole] management team attend this training and [being] able to ask questions of the accreditation body as we were going through all the different areas and what needed to be put in place [were] really helpful. All the resources [whom] I had talked to highly recommended having the accreditation body provide either off-site or on-site training to staff."

Poore adds that willingness to learn is essential to get the most out of lab training, which is why it's so important for the lab managers to select a training program that's comprehensive and addresses all their needs. He suggests that when deciding on a training program, managers should ask the training provider for as many details on and resources for the course as they can give.

"At a minimum, an organization should want to see learning objectives for a given training course to ensure [that] it is right for them," he says. "Other considerations might be whether the content will be tested at the end of the course, or to request a bio of the trainer to determine an adequate level of experience in the content area."

For Wangsness, most of the benefits of ISO 17025 to her lab have been internal so far, as their accreditation is still fairly recent.

"Having to bring on this new accreditation made us really look at our system and clarify things that weren't clear, and put processes in place that just helped streamline how we did things," she says. She adds that though they didn't often have incorrect procedures in the lab, the ISO accreditation has reduced such instances even further. Communication with the nontraditional lab areas, such as facilities and purchasing, has also improved.

"We've learned more about their processes, and they've learned more about ours," she says. "Internally, the benefits have been good. They've really helped give us a better overall system."

Accreditation and training for the future

While the experience of Wangsness's lab shows that traditional training is still alive and well, online training is a growing resource for labs. However, Poore notes, while online training is more convenient, "not all online content is created equal" and there is a "high level of variation between courses and training providers."

For example, he says, prerecorded webinars simply deliver content to listeners with little to no interaction between instructor and learners, though some webinars will have an instructor on standby to answer questions.

"Two-way dialogue is essential in the process of learning many of the nuances involved with accreditation and allows for interaction that cannot always be effectively replicated online," he says. "As training gains popularity, it would be fair to assume that this growth will be both in the online and traditional training course settings."

Breckenridge agrees that traditional training isn't likely to disappear anytime soon.

"We're doing both webinars and teleconferences from our end because many of our members like the opportunity [during] a teleconference to be able to ask some questions," she says of APHL's training options. "A webinar's great for the flexibility of being able to listen to it at your convenience, but sometimes you need someone to answer some questions."

As for accreditation, Poore believes it's an area that will continue to grow.

"As more regulators lean on accreditation as a means of establishing competency, more and more organizations will seek it, whether voluntarily or involuntarily," he says. "It is very likely an area that will see continued growth, especially as accreditation becomes more widely mandated and accepted in the global marketplace and by government entities."

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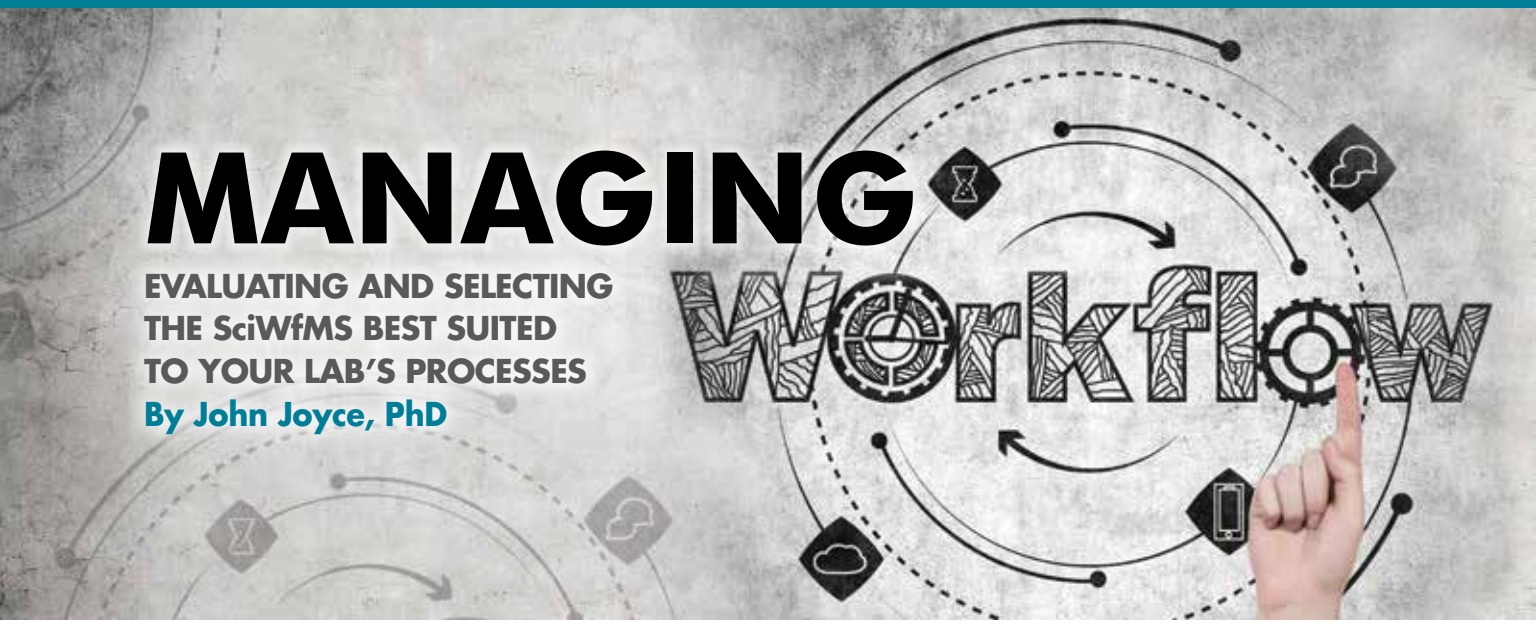

MANAGING

EVALUATING AND SELECTING THE SciWfMS BEST SUITED TO YOUR LAB'S PROCESSES

By John Joyce, PhD

At its heart, a workflow is simply a set of procedural rules used to coordinate tasks between people and systems, while ensuring that all steps and requirements of the process are correctly followed. Workflow management systems (WfMSs) were developed to carry out those processes.

Initial systems were relatively rigid in applying the process rules and occasionally had issues with handling exception conditions. Current state-of-the-art systems are much more flexible in handling these exceptions and in communicating with other informatics systems. However, there is no description consensus regarding what constitutes a workflow management system. On the low end, you might find some organizations using a simple spreadsheet application featuring a routing list that is supposed to be checked off as the process moves from step to step. On the high end, there are automated systems that are capable of maintaining a reliable audit trail of all activities, including who performed them and when.

> "The intrinsic functionality of systems sold as purpose-built WfMSs is anything but standard."

Even if we discount any spreadsheet systems at the start, the intrinsic functionality of systems sold as purpose-built WfMSs is anything but standard. When evaluating systems, some people break them down into two classes: workflow and workflow light. A full-blown workflow system includes significantly more logic. It may allow you to attach multiple files to a single process, apply security controls, handle staff scheduling and consumables monitoring, etc. A workflow light system contains the most basic features and is in the main designed for document handling.

While some of these systems are designed to be very general purpose, which usually implies that more configuration is involved, some are optimized to work with a specific type of process or industry, thus requiring less configuration. This has led to the development of scientific workflow management systems (SciWfMSs).[1] Superficially, a WfMS for business and a SciWfMS can appear very similar; however, they are built on considerably distinct execution models, resulting in fundamental variations between them.[2]

At the start of the selection process, you should perform a high-level review of the applications you are considering to ensure that they include the capabilities you require. This should be followed up with a series of online demos to narrow the field, after which you can get down to the serious business of writing up your Request for Proposal to send over to purchasing.

An implied caveat to this is that you actually know what capabilities you will require. For this to be true, you have to have a solid understanding of what your current workflow is. In my experience, most organizations have only a general understanding of their workflow. If you ask them to draw a flow chart of their process, you tend to end up with an idealization of the process; that is, what the process is when everything works properly. It is only through further examination, usually with those closer to the actual

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execution, that you discover all the exceptions that can occur in the workflow.

A better way of obtaining detailed information is to have the analysts in the group generate a flow chart of their processes and then have someone shadow them for a while to confirm that this actually is what they do, and discuss with them why they do things that way.

As you collect information regarding what your people actually do, you can take one of two courses of action. You can either update your standard operating procedure documents so that they accurately reflect your operations or you can take the more prudent, if potentially more time-consuming, course of using this information to reengineer your processes to make them more efficient, potentially increasing productivity and reducing the risk of generating erroneous data. While this might add significantly to the upfront cost, taking the time to do this will pay major dividends in boosting throughput, catching errors, and overall improving the quality of the data generated.

"At the start of the selection process, you should perform a high-level review of the applications you are considering."

With over 200 workflow-related systems available, this screening is a critical part of the process. One way to help narrow the field is to determine which of the three basic types of workflows you are working with and use that to potentially cut out a large block of prospective systems. The defined types are:[3]

- Sequential workflow (while typically flow chart-based, execution progresses from one stage to the next and does not loop back)
- State machine workflow (progress from state to state, these workflows are more complex and return to a previous point, if required)
- Rules-driven workflow (implemented based on a sequential workflow; the rules dictate the progress of the workflow)

We will now narrow our focus specifically to laboratory operations. Unfortunately, there are additional questions that must be answered, as the functionality required will depend on the type of lab you operate. As a general class, SciWfMSs are designed to handle large volumes of data in multistage simulations in a scalable environment. Pegasus[4] is a good example of such a system. It was first developed in 2001, and since then its capabilities have been extended significantly. A key point of Pegasus is the isolation of the workflow description from the description of the execution environment. This allows the workflow to be portable over a variety of execution environments. It also allows the system to optimize the performance of the workflow for that environment. Other workflow management and supporting systems include Galaxy, DIET, ADAMS, Askalon, Moteur, Kepler, Triana, Nimrod/K, and Makeflow.

Focusing now on chemical and clinical labs, with their respective laboratory information management systems (LIMSs) and laboratory information systems (LISs), a workflow management system has advantages to offer.

Via appropriate queries of the LIMS/LIS database, it has been possible to track the sample workload of the laboratory to aid in budgeting and personnel assignment. However, the initial LIMS products were basically hard-coded with a simple linear workflow. If the laboratory's workflow didn't match this embedded workflow, you were stuck with either paying for modifications to the LIMS program code or coming up with creative use of existing LIMS features.

Today's informatics systems tend to be much more configurable regarding their behavior, but there are still systems where any major modification of behavior still requires customization of their application code. Whenever the latter occurs, best practices require you to revalidate your system. If you are working in a regulated industry, this revalidation is not a suggestion but a requirement.

There are exceptions, but many commercial LIMS/LIS vendors appear to be moving toward product standardization, coupled with extensive configuration capabilities. While this allows you to modify multiple aspects of the system's behavior, permitting the fixed-state workflow model to give the appearance of more flexibility in use, they are still restrictive. This is a situation where site-designed workflows allow you to control the workflow without code modifications. Fortunately, many vendors are also integrating SciWfMS features into their systems as well.

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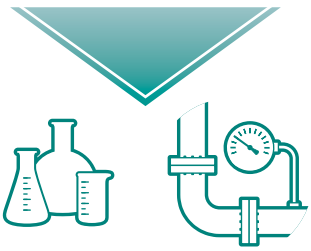

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Benefits of a SciWfMS include:

- Allows the laboratory to define the rounding rules for a specific test, based on client requirement, reducing the number of test versions that must be maintained.
- Allows the laboratory to track analyst certifications for particular instruments and lock them out if their certification has expired.
- Allows the laboratory to track instrument service logs and preventive maintenance, locking the unit out of service if it is past its scheduled preventive maintenance date.
- Allows the system to schedule reflex tests when defined criteria are met. This may mean rerunning the test or scheduling an alternate confirmation test.
- Allows the system to alter test specifications based on the condition of a sample, e.g., alter the limit of detection of the test due to contamination, alter the confidence limits of the results, or switch the test method performed.
- Allows for the alteration of test completion criteria, which would be particularly useful for research laboratories.
- Allows the definition of the criteria to be used to determine the triggering of a status change or a transition between different workflows.

"Many commercial LIMS/LIS vendors appear to be moving toward product standardization, coupled with extensive configuration capabilities."

For an integrated LIMS/SciWfMS, the configuration of the application and the creation of the site-defined workflows should be distinct and separate,[5] reducing potential confusion and simplifying both. For this type of system, a graphical environment for creating, monitoring, and troubleshooting the workflow is preferred for ease of use.

Another point to consider when selecting a system is that LIMS project teams are frequently under severe pressure to get the system installed, tested, and operational as soon as possible. To help reduce this stress, it is wise to ensure that the vendor supplies a basic default workflow framework, allowing analysts to use the system while the project team goes back to customize the site-designed workflows for each test.

Pragmatically, you must determine what data types you want the LIMS to manage, beyond samples, analyses, and results. This might include monitoring the expiration dates of standards or reagents, the analysts' certifications, instrument service logs, etc. The system must be config-

ured to capture sufficient data to allow the troubleshooting of all workflows and how samples were handled. This is particularly true in a regulated environment. All changes, whether of data or workflow, should be captured in an audit trail that is secure from modification.

The bottom line is that a workflow management system can enhance your laboratory's operation, no matter what type of lab you have. Whether a contract laboratory, a clinical laboratory, or a genetic laboratory processing mountains of data, a SciWfMS, whether stand-alone or integrated into a LIMS or LIS, can improve the quality of your data, eliminate unnecessary staff operations, and boost productivity.

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Dr. John Joyce *is a laboratory informatics architect based in Richmond, VA. His background includes extensive work in instrument design and automation for industry, as well as engineering the data flows from instruments to and between data systems. He can be reached via email at jrj_sci@yahoo.com or by phone at 804-601-0211.*

A NEW WORLD OF EXPERIMENTATION

MODELS AND SIMULATIONS CONTINUE TO CONNECT THE REAL LAB SPACE WITH THE VIRTUAL WORLD

By Rachel Muenz

Not too far off from now, lab managers could be overseeing mostly digital experiments as models and simulations continue to become more commonplace in the lab, replacing lab animals, human test subjects, and complicated experimental apparatus. According to Dassault Systèmes CEO Bernard Charlès, such digitalization will mean big changes for everyday lab activities down the road.

"First of all, a science-based industry, like any other industry in the economy, is going to leverage digitalization more and more," Charlès said at Dassault Systèmes' BIOVIA Community Conference held in Orlando in May. He added that the average life cycle of lab instruments is about 15 years, and most often they are connected to PCs. "The PC is more part of the instrument than part of the IT infrastructure. If you think about it very long term, those [instruments] will probably become [part of] the Internet of Things (IoT). I think this entire area of lab activities is going to go through a significant evolution with digitalization to connect a virtual thing with the real experiment."

> "A science-based industry, like any other industry in the economy, is going to leverage digitalization more and more."

Currently, many sectors are moving toward using more modeling and simulations in their labs, and Charlès says he expects that trend to continue, with increasing importance being put on the ability to evaluate and predict everything from how well a car design will stand up in a crash to how a new drug will affect a human being.

"The future of your companies will only come about if you're able to evaluate and predict with the digital twin," Charlès told an audience of BIOVIA end users during his opening remarks at the conference.

That "digital twin" is essentially a virtual model that acts the same as a real-life process or object. In fact, Dassault Systèmes was the first software company to demonstrate the concept 20 years ago in a partnership with Boeing, which designed its 747 airplane based solely on a virtual model, rather than through a physical prototype, for the first time in history.

"Lab managers will face a fantastic turn here," said BIOVIA's Reza Sadeghi, regarding the impact such digital twins will have in the lab. "Computers are now fast enough and the algorithms are now correct enough for the materials [that it's possible] to replace equipment with a digital equivalent."

Such replacement is already happening. However, Sadeghi says he doesn't expect all lab equipment to vanish.

"Very, very arcane equipment is being replaced," he said. "Of course, new equipment will be coming in. I'm not suggesting equipment will go away [completely], but the analogy of the digital twin extends to equipment that sits in the lab as well."

Lab manager in the middle

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their organizations and with outside organizations, but they will also make lab managers' work more visible.

"In companies, the labs' activities are kind of specialized, dedicated to certain domains," Charlès explained. "The more they digitalize their experiences, the more the value of what they do becomes visible to others."

He adds that instead of sharing a written report with colleagues, lab managers will now share the digital twin of the work they've been doing, which other departments can then apply to their own processes.

"It's a completely new game plan for lab managers," he said. "I think it will be exciting for labs."

Modeling and simulations, along with digital platforms that are consistent across different departments and instruments, will also continue to open up what lab managers can do and connect them with other kinds of labs, Charlès said.

"When you add physical labs onto virtual labs, you can do much more."

"Today the labs are very isolated in terms of experimentation depending on which materials [they work with]…whether it's an electronic lab or an electromagnetic lab or a materials lab, a bio lab—they are all siloes," he said. "But I think with [a consistent digital platform], many specialized lab experiences will become connected to others, [becoming] what is called a 'metaphysic' environment. When you add physical labs onto virtual labs, you can do much more."

Such technology and virtual models will also make science more attractive to potential lab managers as well, Charlès added.

"With the new generation coming out of school, they like to have modernized modeling and simulation in the labs—they don't want to only have instrumentation connected to a PC," he said. "They want a new world. I think that will increase the value and the interest of new generations to be part of that community."

An example of this can be seen in fabrication labs, also known as "fab labs," where engineering students, instead of just designing something and passing it off to someone else to build, are now making their designs themselves through 3-D printing.

"They want to do 3-D printing themselves. They want to do laser cutting themselves. Why? Because it's digitally driven," Charlès said. "I think that in the lab, things will happen in a similar way."

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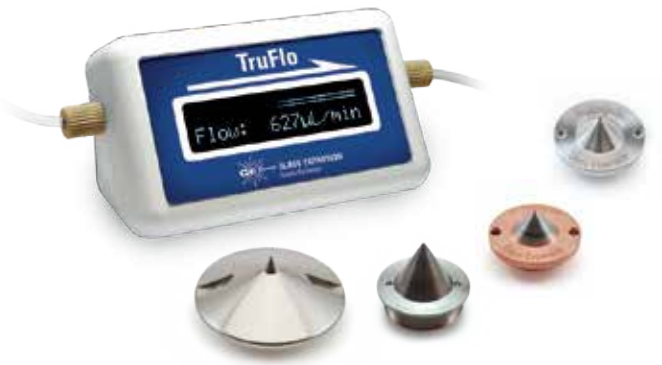

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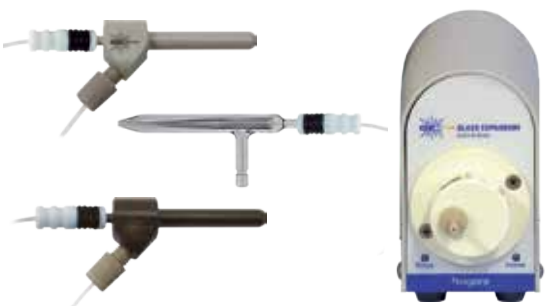

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Cost cutting and collaboration

With experimentation going digital, both Charlès and Sadeghi expect labs' costs will go down. Better collaboration will also help lessen the impact on lab managers' budgets. A large pharmaceutical company with many types of laboratories, for example, would realize huge savings just by having the ability for all of those labs to work together instead of as separate entities.

"That consolidation in terms of savings, cycle time savings, error-capture reduction savings, and cost savings is enormous," Sadeghi said.

> "Better collaboration will also help lessen the impact on lab managers' budgets."

Charlès added that he expects many testing labs will become certification labs in the future.

"There is a big difference between testing and certifying," he said. "It's a new world when you have to certify, because when you have to certify, you have to prove. When you test, you just have to provide the characteristics of the test and that's it."

With the increased collaboration of the future, lab managers and their colleagues will be able to tackle the big problems the world faces like never before.

"We do know that, going forward, innovation cannot be the extrapolation of what was done in the past," Charlès said. "[Researchers] will have to find and create new types of solutions, which are maybe inspired by nature, in biomimicry, inspired by biomaterials science more than the physical materials. The scope of what has to be done in these future labs has nothing to do with what it is today. This multidisciplinary aspect is going to be a real competitive advantage."

