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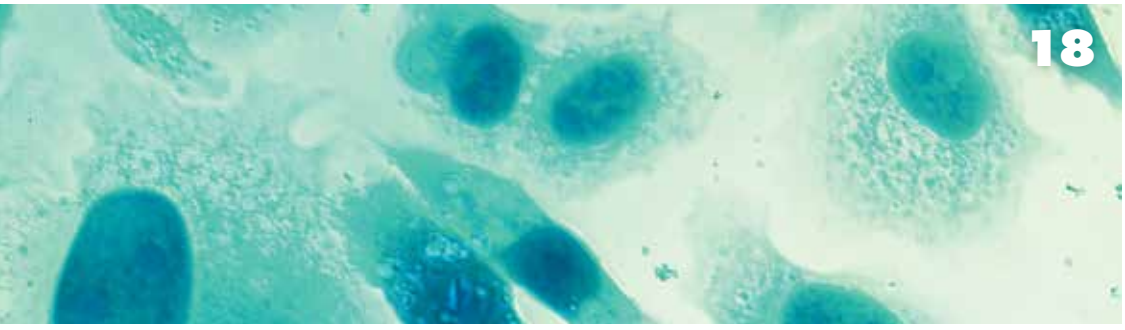

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With businesses under constant pressure to improve their products, processes, and bottom lines, they often look to the heroes of Silicon Valley for inspiration. This month's cover story looks at a business practice that Steve Jobs would certainly have supported—that of intrapreneurship, an idea to create specialized incubators that tap the creative talent within one's existing organization in order to drive and maintain business vitality. "Startups are by their very nature constantly tilling new soil, creating fertile ground for internal innovation. Resources are often limited, so they must create opportunity," says Dr. Elizabeth O'Day, CEO and founder of Olaris Therapeutics, Inc.

As for startups, this month's Lab Less Ordinary (page 14)—the German Aerospace Center's Synlight facility, home of the world's largest artificial sun—is the very definition. Synlight was developed in one year, and "the design started with a blank piece of paper, because no one had ever built a comparable facility." According to Dmitrij Laaber, a research engineer at the facility, working on such challenging research dealing with clean energy resources as well as operating a large facility that he had a hand in designing and building have been the most enjoyable aspects.

Our first business management article this month discusses the authentication of biological reagents. "As products of living organisms, enzymes and antibodies, the most widely used biological reagents, carry the same authentication issues as do cells but with the added factor of the prep or manufacturing process," says author Angelo DePalma. However, in the case of buying authentic reagents, Leonard Freedman, PhD, president of the Global Biological Standards Institute reminds us that, "It's a 'buyer beware' environment."

A similar warning is echoed in our second business management article on buying used laboratory equipment through auctions. Roger Gallo, CEO and president of EquipNet acknowledges that auctions have their risks, however, "the more educated the buyer is, the more savvy of a bidder he or she becomes."

Just as businesses are under pressure to find new opportunities for growth, those working in those organizations are under pressure to get more done in less time. Happily, our leadership & staffing article this month, "Work Smarter, Not Harder" (page 24) provides an abundance of time-saving tips. Not as obvious as a good to-do list, but more important, is the early time spent in training one's staff. Noah Sorrelle, a graduate student at the University of Texas Southwestern Medical Center, emphasized, "Take the time to train people properly. Training [staff] more thoroughly takes time, but it saves you time in the long run."

This month's technology article, "Out of the Box," offers some of the very *least* technologically advanced solutions for labs. Rather, author Andy Tay, postdoctoral fellow in bioengineering at Stanford University, shares some creative new uses for simple lab supplies such as pipette tips, conical tubes, and Styrofoam packaging. Turn to page 28 to see if Andy's "hacks" might find a place in your lab, and whether you might like to share a few of your own.

Other topics this month include safety risks and protection from formaldehyde exposure, current analytical methods to determine taste, and the latest developments in automated sample prep, flow cytometry, cold storage, and glassware washers.

For those of you heading to Pittcon at the end of this month, please stop by booth 1631 to say hi.

Best,
Pam

Pamela Ahlberg
Editor-in-Chief

Correction: An article appearing in our December 2017 issue entitled "Water Purification Systems: Selecting the Right Unit for Your Lab" mistakenly referred to MilliporeSigma, a business of Merck KGaA, Darmstadt Germany, as Merck Millipore. Lab Manager *regrets this error.*

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PROMOTING A STARTUP MINDSET

GROWING YOUR BUSINESS THROUGH COMPANY-CENTRIC INNOVATION

by Bernard Tulsi

Intrapreneurial employees imagining and creating cutting-edge, next-generation tools, products, and services in industry and research laboratories are potent forces for technological and business advancement. Way back in the 1940s, an intrapreneurial venture at Lockheed resulted in the creation of a prototype for a jet fighter in a mere six months, and Steve Jobs' Macintosh success may have stemmed in large measure from intrapreneurial initiatives at Apple. While these endeavors are often secreted away in specialized incubators and at off-site facilities to stave off distraction, interference, and potential sabotage, they are considerably more prevalent and visible today—aided by the coalescence of exponentially increasing volumes of data and computing power fueling the digital world and a dominant millennial workforce that seems to have a steadfast preference for working independently. So considerable effort is expended now to encourage pursuits outside the confines of one's job description, to organize centers of excellence, and to build physical spaces such as multipurpose incubators to incorporate intrapreneurship and internal innovation in the lifeblood of organizations as ways of driving and maintaining vitality.

