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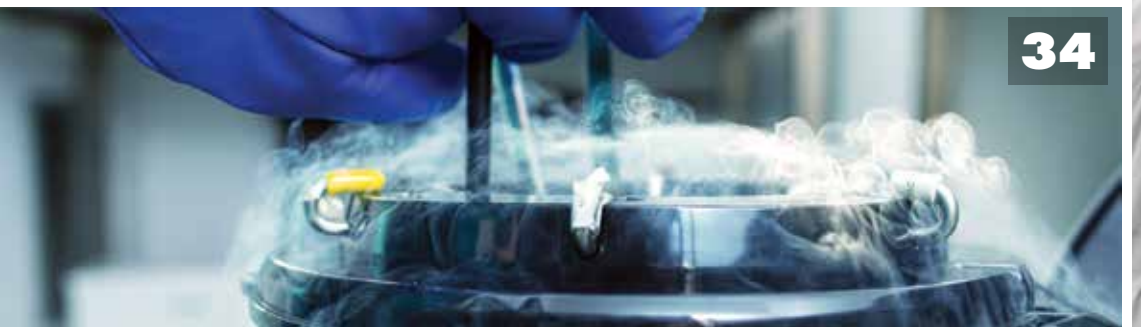

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A VERY *LAB MANAGER* CHRISTMAS

With the holiday season not far off, the *Lab Manager* team is thinking about ideal gifts for lab managers. As a lab manager, what would your ultimate gift be? A key instrument for the lab? Maybe something fun to brighten up your workspace? And, since the holidays are about more than just gifts, what are you most thankful for as a lab manager? Feel free to take a few moments to share your thoughts with us! Responses will be shared in a lighthearted feature in *Lab Manager*'s December issue. Please send your feedback to leverett@labmanager.com.

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STIRLING ULTRACOLD

the bottom line

Without financial support and responsible budgeting, even the most innovative, state-of-the-art laboratory cannot function long term. For this issue, our feature articles have a common theme: money. Whether you're crunching numbers to compare the pros and cons of purchasing used versus new equipment, or you're evaluating the potential benefits of implementing a "greener" design into your lab space, money and profitability will always have an impact on the decisions you make as a lab manager.

This month's cover story focuses on the business aspect of leading a laboratory. Author Bernard Tulsi notes, "At a fundamental level, all lab leaders grapple with the management of their most valuable and least abundant resource: time." As the old saying goes, "time is money" and according to a McKinsey & Company survey cited in the article, the vast majority of managers are not satisfied with how they spend their time. In addition to time, there is a variety of key performance indicators (KPIs) that lab managers can track on a regular basis to gauge the lab's overall success. Examples of KPIs include turnaround time, quality, and productivity. There's also equipment maintenance, new instrument purchases, staff training, and many other elements to be mindful of. Luckily, there are new tools available to help ease the burden of continuous resource management. Turn to page 10 to learn more about how to implement these tools and strategies into your lab.

Continuing with our money-themed issue, our Business Management article on "Negotiating Service Contracts" offers great advice on what to look for when choosing a service plan. With some research and strong negotiation skills, you can minimize unexpected costs and receive quality instrument protection for years to come.

Recruiting new talent is a crucial part of ensuring a productive, successful laboratory. However, retaining quality new hires for the long term is even more important, as high turnover rates can be costly and incredibly time consuming. The first step to ensure that new hires feel they made the right choice in joining your team is through an effective, personal onboarding experience. Traditionally, the onboarding experience can be dry and mundane for new hires. Our Leadership & Staffing article (page 26) discusses ways to make onboarding more engaging and valuable for both the new hire and for your lab as a whole. Provide an interactive tour of the facility, allowing the new hire to meet different departments and get a better idea of the overall mission of the lab and how they will contribute. Get to know them beyond their technical skills, and ask for their input—new employees can offer a different perspective that existing team members have not considered.

In the first of our new Lab Design features, we discuss what exactly a "sustainable lab" is, and how to achieve it. As lab design editor MaryBeth DiDonna says, "Labs are energy hogs, and increased energy usage means higher utility bills—such as water, electricity, ventilation—and higher overall building budgets." So, how can you improve your lab's footprint while saving money? Turn to page 30 to find out.

Best,

Lauren Everett
Managing Editor

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MANAGING RESOURCES

EXPECT THE UNEXPECTED AND BUDGET FOR IT

by Bernard Tulsi

To thrive in the current business environment—with substantial fiscal, human, and technical resource constraints along with lurking supply chain questions—laboratory leaders seek to drive growth in their operations via enhanced individual and organizational performance, and optimal resource management.

At a fundamental level, all lab leaders grapple with the management of their most valuable and least abundant resource: time. A recent McKinsey & Company survey of 1,500 executives reported that only nine percent were *very satisfied*, less than 50 percent were *somewhat satisfied*, and about 33 percent were *actively dissatisfied* with how they spent their time. Overall, the McKinsey report notes just more than half of the respondents considered their use of time in step with their organizations' key priorities.

Among the key prerequisites for aligning organizational priorities and goals are the availability of staff with adequate skills and training, easy to use software, appropriate mechanisms to share uptime, reliable electronic access to data relevant to internal needs and for reporting to regulatory agencies, says Patrick Martell, director of global services, Waters Corporation (Milford, MA).

Richard Chee-a-Tow, director of laboratory operations, Dynacare (Brampton, Ontario) says, "Typically, at a high level we track key performance indicators (KPIs) on a day-to-day basis. These include turnaround time, quality, and productivity, which is likely the case in most labs." He says that at a more granular level, "We track equipment costs, both new equipment and ongoing maintenance, materials, research and development, and staff training, among other relevant areas."

"To ensure that a KPI such as turnaround time is on track, we have to ensure that we have adequate resources, that workflows are optimized, that uptimes are guaranteed by ensuring that vendors are in place to ensure that maintenance is done properly and on schedule," says Chee-a-Tow. Jean-Francois Dion, senior manager, operations, laboratory sciences at Charles River Laboratories says, "We are keeping track of many KPIs in our laboratories but the most important resource is our people. It is very important to have a precise picture of human resources (HR). Each week we review upcoming vacation schedules, sick leaves, maternity and paternity leaves, etc." Emphasizing the critical need to ensure that vital laboratory talent are engaged and nurtured, Dion says, "HR management is key in successfully bringing in talented people and keeping them motivated by providing opportunities to acquire new skills and career growth.

"We have a strong training program to make sure that we support the development of new employees. We also try to keep employees cross-trained between different techniques and departments, with the ultimate goal of having the right talent at the right place."

A number of tools are now readily available for the improvement of resource management. Martell says that one

of Waters' strongest resource management tools is Empower Chromatography Software, which has an embedded database, inherent product data management, analytical tools, and the capacity to accommodate some add-on options that Waters offers to customers. The tool can help to determine system utilization, the number of runs performed on different systems, usage levels of different instrumentation systems, and help to develop maintenance schedules, according to Martell. He says a complimentary Waters tool, Empower Driven Services 365, also provides users with access to critical systems information, help with monitoring utilization, managing resources, identifying training needs, flagging needs for improvements, and help with laying the groundwork for future capital projects. Dion says, "We have a dedicated group specialized in the maintenance and repair of our fleet of instruments. They take care of all the preventive maintenance of all our equipment. Instrumentation in excellent condition is one of the key factors to run the operations of the laboratory smoothly. We also have a dedicated team who is responsible for keeping accurate inventory of our consumables, their availability in all our laboratories, and they control our ordering so they can quickly make adjustments when needed.

"This group is also responsible for all the other reagents used in our laboratories; they communicate backorders with the scientific and technical staff and work with them to identify alternate solutions. They follow the shipments, unpack, identify, and log, keeping our inventory consistently updated. We have thousands of different reagents in our inventory and it is always growing. By the nature of our work, we are always working on developing new techniques and different assays."

"The key is the communication and collaboration between the scientific staff and the technical staff. We have developed a system that allows all the needs from our scientific staff (around 100 scientists in nine different specialties) to funnel to our team of laboratory specialists," says Dion. "Unexpected costs usually come from assays that fail and need to be repeated. Some kits and reagents can be very expensive, added to the scientific and technical hours wasted in repeating assays. The supervisor of each area keeps a close eye on the success of each assay within their group, and when a failure occurs, an investigation is done with the analyst who performed the assay and the scientist in charge of the project." A weekly report is generated with all the information about the investigation, project, assay type, method, cause of failure (reagent issue, technical oversight, scientific oversight, instrumentation failure, etc.), he says. "With all this information in one report, we can identify trends and act rapidly upon them," says Dion.

Proper control of financial resources is critical. Martell notes that labs generally have capital budgets for expansion or to upgrade their equipment along with their operating budgets, which cover current expenses such as service support, consumables, reagents, solvents, and software—all of which require careful planning and control. This requires labs to track information on their run rate and spending rate and manage accordingly, including the judicious use of outsourcing and using cloud-based systems to manage data of all stripes.

Dion sees budgeting and financial management as challenges that are important in the success of operations. "Budgets need to be forecasted at least a year in advance, including which instruments we will need or need to replace, so it is very important to plan the cost of the validations that will be required prior to implementation."

Among the key issues to evaluate, Dion cites, "How many people, and what skill set will be required to perform the upcoming work? Do we want people just out of school or with more experience? There are specific periods for that kind of recruiting. What will be the side cost of the recruitment, travel, interview, training, etc.? We try and do as much advanced planning as possible to anticipate all costs that may come up in a year. The more we're able to plan, the more we are able to stay within our designated budget."

Offering some pointers on avoiding pitfalls to other lab leaders' counterparts, Dion says, "The most common pitfalls are a result of miscommunication. Tracking and communicating financial, performance, production, and quality KPIs along with a good vision of your long-term schedule can save you from some pitfalls (e.g. the commitment for a large amount of work to [be accomplished] in a short period of time without confirmation of abilities of operations to deliver on time).

"That can easily happen when you work in silos and it is often the case in big laboratories. There is so much to consider in advance for the success of a project, many different contributors will have to share their expertise, but clear communication between them is key to avoid pitfalls," says Dion.

Martell says that a number of the labs he interacts with pay close attention to legal questions associated with the

protection of intellectual property, ensuring proper compliance protocols in keeping with regulatory requirements. He notes that labs strive to ensure data compliance and integrity, and in the case of clinical and diagnostic labs, they want to ensure that they have clearance for the tests they are conducting and maintain proper assays for regulatory reviews. He says that lab managers always have to be conscious of their investments, and must be aware that this means more than getting systems into the lab. Other key requirements include ensuring that staff and operators are properly trained and the effective standard operating procedures and work processes are in place. "These are essential, and every bit as important as what kind of equipment the lab purchases," Martell says.

Budgets can be used up quickly without a plan with a horizon of several years, and a firm grasp on questions like "what are we trying to accomplish, what are we trying to get to, what tests and equipment are needed and what are the assays, and what type of backup might be needed," Martell says.

In the future, Martell sees more connected products. He says today there are backup systems that ensure operations do not stall and undermine productivity when systems go down, noting, however, that is a reactive approach that costs money. "What we are seeing now, and what we are trying to work on and optimize is to turn this into a proactive process so that we and our customers will know when the systems will need attention based on trending information from sensors provided to customers." He says that the idea is to bring more information via greater integration, "so that no application is an island," that will drive productivity and growth.

Increasingly, as more software applications reside in the cloud, customers are able to reassess how they invest in and manage software applications. Martell says technology impacts business processes, and is some cases may enable the conversion of items slated for funding via capital budgets into operating expense budgets, which could better align productivity to actual spend.

He says these are the kind of situations where technology is enabling and impacting some of the financial considerations around resource acquisition and management in the labs of some of his organization's customers today.

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Multi-Vendor Services

Value, Selection, and Tips for Implementation

ADHERING TO A THOROUGH SELECTION PROCESS ENSURES A SMOOTH TRANSITION TO A MORE EFFICIENT LABORATORY **by Michelle Dotzert, PhD**

No matter the scale of the laboratory or the field of research, implementing tools and strategies to optimize efficiency yields short- and long-term benefits. Essential to improving efficiency is asset management, which now extends beyond basic maintenance and repair, to encompass calibration, redeployment, disposal, and the information-rich realm of analytics.

Perhaps the most well-known reason to work with a multi-vendor service provider is for equipment maintenance and repair services. Implementing routine maintenance schedules with multiple original equipment manufacturers (OEMs) and vendors may become inefficient and costly, whereas a multi-vendor service provider offers a comprehensive, efficient solution. These providers employ highly trained technicians and engineers, capable of servicing equipment from a wide range of manufacturers and serving as a single point of contact for the laboratory.

Contracting a third party for maintenance and repair services also minimizes the downtime that occurs when instruments are offline. Without a dedicated service provider, service calls may have a prolonged wait time, hindering productivity and requiring laboratory personnel to redirect their focus from analytical work to troubleshooting. Whereas with enough volume, some service providers are able to assign the lab an individual technician who may arrive onsite within 24 hours of a call. To further reduce potential downtime, many of these services maintain a local parts inventory to eliminate shipping delays.

While a multi-vendor service contract is a valuable consideration for laboratories operating numerous relatively low-value, frequently used instruments such as ovens and centrifuges, it is an especially worthwhile investment for labs with high-value, sophisticated instruments. Routine maintenance and calibration, and rapid repair services ensure minimal downtime to maximize output and return on investment for such high-value assets.

Regularly scheduled maintenance also supports labs seeking to achieve or maintain compliance, and various services employ standardized protocols, and provide secure, tamper-proof reports. This is especially valuable during audits, eliminating the added complexity of working with multiple technicians and different protocol standards. An added benefit is the consolidation of calibration and maintenance records by the service provider, rather than individual documents for each instrument and manufacturer.

Many providers begin by compiling a complete inventory of laboratory equipment, along with its location in the laboratory, as well as across multiple laboratory sites. With enhanced data and analytics capabilities, some companies now offer customers valuable data pertaining to asset usage in addition to tracking and inventory. These data are invaluable for asset management, specifically to inform decommissioning, redeployment, and acquisition. Lab managers and principal investigators can refer to an instrument's usage and service history to determine whether an instrument should be decommissioned (minimal use and multiple service or repair reports, for example), or whether an instrument can be relocated or brought online to support growing demand (those in good condition with minimal use). If the decision is made to decommission an instrument, a multi-vendor

service provider may also be able to complete various checkout certifications prior to disposal or resale. Alternatively, usage data may be useful for planning new equipment acquisitions and to support purchase requisitions.

The selection process

When comparing multi-vendor service providers, it is important to consider several factors in addition to cost to ensure the service is a good fit for the lab. The optimal service should provide a tailored solution to meet a laboratory's specific requirements, with the ability to review and adjust over time. The steps outlined below can serve as a general guide for the selection process:

Identify the lab's specific requirements: Consider the number of instruments in the lab (including any additional locations), the nature of the instruments and performance characteristics, requirements for compliance, and whether additional services such as usage data reports and support for decommissioning would provide added value to the service.

Identify "must-haves": Prioritizing requirements may be useful to determine what services and features are most important to the lab, and can help guide the selection process.

Compare service plans: Obtain information from potential providers and evaluate whether individual service plans offer the specific options you have deemed necessary.

Compare vendors that are able to meet your requirements: Once the selection has been narrowed down to providers who offer your requirements, compare any additional features and select the best overall provider.

A thorough comparison of different service plans requires time and effort, but is a valuable exercise to ensure the best fit. In addition to the laboratory's specific requirements, there are some other factors that may be worth considering during the search. For example, does the service provider offer any remote monitoring or support services? Some instruments with internet connectivity may be monitored remotely, and technicians may be able to guide laboratory personnel through basic troubleshooting procedures. Is the provider accredited? Working with an accredited service provider helps to ensure maintenance, repairs, and calibrations are performed by technically competent technicians adhering to quality standards. For labs seeking to achieve or maintain compliance, it may be valuable to ask if the service provider issues compliant documentation as well.