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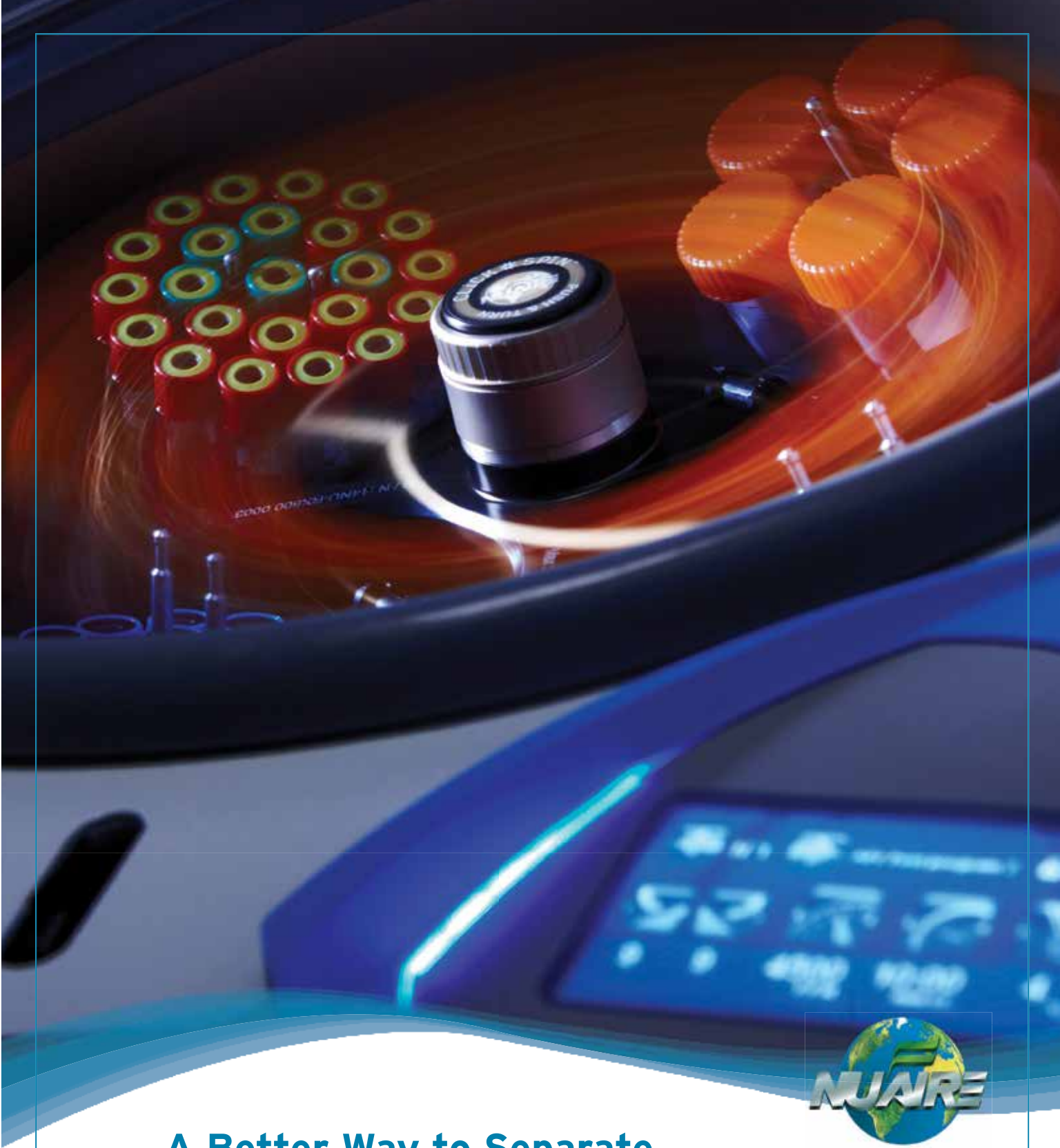
OTHER THOUGHTS ON DIGITALIZATION FROM THE CONFERENCE:

The Big Picture of the Lab—Where the Vision Becomes Real

During this talk, BIOVIA's John McCarthy and Stan Piper discussed the common set of problems affecting all industries they serve as well as the key differences among them. Two key solutions for all industries (such as pharmaceutical, chemical, life sciences, energy, and consumer goods) are collaboration and the predictive side of things with simulation and modeling. Sustainability is also affecting both the consumer goods and energy industries. "As long as there's been business, there's been business transformation," Piper said. "How can we do that smarter?" One way is through doing fewer experiments and testing less, and instead using digital twins to gain new insights and figure out why something—whether it's a new drug or laundry detergent—is or isn't working. Industries are now also looking at things in a bigger picture way, from beginning to end. "The dreams that your executives have, you are making possible," McCarthy told end users at the talk. "You are showing us how you want to transform your industries, and we are creating the means for doing so."



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PREVENTING CONTAMINATION IN PIPETTING

UNDERSTANDING PIPETTE CONTAMINATION TYPES IS KEY

Preventing contamination in pipetting is paramount to achieving reliable results. It requires identification of the potential contamination mechanisms so that they can all be addressed.

Aerosols, suspensions of solid or liquid particles in a gas, are formed in many laboratory activities such as pipetting with air-displacement pipettes, and aerosols are the major contamination source in pipetting. They may transfer into the pipette body when unfiltered pipette tips are used and consequently contaminate subsequent samples. A slow and careful pipetting rhythm helps minimize aerosol formation.

This article addresses the three contamination types that originate from pipetting: pipette-to-sample contamination, sample-to-pipette contamination, and sample-to-sample contamination.

Pipette-to-sample contamination

This type of contamination occurs when a contaminated pipette or pipette tip contaminates the sample.

Pipette tips are available in multiple purity grades from most manufacturers. Purity grades can be divided into three categories:

- no purity certification
- certified free of contaminants like DNase, RNase, and endotoxins
- sterilized to be free of microbial life

Contaminants such as DNase, RNase, and endotoxins are difficult to remove by any sterilization method, so it is very important to prevent contamination during manufacturing. The absence of these contaminants is separately tested, usually by a third-party laboratory. Sterilization after manufacturing ensures that the tips do not contain any microbial life (bacteria, viruses etc.) when delivered to customers.

Pipette tips can also be a potential source of leachables—trace amounts of chemicals originating from materials or the process equipment that can contaminate the samples. Examples of potential leachables are heavy metals, UV stabilizers, antioxidants, pigments, release agents, biocides, and surfactants. High quality tips manufactured from 100 percent virgin polypropylene in a high quality manufacturing facility do not contain leachables. It is recommended that you confirm this with the tip manufacturer.

In daily laboratory work, pipette-to-sample contamination can be avoided by following these simple guidelines:

- Select a tip with the relevant purity class for your application.
- Use (sterilized) filter tips or positive displacement tips. Alternatively, you may be able to use tip-cone filters with some manufacturers' pipettes. The filters prevent aerosols from reaching the pipette body and potentially contaminating subsequent samples.
- Always change the pipette tip after each sample.
- Regularly autoclave, or disinfect, the pipette or the components that may come into contact with the sample.

Sample-to-pipette contamination

This type of contamination takes place when the pipetted liquid or aerosol particles from it enter the pipette body. To minimize the risk of sample-to-pipette contamination, the following precautions are recommended:

- Always release the pipette's push button slowly to prevent aerosol formation and uncontrolled liquid splashing within the pipette tip.

- Hold the pipette in a vertical position during pipetting and store the pipette in an upright position. This prevents liquids from running into the pipette body.
- Use filter tips or positive displacement tips to prevent aerosol transfer from the sample into the pipette body. Alternatively, filters can be used on pipette tip cones.

Sample-to-sample contamination

Sample-to-sample contamination (or carry-over contamination) occurs when aerosol or liquid residue from one sample is carried over to the next sample. This may take place, for example, when the same pipette tips are used multiple times. To avoid carry-over contamination:

- Use filter tips or positive displacement tips to prevent aerosol transfer from the sample into the pipette body, and again to the next sample. Alternatively, filters can be used on pipette tip cones.
- Always change the pipette tip after each sample.
- If you suspect pipette contamination, autoclave or disinfect the pipette according to the manufacturer's instructions.

Definitions

Decontamination: Any activity that reduces microbial load to prevent contamination. Includes methods for sterilization, disinfection, and antisepsis.

Sterilization: The destruction of all microbial life, including bacterial endospores. Can be accomplished using steam, heating, chemicals, or radiation.

Autoclaving: Autoclaving (moist heat) is an efficient sterilization method for laboratories. A hot, pressurized, and saturated steam is applied to destroy microorganisms and decontaminate e.g. laboratory plastic and glassware. Exposure time and temperature are critical. Moreover, the steam needs to penetrate through the entire load to be efficient.

Disinfection: The elimination of virtually all pathogenic microorganisms (excluding bacterial endospores) and reduction of the microbial contamination to an acceptable level.

A practical method for surface decontamination. The disinfectant (e.g. alcohols, phenolic compounds, halogens), concentration, and exposure time should be selected according to the assumed contamination type.

Antisepsis: The application of an antimicrobial chemical to living tissue to destroy microorganisms.

DNase: Powerful enzymes (nucleases) that degrade DNA by hydrolyzing it into short fragments. Even trace amounts of DNases can lead to low or no yields in DNA techniques such as PCR, or to degradation during DNA purification. Contamination sources: human contact, saliva, bacteria.

RNase: Powerful enzymes (nucleases) that catalyze the degradation of RNA into short fragments. Very stable enzymes that are difficult to remove. Contamination sources: oils from skin, as well as hair, tears, bacteria.

Endotoxins: Lipopolysaccharides, large molecules that are part of the outer membrane of Gram-negative bacteria such as E. coli, Salmonella, Shigella, Pseudomonas, and Haemophilus. Cause fever in humans and impair the growth of cell cultures. Are released into the environment when bacteria die and the cell wall is destroyed. Contamination sources: endotoxins are present wherever bacteria are able to grow, i.e. air, water, soil, skin, raw materials, any non-sterile environment.

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OUTSIDE EXPERTISE

CHOOSING THE BEST HEALTH AND SAFETY CONSULTANT FOR YOUR LAB

by Vince McLeod

You might feel that finding and selecting a qualified and appropriate consultant for health and safety issues is like a trip to Las Vegas and a pull on the slots. Admittedly, there are many factors to consider when choosing a professional consultant. For example, you should consider appropriate professional certifications (especially if there is the potential for litigation, as one must have recognized credentials to be viewed as an expert), request demonstration of experience and knowledge through a project portfolio and references from past customers, evaluate past experience with your organization, and determine the cost for services.

Before choosing a consultant, you must first define the problem or project and its scope as thoroughly as possible. If you are vague about why you want the consultant and what you specifically need from him or her, the consultant will have difficulty addressing your concerns. A consultant can answer many questions and do it thoroughly for a reasonable cost. But without good project definition, he or she may never address the issue you are really interested in.

First consider the nature of your problem or project. Is it general in nature or related to a specific issue? Many safety professionals have expertise in several different industries. Some will have great depth and a very narrow focus; others will have a more comprehensive breadth of experience in a variety of settings. If general health and safety concerns exist, you are often best served by looking for a consultant with appropriate credentials and experience in your specific industry. You probably don't want to instruct the consultant on industry basics and be charged for the time to come up to speed on fundamental aspects. In addition, issues may be overlooked because of the consultant's lack of understanding of the industry. The person simply may not know what questions to ask. However, if there is a specific issue—say, a high frequency of back injuries—then the specific need for ergonomics expertise will often outweigh the need for general laboratory knowledge.

> "Many safety professionals have expertise in several different industries."

We have also seen various types of arrangements for the use of consultants. Everyone is familiar with using consultants for specific issues. For smaller companies or institutions where responsibility for health and safety is a collateral duty for an individual or committee—or even a full-time job for a single individual—it can be very helpful to have someone to consult on questions or proposed actions. We have seen successful arrangements with a professional consultant being kept on retainer for two or three hours a month. The company gets free access for inquiries and opinions, or that person acts as a sounding board for bouncing health and safety ideas and concerns off of. The consultant might even be included as a member of a safety committee. If a large special issue comes up that would require much more time, then hours would be billed on a project-specific basis. This often works well because the consultant almost becomes a part of the facility and quite familiar with all aspects of the operation. Further, the consultant can develop a sense of ownership in the company. One of the downfalls is occasionally an unethical consultant might "fish" for work and push projects or concerns that are minimally valid. You must have someone you can trust and work with openly.

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We feel it is important to work with consultants who have recognized professional credentials. The major health and safety certification organizations establish minimum standards of expertise, require continuing education, and have codes of ethics under which certified individuals must practice. The most widely recognized health and safety certifications are Certified Industrial Hygienist (CIH)[1] and Certified Safety Professional (CSP).[2] Many will accurately surmise what a CSP deals with, as the name makes it self-evident. The CSP is a well-respected certification with a proven record in the safety arena. However, we are often asked what an industrial hygienist does. The primary mission of the CIH is to protect the health and well-being of people in the workplace from chemical, microbiological, and physical health hazards. Since we think industrial hygienists certified in comprehensive practice are perhaps the best all-around health and safety practitioners for laboratory and research settings, we will focus our discussion there for our example of a certification program.

The CIH certification is granted by the American Board of Industrial Hygiene (ABIH).[1] It requires:

- A bachelor's or advanced college degree in the sciences or engineering
- A minimum of five years of full-time professional, broad-based experience in health and safety
- Adherence to a strict code of ethics
- Continuing practice and ongoing professional education
- Successful completion of two full days of written examinations

The exams cover 16 different subject areas, including these topics of most interest in laboratory settings: biohazards; engineering and non-engineering controls (e.g., ventilation, personal protective equipment); ergonomics; ethics and management; sampling, monitoring, and instrumentation; noise; ionizing and nonionizing radiation; safety and health regulations, standards, and guidelines; thermal stressors; toxicology; and general topics, including hazardous waste, chemical safety, risk communication, and indoor environmental quality.

As you can see, the benefit of choosing a consultant with certification is that you will work with an individual who is screened and approved by examination, who has applied practical knowledge in the field, and who is on top of current issues and developments through continuing education.

As we mentioned above, if you have specific or complex issues such as licensing for radioisotope use, review of animal use protocols involving potentially infectious agents, or design of an air-handling system for containment of contaminants, specialty consultants in a field such as health physics, biosafety, or engineering should probably be used. The American Biological Safety Association (ABSA),[3] the American Board of Health Physics (ABHP),[4] and the Board of Certified Safety Professionals (BCSP) all have credentialing similar to that of the ABIH. You should

be assured of getting a generally qualified consultant if the person is certified by one of these organizations. A professional engineer (PE) is important for design work. Unlike for the national certifications above, individual state engineering licensure boards regulate the licensed practice of engineering within a state. In all cases, however, passing a written exam and having years of professional-level experience are required to obtain the PE designation. PEs take legal responsibility for their engineering designs and are also bound by a code of ethics to protect public health and safety.

It is a good idea to check references and contact colleagues who may have worked with someone you are considering. Also, try to get firsthand feedback from other customers who have used that consultant.

There are more health and safety consultants out there than you can shake a stick at. Many are very good; some are not. Accurately defining your issue initially and then pursuing a properly credentialed consultant can go a long way toward ensuring a successful outcome that meets your needs.

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American Conference of Governmental Industrial Hygienists (ACGIH®). Cincinnati, OH. http://www.acgih.org/

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INSIGHTS ON CELL CULTURE

THE CASE FOR PRIMARY CELLS

by Angelo DePalma, PhD

For decades, immortalized cell lines have performed admirably in cell-based assays, biomanufacturing, and basic scientific work. "Let's give them due credit," says Daniel Schroen, PhD, a vice president at Cell Applications (San Diego, CA). "They are a mainstay."

Primary cells have similarly been part of life sciences research, and demand for these cells is at an all-time high. Compared with immortalized cells, the key advantages of primary cells are their functional and genetic fidelity.

"The information derived from primary cells is closer to physiologic relevance because these cells lack the genetic changes that allow indefinite in vitro cultivation," Schroen adds.

Primary cells present challenges, however. Their supply is limited, they are difficult to acquire and isolate, they are intolerant to all but very narrow culture conditions, and they don't last long: Primary cells offer at most 15 to 20 passages, or doublings, before they die out, whereas immortalized cell lines go on forever. However, these issues are usually manageable with careful optimization of isolation and culture methods, media, and nutrient feeds.

SPECIALIZED FUNCTION, SPECIALIZED CONDITIONS

Because primary cells are highly specialized, they require individualized environmental and nutritive conditions for optimal growth and maintenance of the desired phenotype. This is typically achieved through application of specific growth media, supplements, and extracellular matrices or other application-specific conditions. "The goal is to preserve the cells' original functionality," says Robert Newman, PhD, director of R&D for ATCC Cell Systems (Manassas, VA).

In carrying out their specialized activities, primary cells have distinctive receptors, enzymes, and signaling pathways that work through unique triggering mechanisms that are absent in non-primary cells. Thus nearly every vendor of primary cells also offers precisely defined media formulations for specific cell lines, e.g., fibroblasts, or kidney or endothelial cells. As with immortalized cells used in biomanufacturing, where the goal is achieving higher protein titers, media formulations for primary cells are optimized by component to achieve in vitro fidelity to their in vivo phenotype.

The finite life of primary cultures recapitulates what occurs in vivo, where cells differentiate, take on their specialized functions, and stop reproducing. Senescence is a complicated process. "Certain signaling pathways cause terminally differentiated cells to stop replicating in the body," Newman says. "When you put those cells into culture, they follow a similar trajectory toward senescence. That's typical for differentiated cells but not for primitive cells, which are at the opposite end of the spectrum with respect to proliferation."

Some primary cells, such as terminally differentiated hepatocytes and neurons, are post-mitotic, and under normal circumstances do not proliferate at all, either in vivo or in culture. While liver tissues repair themselves in vivo, these processes appear to be mediated by resident stem cells and complex triggering signals. Cultured primary hepatocytes barely last for one week without highly specialized media formulations.

TESTING GROUND

Pharmaceutical companies increasingly rely on primary cells throughout research and development. Some isolate and culture the cells on their own, but many turn to companies like Cell Applications for fully authenticated, ready-to-use cells. Cell line

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authentication has become a huge issue with journals and funding agencies, and companies with isolation expertise usually lack the tools to prove their cells are what they claim them to be.

Pharmaceutical drug discovery has become a key testing ground for many advances in the life sciences, and primary cells are no exception. Primary cells are used during very early compound screening through initial low-throughput, low-content assays. "This is when companies are looking for hits that are physiologically relevant," Schroen explains. Primary cells may be used alone or to complement testing in immortalized cells. Later, as screening activity picks up and for practical reasons, companies turn to immortalized cells that respond similarly to primary cells, usually through high-throughput screening. After this phase, they often return to primary cells to fine-tune compound evaluation or to evaluate in vitro efficacy and toxicology.

At this stage companies are particularly interested in three-dimensional primary cell constructs formed either through bio-printing or by physically layering cells onto a suitable matrix. Cell Applications is one of several companies that offer such 3-D cell models (for a more complete treatment of 3-D cell culture see *Lab Manager*, September 2015). Due to their structure and more natural cell-cell interactions, 3-D cultures often supplement 2-D or suspension cultures with additional physiological relevance and data. They also significantly reduce the costs, lengthy time requirements, and potential ethical concerns of animal testing.

Cell Applications has developed a layered 3-D human cell model for skin, where human epidermal keratinocytes differentiate into a stratified squamous epithelium-like construct. Their 3-D airway model consists of human bronchial epithelial cells that form a pseudostratified epithelium. The former is of great interest to pharmaceutical and cosmetics companies, offering an in vitro system for studying wound healing, UV damage, and the absorption, penetration, metabolism, and toxicology of topical agents. The company's bronchial cell products are used to study potential treatments for airway infection, lung injury, mechanical and oxidative stress, inflammation, pulmonary diseases, and smoking.

Because of the complexity of a typical organ, its need for blood vessels, and the sheer number and diversity of functional cell types, Schroen believes it will be a challenge for 3-D bio-printing companies to develop large, fully functional organs

like a kidney or liver. However, he does see the benefits of using what amount to smaller, printed tissue components for pharmaceutical drug and cytotoxicity screening. The foreseeable future could also move three-dimensional cell printing into the clinical realm, for instance with tissues to repair blood vessels or skin, or someday even replace diseased structures within major organs.

ACQUIRING PRIMARY CELLS

"There's a significant learning curve involved in acquiring primary cells, and the process is time- and resource-intensive," Schroen tells *Lab Manager*. Each major primary cell type requires unique isolation and purification protocols. Moreover, somatic primary cell lines show varying susceptibilities to their physical and chemical environments, to enzymes, mechanical disruption, or agitation. By contrast, immortalized cells are relatively hardy, typically thriving in standard off-the-shelf media.

> "Cell line authentication has become a huge issue with journals and funding agencies."

Before releasing a new cell, Cell Applications undertakes an optimization process to assess which media components produce the most desirable cell performance, which, depending on the cell type, can include cell viability, morphology, population doublings, cell surface marker expression, or cell signaling cascades. Some cells will not grow outside of serum-based media, while others do much better in animal-component-free or chemically defined media. Human primary cells have traditionally been obtained in collaboration with research hospitals or tissue banks from surgical excisions, and from post-mortem organ and tissue donations. Nonhuman tissues are sourced primarily from in-house animal facilities, companies that raise animals specifically for research purposes, or carefully monitored animal processing facilities. All tissues, whether animal or human, carry detailed donor information such as age and sex, while the human donor profiles also include ethnicity, any diseases or pathologies, medications taken, and cause of death. It's important with primary cells to have available different lots, for example certain ethnicities, tissues, age, and disease status. "If we get a very narrow request, we can tap into our resources to obtain those cells," Schroen says. "Some pharmaceutical companies request one donor but four or five different tissues; others request a single cell type from multiple donors of different backgrounds."