> "The most successful start-ups are able to walk the fine line between being both focused and flexible."

Nowhere is this more evident than in startup science and technology enterprises and their supporting laboratories—especially when they are led by millennials. "Startups are by their very nature constantly tilling new soil, creating fertile ground for internal innovation. Resources are often limited, so they must create opportunity. The most successful startups are able to walk the fine line between being both focused and flexible," says Dr. Elizabeth O'Day, CEO and founder of Olaris Therapeutics, Inc.

Olaris is focused on the development of technologies to deliver the right drug to the right patient by creating patient classification tools that fundamentally shift the status quo of the way diseases are treated. "We measure biomarker data from current patients suffering with cancer, cardiovascular disease, diabetes, chronic pain, and more. Using our machine learning algorithms, we identify biomarker patterns that tell a story and could be used to optimize treatment decisions for future patients," says O'Day.

"Patient participation is crucial for our ability to develop the most precise tools, but participation is a very personal decision. Some individuals are eager to donate their data, while others are hesitant, worried about the unknown and their privacy. We take these concerns very seriously, and we strive to provide a space where patients who work with us feel empowered and fully understand the role they are playing to improve health treatments," she says.

"To ease concerns, we started working with our clinical partners to help them answer patients' questions. We quickly realized that we wanted to be involved in that dialogue. Putting the patient first and listening, truly listening, to what patients value is a fundamental principle at Olaris. With this in mind, we will continue to innovate the ways in which we communicate with patients to further our mission of putting patients first," says O'Day.

"Some of the key questions are how organizations can innovate internally, how to do strategy and stay on top of what's happening outside in the community, and how to refresh ourselves as every organization has to do every few years to be relevant," says Dr. George Crabtree, director, Joint Center for Energy Storage Research (JCESR) at Argonne National Laboratory.

JCESR, an energy innovation hub, was launched five years ago with 20 participating research organizations with about 150 researchers across them who have the task of inventing the next-generation battery beyond lithium ion. Crabtree says, "Strong needs exist in transportation, certainly, but the greater need is probably in the electricity grid, and there are many other needs. It is very unlikely that one type of battery will be enough to meet all those needs well or even cheaply enough versus a gas turbine or some other fossil-fuel alternative. We started with the premise that there will be two prototypes, one for the grid and one for transportation."

He says that in the quest to develop technologies, "You have to learn to drop things—this is very important. We started out thinking that lithium oxygen would be ideal to pursue because it was thought to be the highest-energy-density battery, and a group of people within the small 'beyond lithium-ion' community was developing it. So we also started working on it but realized from our techno-economic models that the whole lithium-ion, lithium-air, lithium-oxygen battery system had the greatest number of challenges, and that within our five-year time frame, we would not be able to overcome those challenges—so we dropped it, which was the most significant change we made. Some of our very

talented people with expertise in lithium-oxygen were able to transition away, which was very important. And we were able to shift all the resources that we had on lithium-air to other batteries."

Following those changes and after five years, JCESR developed four prototypes—two for the grid and two for transportation. "None of them are perfect, and in none of them have we achieved all our goals, but we have made several advances, and in one case we have already transferred the prototype to a startup in the commercial sector whose plan is to develop it as a battery. This is pretty much what we intended to do from the beginning, and that prototype was proven successful. We were able to achieve our cost goals within 20 percent, and the startup is now in the process of licensing the prototype from JCESR to continue working on that battery," he says.

Crabtree says there are now three startups in the program. One is working on the battery, while the other two are working on battery components using JCESR intellectual property. In all cases, the startups arose naturally from teams working in JCESR; "They themselves saw the promise; it was postdocs and students as well as senior researchers leading them," he says.

To be sure, there are a number of hurdles in the internal innovation process. Crabtree says, "It is a challenge when dealing with diverse groups to agree on a single strategy and to maintain a direction for, say, five years that continues to make sense and bear fruit.

"How to go about this? Initially, we said in our proposal that we would communicate frequently by conference calls and videoconferences and in other ways. Very early, however, we realized that face-to-face communication was so much more effective than the other ways. So we resolved right then to meet face to face—it turned out [to be] quarterly."

Crabtree notes that it takes substantial time to develop the relationships to get everyone to focus and work together—in the case of JCESR, it was about two years. "That would never have happened without a lot of interpersonal interactions. The lesson we learned from that is to develop personal relationships and work on the serious business in parallel. Once the personal relationships are in place, getting the serious business done becomes easier," he says.

"The biggest challenge is communicating to the outside world what JCESR is doing. The charters of the organizations require that they share everything that they learn with the community, so everything is published in peer-reviewed journals and open to everyone.

"The challenge is to communicate the promise of what we have done and find the right people in the community who want that information to take the next steps in development. That is our goal. We want to lower the bar for the people in the big battery commercial sector when it comes to developing the batteries we are working on. We provide the information and guidance to transfer the technology," says Crabtree.

As to advice on avoiding pitfalls for laboratory managers engaged in internal innovation, Crabtree says, "I think it is a mistake to be too internally focused. Of course, you have to be strongly internally focused to achieve your technology and technical goals, but you can have a high level of development internally and never have any impact in the wider world. I think you have to be aware of what is going on in the wider world, know the players, and know what has already been established and how to exchange information with other players in the field.

"The second step is to put together a pathway that is timely and makes sense right now. Opportunities

are made by taking more than one discovery from the community and putting them together. Smartphones are a good example—give Steve Jobs the credit, but it did not come out of one big discovery," he says.