Expert tips for multi-vendor service contract implementation

After completing the selection process and negotiating a contract with a service provider, there still remains some work to ensure a smooth transition to a new process. *Lab Manager* asked Kevin Keras, general manager and chief operating officer of the LabSquad division of Biodirect USA, to share some advice on implementing multi-vendor services:

Tip #1: Setting Expectations vs Reality

While utilizing a single source to coordinate an entire organization's assets, end users need to understand that MVS (multi-vendor service) providers will never know as much as the OEM of the instrument. Some lab stakeholders within the clientele will insist that the MVS purchase expensive service contracts from instrument manufacturers or might refuse to let the MVS provider contract independent service organizations (third parties). It is understandable why they might take this position…their research is at stake, and they believe the manufacturer is the best solution. However, basic period maintenance for lab instruments can often be done by the MVS' on-site staff or an independent service organization like LabSquad. This doesn't mean you can't still work with an OEM…not at all. Just use them for specific things like software/firmware upgrades or major failures. This will keep instrumentation research-ready and help lower costs.

Tip #2: Make it Win-Win, or Nobody Wins

So many end users gravitate toward MVS thinking the main benefit will be cost savings. In many cases that is so, but I would offer that even if the costs were the same, or even slightly higher, the MVS model is still a better and more efficient approach than in-house management. It just has to be entered into with a "win-win" mindset from both parties. Once a client commits to an MVS provider, they need to trust that partner will utilize the best, fastest, and most cost-effective measures to maintain their assets. If the MVS provider loses money by overpaying for services or parts, the relationship will fail.

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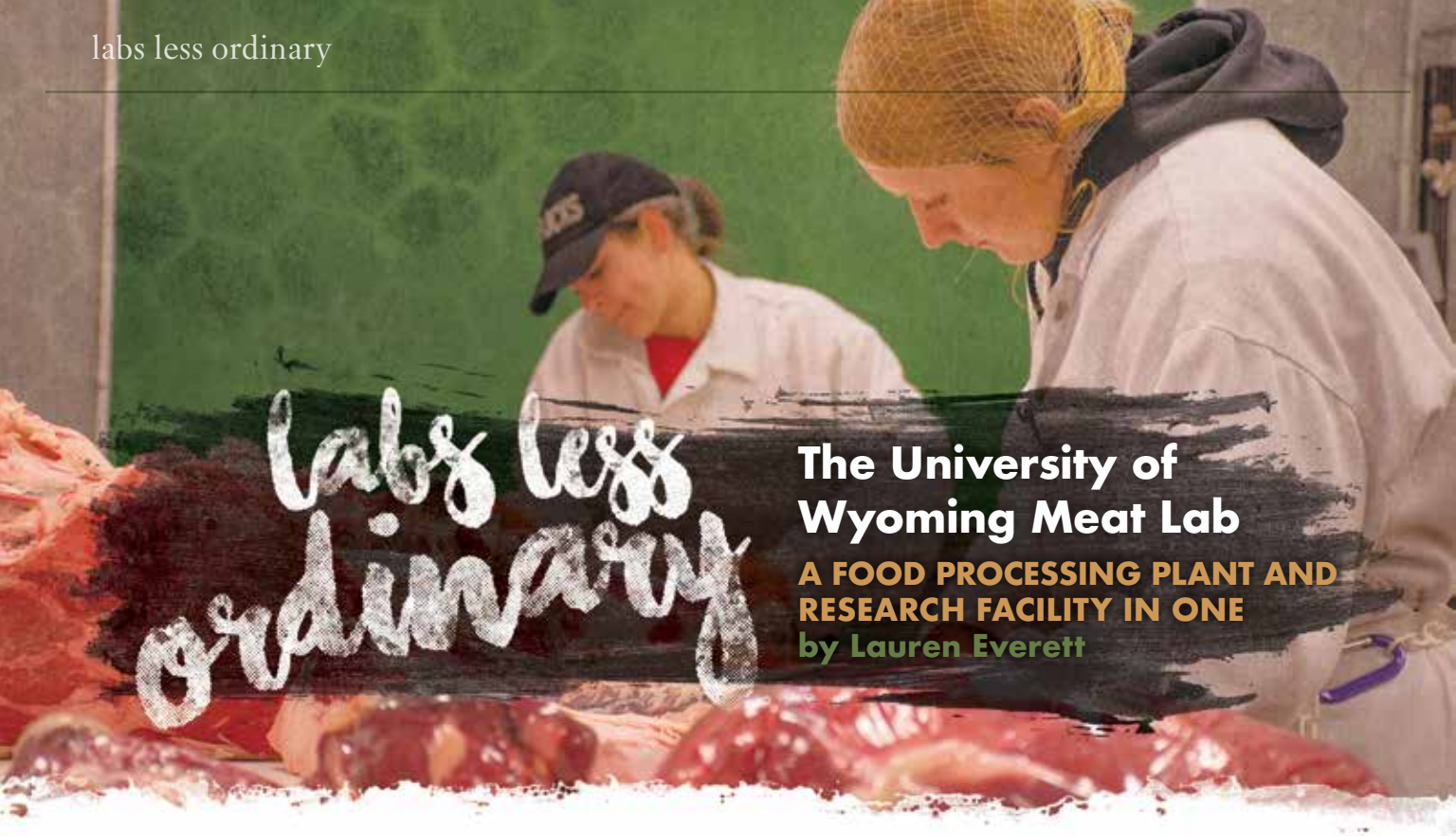

The University of Wyoming Meat Lab

A FOOD PROCESSING PLANT AND RESEARCH FACILITY IN ONE

by Lauren Everett

Many consumers who purchase meats from their local grocery store aren't well informed about where the products come from, or about the steps involved in the harvest process. At the University of Wyoming Meat Lab, students in the College of Agriculture and the Animal/Food Science departments, as well as collaborating researchers, not only learn about the science and process, but are directly involved in it.

The Meat Lab encompasses nearly 10,000 square feet of space, and was designed for education, research, and extension purposes. Because the facility serves multiple purposes, it was crucial to have designated spaces for each function. "The main aspect of construction and design that made the lab unique was the ability to offer a more organized flow via the multitude of rooms that allowed for the separation of different events and processes," says Kyle Phillips, Meat Lab manager. "Not being limited to one large processing area and cooler space is very important."

The facility works with all types of animal meat—pork, lamb, beef, etc.—to produce products like meatballs, sausages, patties, and smoked or cured products. The facility has a slaughter floor, fabrication room, processing room, designated coolers for different needs, a room dedicated just to inedible items, research project storage, and retail item space. "The lab is designed to take a meat animal in, [and] through the harvest process, fabricate it into steaks, roasts, etc., create value-added products, then package, box, and sell these items," explains Phillips.

Feeding future generations

Producing and processing high-quality meat products for consumption is a complex task. Food scientists and those in the meat industry are constantly studying the innate character of muscle and meat to enhance flavor and quality for the consumer. Scientists are also beginning to discover new ways to capitalize on the genetic potential of animals for higher quality products.

Sustainable food production is an important issue across the food industry. Meat scientists, like other food scientists and agriculturists, are looking at new food production methods and practices that are more sustainable for future generations. By 2100, it is estimated that the global population will grow to 11 billion. Meeting that grand demand for nutritious food while limiting harm to the environment is an incredible challenge. In addition to helping solve these challenges, research at the Meat Lab also focuses on the health of local animals. "The UW Meat Lab has been an important facility for assessing animals used in high-altitude disease studies in which organ and tissue samples are collected immediately to assess changes in mRNA," explains Phillips.

The lab is located in Laramie, WY, at an elevation of 7,200 feet, making it an ideal facility for this type of research. Other recent research projects conducted at the lab have involved data collection to help evaluate microbiological control interventions to validate the food safety HACCP (hazard analysis and critical control points) plan in the facility. According to Phillips, "upcoming research

The University of Wyoming's Meat Lab student workers get various meat cuts ready for use by the UW meats judging team practices. *Credit: UW Photo*

conducted in the Meat Lab will assess carcass composition and cutability characteristics in pork and lamb, as well as facilitating collection of various muscles that will be used to predict and characterize sensory performance."

In addition to conducting research, the facility functions as a processing and food production plant. With that, cleanliness and safety are top priority. "As a processing plant, we are state inspected by the Wyoming Department of Agriculture. With this in mind, having a grant of inspection requires us to maintain appropriate GMPs, SOPs, SSOPs, and HACCP plans for every product that is created in the lab," says Phillips. "As a food production facility, we pay close attention to cleanliness, maintain that there is no cross-contamination between different species or items containing allergens, submit to testing for microorganisms to ensure that all of our plans and safeties are working as intended, and that we are creating a safe and wholesome product for consumption." All lab staff are required to scrub in prior to entering the space, and must have on proper hair covers, clean frocks, closed-toe shoes, and hard hats when necessary.

Phillips has extensive experience in the meat industry, previously working at the Rosenthal Meat & Science Technology Center at Texas A&M University, before joining the Meat Lab in Wyoming as manager in August 2019. "This allowed me the opportunity to continue working where my passion lies, which is within the mixture of meat industry, teaching, providing outreach/resources to other meat processors, and assisting in the research that is designed to help solve the challenges faced by meat industry personnel and meat scientists," says Phillips.

The student-employees working in the facility take on a bulk of the daily responsibilities, which Phillips says is beneficial to their development and aids in the transition from college into the first steps of their careers.

Although Phillips is new to the Wyoming Meat Lab team, he has already outlined future goals and a vision going forward for the facility. "It's my hope moving forward that I am able to help expand on the research opportunities within the College of Agriculture and Animal Science Department at the University of Wyoming, as well as with other institutions that we may collaborate with in the future," he says. He also wants to provide more extension and outreach to the community and other local meat processors, and be a source of valuable information for them.

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ELIMINATE HPLC SAMPLE PREPARATION BOTTLENECKS WITH HIGH SPEED EVAPORATION AND LYOPHILIZATION

Innovative technology overcomes the challenges of lyophilizing HPLC samples containing organic solvents and accelerates sample preparation for high-throughput applications

LYOPHILIZATION OF HPLC FRACTIONS

Preparative reverse-phase high-performance liquid chromatography (HPLC) enables the isolation of highly pure compounds, and is widely used in chemical, pharmaceutical, biotechnology, and biochemistry industries. Most samples contain water and polar organic solvents such as acetonitrile, and require careful preparation to ensure accurate results. HPLC fractions are usually dried using a parallel sample evaporator, and during this process it is important to retain the quality and integrity of the sample. Utilizing a centrifugal evaporator to dry HPLC fractions offers many benefits with a few challenges. Alternatively, lyophilization (freeze drying) technology uses subtle conditions and is usually used to dry sensitive biological samples. Due to the more open structure of the sample cake, a higher level of dryness may be achieved in this process. However the drawback to this technique is that it is time consuming. Here we discuss a methodology used to achieve the best of both worlds: a rapid process capable of producing thoroughly dried samples for improved resuspension and easier sample handling.

EVAPORATION, LYOPHILIZATION, AND THE BEST OF BOTH WORLDS

Lyophilization is the process of removing solvents from a sample via sublimation, which is achieved with a low vacuum that boils water below its freezing point. Freeze drying HPLC samples containing water and solvents, such as acetonitrile, pose several challenges for lyophilization. Acetonitrile has a low freezing point (-65°C), and if this is not achieved during lyophilization, sample bumping and contamination may result. If acetonitrile accumulates in the ice trap, it can impair the vacuum and prevent lyophilization. In addition to the challenges faced in working with solvents , the lyophilization process itself is slow, requiring days to achieve the desired sample dryness.

Solvent removal may also be achieved by evaporation, whereby energy (heat) is applied and the liquid is vaporized to a gas and removed, leaving a dry product. Working with a centrifugal evaporator addresses many of the challenges associated with lyophilization, however this approach is not without its own limitations. Trifluoroacetic acid (TFA) is often added to the reverse phase HPLC mobile phase for its buffering capabilities, to

enhance retention, or to suppress certain ionic interactions. At times, centrifugal evaporation is insufficient to remove all of the TFA, due to sample interactions, and the residual could have detrimental effects on analysis. Further, this approach often produces a film-like dried sample on the bottom of the vial, making it difficult to re-suspend and weigh. In addition, fractions containing hydrophobic samples can crash out with the removal of the organic layer, to form a thin film on top, which could restrict the evaporation and may result in incomplete drying.

These challenges led to the development of a combined method, incorporating the speed and efficiency of centrifugal evaporation with the superior drying capability and improved sample integrity achieved with lyophilization. The method development was done using the Genevac HT Series 3i centrifugal evaporator, which consists of a robust oil-free vacuum pump, a low temperature, automatic defrosting and draining condenser and an intuitive user interphase with user programmable methods.

The method shown below is a way to successfully freeze dry HPLC fractions with hydrophobic and hydrophilic compounds. It also accommodates fractions with varying gradients and volumes.

- **Stage 1** - Removal of a portion of acetonitrile by using Dri-Pure with the final pressure at full vacuum. Then hold at full vacuum for a few hours to make sure the samples are frozen
- **Stage 2** - Add heat for a limited time at full vacuum to speed up the sublimation
- **Stage 3** - Then continue to control the pressure at full vacuum with no heat until the samples are completely freeze dried

If the samples are completely water soluble, the organic layer can be removed first and then the aqueous layer can be concentrated before freeze drying. Method details are summarized below:

- **Stage 1** - Evaporate the acetonitrile using Dri-Pure and then control the pressure at 40mbar for a set time
- **Stage 2** - Concentrate the water at 8mbar to reduce the total volume
- **Stage 3** - Freeze the samples by reducing the pressure
- **Stage 4** - Add heat for a limited time at full vacuum to speed up the sublimation
- **Stage 5** - Then continue to hold the pressure at full vacuum with no heat until the samples are completely freeze dried

This method may be further adapted for aqueous samples:

- **Stage 1** - Concentrate the water at 8mbar to reduce the total volume
- **Stage 2** - Freeze the samples by reducing the pressure
- **Stage 3** - Add heat for a limited time at full vacuum to speed up the sublimation
- **Stage 4** - Then hold the pressure at full vacuum with no heat until the samples are completely freeze dried

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Negotiating Service Contracts

THE COMPLEX VARIETY OF LABORATORY INSTRUMENTATION REQUIRES A STRATEGIC APPROACH TO MAINTENANCE CONTRACTS **by Brandoch Cook, PhD**

Did you just purchase a new $180,000 confocal microscope? Congratulations, your lab's images are going to look amazing. But be ready to keep paying for it for years to come. And if your lab is like most others, every time you purchase a major piece of instrumentation, maintenance costs need to be built into laboratory budgets, such that adequate funds can be accounted for in active grants.

There are three primary ways to spend money on maintenance and repair. First, you can wait for equipment to break, fail, or become inconsistent, and then react by purchasing parts and services *a la carte*. Surprisingly, this can be an effective solution for equipment that is less expensive, and less sensitive to wear and tear. For example, the cost of purchase and maintenance for micropipettes is a far cry from that of a confocal microscope or a flow cytometer, and the cost of replacement for a broken one is usually in the range of hundreds of dollars rather than hundreds of thousands. An effective solution for many laboratories is to hire periodical pipette repairs on a per-unit basis, which often cost around $20 each. This may be preferable to extended warranties or service contracts with longer-term costs and obligations.

Secondly, manufacturer's warranties cover many equipment and parts failures and breakages. Although most warranty periods only cover one or two years, extended warranties are available for many types of equipment. These can be especially useful for the more expensive and sensitive instruments with highly engineered parts and advanced software interfaces, especially for refurbished equipment, or instrumentation that you expect to replace within less than five years. Not only will your laboratory avoid having to replace parts, but you also will avoid experimental downtime associated with malfunction. It is much easier to borrow your neighbor's Pipetman than it is to hunt down an available confocal microscope while a part is on a two-month backorder, or you don't have the funds ready to cover it.