STEM CELLS: NOT QUITE THERE YET

The potential of stem cells to retain multi-lineage potential and proliferate extensively in vitro provides new avenues for cell-based therapy

in the restoration of damaged or diseased tissue. Stem cells, particularly induced pluripotent stem cells (iPSCs), are also a potential source of primary cells. Cell Applications has a special interest in iPSCs through their work with iPSC discoverer Shinya Yamanaka, who won a 2012 Nobel Prize for his work. In this case, CAI supplied Dr. Yamanaka's team with human dermal fibroblasts (skin cells), which they coaxed back into a pluripotent state, forming a potential source of primary human cells of nearly unlimited number and cell type. Bone marrow stromal cells, also known as mesenchymal stem cells, can produce bone, cartilage, and fat cells, as well as neuronal and hepatocyte lineages. Multipotent neural stem cells differentiate into neurons, astrocytes, and oligodendrocytes that make up the central nervous system.

This raises the question of the potential for using stem cells, in particular iPSCs, as starting points for generating primary cells. Compared with tissue harvesting, iPSCs have the advantage of a nearly endless supply. They may be expanded to large numbers and stored cryogenically for future expansion or differentiation. "You can control for donor-to-donor genetic variability within a large set of experiments if you can generate larger banks of cells from the same source," Newman explains.

But iPSC-derived primary cells are not quite identical to mature cells harvested from living tissue. Harvested cells tend to retain their native phenotype in culture, albeit for short periods of time, and behave similarly to cells in vivo. Cell-based drug or toxicology assays based on them more closely represent what occurs in intact organisms. "They already possess their fully functional activity," Newman adds.

Since iPSCs were first reported in 2006, biologists have identified conditions, including growth factors and media, that cause iPSCs to differentiate into dozens of cell types. Performance of these cells in assays has been mixed, however, because the cells, while resembling skin, kidney, or heart cells in overt aspects, often do not replicate the behavior of fully mature, differentiated cells.

"Equivalence of iPSC-derived cells to mature in vivo cells varies," Newman explains. "iPSC-derived terminally differentiated cells do not capture the entire mature phenotype of primary cells. You can make hepatocyte-like cells, or cardiomyocyte-type cells, but they usually exhibit functional features of less mature cells."

Interestingly, the success of iPSCs in preclinical regenerative medicine studies results from their achieving fully differentiated status when introduced to their familiar biological niche. "We haven't yet identified all the factors that trigger full differentiation in vitro," Newman notes. "I'm confident that future advances in substrates and media will help solve this problem, and create powerful, robust in vitro assay tools."

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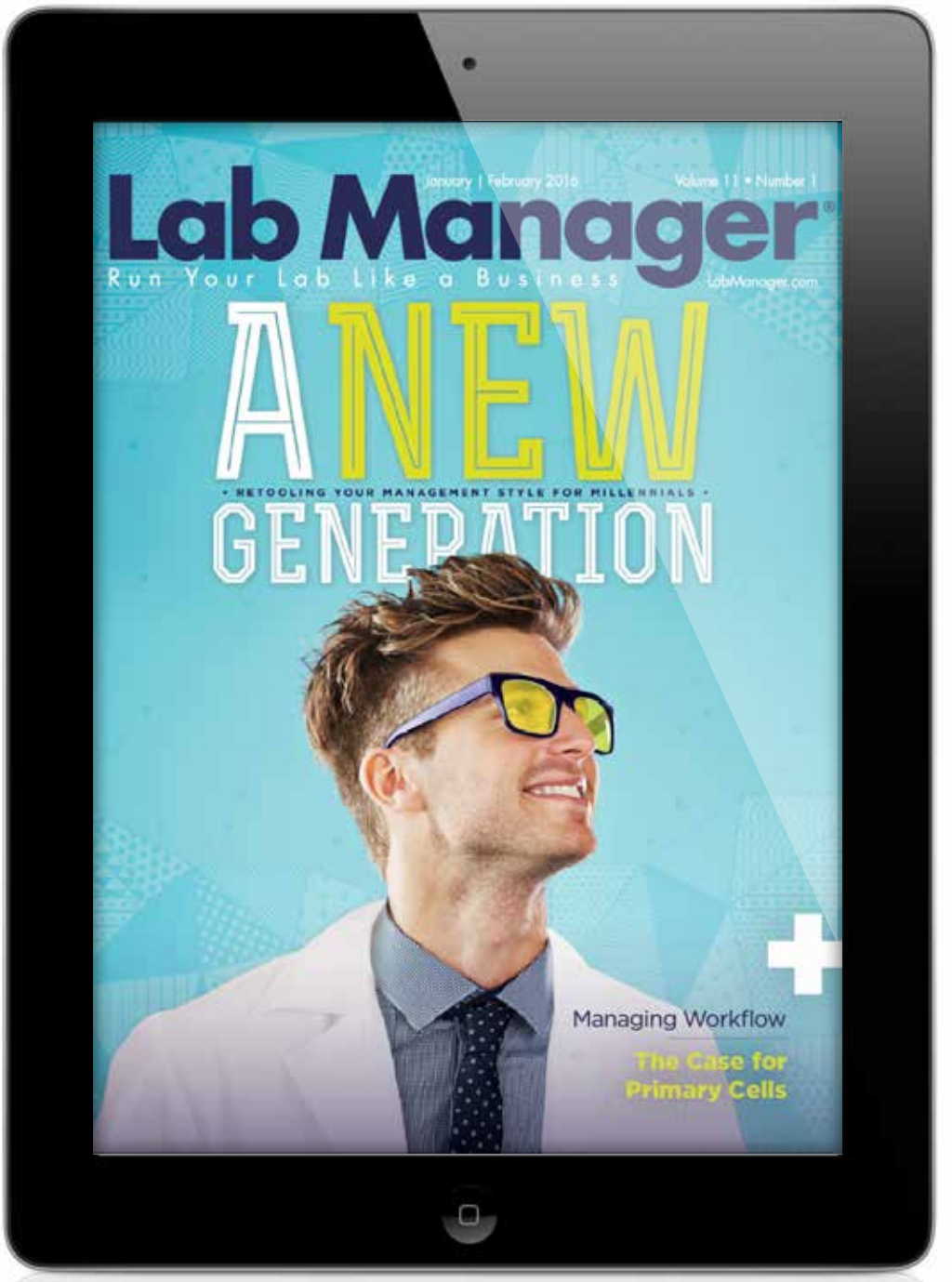

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INSIGHTS ON FOOD AND BEVERAGE SCREENING

BEYOND SPEED, THESE TECHNOLOGIES MUST BE ACCURATE AND VERSATILE

by Mike May, PhD

To feed the world safe and consistent foods and beverages, companies need increasingly fast ways to screen products from start to finish. As Khalil Divan, senior director of food and beverage at Thermo Fisher Scientific in Waltham, Massachusetts, says, "Changes being implemented by regulatory agencies are making high-throughput analysis quite prevalent." For example, the U.S. Food and Drug Administration (FDA) oversees the Food Safety Modernization Act, which the FDA website describes as "the most sweeping reform of our food safety laws in more than 70 years, [and it] aims to ensure the U.S. food supply is safe by shifting the focus from responding to contamination to preventing it." To keep up with the required throughput, the technology must analyze samples fast, and it must work with samples at various stages.

The need for high-throughput screening often starts with raw ingredients, which is the first step for some companies in the food and beverage industry. "When the food industry buys raw ingredients, they want to make sure that it's the right product—not contaminated, not adulterated," Divan says. "Companies want to test the ingredients very quickly to not hold up the process. So high-throughput and fast analyses are very important at the initial stage of the process."

The testing of foods, though, goes on throughout the process. "Plants are producing thousands of products every day, and as the products are being developed they want to make sure everything is going according to the protocol," Divan explains. "So they do spot [tests on] samples during the process." These analyses must also be performed quickly, because the production line can't slow down to wait for results from the quality control department.

Food companies deal with thousands of products in high volumes, as shown on the production line for Carnation products. (Image courtesy of Nestlé.)

MEETING THE DEMAND

To test a higher number of samples or to test samples at more points during processing, companies need faster forms of analysis, but speed is not the only factor. "The current technology that people have needs to be updated and also capable of doing fast analyses with ultra-precision and reproducibility," Divan explains.

To gain speed, a company could add platforms. To test five times faster, for instance, a company could use five times the number of analytical platforms that it currently uses. Some companies might take that approach, but others might not. With the added platforms, says Divan, "the investment becomes much more of a burden on manufacturers, so they don't want that approach." He adds, "Industry is looking for instrumentation that can fit the cost and throughput balance."

Some scientists look for ways to improve analysis of very specific problems. As an example, scientists at Aix-Marseille Université in Marseille, France, published a method of analyzing wine for the amino acid proline in 96-well plates. In a 2014 issue of *Food Chemistry*, they wrote: "Proline is the most abundant amino acid in wine

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and is an important parameter related to wine characteristics or maturation processes of grape." These scientists developed a simple plate-based assay that could speed up such analyses. As the scientists concluded, the "simplicity of the protocol used, with no need for centrifugation or filtration, organic solvents or high temperature, enables its full implementation in plastic microplates and efficient application for routine analysis of proline in wines."

"In the food industry, there are many applications that require analysis of hundreds of batches of samples, with each sample sometimes being analyzed for several hundred analytes."

EVOLVING ENZYMES

When asked where high-throughput screening is used frequently in the food and beverage industry, Natalia Lysaya, global product manager, bioproduct development business at Molecular Devices in Sunnyvale, California, says, "One of the applications is enzyme evolution." This field aims to uncover rare bacterial or yeast strains that exhibit desired characteristics induced by directed evolution of enzymatic pathways.

"For example," says Lysaya, "one of our customers uses high-throughput colorimetric screening of yeast colonies to identify rare yeast mutants that display unique colors indicative of improved brewing behavior to produce great-tasting beer." She adds, "Another customer screens bacterial colonies to identify unique bacterial strains that exhibit such favorable properties as speed of acidification, resistance to bacteriophage or yeast, and others to manufacture bacterial cultures for the dairy environment—such as probiotics, yogurt, cheeses—or to uncover enzymes that have an impact on flavor in the wine industry."

This technology, though, requires that many things work together. The assay must select for a precise

▲ *Companies can separate samples faster with an ultra-high pressure liquid chromatography system, such as the Vanquish UHPLC. (Image courtesy of Thermo Fisher Scientific.)*

bacterial strain for the purpose at hand. In addition, the process must work with large amounts of bacterial samples and process them in an automated fashion. To provide those features, Molecular Devices developed its QPix 400 systems. Lysaya describes these as "industry-proved microbial picking solutions—over 600 systems installed worldwide—that are ultra-fast, compatible with automation, and offer advanced imaging and picking capabilities ensuring that the right colony is picked every time." This platform can pick up to 3,000 bacterial colonies in an hour.

QUICKER CHROMATOGRAPHY

To sort samples for analysis, food and beverage companies often use various forms of chromatography and detection, such as fluorescent detectors or mass spectrometry (MS). In some ways, speeding up some forms of chromatography seems easy enough. With liquid chromatography (LC), for instance, just increase the flow rate and the peaks come out quicker, right? Yes, but it's not as straightforward as it sounds.

As Divan explains, "When you increase the flow rate, the column generates back pressure. So you need a system that can run at high pressure, and the column technology has to be compatible with that high pressure." In addition, the faster flow rate can make peaks harder to resolve. To meet such demands, Thermo Fisher Scientific developed its

Vanquish UHPLC (ultra-high pressure LC) system, which works with the Accucore Vanquish C18 UHPLC column, which uses 1.5-micron solid-core particles. "This system can run at 15,000 pounds per square inch," Divan says. "The combination of the instrument, high-pressure pumping technology, high-pressure columns, and a detector system that can take the high-pressure outlet opens up a new area for speeding up LC."

As an example of the increased throughput of analysis with high-pressure LC, Divan describes an application that measures the sweeteners in beverages. Using the Vanquish, a customer reduced the analysis time from ten to 1.5 minutes.

This industry, though, uses more than LC. To analyze inorganic elements in foods or beverages, many companies use ion chromatography. Higher pressures also speed up this technology. For that, Thermo Fisher Scientific developed its ICS-5000 platforms.

For both of these types of chromatography, according to Divan, "our advances in pumping and column technology provide higher reproducibility than any instrument that we've produced in the past."

ANALYZING WHAT'S DETECTED

"In the food industry, there are many applications that require analysis of hundreds of batches of samples, with each sample sometimes being analyzed for several hundred analytes," says Sharanya Reddy, strategic applications team lead at PerkinElmer in Shelton, Connecticut. "Take the example of pesticide analysis in food; several hundred pesticides are synthesized and used worldwide." Governments create pesticide guidelines for the import and export of raw and processed foods. Running all of the required tests can create large amounts of data. "The users spend close to 70 percent of their time analyzing the data in the post-acquisition environment, and the post-processing software can often be the bottleneck for providing fast analysis of such large batches of data," Reddy says.

When it comes to dealing with pesticides in foods, PerkinElmer provides a fast and accurate solution with its AxION 2 TOF. This time-of-flight MS, says Reddy, "has both high mass resolution and high mass accuracy for comprehensive screening of pesticides."

This MS also comes with AxION Solo software, which can be used for high-throughput screening. With this software, "the user can quickly identify the presence or absence of hundreds of pesticides in large batches of samples using an easy-to-read, color-coded scheme," Reddy says. "In addition, the software allows for user-defined area thresholds for peak integration of each analyte for quick visualization of the presence or absence of analytes at or above a

regulatory limit of 10 parts per billion."

If a company wants to use gas chromatography (GC) and MS, one option is PerkinElmer's AxION iQT. Andrew Tyler of PerkinElmer's strategic applications team describes this platform as "a novel hybrid GC/MS/MS system with a fully integrated cold electron ionization source." He adds, "This is a unique ionization source that enhances the molecular ion by reducing the vibrational energy of the molecules prior to ionization." As a result, it can be used with high GC flows. Overall, Tyler says, this platform "allows for analysis

▲ *The AxION 2 mass spectrometer can quickly analyze a food for pesticide residues. (Image courtesy of PerkinElmer.)*

of a wide range of compounds at high speed, making the technology very amenable for high-throughput screening."

Even some unexpected devices can be used to screen foods. At the University of Illinois at Urbana-Champaign, bioengineer Brian Cunningham and his team turned an iPhone 4 into a food scanner by adding a small cradle with a few optical components. The modified phone can test foods for the peanut allergen. Cunningham says, "We have been working to make our system more user-friendly and to make a small cartridge that can contain all the necessary reagents for the test, so a person can perform it easily." Although more work remains, Cunningham says, "I think that an actual product could be fielded in less than a year if there was clearly market interest that could attract resources." This might not be high-throughput by most standards, but for a parent with a child allergic to peanuts, this could be the fastest tool that they need.

The vast variety of samples in the food and beverage industry makes it a challenge to screen them all quickly and accurately. It takes different kinds of technology to make the right analyses and to do it fast enough to meet the requirements of governments around the world.

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Rohan Steel, PhD

ASK THE EXPERT

AUTOMATION TRENDS IN ANALYTICAL LABS

by Rachel Muenz

Rohan Steel, PhD, is a project leader in the Biological Research Unit at Racing Analytical Services, Ltd. (RASL), in Flemington, Australia. RASL is a leading drug testing lab in Australia, performing sports drug testing, workplace drug testing, and sports supplement testing. Before joining the RASL team, Dr. Steel managed the mass spectrometry facility at St Vincent's Institute of Medical Research in Fitzroy, Australia. He studied biochemistry and cell biology at Melbourne University, completing his PhD at the Peter MacCallum Cancer Centre in Melbourne.

Q: Can you tell me a bit more about the work that Racing Analytical Services does and what you and your team are responsible for as part of the Biological Research Unit?

A: The Biological Research Unit has been established to counter the use of novel biological doping agents. To date, these new forms of doping have encompassed protein- and peptide-based drugs but may eventually include gene doping. All this incredible technology is coming out of biomedical research and is designed to improve human health. But at the same time, other people are combing through this technology looking for other applications that can be exploited for commercial profit. There is now an increasingly large grey market for new medical technology that is targeting the performance enhancement, image enhancement, and life extension markets. The Biological Research Unit focuses on how these new technologies apply to the Victorian [Australia] racing industry, but the majority of the commercial activity appears to be focused on human consumption. Because these protein- and peptide-based drugs are completely different [from] the small molecule drugs normally covered by drug testing laboratories, the Biological Research Unit has had to develop a range of new strategies to achieve efficient and cost-effective testing for these agents.

Q: What do you use automation for in your work?

A: Finding athletes [who] are using performance-enhancing drugs is always a process of "looking for the needle in the haystack." In the case of novel biological doping agents, the search is even more challenging. In order to provide effective screening, the largest number of samples needs to be screened for the minimal possible cost. As labor can be the most expensive part of an analysis, the use of laboratory automation is an attractive solution. Racing Analytical Services is investing significant resources in increasing the use of laboratory automation in an effort to improve sample throughput and reduce testing costs. This is a significant challenge, as most of the existing methods have been developed for individual samples handled in glass tubes.

"Developing effective automated systems can be a steep learning curve, and failure is expensive!"

Q: What key trends have you seen in laboratory automation recently?

A: The testing performed by Racing Analytical Services is SPE [solid phase extraction]-intensive. For the past 20 years, the company has run a battery of automated SPE robots running individual 3 ml SPE cartridges. However, the use of 96-well SPE plates would provide a significant improvement in productivity. There have been a number of robotic systems equipped with 96-well vacuum SPE manifolds, but operating these with difficult matrices such as equine urine and plasma can be a challenge due to variations in sample viscosity. A new range of instruments [is] being produced with positive-pressure SPE manifolds that provide much more even flow rates across the plate. We are currently developing our SPE methods on a Hamilton Microlab NIMBUS equipped with a 96-channel pipetting head and a 96-port positive-pressure manifold. The modern robotic systems with sophisticated sensors and graphical programming systems are so capable it is easy to be enthusiastic about their capabilities. The challenge is adapting your extraction methods to meet the requirements of the robotic liquid handling system. In this case, failure may be due to something as

simple as the plastics used in your labware rather than the sophistication of your robotics. Developing effective automated systems can be a steep learning curve, and failure is expensive!

Q: You mentioned that adapting your extraction methods to meet the requirements of the robotic liquid handling system is amajor challenge you face with your automated systems. How are you dealing with that challenge?

A: It is a research and development problem, and even we don't know if we will find all the answers yet. Fortunately, RASL is one of the few drug testing laboratories in Australia that can still afford to have a capable method development capability. So strong investment in method development is the key way we're tackling this challenge.

Q: What important trends do you think your lab will see in automation in the future? Where do things seem to be heading?

A: I think we will see significant automation of the drug testing industry in the next five years, but this is probably more a reflection of the low level of automation that currently exists. Compared to pathology laboratories, drug testing methods are currently labor-intensive. This is partly due to low investment in automated technology but mainly due to the challenges of translating existing methods to automatable formats. Most of the existing drug testing methods in racing laboratories incorporate labor-intensive steps such as pH adjustment and are usually performed in relatively large volumes in glass tubes and reaction vessels. Once the methods have been streamlined, miniaturized, and implemented in a plate format that is compatible with organic solvents and "sticky" drug molecules, I expect we will see greater opportunities for automation.

"Know your extraction method really well and think about how you would perform it from a robot's perspective."

Q: What advice would you have for other lab managers or professionals who are thinking of going automated in their analytical labs?

A: I think the secret to automation success is twofold. First, know your extraction method really well and think about how you would perform it from a robot's perspective. The method has to be automatable and no robot will be as perceptive or responsive to variations in the process as a human operator. Second, be the master of your robot. Vendor companies will provide programming support, but to guarantee success you need at least one staff member who is capable of programming the instrument. Vendors may be experts at programming, but they are unlikely to know your process as intimately as you do.

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

SAMPLE PREPARATION

FOCUS ON CONSUMABLES: SOLID PHASE EXTRACTION

by Angelo DePalma, PhD

Sample preparation—where analyses are made or broken—consumes up to 80 percent of analysis time. Filtration, drying, concentration, dilution, liquid-liquid extraction, protein precipitation, and chromatography have maintained their niches over the years. All involve consumables, be they solvents, membranes, pipettes, resins, sorbents, chemicals, etc. But arguably the preparation technique available in the most relevant formats today, which lends itself to all purification modes and automation, is solid phase extraction (SPE).