Chuck Booten and Jon Winkler, senior engineers at National Renewable Energy Laboratory, Golden, Colorado, have developed EcoSnap, an innovative air-conditioning system based on tight mechanical and functional integration between the indoor and outdoor units that allows the removal of air conditioners from window openings, frees up space, saves energy, and cuts costs.

"The breakthrough is in the coupling of the indoor and outdoor units. It's a common vapor-compression system, but how we connect the indoor and outdoor units into a functional unit has not been done before," says Booten. Its quicker, simpler, nonprofessional installation will also provide cost benefits. "Putting together an air-conditioning system requires specialized equipment and a trained electrician. EcoSnap air conditioners will bypass all of that and will ultimately become a do-it-yourself project—it takes about the same time to install them as [it does] window units and at about the same cost."

EcoSnap is at the prototype stage now, and no unit has been installed or is being manufactured yet. The fully functional prototype was built with off-the-shelf components. "We used those and put in our intellectual property, our joining system. It can be installed in a wall in three to five minutes and uses existing 120-volt electrical receptacles in a wall," says Booten. It is intended for smaller rooms not connected by ductwork, and in its current configuration, its cooling capacity is similar to that of window units. The team noted that window and portable AC units are not cost-efficient, and "there's growing evidence that people want to get rid of their window units and are willing to spend money to do it."

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The German Aerospace Center's Synlight

RECENT DEVELOPMENTS AT THE WORLD'S LARGEST ARTIFICIAL SUN

by Rachel Muenz

Back in March 2017, the town of Jülich, Germany, got a little brighter, with the inauguration of the German Aerospace Center's (DLR's) research facility, home of the world's largest artificial sun. With 149 high-performance xenon short-arc lamps to mimic natural solar radiation, the key focus of Synlight is on the creation of solar fuels for a commercially viable source of renewable energy.

> "Maybe the most exciting thing for me was the possibility to do the electrical design, the programming of the control system on my own."

An artificial sun is important in solar fuels research because real sunlight, particularly in Central Europe, is too variable to work with due to changing weather conditions and sunlight hours, according to the DLR website. Even sunny locations never have completely reproducible conditions. The conditions at Synlight, on the other hand, can be precisely controlled, making it perfect for testing different processes for producing solar fuels.

Now, with almost a year having passed since its official opening, the Synlight team is currently working on solar reactors that produce hydrogen.

▲ Synlight consists of 149 high-power light sources, each of which is a seven-kilowatt xenon short-arc lamp, as used in cinema projectors. Each source can be individually controlled, which allows various configurations and temperatures in the focal point—even in three simultaneous experiments. Photo credit: Markus Hauschild.

"The process is based on a redox reaction and needs only heat—coming from the sun and concentrated by heliostats—and water," explains Dmitrij Laaber, a research engineer at the facility. "In our facility, we test the reactors, improving them before the field test in the solar tower." He added they have another key project set to start in 2018, but that it's still under wraps for now.

Despite the size of the three-story building that houses the facility's many xenon lamps, Synlight currently has a small staff of five—two engineers, one technician, and two students. And though the facility is still fairly new, the team hasn't had to handle too many challenges.

"The positioning algorithms of the control system were improved in the summer," Laaber says. "And we also had some minor problems with electrical parts—connectors—that met the requirements only in the technical documentation but, unfortunately, not in operation. These [issues] have already been solved by now."

The failed electrical components were replaced by better ones from another supplier, and Synlight's two students were the driving force behind improving the positioning algorithms, working on the math and source code for five months over the spring and summer, Laaber adds.

As far as maintaining such an impressive array—the facility's short-arc lamps can produce 10,000 times the

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1. From left to right: Axel Fuchs, mayor of Jülich, Bernhard Hoffschmidt, director of the DLR Institute for Solar Research; Georg Menzen, head of the Department of Energy Research at the German Federal Ministry of Economic Affairs and Energy; Johannes Remmel, the North Rhine-Westphalia Minister for Climate Protection, Environment, Agriculture, Nature Conservation and Consumer Protection; Karsten Lemmer, executive board member for energy and transportation at the German Aerospace Center; Kai Wieghardt, project manager for Synlight; Carlo Aretz, managing director of the Jülich Research Centre. Photo credit: DLR (CC-BY 3.0.). **2.** Tests can be carried out in three test chambers. Water flows through this reactor, and hydrogen is extracted using the energy of the concentrated light. Photo credit: Markus Hauschild. **3.** Johannes Remmel, the North Rhine-Westphalia Minister for Climate Protection, Environment, Agriculture, Nature Conservation and Consumer Protection is impressed by the size and appearance of the Synlight facility upon arrival. Photo credit: DLR (CC-BY 3.0). **4.** Technicians from the DLR Institute for Solar Research inspect the seven-kilowatt xenon short-arc lamps in the high-power light sources. Photo credit: Markus Hauschild. **5.** The outwardly inconspicuous building that houses Synlight is situated in Jülich, Germany. In the grey hall behind offices and workshops is the 15-meter-high experimental facility. Photo credit: DLR (CC-BY 3.0).

intensity of the solar radiation at Earth's surface, and temperatures at the lamps' target points can get as high as 3,000°C—Laaber says that apart from standard damage checks on the electrical and mechanical parts, cleaning the reflectors takes a while. The regular checks take about two days, while the complete check and maintenance, which needs to be done once a year, takes around a week.

"The height of the facility—the highest module is mounted 15 meters above ground—makes it a bit complicated," he explains of the maintenance process.