Finally, a service contract for equipment maintenance and repair is, ideally, the most hassle-free solution, usually with the most comprehensive coverage and rapid response time. For instance, if you examine the range of options offered by a big supplier such as Thermo Fisher Scientific, there is service contract coverage for an abundance of equipment, a partial list of which includes: autoclaves, centrifuges, biosafety cabinets, incubators, refrigerators and freezers, microplate readers, pipettes, shakers, flow cytometers, mass spectrometers, PCR and qPCR thermal cyclers, next-gen sequencers, and water baths. In other words, there is a range, from comparatively simple everyday use mechanical equipment for which you may want to take your chances, to very sensitive and specialized instrumentation shared by departments under program-level grants for which service contracts are often a necessity. The Thermo Fisher Scientific service provider, Unity Lab Services, offers tiered contracts including a package called the Total Care Plan, which provides unlimited access to phone and email tech support, and unlimited coverage of parts, travel, and labor costs. Although this package is essentially identical to their Extended Warranty Plus plan, even extended warranties don't often go very far beyond original manufacturer's warranties, whereas service contracts may be renewable *ad infinitum*. Additionally, service contracts on new and complicated instrumentation often include initial installation and complete, full-day training sessions.

Where this process gets bewildering is in the sheer number of items that must be covered in one way or another, which way to cover them, and finally, how to pay for it.

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Although the following observations may seem hackneyed, they are no less true for being so. Without further ado, here they are: 1) information is power, and 2) organization is key.

1. Information is power

- You must realize that when you sign a service contract, you are entering into a legally binding agreement for which your laboratory or institution is financially responsible. Educate yourself on contract language, ask questions of your supplier, and read draft contracts thoroughly before signing them so that you are not surprised by their caveats, inclusions, exclusions, and fine print. For instance, service contract renewals sometimes follow an opt-out format, in which you have to actively terminate a contract for a machine you no longer want to maintain, or in favor of a more advantageous service deal, because the contract includes automatic renewal language. For your own benefit, it is best to link purchase order expirations to service contract end dates. In this and similar cases, you should try whenever possible to negotiate language into a more straightforward, and less misleading, format.
- Even service contracts that cover "everything" won't always cover *everything*. The best way to be prepared for this eventuality is to know your equipment in detail, and try to negotiate the language of your contracts so that the parts that are covered are itemized. If anything is missing, or has stated limits of repair, then you can surmise that it is the part most likely to break down and reduce your provider's profit margin. In negotiations, you can try to get it included, perhaps with a minimal increase in cost. Additionally, you should realize that services covered may not automatically include labor, travel, or other obscure costs. These outlays can add up, especially if your contracted field technician works with a partner. You should negotiate these coverages into any contract where they are not explicitly itemized.
- The corollary to the above is that lab managers don't often bother trying to negotiate contracts in the first place, or know that they can. Negotiation, however, is implicit in the process and should be at least attempted. In the way Mitch Marner seemed to get everything he wanted out of his new contract with the Toronto Maple Leafs hockey team, service providers need your continued business at least as much as you need their expertise and availability, and working in your favor is the fact that there are always competitors in the market. Just like an athlete, you can always hold out a little bit, especially if there are third-party contractors available.
- Lastly, know your lab's finances and how your grants' lifespans or departmental budgets may impact your ability or willingness to spend. The expense and complexity of a given machine roughly correlates to the cost of service, and instruments such as flow cytometers or high-end microscopes carry significant service costs, often in the tens of thousands of dollars per year, because of the unpredictable ways in which people use them and the corresponding frequency with which they must be adjusted and repaired by professional technicians. Even with expensive equipment, however, it may be advantageous to sign a five-year service contract to spend down a grant that is expiring and still has significant funds left.

2. Organization is key

- The acquisition of information must be married to a strategy for keeping track of it. You should keep a detailed spreadsheet of all major purchases with their manufacturer's warranty expiration dates so that you are not taken unaware when malfunctions occur, resulting in impromptu purchases of replacement parts and labor. This planner should include, at minimum: all expiration dates for original manufacturers, and extended warranties; expiration dates, and programmed renewal reminders for service contracts; costs of equipment and *per annum* costs of maintenance; and a log of any extra and unplanned costs incurred, so that the next contract you sign can be negotiated accordingly.
- There should be a freer flow of information and a greater level of organization, communication, and transparency, especially among colleagues. Share your information and your concerns with other lab managers or administrators in your department and institution. It may be that they are paying different rates for what amounts to the same level of service, or obtaining more satisfactory service using a means you had not considered.

The process of choosing maintenance strategies for precious instrumentation can sometimes hover on a continuum between mere convolution and graphic nightmare. However, with a focus on information and organization, and a will to negotiate, you can not only choose the best plan for each instrument, but also save money and long-term frustration for your laboratory.

***Brandoch Cook**, PhD, is an assistant professor in the Weill Cornell Medicine Department of Surgery in New York City. He can be reached at brandoch.cook@gmail.com.*

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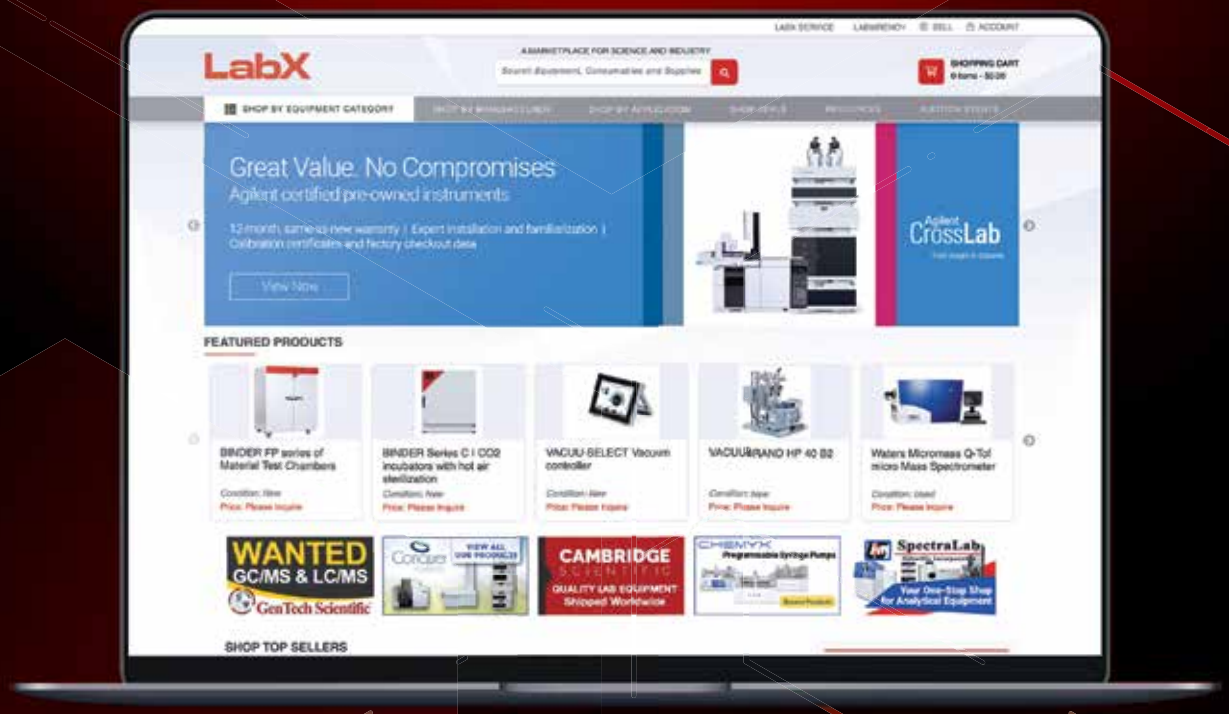

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Purchasing Used Lab Equipment That Won't Cost You Later

ASKING QUALITY ASSURANCE QUESTIONS PRIOR TO PURCHASE IS IMPORTANT TO ENSURE UPFRONT SAVINGS ARE WORTHWHILE **by Michelle Dotzert, PhD**

There are many reasons to consider purchasing pre-owned lab equipment, including environmental benefits and lower cost. Unfortunately, upfront savings may be lost if the instrument or equipment is in poor condition, or is at the end of its life cycle and necessitates costly repairs or disposal. Asking a few quality assurance questions prior to purchase is important to ensure upfront savings aren't lost to additional costs.

Purchasing from a reputable reseller is the first, simplest way to ensure quality. Thirty-day money-back guarantees provide some assurance that the equipment is in good working order, but be sure to confirm the policy with the reseller prior to purchase. It may be worth considering a warranty or service contract, offered by some resellers such as International Equipment Trading Ltd. (IET). "IET provides warranties up to two years and service contracts are available," explains Ceylan Bilgin, director of marketing at IET.

"Next, make sure to ask if the equipment is tested and confirmed to be fully functional," says Reid Hjalmarson, vice president of marketing at BioSurplus, Inc. It is also worth having a conversation with the reseller about the specific application and conditions under which the instrument will be used. "We also recommend that customers give us some background on how they plan to use the equipment. Sometimes, their science requires a creative implementation of an instrument," says Hjalmarson.

It is also important to consider whether the equipment will easily integrate into the existing laboratory setup. "If the lab equipment will be used in conjunction with existing lab equipment, confirm with the vendor and possibly the original manufacturer regarding compatibility. For example, Sciex mass spectrometers are typically paired with an Agilent or Shimadzu HPLC. It may be possible to pair a different LC, but you may run into communication issues," explains Bilgin.

> "If the lab equipment will be used in conjunction with existing lab equipment, confirm with the vendor and possibly the original manufacturer regarding compatibility."

The equipment's life expectancy is another important consideration. Purchasing equipment near the end of its life cycle may result in having to replace it a few months later. Hjalmarson offers some guidance on the subject: "When purchasing cold storage, for instance, look for units that are no more than seven- to eight-years-old. The compressors only last for around this long, and replacement can be costly, particularly if important samples are being stored." In addition to age, "for analytical systems, we take usage hours into consideration

as well. Many chromatography systems last for decades when maintained properly."

The more information you can obtain on a piece of equipment prior to purchase, the better. Don't hesitate to request any additional records or documentation associated with the item. As Hjalmerson notes, "whenever possible, we look to obtain service history and calibration logs for the items we acquire. The more information we can get, the more assurance we can provide a customer that the item has been properly maintained and is in working order." If the previous owner does not provide the calibration history, it may still be possible for the reseller to obtain it. "If the instrument has always been under the manufacturer's service contract, this information is verifiable through the instrument serial number. Depending on the model of the instrumentation and if it can connect to a PC, we can provide qualification data prior to shipment," says Bilgin.

> "Don't hesitate to request any additional records or documentation associated with the item."

Purchasing pre-owned equipment is a great option, but should be done with careful consideration. A conversation with the reseller can help determine their reputability, and obtaining service or calibration records can help you determine the condition and quality of the item. Some time spent on research prior to a purchase can ensure any initial savings aren't lost.

***Michelle Dotzert**, scientific technical editor for* Lab Manager, *can be reached at mdotzert@labmanager.com or 226-376-2538.*

Onboarding: A Valuable Investment

RETAINING NEW TALENT LONG TERM BEGINS WITH INTERACTIVE TRAINING

by Sara Goudarzi

Hiring competent personnel is the first step to successfully filling positions in a laboratory. The next measure to ensure that person's expertise can be fully utilized and integrated into the existing environment involves providing an onboarding experience that gets new hires up to speed efficiently. Setting up rigorous, interesting, and ongoing onboarding programs can lead to higher retention of quality employees, and thus, fewer turnovers for a lab or organization.

Watson Clinic LLP, an outpatient clinic with nine laboratories in Florida, is an example of such a program. With approximately 100 employees, the multi-specialty, high complexity labs experience a turnover of between just five and 10 employees each year. Director of laboratory services Michelle Preston attributes this partially to their initial and ongoing onboarding programs, which ultimately financially benefit the company.

With less turnover, "you don't have the employees leaving, so you're not having to spend more time in the hiring and training process, because that's a lot of downtime for people and a lot of extra work," she says. "So it's always going to be a positive on the financial side because you're keeping the employee and reaping the rewards of having them stay."

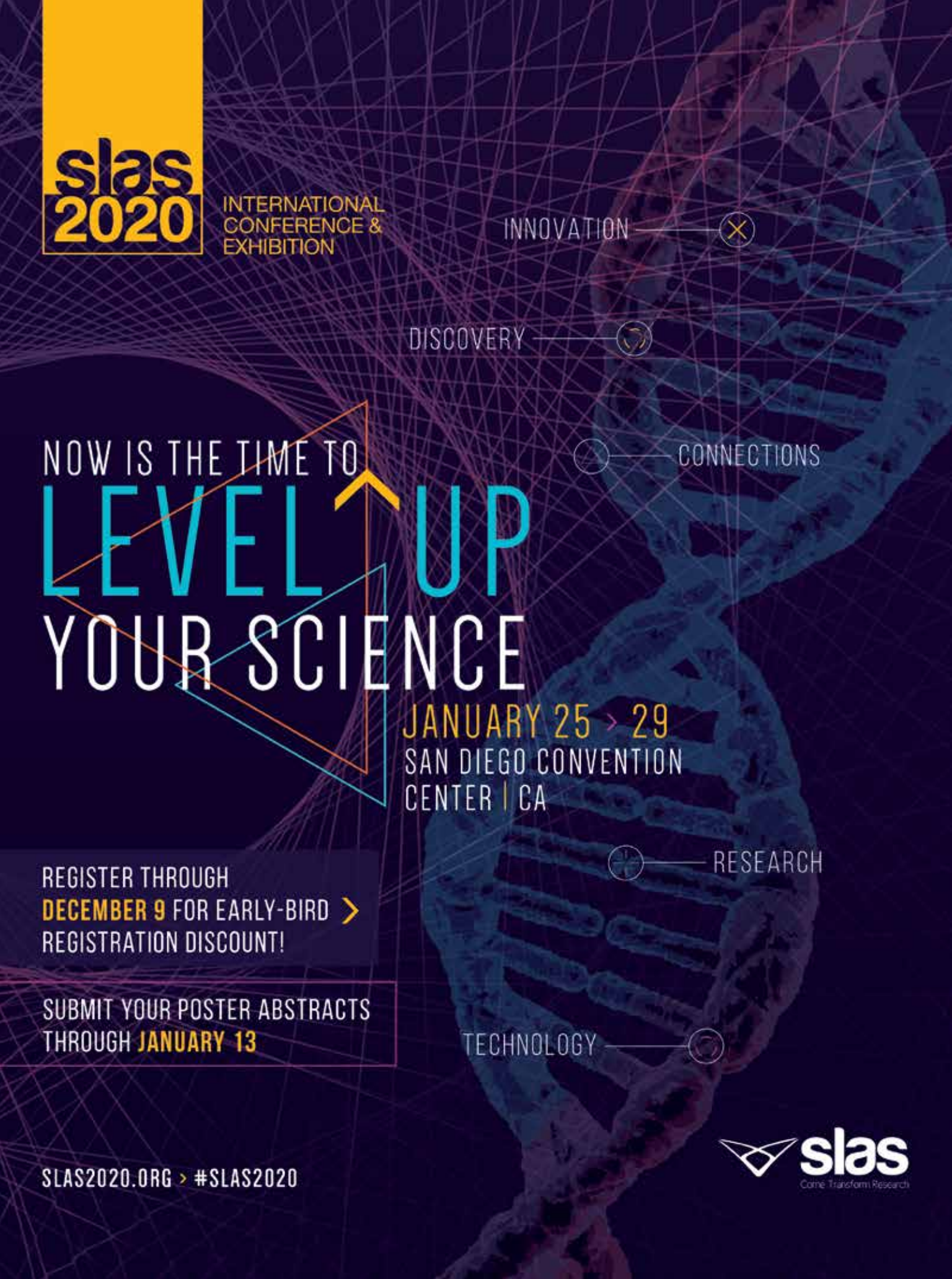
Onboarding for success

Watson Clinic's success lies in a customized program for recent hires, based on their level of expertise. New employees are paired with experienced staff members and work side-by-side until they are comfortable with the laid out responsibilities. Seasoned techs will inevitably move through the program much faster than say technologists right out of school who will need more time and opportunities to gain confidence and grow. "Something else we have also implemented that we find helps quite a bit is a 30-, 60-, 90- day review," Preston says. At the end of each of those designated time periods, a new hire's supervisor sits down with the employee and goes over how they're doing and what areas they need to improve upon.