SPE serves as the front end to numerous analytic modalities, particularly but not limited to gas and liquid chromatography. In addition to chemical selectivity, SPE provides a general cleanup for raw samples in many industries. Due to the versatility of SPE sorbents, the technique lends itself to all manners of automation, ranging from single-cartridge manual operation through multi-tip pipettes to large robotic workstations. The adaptability of SPE creates a wealth of consumables as well, ranging from the sorbent itself to disks, cartridges, pipette tips, microplates, and ad hoc formats.

Revolutionizing multi-residue analysis

"People want to do the least amount of sample preparation and still get optimum results," says Joan Stevens, PhD, senior applications scientist for sample preparation at Agilent Technologies (Wilmington, DE). That option is available today, she adds, because of the sensitivity and selectivity of today's instrumentation. "Instrument performance is in direct response to monitoring agencies, which have set concentration limits for some residues in the parts-per-billion range. That translates to micrograms per kilogram."

Stevens refers to QuEChERS (quick, easy, cheap, effective, rugged, and safe), a method developed by the U.S. Department of Agriculture for analyzing multiple pesticide residues in agricultural products. QuEChERS dramatically reduced sample preparation times from days to hours. "The simplicity and effectiveness of QuEChERS have revolutionized multi-residue analysis," Stevens notes.

Adoption of QuEChERS spurred development of sample prep consumables and kits, and the method was adapted to nonagricultural products. However, the dSPE (dispersive solid phase extraction) of QuEChERS protocol cannot appreciably remove lipids from higher-lipid-content samples. Pesticides, drug residues, and pollutants, all significant analysis targets, contain lipids, but concentrations are particularly high in the food industry and in clinical biological samples.

Many vendors offer consumables for QuEChERS analysis. Agilent has developed kits and products including dispersive SPE sorbents, extraction salts, analytical standards, and homogenizers. Restek offers Q-sep® QuEChERS extraction salts, a dedicated centrifuge, and internal QC standards, as well as QuEChERS-suitable GC and LC columns. Thermo Fisher Scientific provides dispersive solid-phase extraction cleanup products and QuEChERS sorbents. And from Waters comes the DisQue QuEChERS product line.

"People want to do the least amount of sample preparation and still get optimum results."

Conventional QuEChERS dispersive SPE sorbents could work for those analyses, but for the fact that they do not effectively remove lipids from high-fat samples. Fats overwhelm common methods based on GC- or LC-MS. In August 2015, Agilent introduced a novel lipid-removal sorbent, EMR-Lipid (enhanced matrix removal for lipids), that removes up to 92 percent of lipids from common samples. The nanoparticle sorbent operates through a combination of size exclusion and hydrophobic interaction. EMR-Lipid works with the QuEChERS protocol, and with protein "crash" that reduces protein interferences in food samples.

Protein crash denatures proteins using acetonitrile or methanol, which causes the proteins to form globules that bind to open-pore filters. Beneath this filter is a hydrophobic membrane that retains eluent until this is forced through to a collection plate via vacuum.

Most sample preparation methods have been adapted to convenient, single-use formats. In addition to traditional cartridges and tubes, SPE sorbents are also available as microplates consisting of 96 wells charged with small quantities of sorbent, creating opportunities for high-throughput, automated workflows. Positive pressure or vacuum directs flow of solutions required for conditioning, loading, washing, and elution. Collection occurs through a second plate, placed below the 96-well SPE plate.

"Any sorbent that you can put into a cartridge you can put into a well. Sorbents can even be put into pipette tips," Stevens says.

Automate, automate!

Plates consume fewer resources (solvent, sorbent, sample) per analysis than tubes or cartridges. Automation utilizes human resources more efficiently, reduces operator exposure to solvents, and improves reproducibility, consistency, and sorbent consumable performance. In short, the marriage of SPE and automation—at any level—is a win-win proposition.

Automation may be SPE-dedicated or part of broader liquid-handling capabilities. Waters' Oasis PRiME HLB line of purposed SPE systems multiplexes ten SPE sample runs but requires manual pipetting and manipulation, which is how conventional SPE has operated for years. However, the company claims that its proprietary water-wettable sorbents eliminate conditioning and equilibration steps, which saves considerable time. Oasis is also available in microplate format.

Moving up a notch on the automation ladder, the Biomek® 4000 workstation from Beckman Coulter is enabled for SPE as well as cell staining/culture (including stem cells) and plasmid purification. Climbing several more notches, in September 2015 Tecan entered a co-marketing deal with Phenomenex to adapt the latter firm's Strata-X SPE sorbents to Tecan's Freedom EVO robotic workstations. This implementation is geared toward high-throughput laboratories.

Slow adoption

Solid phase extraction has made inroads into most markets, but its adoption has been slow among environmental analysts outside of methods specifically approved for SPE. "Many of

the drinking water methods and some of the methods in SW-846 mention SPE, but wastewater scientists have been behind the times," says Zoe Grosser, PhD, global marketing manager at Horizon Technology (Salem, NH). SW-846 covers physical and chemical methods for evaluating solid waste. "Because EPA methods are so prescriptive, adopting new technologies and benefiting from their cost-effectiveness is difficult despite a willingness on the part of testing labs to adopt them." Grosser adds that analytical lab profit margins are "thin" and that technologies like SPE could improve their productivity.

For example, SPE could speed up and standardize EPA method 625 ("organic chemical analysis of municipal and industrial wastewater"), which currently involves methylene chloride liquid-liquid extraction of semi-volatile organics followed by gas chromatography-mass spectrometry. Unfortunately the method does not specifically mention SPE as an alternative to liquid extraction. "So labs are reluctant to use SPE because they're afraid that their auditor will cite them for not carrying out the method to the letter," Grosser says.

The American Council of Independent Laboratories and its educational group, the Independent Laboratories Institute, are working with several vendors and the EPA on policy changes that could lead to SPE as an alternative method in EPA 625. So in the long term, Grosser is "optimistic that SPE will be allowed in."

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ARE YOU IN THE MARKET FOR A... TITRATOR?

Modern titrators can be simply classified as one of two types: potentiometric and Karl Fischer, with the latter available in both coulometric and volumetric versions. While titration may be considered a basic analytical method, modern titrators are far from simplistic. Many titrators offer a variety of automation options and can perform titrations with great accuracy with minimal operator intervention. According to this year's survey results, over 82 percent of survey respondents use automated titration in their labs, with fully half of respondents also using an autosampler.

Types of titrator used by survey respondents:

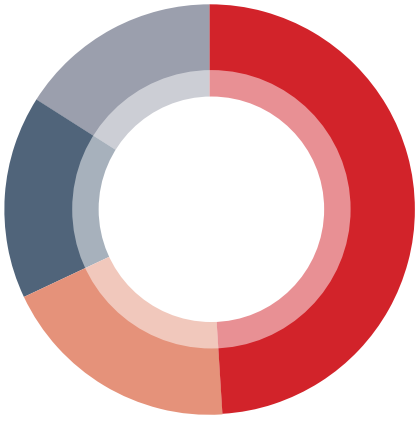
Potentiometric	75%
Karl Fischer Coulometric	29%
Karl Fischer Volumetric	33%
Other	10%

Titrator components used by survey respondents:

Autosampler	71%
Karl Fischer oven	26%
Evaporator	11%
Homogenizer	11%
Other	8%

Nearly 48% of respondents are engaged in purchasing a new titrator. The reasons for these purchases are as follows:

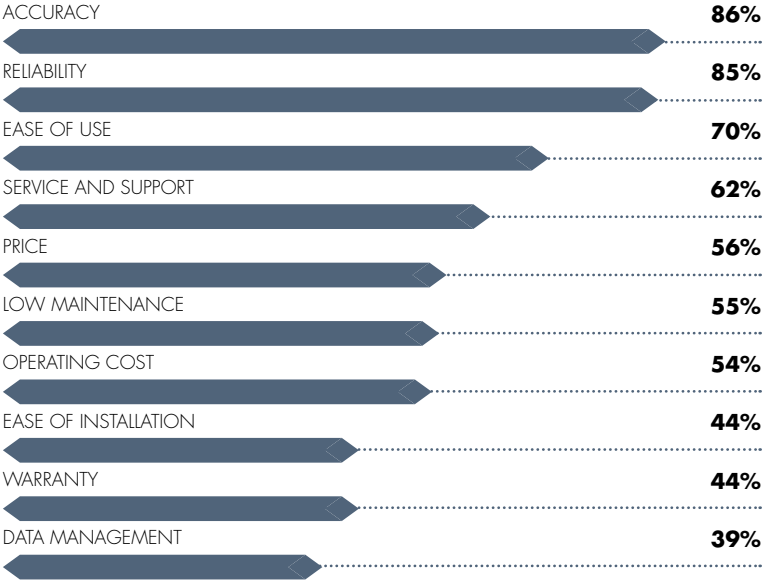
Replacement of an aging system	49%
First time purchase	19%
Addition to existing systems, increase capacity	16%
Setting up a new lab	16%



TOP 6 QUESTIONS
You Should Ask When Buying a Titrator

1. How precise is the titrant delivery system? Is the titrant delivery system certified for accuracy?
2. Can additional titrants be used without having to purge burettes?
3. What information is included in the titrator's display and reports?
4. Is the titrator limited to proprietary electrodes? What is the replacement cost for electrodes?
5. Is the software field upgradeable?
6. What is the service and repair policy?
   - Is on-site support offered?
   - If something goes wrong with the meter, can it be fixed locally?
   - What is the general turnaround time for repair?

TOP 10 FEATURES/FACTORS
Respondents Look for When Purchasing a Titrator



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

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Hanna Automatic Titration System and Autosampler

HI902C Automatic Titrator

The HI902C is an automatic titrator that complements our wide range of products dedicated to efficient and accurate laboratory analysis. The HI902C potentiometric titrator can perform acid/base, redox (ORP), complexometric, precipitation, non-aqueous, argentometric, and ion selective titrations, as well as back titrations and titre determinations. This powerful titrator dispenses the titrant, detects the endpoint, and performs all necessary calculations and graphing automatically. In addition to titration mode, the HI902C also operates as a fully functional pH, mV/ORP, and ion selective electrode (ISE) meter.

HI921 Autosampler

The HI921 autosampler is an automated titration sample handling system designed for use with the HI902C automatic titrator, making titration of multiple samples quick and easy. With the autosampler, up to 18 samples can be run consecutively. The HI921 autosampler interfaces directly with the HI902C to access titration methods. Once a titration method is established, the user can fully customize the automation sequence of their samples. The HI921 can utilize up to three peristaltic pumps for reagent addition, sample leveling, and waste aspiration. It also features stirrer options, status indicator lights, USB interface, and built-in RFID for each tray.

An Improved Experience

Hanna's new software upgrade adds powerful features to both the HI902C and the HI921. The precision dosing system of the HI902C can be programmed to volumetrically add reagent prior to analysis, ensuring consistent results without the chance of operator error. A variety of methods can now be linked to optimize the amount of data that can be taken from a single sample, promoting efficiency and sample conservation. With the HI921, a comprehensive report is generated for an entire batch of samples, proving to be the ultimate option for greater productivity.

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Marina Sirota, PhD

ASK THE EXPERT

ADVANCING BIG DATA SCIENCE

by Tanuja Koppal, PhD

Marina Sirota, PhD, assistant professor at the Institute for Computational Health Sciences at the University of California, San Francisco, talks to contributing editor Tanuja Koppal, PhD, about how she is utilizing big data to address her research questions. She discusses trends in data analysis and tools for data storage and security, and she advises lab managers on how they can tackle some of the challenges associated with big data.

Q: How would you define big data?

A: Over the past couple of decades there has been a lot of data generated using different types of measurements and technologies, such as genomic data, DNA sequencing data, gene expression data, and more. In terms of biomedical science, big data is really a collection of lots of different types of information gathered by measuring various kinds of molecular entities. Another source of big data is electronic medical records. A lot of medical information and records are now provided through computer systems, and that provides another avenue to look at big data. Big data includes a lot of personal information gathered from mobile devices, which includes things like global positioning system (GPS) coordinates or activity levels. Big data is really the intersection of all these diverse types of data and use of the data to ask and answer all sorts of interesting questions. This provides us an opportunity to develop and apply computational techniques to the data, and I am particularly interested in using these tools to ask new questions about diseases. I want to see how we can use these computational methods on very diverse types of data to better understand disease and to develop better diagnostic and therapeutic strategies.

Q: How do you go about asking the right questions so you can get more information from the data that is available?

A: In terms of asking the right questions, you have to first figure out what are the problems or bottlenecks in the field. Then, you have to figure out how to use the data and the data sources that you have to solve those problems. In biomedical science, that may involve reading the literature to find out what questions remain unanswered and what the next steps are. In other areas, it may involve using the data that is available to eliminate a certain bottleneck in a process or analysis. Data-driven approaches can be used to address any kind of question and can be very useful.

Q: How are you using big data to answer the questions you are asking?

A: I can give you an example of a project that I am working on right now that involves studying preterm birth. The idea is to use all different types of data to identify risk factors for individuals who might be at risk for preterm birth. Here we are using genomic approaches to study different populations of individuals who were born preterm versus healthy controls who weren't [in order] to try to identify specific genetic variants that may be associated with preterm birth. In addition, we are also looking at environmental factors that may be contributing to preterm birth. We are trying to pull together genetic and environmental data to see how these factors may interact. In addition, we are also looking at other types of data, such as from microbiome and immune [system] measurements. The idea is to put all these different types of data together to see whether there are any interactions between the contributing risk factors, and whether we can use that to identify the populations that are more at risk for preterm birth.

Q: What challenges do you face when working with big data analysis, and what improvements are you hoping for?

A: There are some challenges in terms of pulling these different types of data together, both when doing the analysis separately for each modality and then pulling the results, and when pulling all the data together first and then doing a comprehensive analysis. For our project, the data is collected on different populations and we try to use the genotype to bring them all together, and there are challenges associated with that. There are certain normalization processes that need to be put in place so that we know what we are finding is real. We also do a lot of validation once we identify certain parameters. Validation is the other challenge, but it is something that has to happen. Computational analysis is a great tool to generate hypotheses, but we have to go back to the biology to understand what is going on, and experimental validation needs to be done.

Q: Can these challenges ever be fully tackled, or are they intrinsic when working with big data?

A: For us, there are challenges with bridging different types of data and when making assumptions, because they are not all collected from the same population. If we can pull data from very well-characterized disease populations, where we have all the genomic data, the electronic medical records, and mobile platform information on a single individual, then we can reduce some of the challenges associated with data analysis and integration. But probably more challenges will arise as we develop new technologies. It's always important to understand the assumptions that come with generating each type of data, regardless of the challenges that exist.

Q: Is it challenging to find and train the people to do the analysis?

A: There are three ways to get into the bioinformatics field. You can start as a biologist and then pick up computer science and programming. You can start as a computer scientist and learn the biology later, or you can start doing both at the same time. It is easier if you can do both at the same time. It is not so common or easy to pick up the computational techniques later. If I were to advise those looking to get into bioinformatics, I would advise them to do both biology and computer science together or get the computational training first. As we generate more data in all different fields, having a statistical or computational background will be very useful.

Q: Are you seeing any trends in the tools available for data analysis or visualization?

A: We do a lot of our analysis using the R statistical software. It's not very difficult to learn, and there have been a lot of methods implemented already. In terms of the machine learning techniques, there is an area called deep learning that is gaining popularity. It has been applied extensively in the field of imaging to perform object recognition using image analysis, and it has been extremely successful. Applications of deep learning in other fields are just starting, and that's something I will be looking out for. We need to understand what kinds of data it can be applied to. It may prove useful for medical imaging and for analyzing genomic and other types of data.

Q: Is there anything to look for in terms of data security or data storage?

A: We are moving a lot of our analysis into the cloud, and that's a trend that will likely continue. There are certainly concerns around data security when it comes to genomic and medical data, but there are groups working specifically on that. Due to the ease of access, more data analysis and storage will likely move to the cloud platform. With more collaborative efforts under way, more people are going to want a cloud-based platform to share data and also their analyses.

Q: Would you recommend the use of open source software?

A: We tend to use a lot of open source software, and the software and methods we develop are also shared and made available to the research community. In terms of the academic community, that's the way forward for sharing data and methodologies. We also do a lot of our analysis on publicly available data. For instance, we regularly use the Gene Expression Omnibus (GEO), which is a database that contains data from over 1.6 million microarray experiments. Whenever a new microarray experiment is published, the data has to be made publicly available through this database. There are many such publicly available databases, and mining all that data is extremely valuable. I strongly believe in open source software, both for analytical methods and for data. When we do our analysis, we use and mix several different approaches on the same dataset. Some include methods that are already well developed, and others we have developed ourselves, and we then look for concordance. Ultimately validation and understanding of the biology are very important for the work that we do.

Q: How would you advise lab managers looking to evaluate and use bioinformatics tools for their work?

A: I would like to stress the importance of thinking about computational methods and learning what questions can be asked and answered using the data that is available to them. There are two ways of looking at it. One is to look at the data and see what types of questions can be addressed using the dataset. Or you can look at the intrinsic problems that exist and find the ones that can be solved using the data that's out there. Start looking at how data science has impacted other fields and see whether you can do the same for your field. Try to think of disruptive technologies in other fields and ways in which your industry can be transformed in similar ways.

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

SHAKERS

SOME PLATFORMS CONTROL THE TEMPERATURE AND RPMS OVER A WIDE RANGE

by Mike May, PhD

Most of today's biology labs need to shake something, and often in a controlled environment. That's a job for a temperature-controlled or incubator shaker. "Incubated/refrigerated shakers are more versatile than open-air orbital shakers," says As Santanu Das from technical product support at VWR International (Radnor, PA). "They offer a wide variety of temperature options including ambient, incubation, and refrigeration." The breadth of experiments and applications that require shaking need this range of temperatures.

As Rick Passanisi, senior product manager at Eppendorf (Enfield, CT), says, "Temperature-controlled shakers are primarily used to culture various cell types, including but not limited to bacteria, insects, yeast, algae, and plant and mammalian cells." He adds, "Orbital shakers operate at a wide variety of temperatures and speeds, creating the optimal environment for the particular cell line that they are growing." The reason for shaking the cells is to get more oxygen to the cell lines, and actually give them just the right amount that they need to grow at their optimal rate.

An eccentric option

In some applications, biologists shake particular cells in very specific ways. As an example, Passanisi says, "The New Brunswick S41i was developed to provide the mammalian cell market with a product that shakes and incubates in a regulated CO_2 environment."

This temperature-controlled shaker provides a variety of key features. For one thing, says Passanisi, a "triple eccentric drive mounted outside of the chamber provides vibration-free shaking without affecting the internal environment." In addition, the user selects a specific temperature, speed, and CO_2 concentration to create the desired environmental conditions for the cells.

Like other chambers used for growing cells, incubator shakers need to be kept clean. The New Brunswick S41i's high-temperature decontamination, says Passanisi, allows the customer to "decontaminate the inside chamber, eliminating the possibility of cross contamination occurring." He also points out that the "seamless chamber provides an internal surface that eliminates a potential source of contamination and makes the chamber exceptionally easy to clean."

In fact, it pays to look for a wide range of features when shopping for a temperature-controlled shaker, and some seem more obvious than others. For example, most users would look for easy decontamination, but what about options that save money? For example, as Passanisi explains, the New Brunswick S41i includes a "sealed inner glass door for viewing the cultures without compromising the sample and environmental integrity." He adds that this "also helps to reduce costly CO_2 consumption." So sometimes you can gain convenience and save money where you might not expect it.

> "It pays to look for a wide range of features when shopping for a temperature-controlled shaker."

Finding your features

When you go shopping for an incubator shaker, it's worth putting together a checklist of what you need. For one thing, how much room do you have? The answer to that question might determine whether you need a shaker that sits on a benchtop or one that sits on the floor. Even various versions of benchtop and floor models offer a size range. For example, VWR's Model 1585 floor shaker takes up a smaller footprint than most. Still, there's much more to consider. How much do you want to shake? You should have an upper weight in mind. "All shakers have weight limits for maximum performance," Das says, and a triple eccentric drive can handle heavier loads than a shaker with a single eccentric drive.

What you want to shake things in—the containers that you'll use—should also be part of the purchasing decision. "Most manufacturers offer dedicated

platforms that are designed to shake only a single vessel size, such as a flask," Das explains. "These platforms provide maximum capacity and come with clamps installed versus universal platforms that provide maximum flexibility for using a mix of different-sized labware on a single platform." If you don't plan to shake things too vigorously, say less than 250 revolutions per minute (rpm), adhesive mats and tapes might be enough to keep your containers in place. Whatever you have in mind, think about writing down a list of all the possible containers and shaking speeds you'll use to focus your search.

> "Sometimes you can gain convenience and save money where you might not expect it."