For Laaber, working on such challenging research dealing with clean energy resources as well as operating a large facility that he had a hand in designing and building have been the most enjoyable aspects of working at Synlight.

"Maybe the most exciting thing for me was the possibility to do the electrical design, the programming of the control system on my own, which is quite challenging, and you rarely get such a chance," he says.

> "The design started with a blank piece of paper, because no one had ever built a comparable facility."

The main success of the facility so far is that it's running so well, especially considering it was put together so quickly. Laaber adds, "The development time was only one year, and the design started with a blank piece of paper, because no one had ever built a comparable facility."

Not too far into the future, the plan is to bring industrial customers to Synlight to test their materials,

reactors, or anything that needs concentrated solar radiation, Laaber says. Though the team isn't allowed to use the facility for commercial purposes until the summer of 2018, once that time arrives, they hope to have a good balance between basic research groups and industrial customers working on product development.

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

Authenticating Biological Reagents

ARE YOUR REAGENTS FOR REAL? **by Angelo DePalma, PhD**

Reproducibility is the cornerstone of science. Sadly, the imperative to publish has made fools of more than one world-class scientist. While honest mistakes are inevitable in any human endeavor, the basic sciences, particularly biology, today find themselves drifting in a sea of irreproducible results.

A 2015 study by Leonard Freedman president of the Global Biological Standards Institute (GBSI) in *Plos Biology* estimated that fully half of published biomedical research in the US, funded by $28 billion of taxpayer money, is irreproducible. Such work becomes the basis of grant renewals worth further billions of dollars, tenure awards at universities, drug approvals, and potentially even Nobel Prizes. Interestingly, top journals were not immune or even less likely than second-tier publications to suffer.

For example, a 2017 article in *Nature Communications* on reseach using estrogen receptor beta (ER-β), a 20-year-old biomarker for breast cancer, demonstrated that just one in 13 commercial antibodies used in that research—amazingly, the least-used product—actually targeted ER-β.

The factors most culpable, according to Freedman, were reagents and reference materials (36 percent), study design (28 percent), data analysis and reporting (25 percent), and laboratory protocols (11 percent).

That biological starting materials and reagents should be center stage in this controversy is not surprising. GBSI has for several years been calling for routine authentication of cell lines used in nearly every field of biomedicine.

As biological systems, cells suffer from genetic drift, contamination by other cells, mislabeling, poor handling, and a host of other issues that may result in vials or plates not containing what the producer says is inside or having lower potency than is advertised.

Large granting agencies and some journals have begun calling for (and in some cases requiring) cell line authentication for work they sponsor or publish, but researchers are essentially on an honor system, and, as recent reports suggest, honor is approximately as common in scientists as in the general population.

Lifelike molecules

As products of living organisms, enzymes and antibodies, the most widely used biological reagents, carry the same authentication issues as do cells but with the added factor of the prep or manufacturing process.

Enzymes and antibodies are unique among biological molecules in their almost lifelike activity. Enzymes, of which millions exist in nature, convert one chemical into another with exquisite specificity; change one tiny physical characteristic on the substrate and the transformation does not proceed. Similarly antibodies, unique and complex molecules manufactured by animals' immune systems, bind strongly and specifically to their targets.

Enzymes and antibodies are proteins isolated through complex manufacturing, and they must be handled with care from the raw-material stage through end use. Since so much of modern biology depends on these two reagent classes, their authentication is becoming the new frontier in scientific integrity.

The National Institutes of Health has published guidelines on the authentication of biological reagents proposed for use in NIH grant applications. Dr. Michael Lauer, deputy director for extramural research, notes that "re-

search performed with unreliable or misidentified resources can negate years of hard work" and "it is imperative that researchers regularly authenticate key resources used in their research." Lauer recognizes that vendor-sourced (as opposed to lab-generated) reagents may or may not have undergone fit-for-purpose testing, but regardless, in their grant applications, users "should also include a plan to independently verify the identity and activity of the product," and if the reagent will undergo long-term storage, they should "consider the stability of the product" over time.

Value, not price

All reputable producers of biological reagents perform some type of quality control before their products ship. Abcam (Cambridge, UK), which provides a wide range of antibodies and reagents, employs extensive validation that includes DNA and peptide identity, activity, and the products' fitness for purpose.

Abcam uses recombinant methods to generate many of its antibodies. Therefore, says Bruce Hamilton, PhD, head of new product development, "we ensure that we're producing a reliable, defined sequence for the monoclonal antibody of interest." Then, Abcam purifies its antibodies to high homogeneity using affinity media based on ligands extremely specific for this class of proteins.

The third validation level involves fit for purpose (specificity), which involves testing the product for performance against specific antigens as well as in actual assays. It is possible to perform binding studies between antibodies or enzymes and substrates to determine activity per mole, milligram of protein, or volume of reagent. This is the minimum one can expect from this type of reagent.

Abcam tests its antibody products in actual assays—for example, Western blots or immunohistochemical (IHC) assays. The company uses knockout cell lines, where the substrate gene has been silenced or deleted, to serve as

a negative control for antibodies destined for cell-based assays. The elegance of this test is that every other variable—cells, culture conditions, readout—is controlled.

"Together these tests validate that the antibodies we say are in a product work in the way they're intended to," Hamilton says.

Quality of antibodies and other reagents is obviously critical for experimental reliability and reproducibility. Titer, or activity per volume or vial of product, is likewise an important consideration for labs interested in getting the most from these costly reagents.