> "A solid onboarding program is more than just getting a new employee to perform a specific set of duties."

Such an approach ensures the lines of communication are open between staff and management. If either party has concerns, they can use the opportunity to convey them. Further, if management feels the new employee is not picking up the skills they need fast enough, they could opt to switch that employee's trainer. Because sometimes, all it takes is another person explaining the same procedures in a different manner or on a level that makes more sense.

"We are really trying to work with that new employee to give them as many of the tools as we can," Preston says. "There have even been times where we have hired for a specific location and as we're doing the training, we realize it may not be as good a fit as we thought. So if we have open positions in other locations, we'll go ahead and move that employee to another location and that has worked very well for us." This ensures the new employee is placed in a location where they are a good fit with their co-workers and surroundings.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Come Transform Research

At Draper Laboratory, a non-profit research and development and engineering innovation organization in Massachusetts, the human resources team manages recent hire orientation and takes new employees on an interactive tour of the organization. Each lab, however, may have its own additional training, as many disciplines exist within the organization. For example, at the Model Based Engineering Lab, system group leader and lab manager Fei Sun, who runs a 30-person work team, approaches onboarding of new employees similar to Preston. To Sun, it's pertinent to supplement the general, group onboarding with resources that fit individual employees, especially because everyone's learning process is different. "We created a buddy program in which newcomers are paired with a current employee based on their mutual interests," Sun says. "They might both be interested in system engineering or a sector like aerospace." After a month, she explains, the buddies switch with someone else in the group, giving more people an opportunity to get to know each other.

"When I designed the buddy system I was thinking about technical orientation, but over time I found some pairs talked about daycare or health benefits as well, which is an important form of information-sharing," she adds. Further, because there are many disciplines and core competencies under one roof at Draper, it helps recent additions to learn about the other areas of the organization.

"A new employee hired into the software directorate will be introduced to our machine shop, additive manufacturing area, Biomedical Solutions Lab, Microfab, or electronic system assembly facility," says Justin Medernach, group leader, System Assembly at Draper. "The tours are specifically tailored to provide new hires with exposure to other functional areas."

> "Interactive training videos with embedded quizzes grab the individual's attention and require thoughtful consideration."

Employee retention

A solid onboarding program is more than just getting a new employee to perform a specific set of duties; it's also a chance to have them become an integrated part of a team with an overarching goal. Working to help new employees understand that goal and know they are part of a valuable mission allows them to better perform and contribute to the overall mission. Effective onboarding also communicates the history and pedigree of the organization, a sell that could have lasting effects on a recent hire.

"When I was new here, it was almost surreal to see artifacts of the Apollo Program's fault-tolerant flight computers," Medernach says. "It doesn't take long for an individual to realize that they can be a part of something special."

Further, onboarding is a chance for a company to provide in a new hire a sense of confidence in their choice of employer—that the employer has a strong mission and is organized and thoughtful.

"If employees are confident in their employer's operation, they are far more likely to stay," Medernach says. "Good employees are always sought by other organizations. As a management team, it's our responsibility to project competence and keep that talent here."

Proper communication of policy and procedure changes and the demonstration of the effectiveness of those changes is also a means of portraying organizational competence. "This has an impact on retention and, in turn, bolsters the organization's financial position," Medernach adds.

Involving new employees is also important: managers can do this by giving new hires a chance to contribute and connect with the group and provide them with opportunities to make contributions. "Why not ask them to suggest book titles for the resource library?" Sun suggests. "Employees are more likely to stay if they contribute."

An engaging experience

Despite the excitement of joining a new team, employees often find the onboarding process dry or boring. In effect, those in management positions are always looking for ways to make training more agreeable. One way to do this is by speeding up the process.

"With a seasoned tech or a seasoned lab assistant, we have found the faster we can work with them and get them going and on their scheduled shift works best," Preston says. "That way they're not getting quite as bored."

With new employees right out of school, streamlining the process can be a bit more difficult, however. For those hires, Preston finds it helpful to involve them in the work. For example, if an issue does come up, ask how they would handle it. This kind of interaction creates bonds with mentors and keeps them involved in the process as opposed to being just an observer.

Another way to make onboarding more interesting is

by having more interactive training sessions. "Read and sign methodologies are simply ineffective when it comes to grabbing an individual's attention and promoting retention of information," says Medernach, who's an advocate of online training modules. "Interactive training videos with embedded quizzes grab the individual's attention and require thoughtful consideration."

Additionally, managers who lead tours can ask new hires to talk about themselves—their backgrounds and interests—and to allow them to see aspects and capabilities of the company they are working for that may not be directly related to their job.

"When I give a tour, my primary goal is to get the new hires excited about life at Draper," Medernach says. "To let them know that we're special and we can provide a service to the American people, and the world, that makes a difference. We try to get them interested in areas that may not be a focus of their normal job functions but are a core competency at Draper. Who doesn't like to watch robots in action or see how things we use every day are made?"

Lastly, it's important for those in management positions to appreciate that onboarding is an ongoing endeavor through which both recent and senior employees are continually growing. Part of this means that not only should recent hires be learning the ropes, they could also provide perspectives that the senior staff could take advantage of.

"New employees, even employees just out of college, can bring a fresh perspective," Sun says. "Recently, Draper was consulting with an automaker to provide an architectural review. Senior members of our team worked closely with junior members trained in the latest visual display software, giving the group a new understanding and perspective of the automaker's systems."

As organizations extend their reach into new areas of technology, including artificial intelligence and machine learning, we are seeing the same information sharing and cross-training between newcomers and existing employees, Sun adds.

Sara Goudarzi *is a freelance writer based in New York City. Her website is www.saragoudarzi.com.*

Designing the Sustainable Lab

DETERMINING WHAT MAKES A LAB "SUSTAINABLE" ISN'T ALWAYS CLEAR-CUT

by MaryBeth DiDonna

An increasing number of laboratory facilities are incorporating sustainability into their design plans. Labs are energy hogs, and increased energy usage means higher utility bills—such as water, electricity, ventilation—and higher overall building budgets.

But what *is* a "sustainable lab," exactly? Most lab planners will probably agree that it's something to strive for, yet each of them may have a different explanation of what it means. "In a broad sense, sustainable design seeks to minimize the impact the built environment has on natural and human resources. This involves being selective about materials, building location, indoor air quality, energy consumption, and water consumption, to name the principal drivers," says Carlos Perez-Rubio, AIA, LEED AP, principal with HERA Lab Planners in Atlanta, GA. According to Perez-Rubio, sustainability for laboratory facilities is principally focused on energy and water consumption, with other sustainable design elements assuming lesser importance to the design process.

"In a broad sense, sustainable design seeks to minimize the impact the built environment has on natural and human resources."

"This is due to the well-known fact that laboratory facilities consume large amounts of energy and water to support the required environmental conditions, to operate the scientific equipment, and to maintain the reliability of the facility. Additionally, some sustainable design elements are hard to incorporate into the laboratory environment since their application is counter to good laboratory operational practices," he says.

"Science changes daily, just like everything else. As processes evolve, so must the workflow, the logistics, and the planning to accommodate said evolution," says Kevin Garden, project specialist at CRB in Los Angeles, CA. "In order to plan for the future, we must think forward but work backward. Whether our particular role is that of project owner, designer, or builder, asking the right questions at the right time is of paramount importance."

"With the rapid advances in technology and the shifting emphasis in research, it is important that laboratories and support spaces be designed for flexibility and adaptability. Long gone are the days of fixed casework and 'locked-in' locations for equipment systems that may require specialized MEP considerations," he adds.

Why build a sustainable lab?

A sustainable lab building saves energy, which in turn saves money, and may mean a better bottom line for the facility over the course of its existence. It's only natural, therefore, that more and more lab buildings are utilizing sustainable methods during new builds or renovations. "A sustainable lab should allow for better control of operating budgets while not constricting the need for operational

flexibility," says Garden. "Eliminating the need for construction every time operational changes are required will save money."

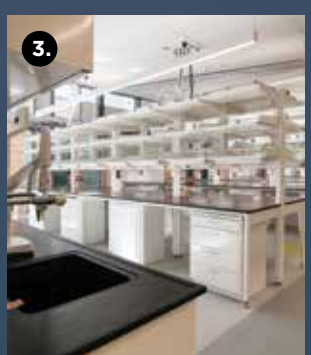
William T. Freeman, PE, LEED AP, director of engineering at HERA Laboratory Planners in Washington, DC, points out that sustainable labs are also changing the ways that lab buildings are designed and constructed. "A sustainable laboratory facility will consume less energy than its predecessor of just 10 years ago. This means the engineering infrastructure is smaller and is less impactful to the building architecture," Freeman said. "Imagine the possible impacts: lower air change rates require fewer and/or smaller air handling units and exhaust fans, thus reducing the demands for physical space; systems such as chilled beams coupled with lower air change rate reduce plenum requirements allowing the floor-to-floor heights to be reduced; more efficient laboratory equipment reduces the electrical demand on the electrical distribution system."

Many lab planners adhere to the old adage of, "A happy worker is a productive worker." Robert Thompson, PE, principal, mechanical engineer with SmithGroup in Phoenix, AZ, comments that sustainable lab facilities carry a great deal of health benefits for employees.

"By providing access to daylighting, the productivity of staff is increased. This, together with increased ventilation in office zones, increases staff satisfaction and retention, improving the enterprise. Having an active program to optimize laboratory

CRB PROJECT SPOTLIGHT

The University of California, Riverside School of Medicine required a laboratory build out project to maintain its current LEED Gold certification. CRB used existing features from the building, such as the orientation and windows, to promote daylight harvesting and light shelf through lighting controls. The existing chilled water distribution loops to incorporate the chilled beams into the design to reduce fan energy consumption and overall chiller energy consumption. The existing air handling system was incorporated to provide increased ventilation to the zones and improve indoor air quality, while still maintaining room cooling/heating load requirements. Low water consumption plumbing fixtures were incorporated to reduce water consumption. Flexible lab spaces were provided to allow for future growth of certain activities since available floor space was limited. Low volatile organic compound (VOC) and locally resourced materials were used.



1. The design features a sloped ceiling with a dual purpose of incorporating chilled beams and daylighting strategies to maximize comfort. **2.** The project included into its design the use of light shelf and daylight harvesting technology to help achieve occupant comfort as well as reduce energy consumption. **3.** The design included the use of Energy Star laboratory equipment, which helped achieve 70 percent (a minimum of 50 percent was required) of installed equipment power from Energy Star equipment.
Credit for all photos: MPB Creative Services

use and eliminate unnecessary storage increases space available for other programs and improves collaboration between groups," says Thompson.

He adds that energy efficient labs "have lower operating costs and can allow for the consolidation of central cooling and heating equipment in older facilities. When office and laboratory supply air systems are combined, the indoor air quality in office zones is greatly increased while simultaneously lowering energy use and the requirement for redundancy. With the loss of a single supply air unit, capacity can be directed from the office to critical laboratory functions. This approach saves both first and operating costs while providing a better environment for staff."

Common challenges

Different labs serve different purposes, which means there is no one-size-fits-all solution to make them more sustainable. As research advances, buildings and labs must adapt alongside it—this may mean that equipment, casework, and the lab space itself must be replaced or updated to keep pace.

"Practices can and do change, but so often laboratory facilities don't change. It is important for facility operators to realize as the hazards change, as the loads change, as the practices change—so can the facility operation. This may not be a simple practice, but it is one that can be accomplished with forethought and planning and relatively low cost," says Freeman.

Safety is, of course, of utmost concern for lab facilities, which presents a two-fold challenge: alignment of safety and sustainability and adjustment of the building's performance in response to changes in hazards. "Sustainable practices are often perceived to be at odds with safety and vice versa. There are the practices of single pass air and high ventilation rates to protect users from a hazardous environment," says Freeman. "However, there are now more efficient, and aerodynamic, enclosures for primary containment. Air changes can be based on scientific/data-driven decisions rather than rules of thumb. It is now possible to challenge the notion of single pass air in certain lab types. New and emerging technologies are enabling the monitoring and modulating [of] air." Many lab planners have noted that working with seasoned researchers and scientists can be a challenge, as they may be very used to doing things a certain way and will therefore be reluctant to adopt new procedures.

"One of the most common challenges we see lab managers face is changing the culture/habits of energy use. This could be as simple as procedures to close fume hood sashes when not in use, consolidating freezer storage, and eliminating unnecessary equipment," says Regal Leftwich, AIA, associate, laboratory planner with SmithGroup in Washington, DC.

Sometimes, research or experiments demand specific types of equipment or utilities in the lab, and therefore the most "sustainable" options are not feasible. "HVAC and lighting controls are now commonplace within any building for the purpose of conserving energy. But laboratory operations usually dictate that utilities must be highly reliable and that environmental conditions be repeatable. Energy efficient systems and recovery methods must be considered early in the planning process. Some lab equipment may require true UPS power," says Garden.

"The question: can this requirement be practically achieved building-wide, or can a 'one-off' need be better addressed with a localized solution?" he adds.

> "In order to plan for the future, we must think forward but work backward."

How to plan a sustainable lab

There are some tactical steps that lab planners can take to ensure that they are developing the most sustainable facility they possibly can. Tom Faucette, PE, principal, Washington DC Science & Technology Studio leader with SmithGroup, advises looking at the building from the outside in. "For a new building, we start by using an early energy modeling to ensure the building's orientation is optimized. The next iteration of the energy model then informs the façade design. Once the external building is optimized, our planning group, interior designers, and engineers work to maximize the energy savings within lab and support spaces," says Faucette. It's also critical to think about the longevity of a lab building. A lab should be maintained throughout its lifespan in order to ensure it stays as up-to-date as possible. "Having a sustainable laboratory facility requires a panoramic understanding of the facility's life cycle. A truly sustainable facility begins with a strong vision and a design that embraces the critical attributes and

characteristics, is constructed and commissioned in keeping with the design intent, then operated and maintained in a manner that keeps the vision alive and current for the duration of the facility's lifespan," says Perez-Rubio.

"Architects, laboratory planners, and engineers must be adept at translating the vision of sustainability into a viable and attractive laboratory design solution," he continues. "However, designing a sustainable facility is only a small portion of the effort."

The future of sustainable lab design

Sustainable lab design is growing more and more prominent every year, as institutions seek ways to slash their budgets as well as deal with issues resulting from climate change. Renovations mean more money, not only for materials and labor but for lab downtime or relocation as well. Planning a flexible lab from the start means it can keep operating with minimal to zero disruption as it adapts to advancing research and technology. "Designing and operating a sustainable laboratory requires a collaborative effort on the part of all interested parties. The design team and the owner's team (construction, operations, safety, etc.) must have a shared vision to understand real versus perceived risks, obstacles to be overcome, and developing a shared understanding of new technologies or approaches. Otherwise, past practices, institutional standards, or funding limitations may prohibit the simplest and most cost-effective solutions," says Perez-Rubio.

Some planners believe that the future of sustainable lab design means a new way of looking at where energy will come from. "We believe there will be a shift to planning for energy districts, areas where lower demand building types (like office and residential) use onsite power generation to feed higher demand laboratory buildings," said Leftwich, adding that communication between the planning team and the lab workers is vital.

"Many end users do not realize the amount of energy many processes take, and an educational campaign can help lab users remain conscious of their decisions," he said.