On top of those specifications, don't forget the more obvious ones, like the temperature range. In general, refrigerated incubator shakers can take cells down to about 4 degrees Celsius, and high-temperature ones can go up to 80 degrees Celsius, which can be used to grow thermophiles. "Even if you just need incubated temperature ranges today, in the future you may want to perform protein studies where refrigerated temperatures of 16 degrees Celsius are required," Das says. "Many customers opt for an incubated/refrigerated shaker to grow with their needs." He adds, "With these versatile units you can grow bacteria and yeast at 37 degrees Celsius or hold temperatures at 4 degrees Celsius, which makes cells ideal for protein expression studies, plasmid purification, and insect cell culture."

Also, try to figure out how big a shaking range you need. As Das says, "Some models will shake as slow as 15 rpm for slow-speed staining applications and go as high as 1,200 rpm."

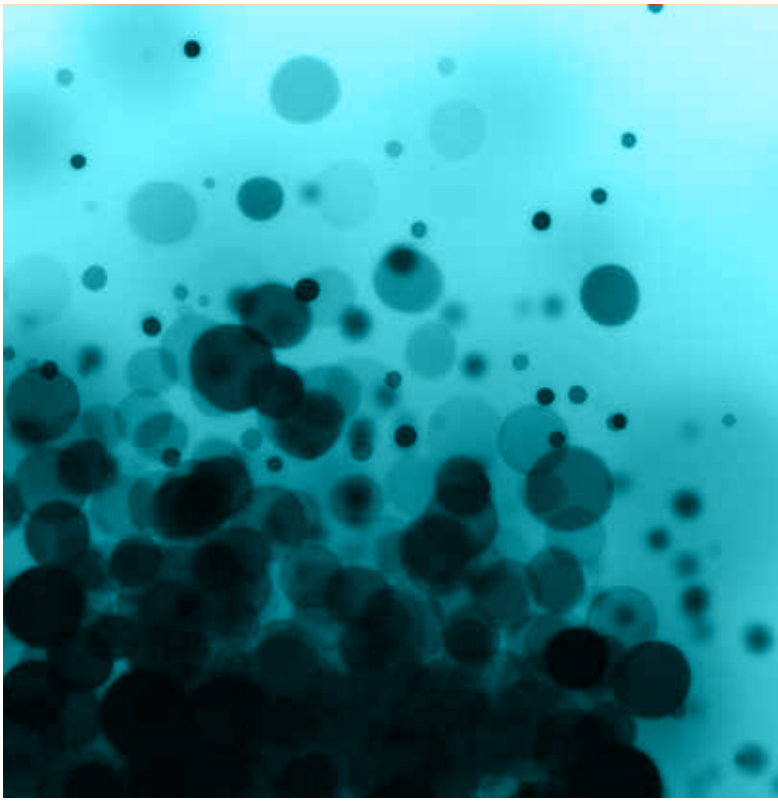
When it comes to temperature and shaking speed, think also about how accurately you need to adjust those parameters. Where more accuracy is needed, go for a digital shaker, which displays the settings on an LED screen as opposed to analog controls. The digital version also benefits anyone who needs to repeat procedures accurately.

Fine-tuning your needs

In the end, some things matter more to some scientists than to others. For example, a review of the Thermo Shaker Incubator MTH-100 on Amazon.com points out its economical mixing blocks and a three-year warranty.

To help you focus on the best shaker for your needs, Thermo Fisher Scientific (Waltham, MA), provides an Orbital Shaker Selector Guide (http://shakerdigitalguide.thermoscientific.com/?ca=shakerguide). This tool helps you find the incubator shaker that will work in your lab. As today's products show, there's much more to a shaker than shaking. You need to know what, how much, how fast, and more to find the device that keeps everything in your lab shaken just right.

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



FOR ADDITIONAL RESOURCES ON SHAKERS, INCLUDING USEFUL ARTICLES AND A LIST OF MANUFACTURERS, VISIT WWW.LABMANAGER.COM/SHAKERS

ARE YOU IN THE MARKET FOR A... MICROPLATE READER?

Microplate readers are commonly used in biological research for assay development (39.4%), measurement of biomolecule concentration (34.5%), cell biology (25%), biomarker research (24.0%), and DNA quantification (20% of survey respondents). In addition, microplate readers find use in disease study, IVF, proteomics, PCR setup, and stem cell research. With multiple read modes available and numerous accessories, choosing a microplate reader that meets your current and future needs can prove a daunting task.

Types of microplate reader used by survey respondents:	
Absorbance	61%
Microplate spectrophotometer	43%
Multi-mode reader	35%
Luminescence reader	34%
Fluorescence polarization	14%
Time-resolved fluorescence (TRF)	10%
AlphaScreen	4%
Time-resolved fluorescence energy transfer (TR-FRET)	3%
Other	3%

Microplate reader components used by survey respondents:	
Microplate washers	56%
Centrifugation	26%
Barcode scanner	20%
Microplate sealers	15%
Microplate stackers	10%
Microplate robotics	10%
Additional stacker cassettes	9%
Microplate handlers	8%
Labeling and sealing	8%
Bulk dispensing	7%
De-lidding stacker cassettes	3%
High-speed robot	3%
Other	8%

Nearly 30% of respondents are engaged in purchasing a new microplate reader. The reasons for these purchases are as follows:	
Replacement of an aging system	45%
Addition to existing systems, increase capacity	26%
Setting up a new lab	13%
First time purchase	13%
Other	2%

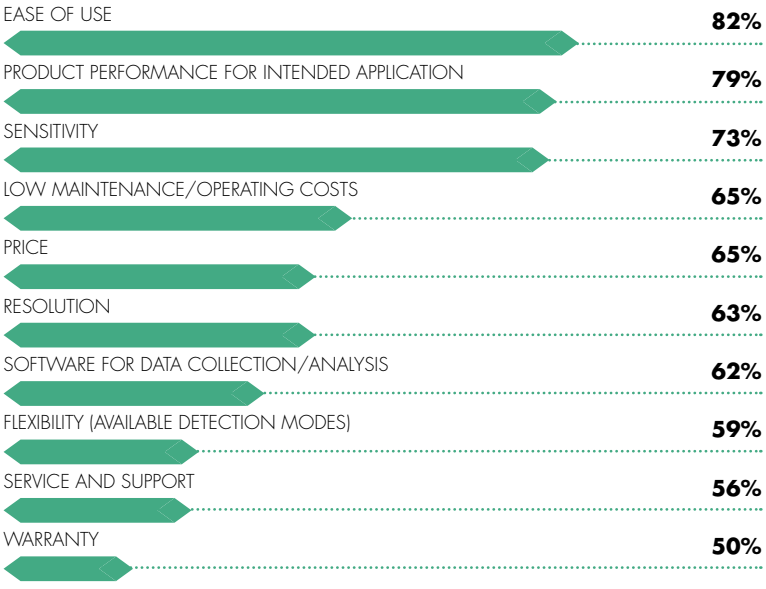
TOP 8 QUESTIONS

You Should Ask When Buying a Microplate Reader

1. How many read modes are offered? Multiple read modes offer greater flexibility and value than single read modes.
2. What kind of detection technology is used? Monochromator-based detection offers flexibility, convenience and spectral scanning; while filter-based detection is characterized by precise sensitivity and may often switch rapidly between distinct wavelengths for kinetic assays. Hybrid detection systems combine both technologies for the utmost in flexibility and sensitivity.
3. Is it upgradeable? If so, can the upgrade be installed on-site? On-site installations reduce overall downtime, and often the technician is available to answer questions or conduct training.
4. Is the reader automatable? Automating the process with a compatible microplate stacker increases throughput with walk-away operation.
5. Ask about the software—is it integrated and user-friendly? Does it allow for pre-programmed and custom protocols? What kind of analysis is offered? How is data exported?
6. Is on-site training available? Is there a fee? On-site training provides an opportunity for all staff to learn about the reader, reducing the number of subsequent trainings needed.
7. What options are available? Options such as gas control, barcode scanning, shaking, and injecting increase assay flexibility for those that need these features.
8. What assay validation data is available for the reader? Assay validation data specific for the reader provides proof that the reader performs as indicated.

TOP 10 FEATURES/FACTORS

Respondents Look for When Purchasing a Microplate Reader



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

REFRACTOMETERS

FOCUS ON LIFE SCIENCES

by Mike May, PhD

A material's refractive index—essentially how much it bends lights—can be used to describe the material and its use. For example, the refractive index of a lens determines how it could be used to magnify an image through a microscope or help someone see with glasses. And the refractive index is not just for glass but for gases, liquids, and solids of all sorts. A material can be modified to fine-tune its refractive index for a particular purpose. Making use of this characteristic, though, depends on being able to accurately and repeatedly measure it.

To measure a material's index of refraction, scientists often use a temperature-controlled refractometer. "As the refractive index depends on the temperature, most of the applications require temperature control to get correct measurements," says Christian Iserland, who manages various technologies, including refractometry, at METTLER TOLEDO (Greifensee, Switzerland). The level of temperature control also affects the results. For example, without accurate temperature control, the measurements can wander over minutes.

The speed of temperature control also matters. "Stabilizing the sample's temperature quickly offers greater throughput of samples being read and also results in greater accuracy," says Larry Pastwik, who handles the technical applications of analytical instruments at Reichert Technologies (Depew, NY). "The way in which accuracy is improved is by the sample being stable when capturing the refractive index value and providing a stable temperature value at the probe."

When using Reichert's AR7 series of temperature-controlled refractometers, Pastwik says, "The customer is assured of sample input values to the instrument's software that have been captured in a timely manner and result in an accurate value being displayed." That's what a customer should look for in any device being considered.

To some extent, the pros and cons of refractometry come from the same thing. The joy of refractometry is that every molecule out there has a refractive index, so you can get a signal from anything, and the heartache is that you get a signal from everything. Therefore, you need the right method and the right device to ensure you get the signal that you want.

Meeting specific needs

Although temperature affects all measurements of a sample's refractive index, that doesn't mean that everyone needs a temperature-controlled device. As an example, Kevin Gable, professor of chemistry at Oregon State University in Corvallis, says, "In our application—an undergraduate lab course—temperature control is not a major issue." He adds, "We operate near room temperature, and the admittedly crude corrections for temperature are sufficiently accurate that we can meet characterization needs without careful temperature control." Nonetheless, Gable's students use additional methods, including gas chromatography and infrared detection to augment their measurements. As he says, "I think the issue would be more critical were we either characterizing new compounds or using refractometry as a sole means of establishing purity."

Today's temperature-controlled digital refractometers provide more opportunities through added technology. For instance, a sample changer can be added to METTLER TOLEDO's LiquiPhysics Excellence refractometers. Then, Iserland says, scientists can "run a series of samples." He adds, "Our OneClick can start a complete workflow including product quality control and export to LIMS/SAP."

Whatever kind of instrument you're using, the right care improves the accuracy of measurements. The fluid in the captured side must be flushed out once a week or so. Also, refractometers are incredibly sensitive to back pressure, so they need to be last in a line of analytical devices with relatively wide-bore tubing.

If a scientist keeps the device functioning properly and compensates for temperature in some way, refractometers can provide accurate measurements for many applications, despite this technology's heartache.

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

FOR ADDITIONAL RESOURCES ON REFRACTOMETERS, INCLUDING USEFUL ARTICLES AND A LIST OF MANUFACTURERS, VISIT WWW.LABMANAGER.COM/REFRACTOMETERS

PARTICLE SIZING

NUMBER- OR VOLUME-BASED REPORTING?

by Angelo DePalma, PhD

Which method of reporting is appropriate for *your* particle sizing/characterization application?

Because number-based imaging techniques are sensitive to the presence of fines, they are useful for detecting low levels of material that is finer than the bulk of the sample.

Volume reporting, on the other hand, as delivered by laser diffraction, is useful for determining the amount of sample lying within an optical size range and for detecting the presence of large particles, such as oversized primary particles or agglomerates within pharmaceutical powders or suspensions.

Only perfect spheres may be precisely characterized using a single parameter, but these rarely occur in industry. For all other particles, the reported size parameter is related to the measurement technique used.

"The reporting associated with a given technique is directly linked to that method, making certain techniques inherently more or less suitable for specific applications," says Dr. Paul Kippax, product group manager at Malvern Instruments (Malvern, UK). "However, data for a given technique are routinely manipulated to present information in ways that optimize its relevance."

Close scrutiny of laser diffraction and image analysis illustrates the practical implications of spherical equivalence, defined as the diameter of a spherical particle with volume equivalent to that of the irregularly shaped particle.

Laser diffraction is an ensemble sizing technique, meaning it generates a result for the whole sample through one measurement. The reported particle size metric is the diameter of a sphere of the same volume as the particle; size distributions are generated on the basis of the volume of the sample in each size fraction.

Alternately, image analyzers capture thousands of images of individual particles and use the dimensions of each to create statistically relevant size and shape distributions. "Here the reported particle size metric is the diameter of a circle with the same 2D surface area as the particle. And because distributions are built up from data for individual particles, they are number-based; that is, the distributions quantify the number of particles in each size fraction," Kippax says.

Converting particle size data from one format to another requires consideration of both the size parameter and the distribution basis. "If particles are close to spherical, then the equivalent volume and equivalent area metrics will typically be similar. However, for other particles, those that are needle-shaped, for example, these numbers will clearly be very different," Kippax adds.

Imaging analysis

FlowCam® from Fluid Imaging Technologies (Scarborough, ME) is an example of imaging analysis. It works by capturing images of the sample as it passes through a flow cell, and storing digital representations of each particle in software. This allows measurement of more than 20 characteristics for each particle, generating both size frequency and volume data.

Historically, most particle analyses were volumetric, measuring some characteristic that is proportional to particle volumes. "But this requires a leap of faith," says Fluid Imaging technical director Lew Brown. "You're assuming that everything is spherical, so if it has a certain volume it must have a specific diameter."

In real-life samples, number and volumetric distributions are very different. A sample containing one million tiny particles and a few very large particles will be skewed heavily toward the smaller particles if number or frequency analysis is desired, whereas volume reporting favors the larger particles.

Brown estimates that today's particle analyzers work in volume mode about 90 percent of the time. "Historically, before all this technology emerged, the most common sizing technique was sieving, which by definition is volumetric."

The question of volume versus frequency becomes complex for foods and drugs. The patent for a popular peanut butter brand is based on particle size frequency for the ground peanuts. For chocolate, sugar crystal volume might be one of the defining contributors to taste and texture. Particle shape is also critical for taste because the shape may influence how the particle interacts with taste buds or even chemical receptors on the tongue. Similarly, shape may affect how quickly and where in the digestive tract a drug dissolves.

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FOR ADDITIONAL RESOURCES ON PARTICLE SIZING, INCLUDING USEFUL ARTICLES AND A LIST OF MANUFACTURERS, VISIT WWW.LABMANAGER.COM/PARTICLE-SIZING

ARE YOU IN THE MARKET FOR A...
LAB OVEN?

Laboratory ovens are common instruments in most laboratories and are used across most scientific disciplines. Lab ovens are most commonly less than 12 cu.ft. in volume, although a great variety of sizes are available in benchtop, stackable, and floor-standing models. Over 25 percent of survey respondents reported using larger ovens in their labs. While lab ovens are most commonly used for heating and drying (77% of respondents), they find a variety of other uses including evaporating (49%), temperature-linked experimentation (47%), sterilization (14%) and baking (13%).

TOP 5 QUESTIONS
You Should Ask When Buying a Lab Oven

1. What temperature range do you require? (Does the product have reserve temperature capacity?)
2. What accuracy and uniformity does the product have? (Will my sample be damaged or will my experiment only function in one "sweet spot"?)
3. Are interior chamber space / weight of my sample and floor space in the lab a match to application and lab?
4. Do I need any computer interfaces, alarms or safety devices on my oven?
5. Are accessories like data loggers, viewing windows and modifications like access ports available from the manufacturer to suit my specific needs?

TOP 10 FEATURES/FACTORS
Respondents Look for When Purchasing a Lab Oven

SAFETY	80%
EASE OF USE	64%
LOW MAINTENANCE / OPERATING COSTS	61%
PRICE	50%
TEMPERATURE RANGES AMBIENT +40C TO 200C / 250C	45%
CONTROLLED AIRFLOW TO PROVIDE UNIFORM TEMPERATURE HEAT DISTRIBUTION	42%
SERVICE AND SUPPORT	41%
WARRANTY	40%
EASE OF INSTALLATION	35%
DOUBLE WALL FOR INSULATION	34%

Types of lab ovens used by survey respondents:

General Purpose Oven	78%
Mechanical Convection Oven	18%
Gravity Convection Oven	15%
Vacuum Oven	22%
Microwave Oven	19%
Other	5%

Lab oven applications as reported by survey respondents:

Heating and drying	77%
Evaporating	49%
Temperature-linked experiments	47%
Sterilization	14%
Baking	13%
Annealing	6%
De-gassing samples	4%
Die-bond curing	1%
Other	9%

Nearly 24% of respondents are engaged in purchasing a new lab oven. The reasons for these purchases are as follows:

Replacement of an aging system	35%
Addition to existing systems, increase capacity	35%
Setting up a new lab	25%
First time purchase	5%

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

ARE YOU IN THE MARKET FOR A... FREEZE DRYER?

Freeze dryers find use in a variety of research and manufacturing environments and are commonly used for material storage, food and pharmaceutical processing, as well as for less common applications such as taxidermy and document recovery. With a wide variety of options available, there is much to consider when purchasing a new freeze dryer.

Types of freeze dryer used by survey respondents:

Manifold Console	41%
Manifold Benchtop	26%
Shelf Console	18%
Dry Ice Benchtop	11%
Non-Sterile Production	7%
Sterile Production	7%

Freeze dryer applications as reported by survey respondents:

Material stabilization and/or storage	52%
Other Applications	30%
Starters and Cultures	15%
Pharmaceuticals	15%
Food Processing	7%
Nutraceuticals	7%

Nearly 46% of respondents are engaged in purchasing a new freeze dryer. The reasons for these purchases are as follows:

Setting up a new lab	35%
Replacement of an aging system	29%
Addition to existing systems, increase capacity	24%
First time purchase	12%

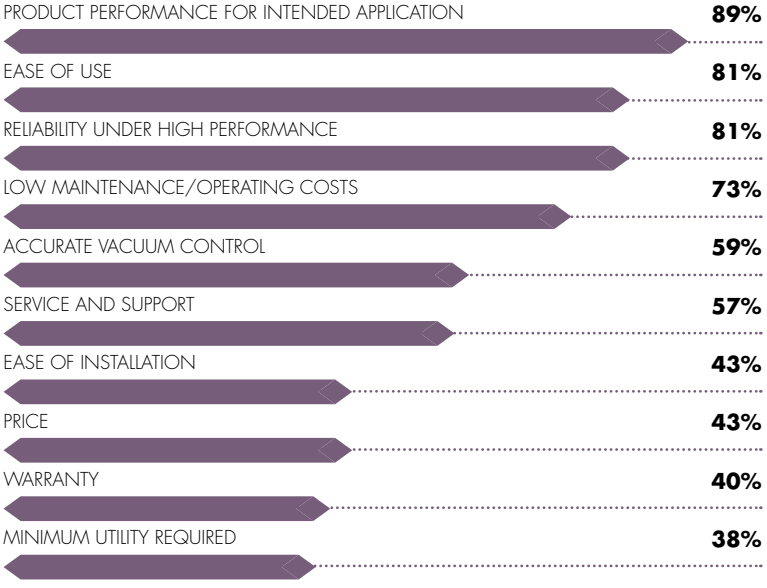
TOP 5 QUESTIONS

You Should Ask When Buying a Freeze Dryer

1. What solvents are you using? A temperature differential between the sample's eutectic temperature and collector temperature of 15–20 degrees is required. If solvents such as acetonitrile are used, a cascade freeze dryer is required.
2. How much sample in liters will you run? When choosing a freeze dryer, vendors recommend loading 1/2 of the listed capacity. For example, a 6L freeze dryer will hold 3L during the run.
3. Do you want to freeze dry in flasks, tubes, or bulk? Many drying accessories are available. On a manifold or drying chamber, flasks can be placed on each port. Test tubes and serum vials can be placed inside of the flasks for multiple samples per container. If samples are bulk, a tray dryer would be a good choice.
4. Do you need to stopper under vacuum? Accessories can allow you to stopper under vacuum or nitrogen without using compressed gas.
5. Is this a shared freeze dryer? A hybrid pump is recommended to prevent damage to the pump.

TOP 10 FEATURES/FACTORS

Respondents Look for When Purchasing a Freeze Dryer



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

SCIENTIFIC
FREEZE DRYER

by HARVESTRIGHT

For the first time, a Laboratory Freeze Dryer that is:

- High Quality
- Large Capacity
- Very Affordable

starting at
$4,299

Call Today!
1-800-401-6822
harvestright.com

MADE IN AMERICA

PATENT PENDING

SAMPLE MANAGEMENT IN THE CLOUD

Problem: With non-automated sample management systems, searching and sharing information within and without the lab is slow and tedious. Labs also cannot easily manage their data and samples remotely without cloud-based sample management software.