"When we put product into a vial, we want to assure customers that they can anticipate how much they will need to conduct a certain number of assays," Hamilton explains. "That number can be significantly different for a Western blot than for an IHC assay. Since we're talking about biological molecules generated in living expression systems, antibodies may perform differently in different assays."

Hamilton views the "problem" with biological reagents more in terms of reproducibility than authentication. The quality of biological reagents comes down to the products doing what they're intended to do. "Antibodies and other biological reagents therefore need to be validated to the highest possible standards so customers have confidence in their work and know that the product will not vary from lot to lot," explains Hamilton.

Minimal validation of biological reagents involves testing whether they perform as promised in specific assays. Mary Doers, senior director, manufacturing operations at Promega (Madison, WI), tells *Lab Manager* that her company performs analytical and functional tests "that have relevance to how our customers use our products. We often perform additional analyses to ensure batch-to-batch uniformity."

While consumers take pleasure in price-shopping, that strategy works only when selecting among vendors that carry identical goods from the same manufacturer, like the latest cell phone or designer perfume. Biological reagents, even those with the same chemical name or product designation, are unique. They are extracted or isolated from living organisms whose cultivation and source may be different. Manufacturing differences also cannot be underestimated. As producers of biological drugs like to say, "The product is the process." Products may differ noticeably, even when standard production methods are employed, between different groups at different locations, and seemingly trivial excursions from SOPs can lead to products of differing quality and performance.

That is why for biological reagents, value, not price, is the operative word.

"We believe that value-shopping is important," Doers says, "because low price might not go hand in hand with high quality. Look for value; choose a reputable company from the start. Contact their technical services team, and get as much information as you can about the product."

Scoring performance

With so many reagents filling so many specific roles, biology is in need of a peer-managed system for evaluating reagents. Toward that end, GBSI has begun alpha testing a scorecard system to evaluate and

rank research antibodies for specific applications based on their intrinsic on-target and off-target activity.

Freedman noted that earlier attempts to improve antibody performance resulted in welcome validation guidelines that too many researchers and antibody producers ignored.

The scorecard system will evolve through application-specific working groups representing stakeholders in preclinical life sciences, including academics, scientists at vendor companies, journal editors, and others.

The system will enable users to search an open database of scored antibodies to find the one most appropriate for their research. Users can contribute to the database by completing a scorecard for antibodies validated in their own lab.

After alpha testing the initial scorecards for Western blot, ELISA, and immunohistochemistry (the three most-used assays), participants will review the outcomes and determine what changes are needed. This step will be applied to scorecard development for the remaining applications. In 2018, GBSI plans to launch a website where users and producers can score antibodies and search for data on what GBSI hopes will be thousands of popular antibodies. GBSI will post scorecards for public comment and publish resulting guidelines and insights.

"It is time," says Freedman, "to assess biological reagents based on their performance, not by name-brand marketing."

As with cell line authentication, all stakeholders are responsible, to some degree, for biological reagents that don't perform as advertised. Reliance on third-party sourcing of critical ingredients (or the product itself), shoddy manufacturing practices or quality control, and a lack of minimal fit-for-purpose testing are all factors, and to a degree the enablers are end users themselves.

Again, analogously to cell line authentication when it was a nascent issue, it's an environment of hear no evil, see no evil. Freedman warns, "It's a 'buyer beware' environment, but users also share some of the blame due to poor training on validating antibodies and their use for given applications."

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

Going once, going twice, sold!

TIPS FOR PURCHASING PRE-OWNED EQUIPMENT AT AUCTIONS

by Erica Tennenhouse, PhD

The search for good deals on used laboratory equipment often leads scientists to auctions. Today, most of the auctions for used laboratory equipment take place online. As Roger Gallo, CEO and president of EquipNet (Canton, MA) explains, these are timed events without an auctioneer. The buyer is able to place bids on any listing at any given time during the auction, which typically lasts between eight and 24 hours. Although live on-site auctions do still occur, he notes that they are waning in popularity.

The attendees of these auctions typically have at least one thing in common: they're looking for value. According to Octavio Espinosa, senior director of sales, marketing, and operations at BioSurplus (San Diego, CA), there are "really, really good deals" to be had at auctions. "The other benefit is that auctions can be great places to source parts," he adds.

The supply of equipment at EquipNet's auctions comes directly from end-user companies, which often have maintenance records and a documented history of what the instrument had been used for, along with a service log history, says Gallo. BioSurplus runs two types of auctions, says Reid Hjalmarson, the company's director of marketing. There are clearance auctions of their own inventory, where customers can find deals on both functional equipment and pieces explicitly advertised as "for parts," and then there are liquidation auctions of functional labs. "That's where customers really get incredible deals on really high-quality equipment that they know that is coming out of a professional working lab," he says.

To get the best deals at an auction, the experts offer a few tips. "Know the market," says Gallo, who recommends that attendees check out the posted ask prices on EquipNet's negotiated sales platform, MarketPlace, and contact their equipment experts to learn more about items ahead of time. "The more educated the buyer is, the more savvy of a bidder he or she becomes."

Along with looking through the catalogs in advance of BioSurplus' auctions, Espinosa advises attendees to ask a lot of questions. "We have a very responsive team," he says. "We'll be on chat, we'll field calls, we'll respond to emails, and we'll entertain visits or line up special visits so that people can see items." Hjalmarson adds that BioSurplus provides watch lists, which enable participants to monitor bidding activity throughout the course of the auction.

"The more educated the buyer is, the more savvy of a bidder he or she becomes."