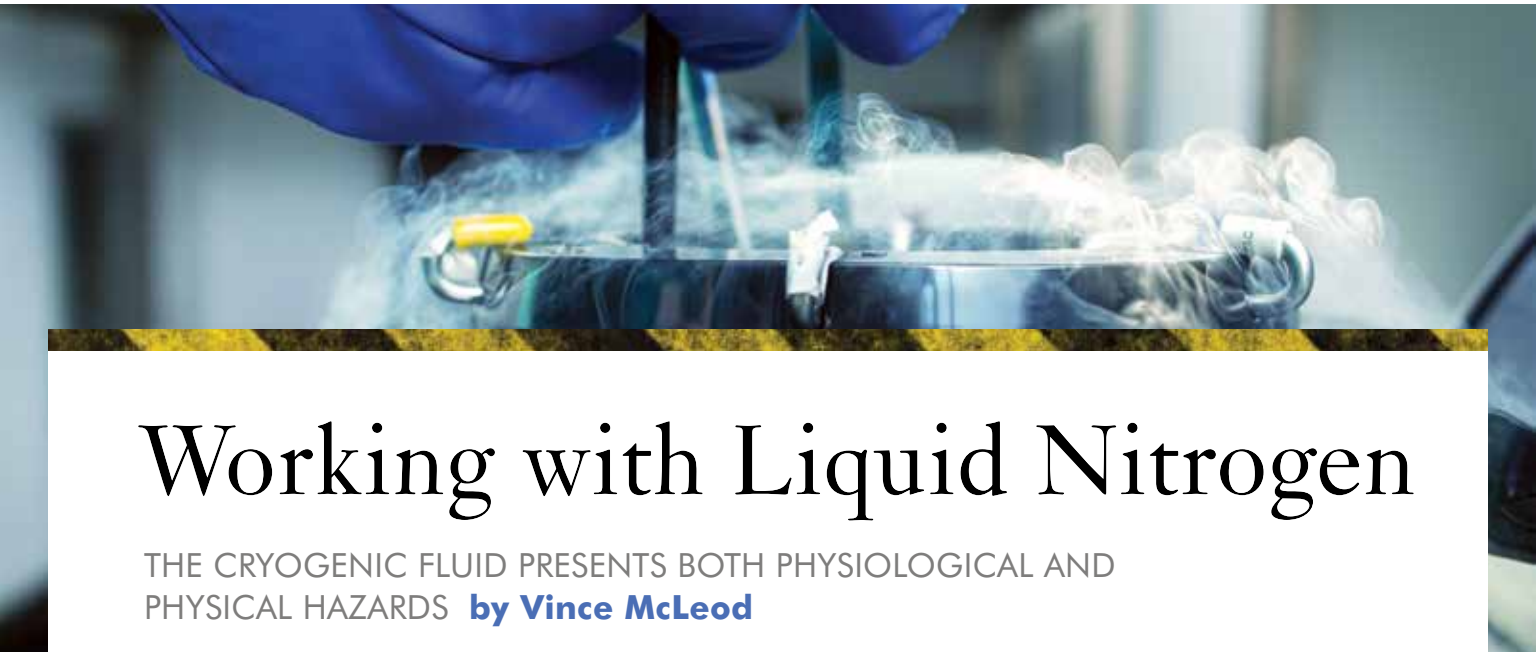
***MaryBeth DiDonna**, lab design editor for* Lab Manager, *can be reached at mdidonna@labmanager.com.*

HERA LAB PLANNERS PROJECT SPOTLIGHT

HERA Lab Planners' work on a confidential Fortune 100 Company research and development center in Minnesota is an example of a project using the "reduce, reuse, recycle" mentality of sustainability. The highest design criteria was the drive to reduce ventilation air requirements, which was accomplished by segregating the laboratory functions into high-, mid-, and low-intensity laboratories. For each zone, the ventilation rates were reduced with the capability to increase rates.

The reuse strategy incorporated local recirculating cooling capabilities (expandable) to handle internal heat loads that are above the base ventilation capacity. The recycle option provided heat recovery on both the chemical fume hood exhaust system and the general exhaust systems.

▲ Confidential Fortune 100 Company research and development center in Minnesota.
Credit: Farm Kid Studios



Working with Liquid Nitrogen

THE CRYOGENIC FLUID PRESENTS BOTH PHYSIOLOGICAL AND PHYSICAL HAZARDS **by Vince McLeod**

Use of liquid nitrogen (LN_2) has grown rapidly the last several years, due in part to the growth in stem cell research and other medical uses. Unfortunately, so have the number of serious accidents and injuries. These incidents have occurred not only during use, but also during transport and storage.

"Physical hazards from LN_2 include explosion risks from pressure buildup."

A wide variety of laboratories use LN_2. Most common are chemistry and physics labs, nanotechnology, computer chip design, and production and cryotube research. There is also growing use in the healthcare arena in the rising need for dermatology and skin cancer treatment and as research and development with stem cells advances.

LN_2 is classed as a cryogenic fluid, being a liquefied gas that must be kept at extremely low temperature. Boiling points for cryogens are defined as below -150°C (-238°F). LN_2 boils at -196°C (-320°F). This fact presents the primary hazard: contact will produce severe burns and more serious injuries due to instant freezing.

As most of you probably know, nitrogen is also an inert gas. Due to LN_2's physical properties, a very small amount of the liquid can expand into very large volumes of gas. This presents the second most important hazard: displacement of oxygen and possibility of asphyxiation.

In addition to the physiological hazards above, physical hazards abound with LN_2. Handling and using LN_2 can be done safely, if we recognize the hazards and strive to control them. If we become cavalier and things go wrong, serious injury and/or death is usually the end result. Here is one recent example:

- A 50-year-old female employee at a Canadian sperm bank died of asphyxiation after attempting to correct an LN_2 leak.[1]

Hazard recognition: Physiological

As mentioned above, the hazards fall into two categories: physiological and physical. Physiological hazards produce bodily harm and fall into two main categories, those that damage tissue from direct contact and those that can cause asphyxiation.

Direct Contact

LN_2 flows freely as a liquid and, as a result, may splash and spill. Accidental splashes or contact with an extremely cold cryogen freezes and kills tissue instantaneously. Therefore, direct contact must be prevented at all costs.

Asphyxiation

Cryogenic liquids contain a tremendous amount of potential gas volume. For example, one unit volume of LN_2 will expand to produce 700 times the volume of gas when vaporized. This rapid and extreme expansion can lead to oxygen displacement. A leak or vessel breakage can result in an oxygen deficient atmosphere very quickly, especially in small enclosed areas with poor

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ventilation. Due to LN_2's odorless and colorless properties, this situation is very hard to recognize.

Hazard recognition: Physical

Physical hazards from LN_2 include explosion risks from pressure buildup. As mentioned above, the gas volume generated from the vaporization of the liquid phase is very large and happens rapidly. If this phase change occurs in a vessel unable to contain the pressures exerted, it can fail catastrophically from over-pressurization.

Control and Prevention

Anyone who handles or uses cryogenic liquids must have adequate knowledge of the particular material's properties and the safe handling practices.[2] Specific understanding acquired through proper training must include:

- Physical properties of LN_2 as a liquid, solid, or a gas
- Materials compatible for use with LN_2 (e.g., compatible with the temperatures and pressures of the material)
- Protective equipment required and its proper use
- Understanding of the equipment being used, including its safety devices
- Emergency procedures, including first aid and treatment.

Ensure all employees handling and using LN_2 read and understand the safety data sheet. In addition, develop and follow standard operating procedures (SOPs) whenever handling or using LN_2. To jump-start your training and SOPs, here are some quick tips[3]:

1. Remove metal jewelry and watches on your hands and wrists before working with LN_2. If exposed to cryogenic liquids or boil-off gases, the jewelry can freeze to the skin.
2. Protect your eyes by wearing safety goggles whenever working with LN_2 or working with samples recently removed from cryogenic temperatures. Full face shields should be used in the following situations: a) when a cryogen is poured; b) for open transfers; c) if fluid in an open container is likely to bubble.
3. Wear a cryogen apron when working with LN_2.
4. Try to cover all exposed skin by wearing long-sleeve shirts, long pants (skirts), a long-sleeve lab coat, well-fitted leather shoes (no sneakers), and gloves. Gloves should be loose-fitting, lightweight, flexible, and insulated so that they can be quickly removed if LN_2 is spilled on them.
5. Use care when filling portable Dewars and do not overfill them.
6. Transfer or pour slowly to minimize boiling and splashing. To reduce the amount of splatter when transferring cryogenic liquids from one container to another, always start slowly, allowing the vaporization to chill the receiving container before filling it. Use a phase separator or special filling funnel (the top of the funnel should be partly covered to reduce splashing). If the liquid cannot be poured, use a cryogenic liquid withdrawal device for the transfer (be sure to follow all instructions provided with the device).
7. Use tubes specifically designed for cryogenic storage and place them in a heavy-walled container or behind a safety shield while thawing.
8. When hand-carrying a cryogen-containing Dewar, ensure it is your only load (no books, coffee, or other items). Watch carefully for people who may run into you and ensure that the Dewar is carried with both hands and as far away from your face and body as comfortably possible.
9. Ensure Dewars are properly labeled. Do not mix different cryogens.
10. To avoid asphyxiation, an oxygen monitor in good working order is recommended if you are working with a cryogen in a confined space.

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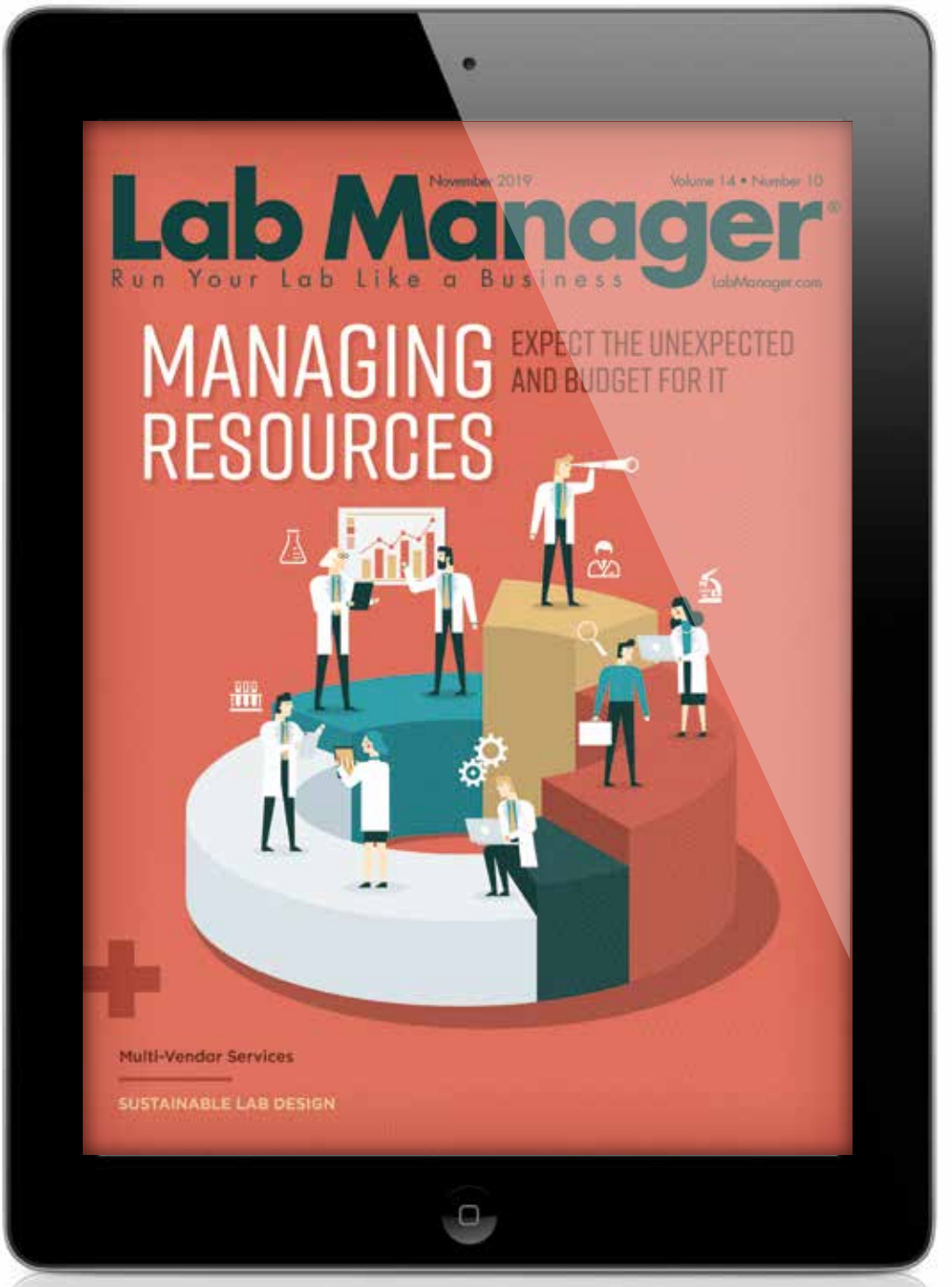
Vince McLeod *is an American Board of Industrial Hygiene-certified industrial hygienist and the senior industrial hygienist with Ascend Environmental + Health Hygiene LLC in Winter Garden, Florida. He has more than 35 years of experience in industrial hygiene and environmental engineering services, including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



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TYPES AND TIPS

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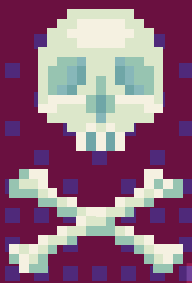

Perform regular electrode maintenance including changing the filling and storage solutions, and cleaning.

Titration is a method of chemical analysis used to determine the concentration of an identified analyte. A known concentration and volume of titrant reacts with the analyte to determine the concentration. Titration is used in laboratory medicine, for pharmaceutical, food science, and environmental applications, among many others.

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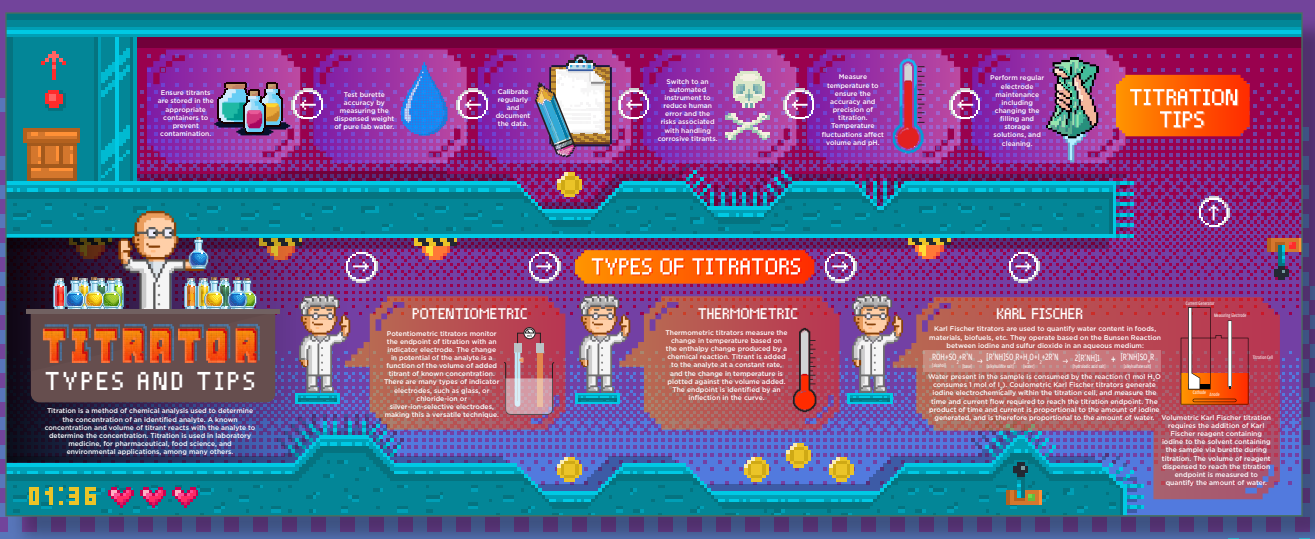

Changes on the Horizon for Nutrition Facts Labels

NEW RULES TAKE EFFECT IN 2020, AND MANUFACTURERS CAN TURN TO ANALYTICAL FOOD LABS FOR ACCURATE SAMPLE ANALYSES **by Michelle Dotzert, PhD**

With the exception of the required addition of trans fat in 2006, the Nutrition Facts label has remained largely unchanged for the last 20 years. In 2016, the Food and Drug Administration (FDA) published final rules for the new label based on new scientific information and the link between diet and chronic diseases. These changes aim to help consumers make more informed choices, and manufacturers must switch to the new label by January 1, 2020. Different analytical techniques are used to determine the composition of food products, and to generate the necessary data to create accurate Nutrition Facts labels. New developments in instrumentation and technology challenge established techniques, offering greater specificity and sensitivity.