Solution: FreezerPro® is one example of a sample management system that is user-friendly, tested to uphold rigorous security standards, and allows sample information to be retrieved and reviewed quickly, in contrast to labor-intensive, non-automated search methods. The latest version, FreezerPro® Cloud, allows lab personnel to manage sample information and activity whenever, wherever, and without any need for local IT staff or infrastructure.

By utilizing cloud-based data management systems, researchers are able to more easily create networks for sharing sample and associated study information. The opportunity for remote management and sharing of sample and study information is not only essential for effective communication among collaborators but also ensures centralized inventory accessibility and reduces data entry errors. Moreover, owners of large sample collections are afforded a highly secure review of their inventory from any remote location with Internet access. FreezerPro Cloud has also been translated into 12 languages and is available at local hosting centers across the Americas, Europe, Asia, and Australasia.

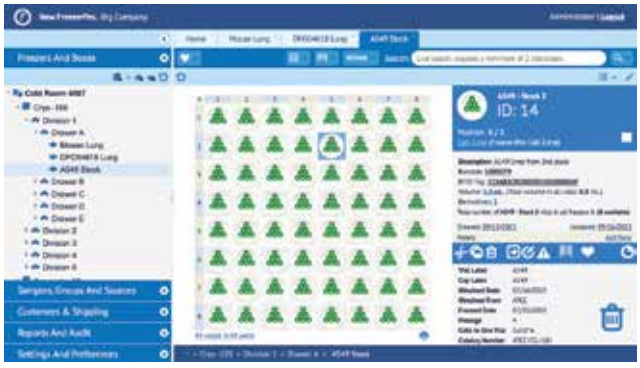
In particular, FreezerPro Cloud does not require installation, allowing local IT resources to be focused elsewhere. The system is easy to use from the start with a simple online sign-up process; a user's account will be available for use within 12 hours. All cross-region servers are directly managed and guaranteed by RURO to be online and available 24 hours a day, seven days a week.

To guarantee online security and data protection, software such as FreezerPro Cloud encrypts its data both in transit and at rest. Data visibility is denied in the event of unauthorized access, whether the data are in use, in transit, at rest, or archived. The software further guarantees protection with 1028-bit encryption, a secure socket layer, and operating system level vulnerability monitoring. Organizations following FDA, Good Laboratory and Good Manufacturing Procedures (cGLP/cGMP), HIPAA, or other accessibility or regulatory guidelines will be fully supported by FreezerPro Cloud security, including permissions modeling and complete audit train records. Customers may also opt for a Private Cloud to further ensure data security.

Cloud-based software such as FreezerPro Cloud retains the features, displays, and feel of previous non-cloud versions. Samples are still identified with a barcode, positioned in specific boxes and racks, and linked to any user-defined data fields. Now with the cloud version, users at separate locations involved in a single master workflow can access sample management information in real time and can share and optionally control data entry. These features provide the ability to better control nomenclature and data integrity with improved visibility. FreezerPro Cloud offers a free downloadable Microsoft Excel Add-In tool to facilitate data migration and guarantees the integrity of an ongoing information transfer. The migration of data from spreadsheet to the software is fast and will preserve your data content.

Cloud-based sample management software such as FreezerPro Cloud is often available in different editions to best fit the user's budgets. Modules and extensions are also available to further optimize the user's data management solution, and technical support is also available by phone, mail, or online.

For more information, visit www.FreezerPro.com



▲ *FreezerPro® Cloud allows lab personnel to manage sample information and activity whenever, wherever, and without any need for local IT staff or infrastructure.*

MICROFLUIDIC TECHNOLOGY FOR IMPLEMENTING AND BUILDING ASSAYS

Problem: Laboratories in the U.S. and abroad face obstacles such as limited budgets and are constrained by inefficient workflow and a lack of qualified personnel and highly specialized technicians to fill a growing number of professional laboratory positions.

The U.S. Bureau of Labor Statistics reports that the number of medical laboratory technologist and technician positions is expected to increase to more than 373,500 by 2020, an increase of 13 percent from 2010. Many positions remain unfilled, as over half of all laboratories are reporting difficulty hiring laboratory personnel. This issue is compounded by an aging workforce. According to the American Society for Clinical Pathology (ASCP), the national average age of the laboratory workforce in 2010 was 49.2, compared with 43.6 just four years prior. The ASCP also reports a decrease in the number of laboratory training programs by almost 25 percent from 1990 to 2010 and a decline in the number of individuals graduating from these programs.

To overcome these obstacles, laboratories need equipment that can accommodate the demand for more sophisticated laboratory tests, technology that is capable of high throughput and high complexity, and processes that improve workflow efficiencies with minimal user intervention.

Solution: Microfluidics enables the adoption of advanced molecular technology by laboratories of all types, from small community hospital labs to highly complex, centralized laboratories. When fully automated and enclosed within a device, microfluidics can eliminate the potential for contamination, reduce user error and streamline workflow, thus helping smaller laboratories complete more tests with increased accuracy.

The Rheonix CARD® (Chemistry and Reagent Device) cartridge uses microfluidics to perform assays on the company's Encompass MDx® and Encompass *Optimum*™ workstations, making it simpler and easier to perform molecular analyses at a fraction of the cost of other options.

The dual-layer design of the microfluidic technology when interfaced with its workstation automatically manipulates reagents internally with its active fluidic network of pumps, valves and channels. The upper surface contains reservoirs that hold reagents used in the extraction, purification, amplification, and detection processes, and any resulting liquid waste. The channels and pumps located on the lower surface of the microfluidic device are used to transport and mix reagents and move waste into the reservoirs formed in the top surface of the device. By actively pumping fluids from reservoir to reservoir within the CARD cartridge, molecular analyses are automated. The design will facilitate implementation of molecular analyses across a wide range of markets, including next-generation sequencing sample preparation, research-use-only testing, food and beverage industry applications, and in vitro diagnostics.

The workstations allow laboratories to quickly, easily and cost-effectively run several samples through fully integrated and automated nucleic acid amplification analyses, from raw sample input through detection, with no user intervention. Each CARD cartridge allows for simultaneous analysis of four different samples and can handle a broad range of sample types, such as fresh tissue, urine, whole blood, serum, saliva, swabs, and formalin-fixed, paraffin-embedded (FFPE) tissue. The cartridge also performs multiple molecular techniques, including sample preparation, such as chemical and enzymatic lysis and DNA purification; amplification, such as endpoint polymerase chain reaction (PCR), reverse transcriptase PCR and quantitative PCR; and detection on a low-density microarray or lateral flow strip.

While other systems have traditionally emphasized either multiplexing or throughput, the single-use CARD cartridges do both and can perform sophisticated functions with a simple design. This lowers laboratory costs by eliminating waste in time, equipment and consumables, and reduces the amount of highly skilled labor.

For more information on Rheonix, visit www.rheonix.com.

▲ *The Rheonix CARD*

TECHNOLOGYNEWS

PITTCON CONFERENCE & EXPO 2016

THE EQUIPMENT, INSTRUMENTS, AND SYSTEMS INTRODUCED TO THE LABORATORY MARKET AT **PITTCON 2016**

ANALYTICAL

Intelligent Plasma Assisted Purifier System

IPAPS™
BOOTH 4327

- Includes a plasma to increase the lifetime of the heated gettering alloy
- Features a genuine end of life monitoring system, unique impurity overload detection, and a capacity of 1L/min
- Suited for applications like; gas purification, zero gas generator used for calibration of on-line analyzers, mass spectrometers, and all kinds of detectors

Analytical Flow Products www.afproducts.ca

Multi-Mode Plasma Detector

MMPD™
BOOTH 4327

- New concept is being released based on patent pending design features, resulting in a full open architecture product
- Allows any user to optimize a specific GC application with the MMPD development system and install it on the target system using only the required hardware and firmware necessary to fulfill the task
- Based on a plasma generated through a dielectric barrier

Analytical Flow Products www.afproducts.ca

Handheld Raman Spectrometer

BRAVO
BOOTH 3121

- Includes patented fluorescence mitigation SSE™ (Sequentially Shifted Excitation) for a wider range of raw material measurements
- Intuitive user interface and touchscreen provide a guided workflow
- Features Duo LASER™ excitation with two wavelengths resulting in high sensitivity across the spectral range
- Also includes automated wavenumber calibration for precise measurements and automated measuring adapter recognition IntelliTip™

Bruker www.bruker.com/BRAVO

LIBS Analyzer

NanoLIBS
BOOTH 457

- Features a matchbox-sized advanced microLIBS laser with a high repetition rate and a compact spectrometer for "real-time spectroscopy"
- Offers handheld or lightweight portable integration with battery operation under Linux, Android, or Windows OS
- Patent-pending chemometric/calibration engine for the identification and quantitative analysis of pure materials enables users to utilize the solution's fullest capabilities
- Customization options available

B&W Tek www.bwtek.com

Sample Introduction System for ICP-MS

MVX-7100 µL Workstation
BOOTH 2531

- Supports sample volumes as low as 5 microliters
- Designed to help laboratories efficiently perform trace element analysis on their smallest, most precious samples
- Brings together an autosampler, syringe pumps, temperature control, a six-port valve, and automation software
- Samples can be drawn from conventional vials, septum vials, or microtiter plates up to 384 wells

Teledyne CETAC Technologies www.cetac.com

GC-MS System

AirmoSCANXpert
BOOTH 1425

- Allows users to track more than 100 VOCs and monitor molecules listed in PAMS 56, TO14, TO15, etc.
- Enables identification of compounds and quantification at ppt, ppb, ppm, and % levels for process or ambient air
- User-friendly instrument automatically monitors all AMCs and allows increased production efficiency
- Special multiplexing system integrated in the MS allows measurements from two streams

Chromatotec www.chromatotec.com

Isolated 532 nm Lasers for Raman Spectroscopy

DPL™ 532 nm
BOOTH 761

- SLM DPSSL now available with an integrated optical isolator for the toughest of highly reflective samples
- Features up to 160 mW after the optical isolator, is SLM, and has rms noise <0.25 %
- With totally integrated electronics, the DPL™ 532 nm is easily integrated into high-end Raman-based systems

Cobolt www.cobolt.se

Ultrafast Gas Chromatograph

CALIDUS GS™

BOOTH 1842

- New gas sampling model is designed for measuring environmental gases including greenhouse, stack gas, process ventilation, tank car headspace, and other low pressure applications
- Available with FID, DBD, and FPD detectors and its sensitivity range includes sub-ppm TNMHC measurements and SF6 measurements at the ppt level
- Resistively heated column speeds analysis from 3 to 50 times faster than traditional GCs

Falcon Analytical www.falconfast.net

Ion Analysis Module

BOOTH 2145

- Developed to regularly measure the concentration of various ions in liquid fertilizer during a 2017 space mission, but is also suitable for Industry 4.0 applications (i.e. fully-automated monitoring of ionic liquids)
- Uses a microfluidic chip-based electrophoresis concept
- Features a lightweight, compact design as well as fully-automated sampling and data acquisition

Fraunhofer ICT-IMM www.imm.fraunhofer.de

Trace Gas Analyzer

PTR-TOF 1000ultra

BOOTH 1628

- Provides up to 10x more sensitivity thanks to the new ION BOOSTER-funnel technology
- Compared to traditional transfer lens systems, the funnel improves ion transmission, leading to a much higher sensitivity
- Offers ultra-sensitive volatile organic compound (VOC) analysis in real-time, integrated in an affordable, small, and light PTR-TOFMS instrument

IONICON www.ionicon.com

FTIR Spectrometer

microFTS®

BOOTH 922

- Designed for in-line process monitoring
- Features a novel optical design that eliminates the use of remote sampling or use of fiber-optic couplers
- Boasts a compact, lightweight, portable, and robust design
- Rugged instrument is immune to vibration
- Provides a fast measurement time

Keit www.keit.co.uk

HPLC Columns

Roc™

BOOTH 1746, 1747

- Pressure rated for any 400-bar HPLC system and deliver the peak shape, reproducibility, ruggedness, and performance needed for all the user's conventional HPLC applications
- Made from high-purity silica backed by quality manufacturing
- Available with C18, C8, Phenyl-Hexyl, Cyano, and bare silica phases on either 3 or 5 µm spherical particles

Restek www.restek.com/roc

Bio UV-Vis Spectrophotometer

Nano-MD

BOOTH 1056

- Designed for accurate micro-volume measurements
- Able to measure multiple samples (up to 8 samples) at a single sampling
- Features a compact, small footprint; accuracy and reproducibility; and user-friendly software
- Does not require warm-up time and does not cause photo-degradation of the sample
- Micro-volume sample amount is 1 µl ~ 2.5 µl
- Available with a standard cuvette

Scinco www.scinco.com

Gas Chromatograph Mass Spectrometer

GCMS-QP2020

BOOTH 1338

- Features a proprietary multi-function ion source, patented high-speed scan control, and a new ultra-fast turbomolecular pump
- These features, along with comprehensive databases and multiple sample introduction devices, enable excellent performance and custom configurations tailored to fit the needs of laboratories in such areas as environmental, food, and forensics
- Upgraded GCMSsolution software provides intuitive control of the GCMS-QP2020

Shimadzu www.shimadzu.com

HPLC Columns

SiliaChrom Plus

BOOTH 4332

- Over ten different phases available, offering chromatographers the flexibility of choosing the appropriate selectivity for their analyses
- Provide excellent peak shape, high surface area, and reduced silanol activity, and will also show excellent lot-to-lot reproducibility
- Custom dimensions and packing are also offered to accommodate the user's specific requirements

SiliCycle www.silicycle.com

Ion Mobility Spectrometer

Ion Mobility Spectrometer 2.0
BOOTH 1026

- Provides real-time monitoring of airborne molecular contamination (AMC) in semiconductor processing, ambient air monitoring, and process gas monitoring for industrial processes and safety applications
- Designed for continuous monitoring of all contaminants in industrial applications in ultralow ppb ranges
- Can analyze airborne chemical contamination at far lower concentrations than traditional analyzers and react in real-time

STEP Analytics USA www.stepanalyticsusa.com

Quaternary Liquid Chromatograph

Waters ACQUITY Arc System
BOOTH 3538

- Gives analytical laboratories running established LC methods another option for replicating or improving their separations performance
- Specifically engineered to respond to the needs of analytical scientists for a single LC platform that can enable them to efficiently transfer, adjust, or improve their methods regardless of the LC platform on which they were originally developed

Waters www.waters.com/arc

Analytical Instruments & Optical Components

BOOTH 728

- Zolix manufactures monochromator/ spectrometers, light sources, tunable monochromatic light sources, motorized stages, manual stages, mirror mounts, and related optical components
- All components are specialized for OEM customers, for example: analytical instruments suppliers, laser suppliers, etc.

Zolix www.zolix.com.cn

BASIC LAB

Moisture Content Analyzer

TrueDry
BOOTH 2421

- Allows users to measure moisture content of nine samples with just four minutes of hands-on work time
- Users can select drying temperature and dry to a specific time or to constant weight
- Weight is monitored digitally and automatically during drying, meaning just one interruption of the user's workflow to measure nine samples
- Each sample is dried to 1% relative humidity

AquaLab www.aqualab.com

Safety Storage Cabinets

Q-CLASSIC-90
BOOTH 926

- Now approved and certified according to FM standards
- Offer 90 minutes of fire resistance, suitable for remote locations without quick access to fire-fighting emergency services
- Also meet European Standards—EN 14470-1 and 14727, and the "GS" mark guarantees robust construction and longevity
- Feature self-closing wing doors in the event of fire, secure cylinder locking, and ventilation options

asecos www.asecos.com

Alternative to Karl Fischer Titration

Computrac® Vapor Pro®
BOOTH 2031

- Delivers accurate, precise moisture-specific measurements as low as 10 parts per million without the use of hazardous chemical reagents, expensive glassware, or special expertise
- Designed to perform in both manufacturing and lab environments
- Features a simpler, faster testing process than Karl Fischer titration

Arizona Instrument www.azic.com

Bottletop Dispensers

Dispensette® S
BOOTH 1859

- Bring safety and convenience to dispensing of virtually any laboratory liquid
- Feature elimination of seals, improved safety valves, faster priming, easier volume selection, and even lower operation forces
- A large variety of bottle adapters and accessories adapt the Dispensette® S to nearly any unpressurized application
- Models available for general purpose dispensing, organics and concentrated acids, and trace analysis

BrandTech Scientific www.brandtech.com

Vacuum Gauges

VACUUBRAND VACUU•VIEW &
VACUU•VIEW extended
BOOTH 1859

- Feature corrosion resistant transducers for use in laboratory applications
- VACUU•VIEW model has a capacitive transducer for absolute pressure readings from atmosphere to 0.1 mbar/hPa (0.075 Torr) with user-selectable units
- VACUU•VIEW extended switches automatically between capacitive and a ceramic sheathed Pirani transducer for readings to 10-3 Torr/mbar/hPa

BrandTech Scientific www.brandtech.com

Viscometers and Rheometers

BOOTH 2231

- Include a unique line of touchscreen instrumentation that research labs, QC, and production environments count on for dependability and accuracy
- The CT3 Texture Analyzer is well-suited for tension and compression testing
- The Powder Flow Tester delivers quick and easy analysis of powder flow behavior in industrial processing equipment

Brookfield Engineering www.brookfieldengineering.com

Nano Particle Size Analyzer

Nano DS

BOOTH 2729

- Designed to address even the most challenging nano particle size research
- Allows the researcher to select different measurement angles depending on the sample
- Automatically scans and identifies the optimal measurement angle to help identify particles that might otherwise go undetected
- Combines static and dynamic light scattering measurements in one single optical system

Cilas Particle Size www.particle-size.com

Temperature & Humidity Monitoring Device

DWE

BOOTH 3824

- Wi-Fi- and Ethernet-based
- Provides users with reliable cloud-based access to their vital environmental data via web interfaces that can be accessed by any Internet-connected device at anytime from anywhere
- Replaceable sensors make calibration simple by saving users time and money by making the process as easy as swapping batteries

Dickson www.dicksondata.com

Automatic Fire Detection & Suppression Systems

BOOTH 3229

- Designed for chemical fume hoods and storage cabinets
- React more than ten times faster than competing systems because they are designed to detect a fire inside the fume hood or cabinet—right where it starts
- Can meet the requirements of new 2015 NFPA 45 fire code for laboratory fume hoods to ensure the user's laboratory is compliant with current code

Firetrace International www.firetrace.com

Dust Monitoring System

(DMS)-100

BOOTH 828

- Uses laser back scatter measurement with imported core components
- Especially suited for continuous monitoring of various source emissions of particulate matter concentrations
- Can be equipped with CEMS, used alone, or with several units together to form a dust monitoring network with a shared data acquisition and processing unit

Hangzhou Zetian Technology www.zetian-tech.com

Flue Gas Analyzer

EM-5

BOOTH 828

- Based on DOAS and chemometric algorithms (PLS), able to measure SO_2, NO, NO_2, O_2, NH_3, CO, CO_2, Cl_2, O_3, H_2S, HCl, CH_3I, etc.
- Features high accuracy and reliability, low operating costs, fast response time, and wide measurement range
- Using return light path and a high quality spectrograph, the minimum measuring range is 0-20ppm—lowest detection limit is 200ppb

Hangzhou Zetian Technology www.zetian-tech.com

Laser Gas Analyzer

LGT-100

BOOTH 828

- A flameproof in situ probe-type tunable laser gas analyzer for industrial online analysis and environmental on-line monitoring
- Analyzes O_2, CO, NH_3, CO_2, CH_4, H_2O, HCl, HF, and other gases of various complex conditions
- Features a modular design, field replaceable laser module, and easy maintenance
- LGT-180 model also available

Hangzhou Zetian Technology www.zetian-tech.com

Micro Annular Gear Pumps

BOOTH 2727

- Feature low pulse delivery, minimal dead volume, long service life, small dimensions, powerful materials, and ease of maintenance
- Five series of micro annular gear pumps guarantee a flow rate from 1 µl/h to 1152 ml/min and enable high pressure up to 80 bar
- HNP Mikrosysteme also offers the development of OEM pumps, comprehensive application-specific consulting, and technical support

HNP Mikrosysteme www.hnp-mikrosysteme.com

Scanning Electron Microscope

IT100
BOOTH 2857

- Features expanded EDS analysis capabilities and ports for multiple detectors
- Can be configured to meet individual lab requirements at an exceptional value
- Offers high resolution imaging and a range of acceleration voltages at both high and low vacuum modes
- Allows users to quickly and easily obtain high quality images using both secondary electron and backscatter imaging

JEOL USA www.jeolusa.com

Sensor System for HPLC Reservoir Levels

Sonic
BOOTH 3057

- Measures the levels of solvents used in unattended liquid chromatographic separations in real time
- Employs a sound wave transmitter positioned in the reservoir's cap to accurately measure the level of the solvent in the 1-liter reservoir
- Safeguards the loss of valuable samples and analysis time while preventing the waste container from overflowing and creating a hazardous spill in the lab