The entire process begins, however, with finding an auction. As Espinosa points out, the life-sciences community has a number of options when it comes to auction houses. "I would say consider what each auction program offers in terms of the quality of equipment that's offered, as well as how customer-centric a given program is."

"There are many good auctioneers out there; there are others who are less reputable," Gallo notes. To make sure they are selecting a reputable auction, individuals are well advised to become familiar with the company's terms and conditions, assess the quality of the listings in the catalog, and find out how many auction events the auction house holds each week or month.

***Erica Tennenhouse**, scientific content editor for* Lab Manager, *can be reached at etennenhouse@labmanager.com or 647-500-7039.*

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Work Smarter, Not Harder

TIPS FOR MANAGING LABORATORY TIME AND TASKS MORE EFFICIENTLY

by Donna Kridelbaugh

In the era of lab automation and instant communication, there seems to be increasing pressure to be exponentially more productive. But there are only so many hours in the day and so much information that can be absorbed before leading to burnout. So how can lab managers help employees learn to be more efficient and to manage their time without sacrificing quality or sanity? We turned to social media to ask lab professionals for their best time-saving tips to answer this question. Here's what they had to say.

Organize your lab life

It's important to schedule your lab time to track overall project deadlines and goals while knowing what steps need to be taken to achieve them. Some people like to make to-do lists and others do not, but what's important is to find a system that works for you. A few scientists who are on Twitter shared details on scheduling systems that work well for them.

Drew Doering, a doctoral student at the University of Wisconsin-Madison, emphasizes the importance of planning experiments and knowing how long each will take by recording start and stop times. As he explains, "Map out the time each experiment will take in your day—it's important to be realistic here—and add it to a calendar or something visual. A to-do list, a planner, and/or calendar apps can help here, but I haven't found one that works for me, so I made my own template." This useful template, along with detailed instructions, can be viewed on his Imgur site.[1]

Likewise, in a recent post, The Lab Coat Domestic blogger explains her scheduling methodology, which breaks down into both macro- and micro-scheduling categories. For macro-scheduling, all major milestones, equipment maintenance, and reporting deadlines are added to a monthly calendar for easy visualization. On days with multiple experiments, she uses a micro-schedule to assign specific times to each experimental step and to plan coinciding work. She also goes a step further to write out all steps of experiments in advance (i.e., mini-version of standard operating procedure) to ensure that materials are ready and to refamiliarize herself with the protocol. Examples and details are provided in the blog post.[2]

> "Map out the time each experiment will take in your day."

Additionally, Nicole Paulk, instructor at the Stanford University School of Medicine, shared via Twitter some simple rules she follows to get her day and week off to a good start. Paulk advises, "Never sit down at your lab desk for any reason until you've set up an experiment for the day." She also advises starting with the most difficult tasks early on to avoid a pileup at the end of the week.

It also may be ideal to set up for experiments or bench work the day before. As Reddit user "sgijc" suggests, "I'm super foggy-brained in the morning, so I set up everything the afternoon before, especially labeling in different tape colors. That way I don't have to think too hard. I just follow the colors until the coffee kicks in."

Use time-saving lab hacks

It's the little things that really can shave off time from your lab day and make you more productive. Many Reddit users had some great lab hacks to share with others. While many of these tips seem obvious, the truth is that it's easy to get in a rush and forget about the basic planning ahead and preparation required to keep lab work running smoothly.

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These tips include making stock master mixes (e.g., PCR reagents and growth media), labeling reagents clearly, and restocking supplies and reagents during down periods. Some other important notes include backing up your data in multiple places, creating a naming system for data files, and using spreadsheets to create templates for everything from calculating reagent quantities in a master mix to scoring employee performance reviews. This also emphasizes the value in reaching out to online science communities (e.g., Reddit, ResearchGate, Nature's Protocol Exchange) to exchange advice with fellow scientists on creative ways to become even more efficient in the lab.

Finally, another great tip comes from a clinical laboratory director who responded by email that a big time-saver involves the layout of the lab itself. As he explains, "If your lab is nothing but single-entry and -exit boxes, you're going to have inefficiency because of all the wasted steps needed to go from point A to point B. A lab should be designed so that staff can flow seamlessly from area to area without having bottlenecks and following hamster-cage mazes to get where they're going."

Invest time in training

While it initially seems like a huge time burden, it's worth the effort to train people the right way early on. Noah Sorrelle, a graduate student at the University of Texas Southwestern Medical Center, emphasized in a Reddit comment, "Take the time to train people properly. Training [staff] more thoroughly takes time, but it saves you time in the long run." And, he concludes, "If you don't invest time into [staff], don't expect any returns."

Sorrelle also shares some methods learned during his past military experience that can be useful in training staff. For example, consider doing after-action reviews with team members. This involves reflection on the week's activities for what went well and what needs improvement, with constructive criticism provided in a positive manner. Also, the use of repeat-backs can ensure that communication with staff is effective. As Sorrelle explains, "Having [staff members] repeat instructions back to you, in their own words, will identify any issues in understanding ahead of time, which will save one a lot of trouble and wasted time in the long run."

There also was some discussion about the value of having a good student or other trainee to help free up time for your own work and side projects. Of course, proper training is needed in the beginning before trainees can be productive, which includes teaching them about time-management strategies, too.

As Paris Grey, a research coordinator at the University of Florida, recalls, "Teaching time management is as much for the mentor as it is for the researchers they guide. I don't think that's obvious to new supervisors. I interviewed a new PI recently who told me that their philosophy is that 'graduate students should figure out time management on their own,' yet the PI was puzzled about why their grad students weren't meeting the benchmarks set by their grad committee."