> "According to the FDA, the new label is aimed at making it easier for consumers to make more informed choices, and is based on updated nutrition science."

CHANGING REQUIREMENTS AND ESTABLISHED METHODS

Current Nutrition Facts labels have 13 key requirements including: serving size and servings per package; calories and calories from fat; total, saturated, and trans fat; cholesterol; sodium; carbohydrate; fiber; sugar; protein; vitamins A and C; calcium; and iron. The new requirements will necessitate design changes to the serving size, servings per container, and calories text. The amount of added sugar in grams and %DV (percent of daily value) will be required, and the amount of vitamin D, potassium, calcium, and iron will replace vitamins A and C, and must be presented as %DV in micrograms or milligrams. According to the FDA, the new label is aimed at making it easier for consumers to make informed choices, and is based on updated nutrition science.

There are many analytical laboratories that perform nutrient analysis; however, the FDA does not approve or recommend specific laboratories. Therefore, it is the manufacturer's responsibility to work with a laboratory that employs appropriate methods including those published by The Association of Analytical Chemists (AOAC), a globally recognized, independent, third party, not-for-profit association and voluntary consensus standards developing organization. Analytical Food Laboratories (AFL) in Grand Prairie, TX is one such laboratory: "We use methodologies that have been proven by other agencies (AOAC, USDA, AOCS)," says Stephen Wuller, PhD, CFS, chemistry manager at AFL.

QUANTIFYING MACRO- AND MICRO-NUTRIENTS

Different vitamins, minerals, macro-, and micro-nutrients are quantified with various analytical methods. The amount of crude protein in a sample is often determined from nitrogen content using the Kjeldahl method, which

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relies on digestion in concentrated sulfuric acid followed by the conversion of organic nitrogen to ammonium sulfate. Ammonia is distilled into boric acid solution and the borate ions are titrated to calculate nitrogen content. Alternatively, the Dumas combustion method may be used to quantify nitrogen, and subsequently protein in a sample. The method relies on sample combustion at high temperature in an oxygen atmosphere, and oxidation and reduction tubes to convert nitrogen to N_2. Nitrogen gas is measured via thermal conductivity detector. "Our combustion analyzer determines the nitrogen gas content in combusted foods and from that value determines the protein content," says Robert Abad, principal food chemist at Pacific Coast Analytical Services.

Total fat determination can be achieved with gas chromatography coupled to a flame ionization detector (GC-FID). "We analyze fatty acids and cholesterol with GC-FID," explains Abad. Prior to analysis, all lipid compound classes must be extracted, and bonds and interactions with non-fat compounds must be broken. This is often achieved with non-polar organic solvents like chloroform, *n*-hexane, and polar organic solvents such as methanol. The Soxhlet method is used to extract neutral lipid, such as triacylglycerol from various foods, and involves transferring partially soluble components of a solid to a liquid phase with a Soxhlet extractor. While this is an effective technique, new efficient methods are emerging. "We examine new technologies that either can improve or speed up analysis," says Wuller. "Adoption of a pressurized heated fat extractor essentially halved the total analysis time vs. traditional Soxhlet methodology."

In recent years, the demonization of fats by food manufacturers and the media has shifted, and sugar is now considered the primary dietary culprit of obesity and cardiometabolic disease. Nutritional labeling requirements for sugar encompass all monosaccharides (fructose, glucose, and galactose) and disaccharides (lactose, maltose, and sucrose) in the food product. These are referred to as free sugars, which are naturally present in various food products, and may also be added by the manufacturer. Current analytical methods for sugar quantification include LC-RI (liquid chromatography with refractive index detection), and LC-ELSI (liquid chromatography with evaporative light scattering detection).

Under the new regulations, the amount of added sugar, in grams and %DV, will be required. However, differentiating between naturally occurring and added sugars poses challenges for analytical labs. "For added sugars, there's still no way analytically to differentiate the sugar (e.g. sucrose) coming from additional added or the original product," explains Wuller. The inability to distinguish naturally occurring or added sugars creates an opportunity for manufacturers to modify products with added sugars to improve flavor or reduce cost. He notes, however, that "column and/or instrument manufacturers provide technical notes/applications that have proved useful for new testing requests."

> "It is the manufacturer's responsibility to work with a laboratory that employs appropriate methods including those published by The Association of Analytical Chemists."

The upcoming changes will also include the replacement of vitamins A and C content with vitamin D. The rationale for the change is that vitamin A and C deficiencies are now very rare, while many Americans do not meet the requirements for vitamin D. "We use LC-MS/MS for vitamin D," says Wuller. Indeed, LC-MS (liquid chromatography coupled to mass spectrometry) is the AOAC validated method for analysis of vitamin D in food. While methods differ slightly depending on the nature of the sample, they all involve four essential steps: digestion to break down the matrix; extraction of vitamin D from the matrix; clean-up; and quantitative detection by HPLC. However, as vitamin D exists in D_2 (ergocalciferol) and D_3 (cholecalciferol) forms, it poses challenges for chromatographic resolution. New stationary phases, and LC-MS and LC-MS/MS with stable isotope-labeled internal standards aim to improve accuracy.

In addition to calcium and iron, the %DV and milligrams or micrograms of potassium must be included to meet the new label requirements. ICP-MS (inductively coupled plasma mass spectrometry) enables simultaneous detection of these elements, has a wide linear dynamic range, high sensitivity, and facilitates high sample throughput.

CHALLENGING MATRICES

With various guidelines and well-established methods, nutritional analyses may initially seem like routine processes. Certainly, established methods are valuable; however, the challenge lies in the complexity of the samples. As Wuller explains, "mixed matrix samples (e.g. beef enchilada or stews with vegetables and meats) or when the method is not amenable to the typical food analysis (e.g. dietary fiber on meat samples)" are examples of circumstances that require special consideration. According to Abad, "A wide range of sample matrices come in and out of the lab on a daily basis ranging from dog snacks to potato chips to edible insects and CBD oils. Since we are a food testing lab, we see all sorts of challenging and labor-intensive products with challenging matrices. One of the main goals with any sample is to ensure a homogeneous matrix. Having this allows the best representation of uniformly distributed macro and micronutrient content in any particular sampling."

A homogeneous matrix is critical for accurate analyses, but how is this achieved? "We have developed many useful techniques working with blenders, grinders, mortar and pestles, and other mechanical means to ensure that the sample is homogeneous and fits the criteria for the particular analyte being tested," explains Abad. "To do this efficiently and effectively is a difficult task that evolves with the samples that continue to come into the lab."

The upcoming changes to the Nutrition Facts labels represent a hurdle for food product manufacturers. Fortunately, analytical food labs are equipped with reliable methodology and new technologies for accurate analyses.

***Michelle Dotzert**, scientific technical editor for* Lab Manager, *can be reached at mdotzert@labmanager.com or 226-376-2538.*

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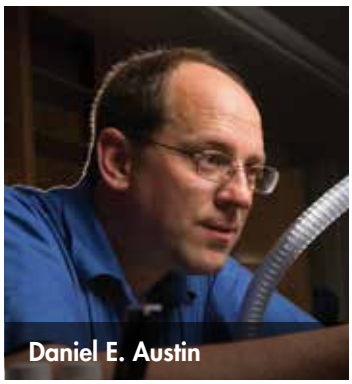

Daniel E. Austin

ASK THE EXPERT

TRENDS IN PORTABLE ANALYSIS

by Lauren Everett

Christopher C. Mulligan is a professor of analytical chemistry at Illinois State University. He has more than 15 years of experience in developing miniaturized analytical devices, with specific expertise in portable and miniaturized mass spectrometric instrumentation development, novel ionization methods, and application development. Through his research, Mulligan seeks to demonstrate the impact and practicality of portable MS systems for use in crime scene investigation, law enforcement, security applications, and environmental science.

Daniel E. Austin is a professor of chemistry at Brigham Young University (Provo, UT). He received his PhD at the California Institute of Technology and subsequently worked as a senior member of the technical staff at Sandia National Laboratories in Albuquerque, NM. His research interests include developing miniaturized ion trap mass analyzers, experiments in surface induced dissociation of fast neutrals, and charge detection mass spectrometry. He received the 2018 Curt Brunnée Award from the International Mass Spectrometry Foundation, and has received several other awards.

Q: Please explain your experience with developing portable mass spectrometers.

Christopher Mulligan: My group combines fieldable mass spectrometry (MS) technologies with so-called "ambient" ionization methods, where samples of interest are analyzed with little to no preparation. In this way, we hope to provide the first response, forensic science, and environmental monitoring communities with near-real time chemical information, but in a platform that is easy to use, reliable, and, for samples of legal concern, court-admissible. Our efforts are split between instrumentation development, investigating novel ionization sources, and applications for disciplines that would benefit from such an analysis strategy.

Daniel Austin: For several years, we have focused on using microfabrication and novel electrode geometry to make smaller ion trap mass analyzers that retain as much performance as possible and can be used in portable systems. Much of our work uses ion traps made using lithographically patterned substrates. We have also done work on toroidal ion traps, which have a larger trapping capacity. As ion traps become smaller, it is important to maintain analyte sensitivity by keeping the ion trapping capacity as large as possible.

Q: Why is there a need to bring mass spectrometers out of the lab and into the field for analysis?

Christopher Mulligan: For field-borne samples, the main determiner of overall analytical throughput is not how fast you can analyze the sample, but how quickly you can transport it to the traditional off-site laboratory. The old axiom of "time equals money" applies, but for time sensitive situations like chemical spills, criminal investigations, and homeland security events, this downtime between sample collection and processing can determine how effective response efforts are.

Daniel Austin: For many applications, it is possible to collect samples and send them off to a mass spectrometry facility for analysis, although it can take time to get the results. However, on-site and rapid analysis allows quick decisions to be made, which would be particularly helpful in emergency response, national security, forensics, etc. In addition, many samples are too complex spatially, or vary in time, and multiple samples are needed. For some types of analysis, the sample could change during storage and transport—problems avoided with on-site analysis.

Q: What challenges can you run into when trying to develop and build a smaller, portable spectrometer? How can these challenges be overcome?

Christopher Mulligan: As a general trend, smaller would be better with portable MS systems—the pinnacle achievement would be a device akin to the Tricorder from *Star Trek*, handheld and diverse in the data it can yield. However, reducing the size of the MS typically reduces the analytical performance, as well. Historically, the size of the MS device was dictated by the vacuum system it employs and the necessary RF/DC

electronics for operation. Advances in vacuum technology and electronics have allowed even lab-scale MS systems to undergo a massive size reduction. Further miniaturization has a cost, though. Less vacuum leads to fewer ions being sampled and lower sensitivity (for atmospheric pressure and ambient ionization sources). Smaller, lower performance electronics lead to lower resolution spectra and/or a reduced mass range. In this way, there is a natural divide in fieldable MS development, that being miniature/handheld devices that may have reduced performance and portable devices that maintain some performance attributes of lab-scale systems.

Daniel Austin: There are many challenges, and some that we didn't anticipate when we started working in this area. Interestingly, most groups in recent years have moved away from trying to make the mass analyzers smaller and are focusing on making everything else smaller. We have continued to try to make the mass analyzers smaller, as have a small handful of other groups. A lot of the competition is now from companies. One of the challenges is that there are so many sub-systems to a mass spectrometer that it is out of reach for academic groups to actually produce an instrument. There is a lot of engineering, electronics, computer interfacing, etc. that is necessary to generating a mass spectrum, but it is not what we can expect from graduate students in a single discipline such as chemistry. That is one reason my group has focused on the analyzer itself.

We have had challenges related to engineering small devices—what materials work or don't work, how to make small but reliable electrical connections, what to do when we don't see signal, contamination issues, burned out components, etc. Everything scales differently at smaller scale, so we sometimes don't correctly anticipate heat build-up or cooling, misalignments and their effects, etc.

Q: What limitations are associated with current portable spectrometer technology on the market compared to regular-sized instruments in the lab?

Daniel Austin: There are several portable mass spectrometers on the market, typically in the range of 15-20 kg. This is still a sizeable instrument. I've also seen larger instruments, or in some cases full-sized lab-scale instruments, made portable for specific applications by putting the instrument in a vehicle. There are still challenges even with that. These types of applications underscore the potential for truly portable instruments to come.

Q: Can you put into perspective the difference in size and weight of a portable mass spectrometer compared to a bulkier one in the lab?

Christopher Mulligan: Lab-scale mass spectrometers are deceiving, as the instrument itself is big, but there are also roughing pumps, gas tanks, etc. that are required for operation. For portable mass spectrometers, the goal is that all of the required consumables (such as compressed gases, delivered solvents, etc.) and any needed voltage sources for sample ionization are included in a form factor that is person-portable. What you see is what you get.

Daniel Austin: Benchtop instruments are often two to three times the size and weight. So you can see that there has been some miniaturization, but not yet as dramatic a difference as we really need to take mass spectrometers into the field as easily as we take a cell phone.

Q: Aside from spectrometers, what other instruments are being developed to be portable?

Christopher Mulligan: There are quite a few commercially-available, portable technologies for chemical analysis now. Portable GC-MS systems have been around for almost 20 years, and companies such as Advion now offer "compact" LC-MS systems for varying applications like reaction monitoring. Several types of spectroscopy (e.g. XRF, NIR, Raman, FTIR) have portable versions that offer point and shoot chemical screening. And there are even benchtop scale NMRs now.

Q: How do you see mass spectrometers evolving in the future (over the next 5-10 years)?

Christopher Mulligan: Five to 10 years may be ambitious, but I think advances in miniaturization will eventually yield the handheld "personal" mass spectrometer. Combining such a technology with the Internet of Things could revolutionize fields like medicine, public safety, etc.

Daniel Austin: Several new companies have emerged in recent years with the intention of developing portable mass spectrometers. A lot of progress is being made, and I think this will continue. At the same time, many applications are being reported that make use of the existing portable instruments.

***Lauren Everett**, managing editor for* Lab Manager, *can be reached at leverett@labmanager.com or 973-721-4070.*

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FINDING THE JUST-RIGHT INCUBATOR TO MEET YOUR LAB'S NEEDS

by Mike May, PhD

Any lab working with cells or tissues needs an incubator, often one that controls carbon dioxide (CO_2). With a CO_2 incubator, a scientist can optimize the environment for growing and maintaining live samples. Picking the right CO_2 incubator, though, depends on a lab's needs and circumstances.

At the University of Kansas Medical Center in Kansas City, MO, Robin Maser, associate professor of clinical laboratory sciences, studies polycystic kidney disease, an inherited disease that can lead to kidney failure. This work requires various samples that must be maintained for specific studies. "We use our CO_2 incubator for mammalian cell culture, metanephric organ culture, and for fluid shear-stress experiments with mammalian cells," she says.

Sometimes, scientists place other devices inside a CO_2 incubator. In growing cells, for example, Dan Simionescu, Harriet and Jerry Dempsey Professor of Bioengineering at Clemson University in South Carolina, says that he puts rotators and bioreactors "inside the incubator for dynamic 3D cell culture and bioreactor conditioning of tissue engineered scaffolds." In general, a lab manager shopping for a CO_2 incubator wants one that is easy to use, reliable, and either resists contamination or can be easily sterilized—usually both. Even if a manager only considered those things, many products might meet a lab's needs. Yet, there are many other features that matter to some lab managers. So, it takes time and effort to find the best CO_2 incubator for a particular lab.