JM Science www.jmscience.com

Reaction Solutions

BOOTH 3549

- Reaction solutions use heavy-duty glassware, stainless steel, or pressure reactors
- Newly-added stirrers, vacuum pumps, hot plates, and more aim to help users save time and energy to optimize their reaction systems
- New CORIO™ laboratory circulators also available

JULABO USA www.julabo.com/us

Laboratory Equipment Rental Marketplace

KWIPPED.com
BOOTH 1225

- The world's first laboratory equipment rental marketplace for lab professionals to locate and rent specialized equipment for laboratory applications
- Facilitates a highly efficient equipment rental process by enabling businesses and organizations that need to rent laboratory equipment to easily connect with a global network of suppliers that rent their equipment through the site
- KWIPPED's platform facilitates and automates the entire rental process

KWIPPED www.KWIPPED.com

Freeze Dryers

FreeZone®
BOOTH 1638 & 1639

- Newly redesigned
- Now incorporate a touchscreen display that allows users to monitor parameters with real-time graphs and access stored data
- Feature the Run-Smart™ operating system with large 5", full color touchscreen display
- Include automatic start up and capacity for 30 stored programs
- Offer an Ethernet connection to receive email status updates, such as vacuum level and temperature alerts

Labconco Labconco.com

Microtube Shaking Incubator

AccuTherm
BOOTH 1623

- This temperature controlled vortexer uses Peltier technology to rapidly heat and cool precious samples
- Features a temperature setting range of 0-105°C
- Provides a mixing speed range of 300-1,500 rpm's
- Offers a heating time of 6.5°C/minute and cooling time of 1.5°C/minute

Labnet International www.labnetinternational.com

Online Real-Time COD Analyzer

P100
BOOTH 2519

- Eliminates the use of dichromate
- Especially suited to industrial and municipal applications
- Features 4-20 mA output
- Provides online COD and BOD monitoring

MANTECH
www.mantech-inc.com

Fume Hood

Observation2
BOOTH 4150

- Large glass panels bring in natural light and views while giving supervisors the ability to see that students or employees are working safely
- UL 1805 listed, tested to ASHRAE 110 standards, provides containment at face velocities as low as 60 fpm, and is designed for multiple applications
- Available in single and double-faced configurations and available for CAV or VAV situations

Mott Manufacturing www.mott.ca

Stainless Steel Fume Extractor

MEX-AAF
BOOTH 1330

- Specifically developed for the extraction of airborne pollutants at high temperatures such as those generated from atomic absorption apparatus
- Newly designed rectangular 10" by 19" hood profile also allows for exhaust capture from dual oven ports in close proximity
- Recently upgraded 5" diameter, 5' length of high temperature flex hose is included to facilitate safe connection to existing exhaust channels

Movex www.movexinc.com

Laboratory Furnaces

BOOTH 4365

- Almost all new models are now delivered with Nabertherm's new controllers and a new linen structure design
- Controllers provide for intuitive operation, plain text display, language switching, USB-process documentation, and many other useful functions
- All standard laboratory furnaces with the controllers B 400 - P 470 can be read out via an integrated USB-process documentation

Nabertherm www.nabertherm.com

Dual Channel Data Loggers

OM-CP-HITEMP140X2-FP
BOOTH 3348

- Offer two remote flexible probes that can measure up to 350°C (662°F) with an accuracy of ±0.1°C (±0.18°F)
- Available in a combination of flexible PFA insulation and bendable stainless steel
- Dual probes allow for simultaneous monitoring and can be used for oven mapping, surface temperature monitoring, autoclave validation, and sterilization processes

OMEGA www.omega.com

Isolated Wireless Potentiostat

BOOTH 1220

- Can be used for a wide range of amperometric systems, including lab-on-chip and sensors
- Isolated design makes it especially suited for in-channel and end-channel detection in capillary electrophoresis systems
- Features sample rate of 6.75 Hz, bias range of 40 nA (standard) or 80 uA (extended range), battery life of ~100 hrs (continuous use), and more

Pinnacle Technology www.pinnaclet.com

Twin Head Blowdown Evaporator

MiniVap™ Gemini
BOOTH 3831 & 3931

- Designed to remove the solvent from two microplates simultaneously
- Uses an efficient evaporator head technology and an innovative manifold design
- Enables researchers to remove the traditional laboratory bottleneck of solvent evaporation from microplates prior to analysis or reconstitution in buffer
- Able to accommodate any ANSI / SLAS footprint 96-well microplate up to 60mm high

Porvair Sciences www.porvair-sciences.com

Specialty Gases

PurityPlus®
BOOTH 757

- Available exclusively through select, independent, local, privately-owned companies
- Working directly with an independent producer means that users get more service, technical expertise, and responsiveness in time-critical applications
- Over 150 local distributors and over 600 locations across North America available
- Include a complete line of pure, rare, calibration, emission, food and beverage, and medical and medical device gases

PurityPlus www.purityplusgases.com

Gas Sorption Analyzer

NOVAtouch™
BOOTH 2732

- Full automation, including built-in sample preparation capabilities, enhance analytical simplicity and operator convenience
- One, two, three, or four station units with individual Po cells and dedicated Po transducers (on LX models) for utmost accuracy are available
- Built-in microprocessor and Ethernet port enable substantial bench-space savings and optional remote communications

Quantachrome Instruments www.quantachrome.com

Stainless Steel Test Weights

Essential Weights™
BOOTH 3444

- Customized sets of three or four stainless steel test weights specifically tailored to the user's laboratory precision weighing equipment
- Especially suited for specific calibrations, shift tests, and sensitivity tests
- Designed with convenience in mind without sacrificing accuracy or quality
- These polished stainless steel Type II design ASTM Class 1 weights include a small, durable carrying case

Rice Lake Weighing Systems www.ricelake.com

Micro Synthesis Set

MiniBlock®
BOOTH 4332

- A complete platform for six to 48 parallel reactions (40 to 4 mL)
- Includes its own orbital shaker and heating (up to 120°C) / cooling (down to -20°C) / inerting capabilities
- Especially suited for route scouting peptide synthesis and scavenging studies
- Allows users to screen reaction conditions, optimize their synthesis, and remove excess reagents, side-products, and catalysts

SiliCycle www.silicycle.com

Wall Shelving System

BOOTH 522

- Can easily be modified according to need and is reusable, since it can be dismantled and reinstalled in a new location with minimal effort
- Can be mounted on the wall either directly or using a horizontal rail
- Consists of horizontal rails and upright profiles, with a wide range of shelf sizes and accessories available

Sovella USA www.sovella.com

Closed-Loop Motorized XY Scanning Stages

ASR-E Series
BOOTH 3226

- Designed as replacements for manual stages on upright and inverted microscopes or for stand-alone operation
- Extremely low profile and small footprint of ASR-E stages allow them to be incorporated into many different types of scanning systems and easily mounted to most common microscope platforms
- Stage movement is handled by crossed roller bearings and hardened stainless steel rails

Zaber zaber.com

Motorized Micromanipulator

M-LSM Series
BOOTH 3226

- These versatile standalone units are able to be controlled by computer or joystick
- Many configurations are available, as the M-LSM Series can be mounted on metric or optical breadboards, and the orientation can be switched from right to left
- Able to move along three axes, while the programmable or joystick-activated fourth virtual axis allows an approach along the probe angle

Zaber zaber.com

Miniature Motorized Linear Stages

X-LSM-E Series
BOOTH 3226

- Especially suited for applications where a small profile and high resolution is required as they are only 21 mm high
- Design allows speeds up to 104 mm/s and loads up to 10 kg
- Built-in motor encoder allows closed-loop operation and provides slip/stall recovery features
- Optional indexed knob provides convenient manual control for versatile operation even without a computer

Zaber zaber.com

Motorized Rotation Stages

X-RSB-E Series
BOOTH 3226

- Feature a compact footprint, low profile, and load capability up to 20 kg
- With a maximum speed of 300 rpm, these stages are ideal for the rapid positioning of light loads to within a fraction of a degree
- A built-in motor encoder allows for closed-loop operation and slip/stall recovery features

Zaber zaber.com

CHEMICALS, KITS, & REAGENTS

Pharmaceutical Reference Materials

Esters of NSAID
BOOTH 2219

- LGC has added over 150 new esters of NSAID (non-steroidal anti-inflammatory drugs) to its portfolio of pharmaceutical reference materials
- Help in accurate identification and quantification during the user's stability testing projects and QC release testing of NSAID-based finished dosage forms
- Primary standards, impurity standards, and monograph standards from the world's pharmacopoeias also available

LGC Standards www.lgcstandards.com

Standard Reference Materials

NIST
BOOTH 4338, 4339

- Support accurate and compatible measurements by certifying and providing more than 1,200 standard reference materials with well-characterized composition or properties, or both
- Used to perform instrument calibrations as part of overall quality assurance programs, verify the accuracy of specific measurements, and support the development of new measurement methods
- Standard Reference Data Group provides well-documented numeric data to scientists and engineers

NIST
National Institute of Standards and Technology
U.S. Department of Commerce

NIST www.nist.gov

ChIP-seq Kit

Chromatrap® version 1.2
BOOTH 3831 & 3931

- High quality chromatin can now be achieved via sonication or enzymatic digestion and high and low abundant enrichment is possible from small chromatin samples
- Now features improved antibody binding, greater chromatin loading flexibility, and the ability to use increased slurry volumes for difficult samples
- Specifically adapted for broader chromatin concentrations

Porvair Sciences www.porvair-sciences.com

Certified Reference Materials for Cannabis

BOOTH 2538 & 2539

- Include a range of CRMs for all of the common contaminants found in medical and recreational *cannabis*, including pesticide residues, residual solvents, terpenes, among others
- Standard mixes allow the analyst to identify and quantitate a wide range of compounds found in *cannabis* flowers, concentrates, edibles, and tinctures
- Backed by ISO Guide 34, ISO 17025, and ISO 9001 certifications and accreditations

SPEX CertiPrep www.spexcertiprep.com

N-Glycan Analysis Kit

GlycoWorks RapiFluor-MS
BOOTH 3538

- Now comes in a 24-sample format to complement the 96-sample format version
- New format processes 24 samples—eight at a time—and opens the door further to laboratories that want to begin realizing the benefits that RapiFluor-MS brings to glycan analysis
- Labeling reagent yields enhanced MS sensitivity that is 100 to 1,000-fold greater than current approaches

Waters www.waters.com/glycans

INFORMATICS

LIMS

NetSynergy
BOOTH 4160

- Developed exclusively for petroleum laboratories, refineries, and terminals
- Built on a highly stable, secure, and flexible application and database platform that quickly and seamlessly adapts to the unique needs of user's labs
- Can be operated from most browser-based Internet devices including smartphones and tablet computers
- Complete lab data center management service also offered

Camin Cargo Control labdatacentersales.com

Scientific Graphing & Data Analysis Software

Origin
BOOTH 1946

- Allows users to accomplish tasks—including data import and exploration, graphing, analysis, and generating reports—in one application using a point-and-click graphical user interface
- Provides over 100 built-in graph types including 2D, 3D, contour, heat map, polar, statistical, multi-axis, and multi-panel graphs
- Users can automatically update graphs and analysis results by simply importing new data

OriginLab originlab.com

Scientific Information System

UNIFI 1.8
BOOTH 3538

- Merges LC and high performance MS data (both quadrupole and time-of-flight) into a single solution that encompasses data acquisition, processing, visualization, reporting, and configurable compliance tools within a networked laboratory environment
- New features include support of the VION IMS QTof MS System, native APGC control, time-of-flight (Tof) MRM support, support of collision cross section (CCS) data, and Tof quantitative and qualitative workflows

Waters www.waters.com/unifi

LAB AUTOMATION

Autosampler

ASX-560
BOOTH 2531

- Builds upon the reliability of the ASX-520
- Injection molded parts and advanced materials provide better chemical compatibility and keep metal parts away from samples
- Improved pump technology is quieter, easier to maintain, and provides a greater range of flow rates
- Higher resolution positioning allows for 96 well plates
- Customizable for a wide range of automation applications

Teledyne CETAC Technologies www.cetac.com

Sulfur/Carbon Analysis Solution

832 Series
BOOTH 2557

- Provides a versatile solution for any high-throughput lab needing simplified, reliable sulfur and carbon determination in organic samples
- An optional autoloader package provides seamless automation for up to 100 samples for improved walk-away time and minimal maintenance
- Features a high-efficiency combustion furnace, improved IR cell design, and a robust, rugged design

LECO www.leco.com

Interoperability Platforms for Sensors & Automation

BOOTH 625

- Hardware IO interfaces and ScriptML transport language allow multiple types of instrumentation to seamlessly interact as a single system regardless of device vendor, make, or data protocol
- OpenIOLabs system consists of a main controller and IO interfaces (IOI) connected to the user's own instruments
- Provides connectivity for simple sensors and instruments to sophisticated scanning probe microscopes

OpenIOLabs www.OpenIOLabs.com

LIFE SCIENCE

Cooling Blocks

Polarsafe™

BOOTH 1362

- Protect the integrity of valuable cryogenic samples at a lower cost than comparable products on the market
- Adjust from laboratory ambient temperatures to the desired target temperature within a matter of minutes, allowing users to safely transfer samples directly into the cooling blocks with no risk of warming
- Hold 1.5/2.0mL MCT's and cryogenic vials, 0.5mL tubes, and 96- and 384-well plates

Argos Technologies www.argos-tech.com

Cell Density Sensors

Incyte & Dencytee

BOOTH 3419

- Incyte is a capacitance sensor for viable cell density monitoring in bioprocessing
- Dencytee is an optical sensor for total cell density measurement
- These sensors deliver real-time insight into cellular health during a process—data that can be used to optimize product yield and quality
- Can be used independently or together with Hamilton's online pH and dissolved oxygen sensors

Hamilton Company www.hamiltoncompany.com

Lab Suction and Filtration System

Lafil 100

BOOTH 1019

- Provides an innovative suction system for disposal of media from cell cultures and washing solutions from microplates and supernatants after centrifugation
- Portable size allows system to be used in a laminar flow
- Filtration function assists users in doing easy purification of buffers and tissue culture media
- Design can accommodate 50ml and 15ml centrifuge tubes and funnels for small volume filtration

Rocker Scientific www.rocker.com.tw

Growth Chambers

BOOTH 1124

- Include greenhouse, reach-in, and walk in models
- Ensure the desired programmed values for temperature, humidity, lights, CO_2, or any other gas, are accurate to maintain a stable experiment environment
- Stability chambers and water baths also available

TAIWAN HIPOINT www.twhipoint.com

SUPPLIES & CONSUMABLES

Sample Storage and Retrieval Vials

ACCUFORM© SSR™

BOOTH 1631

- Designed for scientists who require reliable storage, retrieval, analysis, and delivery of valuable liquid or powder samples
- Engineered for consistent high performance in laboratory automation equipment, these vials will help minimize expensive downtime
- Feature smooth, conical interior surfaces, with less than 10uL of dead space
- Smooth exterior bottoms are especially suited for barcoding

Kimble Chase www.kimble-chase.com

Couplings

30AC Series

BOOTH 822

- The first small all-plastic series couplings
- Offers the same 1/8" flow size as the 20 Series but is more reliable with less moving parts due to its advanced design with no external springs
- Cost efficient all plastic thumb-latch design makes an audible click when coupled to ensure a secure connection

LinkTech Couplings www.linktechcouplings.com

Couplings

60PP-Black Series

BOOTH 822

- Offer 3/8" flow size and are produced from medical grade, gamma-sterilizable, UV-resistant polypropylene
- Solid "Black-out" color allows the ability to color key applications, as well as makes these couplings more resistant to UV radiation due to its already advanced raw material capabilities
- Available in both valved and non-valved configurations

LinkTech Couplings www.linktechcouplings.com

Laboratory Glassware, Plasticware, & Instrumentation

BOOTH 1132

- MEDILAB is a consortium of manufacturers of laboratory glassware, educational labware, general labware, scientific instruments, plastic labware, microscopes, and anatomical models
- Consortium specializes in scientific glass blowing and offers a wide range of interchangeable glassware, volumetric glassware, condensers, assemblies, PTFE stopcocks, joints, stoppers, sintered glassware, flasks, etc.
- Custom options available

MEDILAB www.medilabexports.com

Precision Ceramic Components

BOOTH 4425

- Used in the harsh environments where other materials like plastics and metals are not usable
- Offer electrical insulation against high voltages and currents, thermal dissipation or insulation, wear and corrosion resistance, and are also compatible with ultra-high vacuum
- Available grades include alumina, zirconia, aluminium nitride, silicon nitride, silicon carbide, quartz, glass, and Macor

Microcertec www.microcertec.com

IVD Products

BOOTH 3524

- Minitubes draws its own tubing and is therefore able to provide the customer with smooth ID, low variation in ID, and OD dimensions in almost any metal material
- Allows improved precision in sampling for seamless capillary tubing, needles, and other tubing used in LC/GC and UHPLC
- Minitubes has also developed new equipment for cleaning and testing of tubing

Minitubes www.minitubes-usa.com

Nano-Capillary Tubing

BOOTH 2333

- Used in a wide range of analytical applications, encompassing GC, CE, capillary LC, and CEC
- Polymicro now offers five standard nano-capillary size ranges (200 – 1000nm ± 100nm)
- 25 standard products with internal diameters (ID) of less than 50 µm are also available, with six of those having ID tolerances of ± 1 µm

Polymicro Technologies www.molex.com/polymicro

FKM White Tubing

BOOTH 1818

- Manufactured from one of the latest specialty types of fluoroelastomer with advanced polymer architecture
- Provides excellent chemical resistance to acids, alcohols, fuel, aliphatic, aromatic hydrocarbons, and commercial cleaning fluids
- Compared to traditional Viton® tubing, this flexible tubing provides an extended pump life of 300-750 hr at 0 psi, reducing downtime due to pump failure

Saint-Gobain www.labpure.com

FEP Bags

LabPure®

BOOTH 1818

- Offered for research and industrial applications in six sizes, 25 to 1,000 ml
- Have exceptional properties including inertness, purity, and chemical and temperature resistance (-200°C to +200°C)
- FEP material is USP Class VI certified with excellent biocompatibility, animal derived component free (ADCF), and very low extractables
- Offer the ability to close the system through non-DEHP, ADCF Tygon® tubing

Saint-Gobain www.labpure.com

Micro Valves for LC and GC

BOOTH 2019

- Feature a unique design of the fitting that allows a leak-free seal with no potential for rotor damage from overtightening
- The ¼-28 fitting details permit use of 1/16" or 1/8" OD tubing
- Specifications are 200 psi and flowpath is .060" (1.5mm)
- These panel-mount, manually operated valves have three configurations with seven different flowpaths

VICI www.vici.com

Sample Extraction Products

Oasis PRiME HLB

BOOTH 3538

- This next-generation solid phase extraction (SPE) family of products provides cleaner samples in less time and with less effort for LC and LC-MS analyses
- Cartridges and multiwell plates simplify and speed up extraction protocols to ensure consistent, reproducible LC and LC-MS results
- Allow labs to process samples up to 40% faster

Waters wvmc.waters.com/prime

ADAM EQUIPMENT'S NEW ECLIPSE BALANCES OFFER A UNIQUE WEIGHING EXPERIENCE FOR LAB PROFESSIONALS

With its elegant capacitive touch keypad, large display and a full spectrum of advanced features, the new Eclipse range of balances from Adam Equipment aligns precision and performance.

The Eclipse boasts a clever design and compact footprint, occupying minimal space on the bench. The full series of analytical and precision balances offers capacities up to 32,000g and readabilities starting at 0.0001g (0.1mg). Precision models with 0.001g readability have a removable drafts shield. Analytical models have a glass-enclosed weighing chamber that can be disassembled for cleaning.

The Eclipse is available with internal and external calibration; select precision models are available with a pillar. All models have an extruded, single-piece metal base, which offers greater strength and balance stability for highly repeatable results.

The capacitive touch keypad contains color-coded keys, which enable uncomplicated navigation of the functions. Operating with a feather-light touch, the keys respond readily, even to latex-gloved fingers. Illuminated keys guide users through tasks, highlighting selectable buttons. The keypad's smooth surface allows fingerprints to be wiped off easily.

Featuring one of the largest LCD readouts in the industry, the Eclipse displays 24mm-high white digits on a deep-blue background, ensuring ultimate visibility. A second line shows text prompts, instructions and any other relevant information. Clear, discernable symbols and multi-lingual text enable easy operation, while prompts simplify even the most complex activities.

The Eclipse achieves connectivity with precision and speed, whether it's basic data printing or advanced communication with a LIMS system. Printouts with time, date, and other information are provided to comply with GLP requirements. USB and RS-232 interfaces optimize connections, while a third interface allows use of an optional remote display.