She continues, "During the conversation, I shared several thoughts, including that there is a huge difference between micromanaging a grad student's time—something an advisor should never do—and offering suggestions, practical advice, and having discussions about what productivity barriers the student is struggling with and giving specific strategies on overcoming them."

One such strategy that Reddit user "possiblysmart" recommends is not to do too much too fast, saying, "There's no need to burn out in the first month. Set experimental goals for each week and complete them. Sometimes it can be to generate data, sometimes it can be to learn a new technique, but setting realistic goals is important."

There also are a number of resources available that can help trainees learn more about managing time and becoming more independent. For example, Grey is co-author of both the website UndergradintheLab.com and the book *Getting In: The Insider's Guide to Finding the Perfect Undergraduate Research Experience,* which provide regular pro tips on how to plan for and organize research at the bench.[3]

Avoid time wasters

We are bombarded with distractions throughout the day that can waste a lot of time, from social-media browsing to break-room gossip. While it's important to take breaks and form collegial relationships with co-workers, these activities should be built into your daily schedule separate from time specifically allocated to work functions. A number of productivity methods (e.g., the Pomodoro Technique) can be adopted to increase focus and attention through alternating intervals of work and breaks, along with taking steps to minimize distractions during the work sessions.[4]

Grey further advises, "Although you won't be able to do it every minute of every lab day, try to reserve your research time for the tasks that you cannot do if you literally weren't in the lab. Of course, attending seminars, bonding with lab mates, and staying on top of the literature is important, but using your core research time to work at the bench will make you more efficient and pave the way for you to have your life outside the lab."

If feasible, it also may be useful to adjust your schedule by coming in earlier or staying later. That way, you can take advantage of when you are naturally most productive in the day and avoid tripping over people during the busiest times in the lab. Additionally, if there's the option, periodically working from home may help managers get caught up on administrative tasks without the hassle of unnecessary workplace distractions.

In the end, as Reddit user "OolongandJasmineMLS" points out, one of the biggest time wasters can be taking on too much work. As this scientist explains, "Trying to do too much is a big source of error in the clinical lab. There have been serious efficiency pressures at the bench for years. Rushing is no good if you drop the tube and need a redraw, send an erroneous result that ends on an amended report and a chat with your supervisor, or stick yourself and spend good time cooling your heels with occupational health."

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

Out of the Box

FINDING CREATIVE NEW USES FOR COMMON LABORATORY SUPPLIES

by Andy Tay

Lab supplies such as pipette tips and conical tubes are two of the products scientists, especially biologists, will encounter in their careers and use almost daily. Interestingly, while they were designed for specific applications such as aspirating or holding liquids, researchers have found out-of-box (and ingenious) applications for them. Such an exercise of creativity often leads to higher research productivity, cost savings, and convenience.

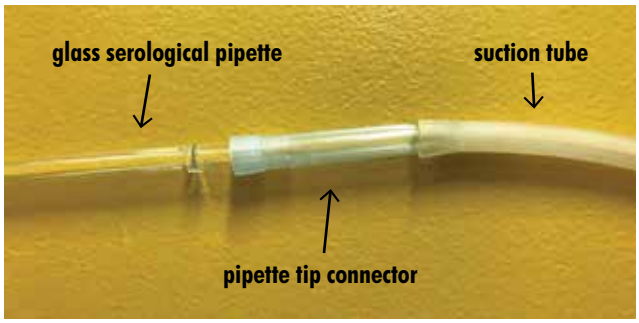
In this article, the featured lab supplies are our favorite pipette tips and conical tubes. Hopefully, it can also inspire other creative use of lab inventories.

> "Serological pipettes and suction tubes from different manufacturers can come in incompatible diameters."

Let's pick up some (pipette) tips

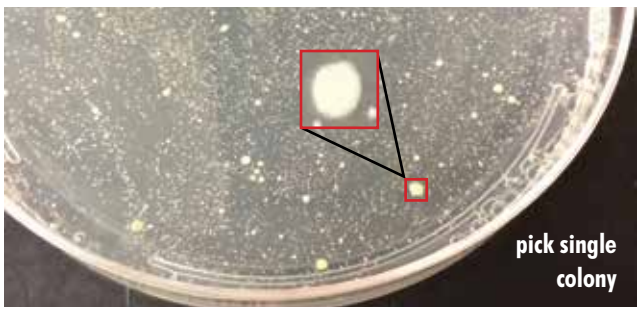
Walk by any biosafety cabinet, and you will see a suction tube used to aspirate liquids into a waste bottle. This is a step that is typically performed using a serological pipette attached to a tube whose suction is provided by a vacuum flask. Unfortunately, serological pipettes and suction tubes from different manufacturers can come in incompatible diameters. Fear not, you can count on pipette tips to solve this problem!

Connector: The conical shape of pipette tips allows them to be a cheap connector between serological pipettes and suction tubes of any reasonable diameters (Fig. 1a). This reduces the need to purchase customized connectors. It also gives your lab the freedom to purchase serological pipettes and suction tubes from any company.



▲ *Fig. 1a: Pipette tip connector between serological pipettes and suction tubes. Photo credit: Andy Tay.*

Picker: Pipette tips are also extremely useful for picking bacterial (Fig. 1b) and stem cell colonies with minimal cross contamination. For many microbiology and stem cell experiments, it is important to pick just one single colony to ensure that the bacteria and stem cells you are working with are of the same genetic composition. Pipette tips, with their small, pointed tips, can easily pick up a single colony before subsequent culture.