Technology overview

With a CO_2 incubator, a scientist can control the temperature, humidity, and CO_2 level to which cells are exposed. Cells and tissues grow best at a specific temperature and humidity, usually about 37° Celsius and 95 percent, respectively. The CO_2 level determines the pH level, and most scientists set the CO_2 level at five percent.

Various technologies can be used to provide the desired environment in an incubator. To maintain the selected temperature, manufacturers use one of three methods: direct heat or an air or water jacket. Direct heat radiates from the incubator walls and into the chamber; for jacketed options, the heat moves by convection from the air or water into the chamber. A direct method of heating can adjust the temperature faster and recover faster after a door opening, but a jacketed option—especially a water jacket—maintains incubator temperature longer in the event of a power outage.

Something as simple as a tray of water can be used to add humidity inside an incubator. (For more on humidity control, watch the *Lab Manager* webinar, "Controlling Relative Humidity and Condensation in a CO_2 Incubator")

> "The level of control needed depends on how an incubator will be used."

To control the CO_2 level, incubators are manufactured with a thermal-conductivity sensor or infrared sensor. When the CO_2 level is less than the set point, more is automatically added. For the highest accuracy on measuring the CO_2 level, select one that uses an infrared sensor, but that tends to cost more.

Find your features

At the Integrated Bioscience and Nanotechnology Cleanroom at the University of Georgia College of Engineering in Athens, GA, scientists primarily grow cells in CO_2 incubators. In thinking about the incubator requirements, manager Kun Yao says, "As long as the temperature and gas atmosphere can be controlled, I think it should be fine."

The desired features of a CO_2 incubator, though, vary from one investigator to another and how the product will be used. In terms of the physical features of a CO_2 incubator, some general things should be considered:

Size: This includes the inside volume, which plays a key role in how much an incubator can hold. The footprint also matters in many labs, because there is only so much room for an incubator. The height can also matter, especially if the incubator will go on a benchtop.

"For most labs, more than one feature will be considered in selecting the best CO_2 incubator."

Shelving: How the shelves are arranged in an incubator or how they can be rearranged also impacts how many samples can be stored.

Surface: Various materials can be used inside. To prevent corrosion and simplify cleaning, stainless steel is a good choice. For lower cost, aluminum might be better. Some labs prefer a copper lining, which can reduce the risk of contamination.

Air flow: Gravity convection can be relied on to move air in less expensive incubators. To keep the temperature more uniform inside the incubator, a fan is required. For air purification, an incubator can also include a HEPA filter for incoming air.

Controls: The level of control needed depends on how an incubator will be used. If the accuracy of inside conditions, such as temperature, is not highly sensitive in an application, analog controls can keep costs down. For higher accuracy and setting up sequences of conditions, digital controls and even a computer connection works better.

For most labs, more than one feature will be considered in selecting the best CO_2 incubator. For example, Maser points out that her lab based its search on four things: cost, due to limited grant funds; ports on the outside for pump tubing and cords; stacking incubators, because of limited space in the culture room; and a sterilization cycle, "because the solutions used for decontaminating the incubator are health hazards," she says.

Scientists tend to favor their own mix of features. For instance, Simionescu says the key factors are "temperature, CO_2 stability, and short recovery time after opening the door." To add rotators and bioreactors inside a CO_2 incubator, he picks ones with cord and cable access. "For this, we prefer the incubators that have an orifice in the back that communicates with the outside," he says. "Typically, it's about one inch in diameter, sufficient to pull through two to three power cords and a couple of pressure transducers." In some cases, one consideration leads to another. As Maser explains, "We were considering incubators with a sterilization cycle, which eliminated water-jacketed incubators, and we felt that infrared sensing equipment might have a shorter half-life due to heat sterilization, so we went with thermal conductivity for the CO_2 sensor."

As Maser indicates, some qualitative decisions must be made. The more research behind a purchasing decision, though, the more likely a lab is to select a CO_2 incubator that meets as many demands as possible.

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ELECTROPHORESIS

OLD IDEA, NEW DEVICES AND SYSTEMS

by Angelo DePalma, PhD

Conceived during the late 1980s, the "lab-on-a-chip" idea sought to create the equivalent of an entire analytical laboratory on matchbook-sized slabs of silicon, glass, and plastic. Most of these devices were based on capillary electrophoresis, an analytical mode that remains dominant in microfluidic analytical devices.

The dream of fabricating anything resembling an entire laboratory on a matchbook-sized substrate was never realized, but commercial instrumentation has emerged that performs straightforward electrophoresis on chips. These mostly serve the life sciences, including medical diagnostics. A market research report estimates a robust seven percent yearly growth rate for such systems.

Throughput and resolution

PerkinElmer offers two microfluidic electrophoresis platforms—the LabChip® GX Touch™ nucleic acid analyzer for DNA and RNA, and the LabChip® GXII Touch™ protein characterization system for proteins and glycans. Both systems provide high-throughput platforms for electrophoresis-based biomolecule separation, sizing, and quantitation. PerkinElmer developed special microfabrication methods that embed low-micron-sized channels into thin glass and quartz microchips. The microchips interface with the instrument via plastic caddies to support easy sample loading and engagement with the instrumentation.

"The primary advantages of microfluidic-based vs. gel-based biomolecule analysis are the throughput, resolution, ease of use, sensitivity, and versatility," says James Atwood PhD, general manager of automation and microfluidics at PerkinElmer. "Traditional gel electrophoresis is time consuming, labor-intensive, prone to variability, and consumes large quantities of precious samples."

LabChip microfluidic-based assays consume just 150 nanoliters of sample per separation and are compatible with nucleic acid and protein samples in the low pg/μL and ng/mL concentration ranges, respectively.

Throughput of up to 384 samples per cycle for LabChip far exceeds that of gel-based systems and biomolecules, such as N-linked glycans, which are not amendable to electrophoresis gel-based separation but can be separated and detected in microfluidic systems. Another important advantage of microfluidic-based biomolecule separation is separation and quantitation of native proteins, based on charge alone, to detect charge variants. Gel-based electrophoresis cannot resolve protein charge variants.

In typical gel electrophoresis-based mass spectrometry workflows, the compounds are first separated in the gel then the bands corresponding to the biomolecules of interest are excised. In proteomic workflows, proteins are enzymatically degraded, and peptide fragments are extracted from the gel prior to LC-MS/MS. While this approach has a number of advantages, including being an orthogonal separation mode, it is extremely tedious.

Several microfluidic-based systems have been developed that enable the direct coupling of a microfluidic chip to an HPLC system and mass spectrometer. In these microchromatography systems, the microfluidic channels are packed with a stationary phase that is specific to the desired separation mode. This enables the automated capture and/or separation of biomolecules directly on-chip with elution, ionization, and detection in the mass spectrometer. In contrast to gel-based approaches, the microchromatography systems are automation-friendly and can be tailored to target specific biomolecules of interest based on modifying the packing material.

Minimizing sample volumes

The chips used with the Agilent 2100 Bioanalyzer system consist of a plastic caddy with 16 wells used for reagent and sample application. Each chip is labeled with identifiers for assay type, lot number, and the assay-specific chip setup. The glass chip incorporates etched microchannels and is glued onto the backside of the caddy. "The production process of the glass chip and separation channel is similar to that of semiconductor devices," says Eva Graf, product manager for bioanalyzers at Agilent Technologies

(Santa Clara, CA). Agilent uses special protective masks for protein and nucleic acid chips, which mirror the channel structure. When the glass chips are exposed to the etching agent, only the channels are etched into the glass. The remaining chip surface is protected by the mask.

The microchannel system connects all wells of the caddy with the injection cross and separation channel. Before applying samples, the microchannels are filled with a mix of separative gel and fluorescent dye. During the chip run, a high voltage is applied in multiple steps according to an assay-specific script reflecting the layout of the microchannels in the glass chip. "The script coordinates pre-draw, electrokinetic injection and, of course, electrophoretic separation of the samples," Graf explains. "Simultaneous electrophoretic separation and pre-draw of the subsequent sample reduces the analysis time to minutes per sample." Separated analytes are then detected within the separation channel by laser-induced fluorescence and the signal is translated into gel-like images and electropherograms.

Electrophoresis-on-a-chip allows highly resolving separation requiring only minimal sample volume, which makes the technology attractive for quality control of precious samples before any downstream application.

For Agilent, top electrophoresis-chip applications include library quality control in next-generation sequencing workflows. According to Graf, accurate calculation of size distribution and sample concentration before sequencing is crucial to achieving optimal cluster density, and assessing the quantity and quality of experimental starting material is essential for research success. "When using RNA as starting material for gene expression analysis using NGS, microarrays, or qPCR, RNase degradation is a common reason for failed experiments. The chip-based RNA assays make it easy to visually detect even small degradation effects, and the RNA integrity number allows objective sample qualification."

By contrast, traditional gel electrophoresis only allows estimation of sample integrity, which is prone to user-dependent interpretation. "High sensitivity and a large linear dynamic range of the DNA assays make it an optimal tool for analyzing fragments amplified by PCR or digested by restriction enzymes, and enables easy evaluation of cleavage efficiency of synthesized gRNA in genome editing," Graf says.

On the protein analysis side, EPCs provide a rapid, reliable way to replace analytical SDS-PAGE methods. Typical applications include assessment of size, purity, and concentration of proteins during processes like expression of recombinant proteins, protein purification, stability studies, or general antibody analysis.

Purchase considerations

Lab managers evaluate instrumentation based on its capabilities, not its buzz factor. Purchasers of chip-based systems should therefore make sure that systems under consideration provide the depth and breadth of assays they expect to run.

Graf recommends systems that offer assays "appropriate for your sample type, especially with regards to sample concentration, sample size, sample type (DNA, RNA, protein, etc.)," always with an eye on sample throughput. "Also, consider the vendor's services for support, warranty, repair, and installation, and the system's ease of use, all of which can help reduce lab downtime to a minimum."

Sample volumes have become a major selling point with all analytical instruments. Smaller volumes consume less reagent and less sample, and allow researchers to do more with rare or scarce samples. Agilent's 2100 Bioanalyzer, for example, requires just one microliter of sample for RNA and DNA assays.

Regulatory compliance is an issue for pharmaceutical R&D labs, with 21 CFR part 11 being the applicable regulation covering electronic records. Compliance also plays into standard operations for diagnostics labs and any facility with ongoing interaction with the patent or legal system, for example, forensics.

Cost is always a consideration, but for instrumentation that labs use every day, cost of ownership must be considered with regard to energy and reagent consumption. Service plans tend to be comprehensive, with generally rapid response, but very busy labs should also consider the economic impact of downtime.

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HOMOGENIZERS

GENERATOR AND SONICATOR PROBES ARE DIFFERENTIALLY ADAPTED TO DIFFERENT SAMPLE TYPES AND SIZES

by Brandoch Cook, PhD

Advances in cellular fractionation germinated, quite accidentally, the field of molecular biology, and many years later, more purposefully initiated the modern era of cell biology. In 1869, Friedrich Miescher began investigating the nucleus, at a time when cell theory was still in its infancy. He isolated neutrophils from pus on bandages with saline washes, then separated nuclei from cytoplasm by alkaline extraction. The resulting precipitates contained a substance with phosphorous in novel stoichiometric ratios. He named it nuclein, and its function as the carrier of heritable information would not be appreciated or even hypothesized for several decades. In the 1940s, Albert Claude, interested in obtaining a functional picture of a living cell, pioneered the use of differential centrifugation, and combining it with nascent electron microscopy, identified several subcellular organelles, and isolated viral particles after infection. Later improvements to tissue fractionation led to seminal discoveries in oxidative phosphorylation, intracellular digestion, protein synthesis, transport and secretion, organelle biosynthesis, and the study of metabolites.

An unsung hero in these landmarks is cell disruption via homogenization. Throughout the early years, however, homogenization was limited to the ancient technology of the mortar and pestle, or to the destructive power of the Waring blender. In countless experiments, fractions that were deemed insoluble in homogenization steps were simply discarded, until the realization that these seemingly impenetrable residues contained compartments, particles, and molecules of great interest. Although mortars and pestles and Douncers are still widely used for applications ranging from RNA extraction to disruption of organs and embryos, modern mechanical homogenizers are usually more reliable, especially when throughput is a concern. Bead mill homogenizers facilitate high-throughput disruption of hard tissues in small volumes, and high-pressure homogenizers can create emulsifications and cell lysates at industrial scales. Both are less versatile and ubiquitous, however, than rotor-stators and sonicators.

A rotor-stator works by rapid rotation of an inner rotor within a stationary sheath, disrupting cells or tissue by mechanical tearing, shear forces, or cavitation, a shock wave produced by rapidly collapsing bubbles in solution. A sonicator consists of a generator and a transducer, which uses a piezoelectric charge to impart its resonant frequency to an ultrasonic probe. The probe's resulting vibrations cause shear and shock waves in the liquid sample, resulting in an emulsion. For both types of homogenizer, the probe tip diameter determines the appropriate sample volume, and the vessel in which disruption or emulsification can take place. Therefore, there is a wide variety of probe sizes, and a corresponding range of samples that a laboratory homogenizer can handle, from less than 200 microliters to more than five liters.

Companies such as Omni International supply rotor-stator generator probes that vary in size and have different types of tips. Samples of the smallest volumes and softest consistencies use the narrowest probes with flat bottoms. The incorporation of saw-tooth blades in medium-sized probes allows disruption of larger and tougher samples, while large probes with open-slotted bottoms can be used for larger volumes and thicker samples in beakers and flasks. For sonicators, BioLogics and others provide solid or tapped ultrasonic tips that correspond to larger volumes, necessitating wider diameters, lower radiation of ultrasonic energy, and a wider cavitation field. Solid tips are more appropriate for organic solvents, unlike tapped tips, which have threaded ends to accept disposable attachments for high-throughput applications. Microtips for smaller volumes transfer a greater amount of energy with narrower cavitation. Stepped and tapered microtips are similar in the way they impart ultrasonic vibrations, although stepped microtips are longer and can reach into deeper vessels, potentially mitigating sample loss due to splashing or evaporation through heat. Regardless of whether your protocol calls for mechanical disruption or ultrasonic emulsification, there's a probe for that.

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INTEGRA ASSIST PLUS pipetting robots—hands-free multichannel pipetting

INTEGRA has launched the ASSIST PLUS pipetting robot to put automated pipetting within reach of virtually every lab. This compact system offers laboratory automation at an affordable price, providing reproducible and error-free processing while eliminating repetitive manual pipetting tasks.

Using any INTEGRA electronic multichannel pipette, the ASSIST PLUS is designed to offer exceptional flexibility, without the need for dedicated personnel or complex programming. From plate filling and reagent addition to serial dilutions, the system eliminates the influence of human error and inter-operator variability on pipetting, leading to better reproducibility. And, as the smallest and most economical pipetting robot on the market to offer variable tip spacing, it is also ideal for tasks such as tube-to-plate transfers and plate reformatting.

Multichannel pipettes are routinely used to increase throughput in today's laboratories. However, prolonged manual pipetting still takes up precious time, and can lead to repetitive strain injuries. In addition, ever-decreasing sample sizes have made it increasingly difficult to pipette correctly and accurately. A pipetting robot is a considerable investment, unachievable for many laboratories, which is why INTEGRA has developed the compact ASSIST PLUS pipetting robot to streamline pipetting tasks at an affordable price. Using the company's range of VIAFLO II and VOYAGER II electronic multichannel pipettes—from four to 16 channels—the system automates routine liquid transfers, eliminating physical strain and ensuring reproducible and error-free pipetting.

ASSIST PLUS is the smallest and most economical pipetting robot offering on-the-fly adjustment of tip spacing in combination with the VOYAGER II pipette. This makes performing serial dilutions or plate reformatting by hand a thing of the past, ensuring that these tedious and error-prone tasks are performed reproducibly and reliably, with the option to exchange tips after every transfer to minimize carryover. The robot can also automatically reformat samples—eg. from tubes into plates—up to 12 times faster than with a single channel pipette. The flexible deck layout of the ASSIST PLUS accommodates tubes, reservoirs, and plates, enabling multi-step transfers of samples, buffers, or media to the assay plate.