Movement such as vibrations, air currents or objects shifting on the pan can result in inconsistent readings. The Eclipse is outfitted with a dynamic weighing mode and digital filter settings to help improve measurement accuracy. Below-balance weighing allows density measurement of both liquids and solids. The capacitive touch keypad guides users through the process, while built-in software calculates results.

The Eclipse offers a wide range of weighing units to facilitate numerous lab applications. Users can program a custom unit for more complex unit weight calculations. Illuminate your lab with the Eclipse.

ADAM®
PERFECT BALANCE
Speed, Performance, Value

Adam Equipment Inc.
www.adamequipment.com

HANNA INSTRUMENTS' AUTOMATIC TITRATION SYSTEMS

Personalized Titrator, Personalized Service

Hanna Instruments provides immediate answers and support to all titration questions before and after the sale. Hanna understands industry needs, so the titrator(s) will be configured to your specific requirements and you will be trained and consulted on the most efficient use of the titrator.

The Hanna HI902C automatic titrator is designed for fast, accurate, and efficient titrations at the best price for its features in the industry. The HI902C potentiometric titrator performs acid/base, redox (ORP), complexometric, precipitation, non-aqueous, argentometric, ion selective, and back titrations, as well as titre determinations.

New upgrades have made the HI902C titrator even better through improved security settings, increased measurement options, and advanced automation. Hanna's Personalized Titrator and Personalized Service will deliver cost savings, great customer service, and accuracy which you require.

Security and Traceability

Users can adhere to traceability requirements through password protection. By setting a PIN code, the HI902C is protected from unauthorized method manipulation and data deletion. Operators can perform programmed titrations in a safe and secure data environment. Those companies with strict Quality Assurance Programs will have peace of mind that methods and data are secure.

Flexible Measurements

The Hanna HI902C is not only an automatic titrator, but also a pH, ORP, and ion selective(ISE) meter. Save space and easily manage results and data with a single unit. A single sample can be used to analyze two parameters simultaneously.

Automated Productivity

Skip manual measurement and additional steps. The 40,000 step pump will precisely add reagent to a sample prior to titration or direct pH/ORP/ISE measurement. This increases repeatability while decreasing human error. The complete measurement cycle is now performed with a single push of a button. That means greater productivity elsewhere.

Linking Methods

The Hanna HI902C automatic titrator gives you the option to perform two analyses on a single sample automatically. Two titration methods like acidity and salt for food analysis can be linked together; or a pH/ORP/ISE measurement can be linked to a titration method. This speeds up testing time, improves accuracy, and reduces sample waste.

Titration Sequencing

The HI902C can be paired with the Hanna HI921 autosampler, which can manage up to 18 samples automatically. The increased efficiency cuts down on operator time while automating the process. The same accuracy standards are maintained with higher sample throughput. Whether you are doing single or multiple end-point, linked analyses, or back titrations the Hanna titrator and autosampler will deliver accurate and repeatable results.

HANNA® instruments

Hanna Instruments, Inc.
www.hannainst.com

NOR-LAKE® SCIENTIFIC -86°C SELECT™ ULTRA-LOW UPRIGHT FREEZERS

Designed to meet the demanding requirements for scientific and laboratory research. Advanced engineered design incorporates the latest in cabinet, refrigeration, temperature control and monitoring features. Provides energy efficient, convenient, safe and reliable performance for optimal storage temperature environments necessary for a wide range of life science, pharmacy, biological, medical, clinical, and industrial applications.

CONSTRUCTION

- CFC free polyurethane cabinet and door foam insulation.
- High-impact, smooth scratch and corrosion resistant painted exterior and smooth white painted interior, provides attractive appearance and easy to clean surfaces.
- Interior and exterior of the freezer cabinet are white painted galvanized steel.
- Combination cabinet mounted multi-bulb and door perimeter gaskets provide multiple points of door sealing. Ensures reliable frost resistant performance and enhances energy efficient cold performance for long term sample security and storage.
- Interior doors (5) independent hinged steel inner doors are constructed of insulating material with magnetic catch and easy pull handles. Reduces cold loss during door openings and sample retrieval.
- Five internal storage compartments with four heavy duty reinforced stainless steel shelves. Shelves are adjustable in 1 inch increments. Compatible with optional stainless steel storage racks, fiberboard boxes and dividers for multiple storage needs.
- Multi-feed patent pending cold wall evaporator design provides superior refrigerant flow and maximizes cooling power by ensuring that the evaporator is always 100% in contact with the freezer wall, maximizing cold transfer into the freezer and heat removal from the chamber.

SELECT™ CONTROL SYSTEM

- Advanced PLC (programmable logic) microprocessor controller (door mounted eye level display and interface) includes real time clock, event logging alarm history, advanced alarms, alarm-test, and memory functions.
- Password protection (2 levels, setpoints and parameters) security for power, temperature and alarm settings.
- Key pad, multifunction, menu driven, LCD display for trouble free access on monitoring of all control features.
- Temperature adjustable in 0.1°C increments. Temperature display to 0.1°C increments.
- Control probe located in rear wall bottom left corner for optimal and accurate temperature measurement and control.

SELECT™ REFRIGERATION SYSTEM

Nor-Lake Scientific's Select™ Refrigeration system ispowered by an advanced low noise high performance cascade refrigeration system using two next generation 1 HP hermetically-sealed compressors.

Exclusive engineered super capacity (tri-tube) capillary tube system delivers refrigerant on demand matching with advanced heat exchangerdesign providing optimal heat removal and superior low temperature performance.

Evaporator design enhances refrigerant flow increasing the overall efficiency, temperature uniformity and recovery performance.

Air cooled condenser, high capacity with large surface area. Washable condenser filter maintains optimal efficiency and performance.

NORLAKE SCIENTIFIC®

727 Second Street
Hudson, WI 54016
800-477-5253
www.norlakescientific.com

PolyScience

For 50 years, PolyScience has been the market leader in liquid temperature control equipment. From un-stirred and circulating baths to industrial-sized chillers, PolyScience has the perfect, precise and reliable solution for your needs.

POLYSCIENCE TEMPERATURE CONTROL SOLUTIONS

In laboratory settings, there are many applications that require temperature control: from GC-MS to rotary evaporators, from plasma thawing to electrophoresis. PolyScience provides solutions for them all.

Our award-winning line of circulating baths introduces a multitude of features new to the market, including touch screen displays, the patent-pending Swivel 180™ rotating controller technology and LidDock™ lid docking system. Not only do these circulating baths enhance work flow and ease of use, they bring with them a new design aesthetic and are perfect for freezing or thawing or cooling equipment such as spectrophotometers, rotary evaporators, and Peltier devices.

90 Circulator models including:

- Refrigerated/Heated, Heated-only, and Immersion
- six controller options
- various communication protocols
- reservoir sizes from 6 to 75 liters

General purpose water baths provide heating required for thawing plasma or frozen samples or even warming culture media. With the see-through gable cover, flasks and other tall sample vessels are accommodated, while the lid tilts out of the way, allowing condensate to drain back into the bath.

PolyScience Recirculating Chillers provide circulated cooling for incubation water jackets, electron microscopes, and larger distillation systems. With different sizes and cooling capacities, the PolyScience Benchtop and 6000 Series Chillers fit your lab needs.

PolyScience also manufactures a wide range of specialty products including:

- histology products
- calibration baths
- viscosity baths
- 75 and 190 Liter Refrigerated Baths for accelerated beverage aging studies

So whether you're in a life science lab or a quality control lab, PolyScience can meet your temperature control needs.

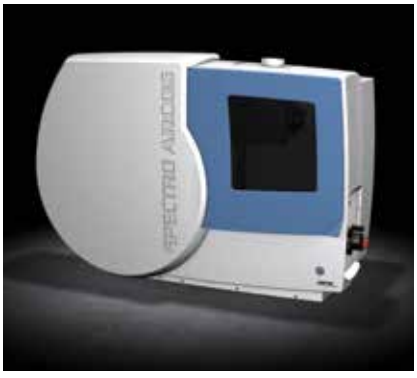
For more information, visit: www.polyscience.com

PolyScience®
Temperature Control Solutions

www.polyscience.com

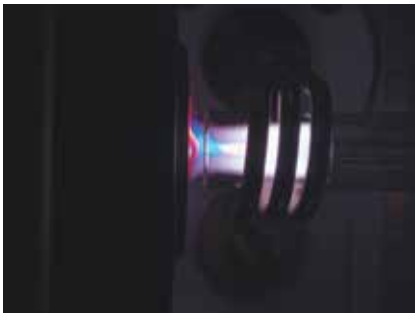
THE NEW SPECTRO ARCOS — ICP-OES FOR THE MOST DEMANDING ELEMENTAL ANALYSES IN INDUSTRY AND RESEARCH

The new SPECTRO ARCOS analyzer represents a new pinnacle of productivity and performance for inductively coupled plasma optical emission spectrometers. It's a worthy successor to previous industry-leading ARCOS models — and the capstone to more than 30 years of SPECTRO experience in producing the world's leading ICP-OES instruments. The ARCOS design ensures exceptionally low operating costs over a long, reliable service life. It packs a modern, ergonomic chassis with proven features such as no-purge UV-PLUS sealed gas purification technology, no-external-cooling OPI-Air interface, simplified sample introduction, and easy accessibility for service and maintenance. Best of all, SPECTRO ARCOS delivers unmatched optical performance, with its recently unveiled MultiView technology.



MULTIVIEW MAKES IT TWO INSTRUMENTS IN ONE

The new SPECTRO ARCOS with MultiView technology eliminates plasma-viewing compromises and revolutionizes spectrometer design. ARCOS provides uncompromised axial-view and radial-view plasma observation in a single instrument because MultiView is truly axial, truly radial, and totally radical. The periscope-free design means operators now can literally "turn" a radial-view instrument into an axial-view device, or vice-versa – in 90 seconds or less! Users get full axial sensitivity and full radial precision — with no dual-view compromises. A new white paper in the SPECTRO ARCOS Resource Center explains why the plasma interface is so important for analytical results.



ENGINEERED TO PROVIDE THE LOWEST COST OF OWNERSHIP

Eliminates costly gas purging

Innovative SPECTRO ARCOS eliminates the waste and expense required by conventional instruments that must consume and purge gas on a constant basis. Its unique sealed, no-purge optical technology saves thousands of dollars each year – about $3,800 per year – versus ordinary spectrometers. That's because its UV-PLUS sealed optical system is permanently argon-filled. ARCOS re-circulates gas through a small cleaning cartridge that typically will last for up to 2 years. Users can start and stop the instrument at will and the result is highly stable analysis and excellent low UV performance without purge waiting or delays at startup.

Eliminates costly, complicated, external cooling

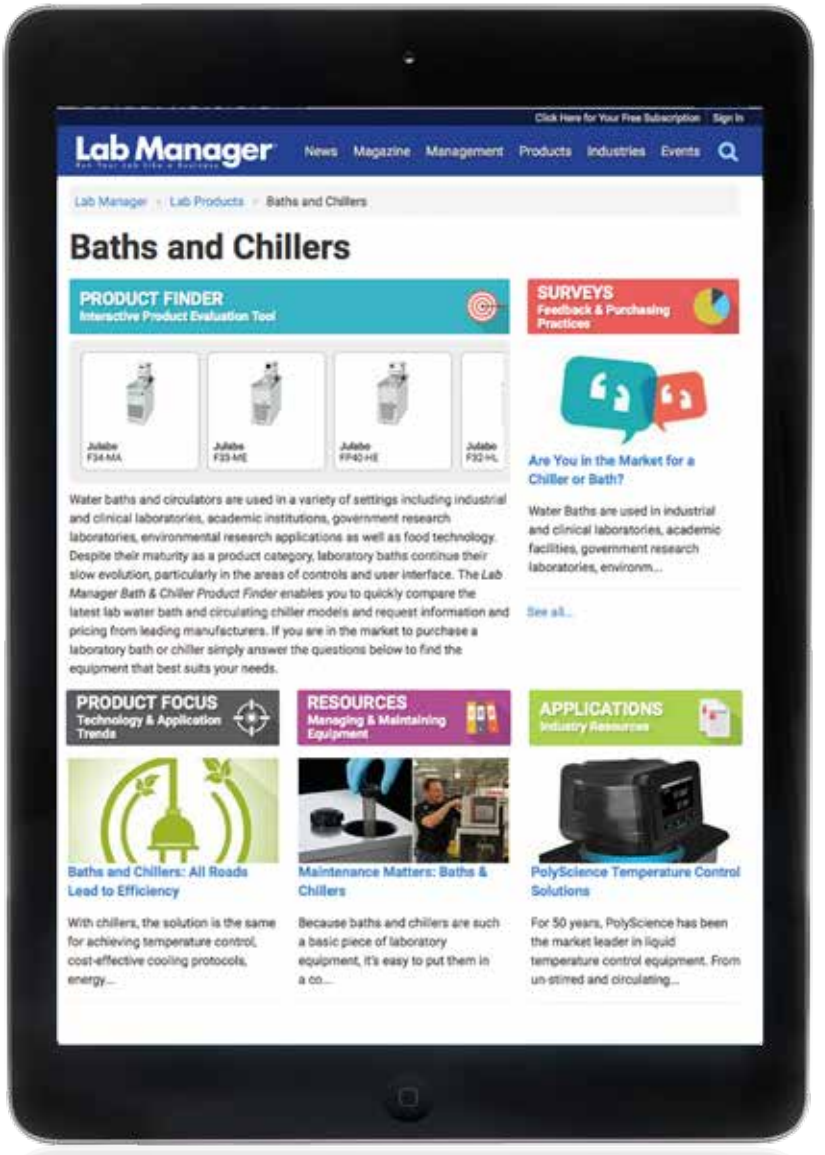
Plasmas generate quite a bit of heat and traditional ICP-OES instruments require an external cooling system. These water-based chillers are expensive, complicated and can represent a significant headache. They're prone to internal leaks, which can cause corrosion and failure of expensive instrument components and few chillers outlast their spectrometers. A separate chiller purchase may total as much as $5000. And energy costs, for this power-hungry component, can boost utility bills for the life of the instrument. SPECTRO ARCOS integrates innovative, patented air-cooling technology that's very simple in conception. The instrument generates inherently less need for cooling than conventional designs so it saves the cost of the chiller, higher continuing energy costs, and it eliminates leaks and corrosion while reducing maintenance and downtime.

There's much to learn about this amazing new instrument. Visit the SPECTRO ARCOS Resource Center for white papers, webinars, product brochures and more.

SPECTRO

AMETEK®
MATERIALS ANALYSIS DIVISION

SPECTRO Analytical Instruments Inc.
91 McKee Drive, Mahwah, NJ 07430 USA
+1.800.548.5809 | **www.spectro.com**



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

PMB: THE RIGHT MOISTURE ANALYZER FOR CONNECTED LABS

Adam Equipment's PMB surpasses the connectivity capabilities of other moisture analyzers.

- A USB host and RS-232 interface provide data connections
- An additional USB port accommodates a flash drive for storing test programs and collecting data
- Automatic test-setting enables easy recall for frequent, repetitive testing

Two models are available to meet most moisture analysis needs in the lab: PMB 53 provides results at 0.01%/1mg with a capacity of 50g, while PMB 202 provides results at 0.05%/10mg with a capacity of 200g.

Contact: Adam Equipment Inc.
www.adamequipment.com

ADAM
PERFECT BALANCE
Speed, Performance, Value

AUTO SERIES PRESSES

Carver's Auto Series automatic hydraulic laboratory presses feature the enhanced "NE" control system. Offering 15 to 48 tons of clamping force and 6" x 6" to 19" x 19" platens, these benchtop presses are used in quality control and research and development for test sample preparations, destructive testing, molding, laminating and fluid extraction. The "NE" controls feature full touch screen interface, proximity switch for adjustable slowdown position and all heat controlled through PLC and interface. ISO 9001:2008 certified.

Contact:
Carver, Inc.
Booth No. 2011
Phone: 260-563-7577
www.carverpress.com/benchtop_auto_standard.html

CARVER

Custom BioGenic Systems offers a *"Complete Solution"* for freezing and storing cell lines and biologicals.

Controlled Rate Freezers
A Controlled Rate Freezer produces a better product and better results, reproducibility, documentation and aids in compliance with 21 CFR part 11.

Inventory Control
Custom BioGenic Systems manufactures freezer racks for all types of freezers.

Long Term Storage
Our patented Isothermal liquid nitrogen freezers are known worldwide for providing safe, dry, liquid nitrogen storage without liquid nitrogen contact.

Remote Asset Monitoring
VersAlert offers wireless and hardwired remote asset monitoring solutions.

Contact:
(586)-331-2600
www.custombiogenics.com

STOP FUME HOOD FIRES WITH FIRETRACE!

Firetrace systems have been protecting fume hoods against the risk of fire for more than two decades.

A Firetrace system will automatically detect and suppress a fume hood fire in seconds before it can become a threat to life and property.

Keep your lab in compliance with NFPA 45 – call Firetrace today.

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Firetrace International
1-866-607-1218
www.firetrace.com

FIRETRACE
POWER TO INNOVATE. FLEXIBILITY TO ADAPT.

CELEBRATING 20 YEARS! PLUS FREE SYSTEMS GIVEAWAY!

GenTech is proud to celebrate its 20 Years of success and growth! Without our outstanding employees and amazing customers we would not be where we are today. We are grateful to our customers who have allowed us to serve them these past 20 years. To mark GenTech's anniversary this year we want to celebrate by giving away three FREE systems. Enter to win a refurbished Thermo LTQ Orbitrap, Agilent 6890/5973 GC/MSD or an Agilent 6890 GC for your lab at **www.gentechscientific.com/anniversary**.

Contact: GenTech Scientific
www.GenTechScientific.com
585-492-1068

PREVENT HAZARDOUS SPILLS IN THE LAB

The Sonic Reservoir Sensor System is used in labs to measure levels of solvents and liquid waste used in unattended LC separations in real time. A sound wave transmitter in the reservoir's cap accurately measures the solvent level in the 1L reservoir or waste container. This provides safe, unattended operation by automatically sending a signal to stop the pump when LC solvents get low or to switch a valve to continue analysis without interruption. It safeguards the loss of valuable samples and analysis time while preventing the waste container from overflowing and creating a hazardous spill in the lab.

Contact: JM Science, Inc.
www.jmscience.com

JM SCIENCE

LABCONCO SCRUBAIR™ PIPETTE WASHER/DRYER: SAVES WATER, TIME, MONEY

The ScrubAir Pipette Washer/Dryer requires 98% less water and 85% less time to use compared to traditional siphon washing and oven drying. Wash, rinse and dry up to 60 pipettes in just 3.25 hours. The ScrubAir's standard wash cycle uses only 12.5 L of water, compared to 600 L used with a siphoning method.

- Saves water, time & money
- Automated, requires far less glassware handling than traditional methods
- Fast and thorough cleaning with percolating action
- Programmable cycle settings including delayed start

Demonstration Monday, March 7 at 12:30pm in Demo Space 2.

Contact: Labconco Corporation
Labconco.com/contact

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Formerly from m-u-t, the Sarstedt HCTS2000 MK2 accessions and sorts up to 2000 closed primary sample tubes per hour to 7 user-defined target bins. Optional extension modules add 5 bins each for up to 22 targets. Tubes can be loaded and unloaded without interruption. Users can select 10 different sets of sorting rules, and the HCTS2000 MK2 can sort with or without LIS connection. The HCTS2000 MK2 is compatible with a broad range of tubes, regardless of manufacturer.

Contact: Sarstedt, Inc.
www.sarstedt.com

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MARKETPLACE

LAB MANAGER ONLINE

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

1 *Lab Manager*'s 2015 Year in Review

This past year saw a number of changes for *Lab Manager*. We look back at our biggest moments from each month in 2015. We started the year off with a bang when we released a new look for the magazine and ended things with a redesigned navigation bar on our website for a better user experience.

Read more at **LabManager.com/2015-review**

2 Trending on Social Media: Planned Pipette Care

As of January 5, *Lab Manager*'s top December issue article posted to Facebook was our Product Focus on Planned Pipette Care. In this article, manufacturers shared their most important tips for keeping your pipettes in top working order, including keeping the instruments clean and calibrated.

Read more at **LabManager.com/pipette-care**

3 Most Popular Webinar

Last month's top webinar on LabManager.com with 462 registrants was "Be the Ringmaster of Your Work and Life," presented by Jones Loflin. This presentation shared how to take more conscious control of your time. Though it ran December 2, you can still catch it on demand at the link below.

Read more at **LabManager.com/ringmaster**

LabManager.com

NEXT ISSUE ➡

Government Regulations

Like death and taxes, government regulations in the lab are inescapable. Our March cover story will look at the impact of those regulations from a lab manager's point of view. How do they impact the day-to-day running of the lab; who manages/monitors regulatory compliance; and what are some best practices?

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