Automating pipetting processes with ASSIST PLUS ensures constant pipetting angles, consistent tip immersion depths, controlled pipetting speeds, and accurate well targeting. This eliminates inter-operator variability and human errors—such as skipping rows or air aspiration—leading to increased reproducibility and better quality results. Automation also ensures that pipetting protocols are precisely followed, enhancing workflow consistency and process control. Programmable either directly on the pipette or remotely using INTEGRA's VIALAB or VIALINK software packages, ASSIST PLUS allows users to quickly and easily set up their protocols, then perform other activities while the robot precisely and reliably carries out the pipetting task. Combined with broad labware compatibility and a range of accessories—from tube racks to high capacity reservoirs—this ensures it fits seamlessly into a variety of laboratory workflows, while still giving you the option to use the same electronic multichannel pipettes for manual tasks as required.

About INTEGRA Biosciences

INTEGRA Biosciences (https://www.integra-biosciences.com) is a leading provider of high-quality laboratory tools for liquid handling and media preparation. The company is committed to creating innovative solutions which fulfil the needs of its customers in research, diagnostics, and quality control within the life science markets and medical industry. Today, INTEGRA innovative laboratory products are widely used all around the world. More than 90 distribution partners form a worldwide sales network providing responsive and competent services to customers. These distribution partners are supported by a highly motivated and experienced team of specialists at the company headquarters in Zizers, Switzerland and Hudson, NH, USA. INTEGRA is an ISO 9001 certified company.

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PIPETTES

ELECTRONIC PIPETTES ARE THE PREFERRED SOLUTION FOR EFFICIENCY, CONSISTENCY, AND RELIABILITY

by Brandoch Cook, PhD

A pipette is a thin tube used for transferring liquids, and has been an indispensable tool of science since the time of Pasteur. He and other Victorian-era scientists used bulbs, inlet tubes, and cotton wool filters to enhance suction and forestall contamination. Although their volumetric consistency was inadequate, these adaptations spurred a leap forward in microbiology and allowed researchers to safely transfer liquids with their fingers instead of their mouths. Nonetheless, the first report of infection occurred contemporaneously, in 1893, when a researcher mouth-pipetted the bacterium that causes typhoid. The victim was a sentinel for trends to come, and by the 1950s up to 40 percent of laboratory-derived infections were caused by mouth pipetting. A 1966 US Army study came to the obvious conclusion that researchers should stop doing it. Heedless of this advice, bacterial and viral infections, radioactive poisoning, and chemical burns were common occurrences until the 1970s, when precision micropipettes became widespread.

The manual, piston-stroke micropipette was introduced by Eppendorf in 1961, and marked significant improvements in accuracy and standardization compared to previous iterations, oral or otherwise, which depended on forces of suction and expulsion that were unique to each user. Gilson later updated the technology to allow for adjustable volume control. The introduction of instruments oriented toward microliter amounts helped drive biomedical science into the realm of the very small. It changed investigators' approaches to scientific questions, and the industry itself, as it moved toward production of microcentrifuges and graduated microvolume test tubes. More recent advances in pipetting technology stem from increased throughput in experimentation. The success of the Human Genome Project, and the rise of deep sequencing platforms, spurred companies including Eppendorf to begin introducing electronic pipettes. Now, many laboratories have a range of pipetting options, with electronic repeater and multichannel pipettes, and a full series of manual P20, P200, and P1000 pipettes for each staff member.

Choice can sometimes be an experimental hazard, though. It is frustrating to watch a student pipet vanishingly small volumes, for instance adding 0.27 microliters of an enzyme in 10 percent glycerol to a reaction tube using a P2. Additionally, because of the ability of the manual piston to go past its point of measured accuracy, people erroneously take up volumes that exceed the calibrated range. As manual pipettes are particularly vulnerable to hysteresis, transfer of seemingly identical volumes to many samples is actually subject to a significant amount of error. Finally, how can any of us over the age of 35 hope to be accurate when we can't even see the little tick marks in between the microliter values anymore?

Electronic pipettes contain a motor to precisely regulate aspiration and dispensing rates, which reduces air bubbles and barrel contamination. Moreover, repeater pipettes reduce measurement error in experiments with many samples and replicates. Push-button functionality provides an ergonomic advantage, avoiding mechanical wear associated with force-dependent actions like tip ejection, and obviating laboratory casualties like pipette thumb. Electronic pipettes are often programmable, allow storage and modification of protocols, save on overall tip usage, and drive greater efficiency in experimental setup. Several providers have taken the technology a step further and created linked smart pipetting systems. Thermo Fisher Scientific offers E1 pipettes that are programmable and Bluetooth-enabled, although they require proprietary ClipTips. Similarly, Gilson offers the Pipetman M series that interfaces via Bluetooth with the Trackman digital tablet to keep track in real time of complex multiwell pipetting tasks, and store data for further analysis. Finally, although electronic pipettes are usually two to three times the price of manual ones, the increased accuracy, and hence efficiency and confidence in results, are well worth it.

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STARLINE
PLUG-IN RACEWAY

Starline helps Princeton Plasma Physics Laboratory plan ahead for future facility.

Princeton Plasma Physics Laboratory (PPPL) in Princeton, New Jersey is a collaborative national center for fusion energy research. Funded by the Department of Energy, the laboratory advances the coupled fields of fusion energy and plasma physics research, and, with collaborators, is developing the scientific understanding and key innovations needed to realize fusion as an energy source for the world.

In 2015, in order to continue expanding its plasma research for the production of nano particles, PPPL embarked on a project to design a brand new Laboratory of Nano Synthesis.

Problem

When planning its new laboratory space, PPPL's designing engineers recognized that science is constantly evolving and imposes continuous changes in the facility infrastructure. In order to accommodate these future changes, the lab had to have a modern design that would be able to adapt to future, various layouts.

Unfortunately, using traditional power methods often results in outlets that are hard wired in place. Not only do these inhibit layout changes, but in most cases they also lead to expensive rewiring work in the future that wastes valuable resources and time.

"The objective for the electrical design in the new lab space was to incorporate infrastructure flexibility for the changing environment of plasma research," said Power Engineer Craig Shaw with PPPL.

With flexibility being a major concern, PPPL needed a power distribution system that would grow with its space, as opposed to being a main obstacle for future innovation.

Solution

PPPL ultimately chose Starline Plug-In Raceway and Track Busway as the power distribution systems for its new Laboratory of Nano Synthesis. With Starline, PPPL is able to arrange its electrical outlets based upon the needs of its workspace, instead of arranging its workspace around the electrical outlets.

> **"The objective for the electrical design in the new lab space was to incorporate infrastructure flexibility for the changing environment of plasma research."**
>
> - Craig Shaw,
> Power Engineer PPPL

"Cost is always a factor, however, providing a well-engineered, flexible solution at a modest cost premium saves much more in future modifications," said Shaw.

Plug-In Raceway comes with a prewired backplane and takes approximately one third less time to install than similar products. The backplane can then be covered by an assortment of snap-on cover pieces and plug-in modules that can be rearranged for convenient access to power. Starline Track Busway is an overhead power distribution system that has a continuous access slot to plug into power. Available with a versatile selection of plug-in units, the busway gives PPPL the ability to access power when and where they need it.

With flexibility being a major concern for PPPL's new lab space, it needed a customizable power system that could grow and change with its research needs. Plug-In Raceway and Track Busway were chosen as its products of choice due to the systems flexibility and ease of installation and future modifications.

Result

By choosing Starline for its power distribution, PPPL ensured its access to power would never be an obstacle to the laboratory's future arrangements. The Laboratory of Nano Synthesis will be able to accommodate whatever equipment layout is most efficient for its Research, without any costly electrical modifications.

When asked about the final results of the project in regard to Starline, Shaw stated "the outcome provided a comprehensive, flexible electrical solution of which modifications will be easier and faster. I would absolutely recommend Starline for a similar project."

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Research shows that meetings can consume up to 40 percent of working time for managers. To make matters worse, nearly half (40 percent) of meeting time is spent on information that could be delivered prior to the meeting. Managing staff, resources, and your lab's assets is already a difficult task—making inefficient use of your valuable time compounds those challenges. Respond to these five statements, provided by the Strategic Meetings Assessment, to evaluate the meetings you attend:

1. Relevant information is sent out prior to meetings to avoid one-way presentations during the meetings. (Yes or No)
2. Meetings start at their scheduled time. (Yes or No)
3. People are fully attentive and not engaged in multitasking (e.g., checking phones). (Yes or No)
4. People leave meetings with a clear understanding of who is doing what by when. (Yes or No)
5. I decline meeting invitations when the purpose and/or agenda has not been communicated. (Yes or No)

A score of three or more "No's" indicates an opportunity to dramatically improve the efficacy and productivity of your meetings..

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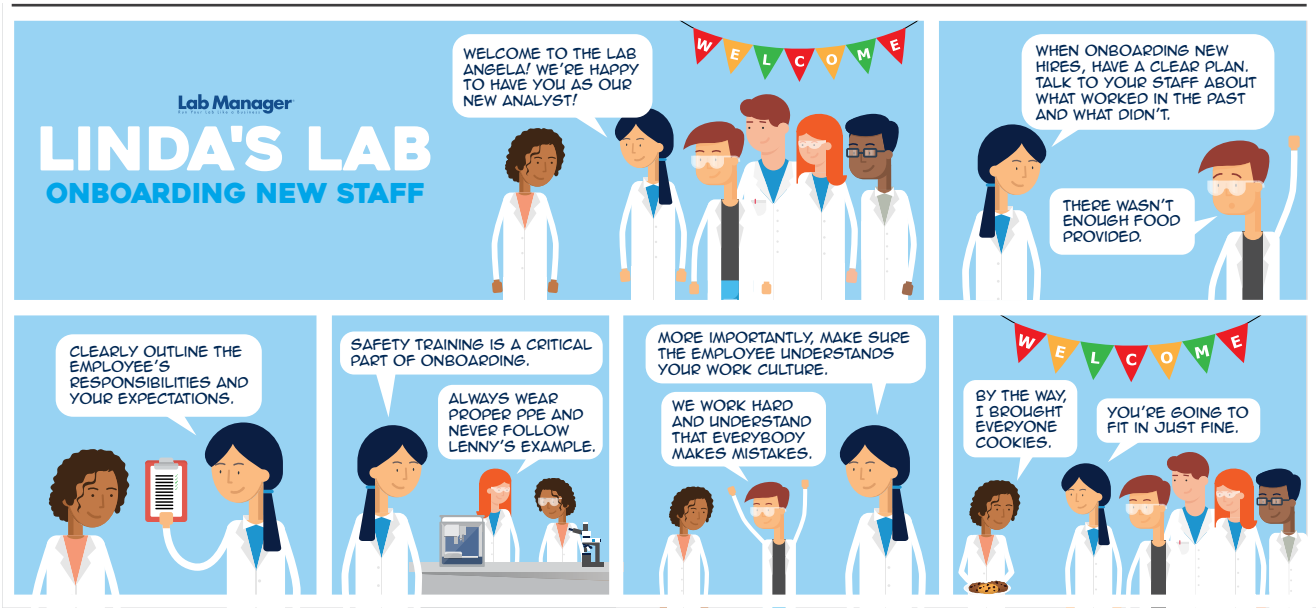

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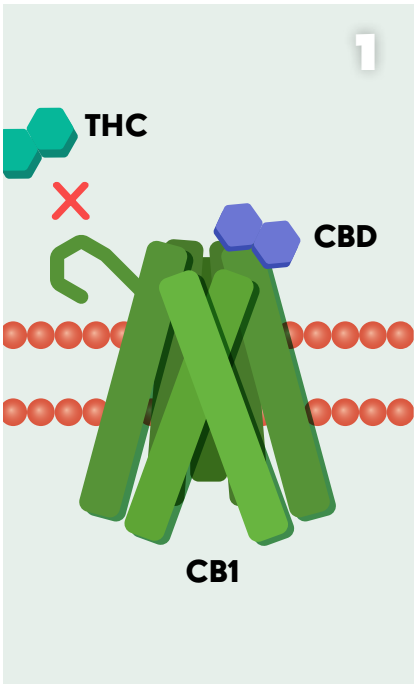

LM ONLINE

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

1 THC vs CBD: Uses, Side Effects, and Structure

Cannabis is a product of the cannabis sativa plant, and contains many cannabinoids that interact with the endocannabinoid system. Delta-9-tetrahydrocannabinol (THC) and cannabidiol (CBD) are two of the most well-studied cannabinoids. THC is psychotropic, and capable of producing a "high", while CBD is non-psychotropic and does not exert this effect. Learn more about the differences between the two, and how they are being used for medical conditions.

Read more at **LabManager.com/THC-CBD**

2 Trending on Social Media

As of October 15, *Lab Manager*'s top October issue article posted to social media was our Leadership & Staffing feature, "Building Laboratory and IT Teams." The best approach to interactions between laboratory and IT staff is to build a team atmosphere where both groups are working together to reach a common goal. As a lab manager, it's your job to foster this positive working relationship.

Read more at **LabManager.com/IT-team-building**

3 Most Popular Webinar

Our most recent top webinar on LabManager.com with 174 registrants was "The Science Behind Precision Instrument Measurement." This Product Spotlight webinar addressed the importance of the pipette-tip system, and accuracy and precision. Attendees also learned about proper technique, and discussed basic maintenance and calibration. Though it ran on September 26, you can still register to watch on-demand.

Read more at **LabManager.com/precision-measurement**

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NEXT ISSUE ➡

Lab Gadgets & Apps

What does the "lab of the future" look like? What trends and tools are being developed to help lab managers and scientists improve workflows? Next month's cover story will discuss the emergence of digital laboratory assistants and other innovative technologies that are being implemented in labs to automate mundane tasks, speed up experiments, and better manage lab supplies.

PRO Scientific Multi-Prep Rapid Homogenizing System

Homogenizing is a critical step of sample preparation and PRO Scientific's Multi-Prep Rapid Homogenizing System is the ideal compact system for automating the homogenization of multiple samples at a time. With its automated processes, the Multi-Prep homogenizing system can produce more consistent homogenizing results compared to traditional non-automated and standard manual homogenizing methods.

AUTOMATED TIME SAVER: The automated engagement and disengagement of Multi-Prep Probes make multi-sample homogenizing quick and easy. A typical run time of six samples is complete in mere seconds allowing for up to 300 samples to be homogenized per hour!

VERSATILE PROGRAMMABILITY: The ergonomically arranged LCD and control panel allows for up to 10 different homogenizing programs to be stored. For new homogenizing trials or quick-runs, the Multi-Prep can be used in the manual mode for individual sample processing.

QUIETER HOMOGENIZATION: All processing is contained in a sound-abating enclosure with a rounded clear polycarbonate door for a full view inside.

AVOID CROSS-CONTAMINATION: A clean Multi-Prep Probe easily locks into place for each sample so that carryover in between samples is avoided.

WORKS WITH YOUR CURRENT TUBES: With the Multi-Prep system, there is no special tubes or beads to have to invest in or to continue to buy. Tubes from 5ml up to 50ml can be easily loaded into the appropriate small or large tube Spider Tube Racks.

ENHANCED HOMOGENIZING PERFORMANCE: Oscillating Spider Tube Racks mimic the up-down motion of hand-held homogenizing and can perform 60 oscillations per minute.

PRECISION HOMOGENIZATION: The Multi-Prep system features an 805-watt motor and is equipped with Multi-Prep Probes manufactured from superior 316 stainless steel and PTFE, making them ideal for processing BOTH soft and hard samples.

PRO Scientific

To learn more, visit https://proscientific.com/automated-homogenizers/

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{image *almost* to scale}

Introducing the **smallest** and **easiest** to use **hydrogen generator** for GC-FID

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