▲ *Fig. 1b: Pipette tip picker for a single colony of bacteria. Photo credit: Andy Tay.*

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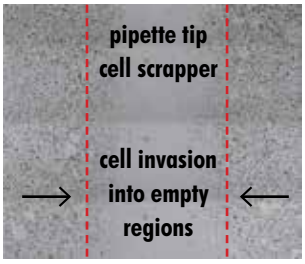
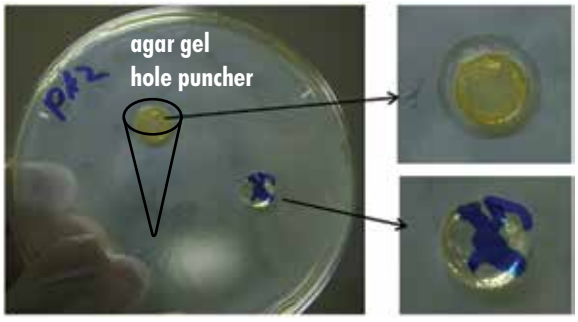
Scraper: For those of you studying cell migration, do you know that pipette tips are also handy tools to perform the standard scratch assay (Fig. 1c)? In this assay, cells are scratched away, leaving behind an empty region. Cell migration is assessed by monitoring the invasion of neighboring cells into the region. One additional advantage of using pipette tips is that they can be cut at different diameters to create empty regions with different widths.



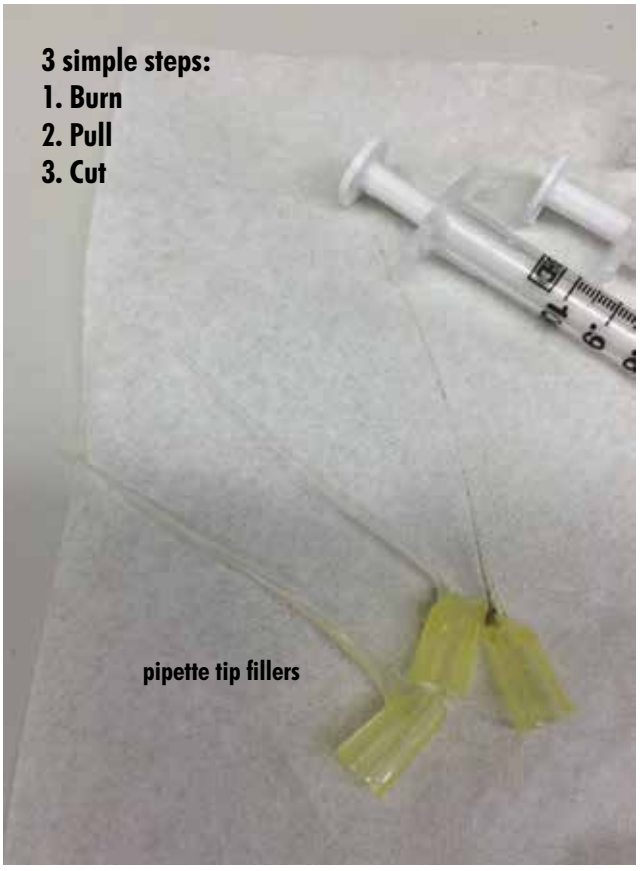
◀ *Fig. 1c: Pipette tip cell scraper for scratch assay. Photo credit: Andy Tay.*

Hole Puncher: Pipette tips have also been cleverly used in agar gel experiments to test the antimicrobial properties of materials (Fig. 1d). The circular head of a pipette tip is first used to punch out holes from agar gel streaked with microbes. Next, antimicrobial materials are injected into the holes and the hole diameters are monitored over time. The larger the region of dead microbes, the more effective the antimicrobial agents are.



▲ *Fig. 1d: Pipette tip hole puncher for antimicrobial assay. Photo credit: Michael Reithofer.*

Filler: Another creative, and probably the least known, use of pipette tips is using them as fillers for thin glass pipettes in experiments in electrophysiology. Currently, polyetheretherketone (PEEK) tubing is used for filling glass pipettes. However, with three simple steps, pipette tips can be transformed into a filler (Fig. 1e)! First, hold a 2-200 µL pipette tip horizontally and heat it at around two-third of its length over a Bunsen burner. Once the plastic starts to melt, use tweezers to pull the melted part vertically downward. Finally, use a razor blade to cut off excess length to get yourself a pipette tip filler.



▲ *Fig. 1e: Pipette tip fillers for thin glass pipettes used in electrophysiology experiments. Photo credit: Andy Tay.*

A 10-foot PEEK tubing, which is sufficient for 40 × 7.5 cm filler, costs ~USD 75 whereas a bag of 960 pipette tips costs only ~USD 24. True, it may take some time to master creating the perfect pipette tip filler, but the effort can certainly save your lab a significant sum of money over time.

And now, conical tubes and their Styrofoam packaging

Markers are frequently used in labs for writing, drawing, and labeling. Have you experienced losing markers and later finding them in random drawers, or in someone's lab coat days later? Although conical tubes were designed for holding liquids, they have found an exceptionally useful alternative role as marker holders in many labs! With the aid of adhesive materials like plasticine, conical tubes can be attached to nearly any surface near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whiteboards (Fig. 2a) and biosafety cabinets (Fig. 2b), where markers are frequently used.

▲ *Left to right: Fig. 2a and Fig. 2b: Conical tubes as marker holders. Photo credit: Andy Tay.*

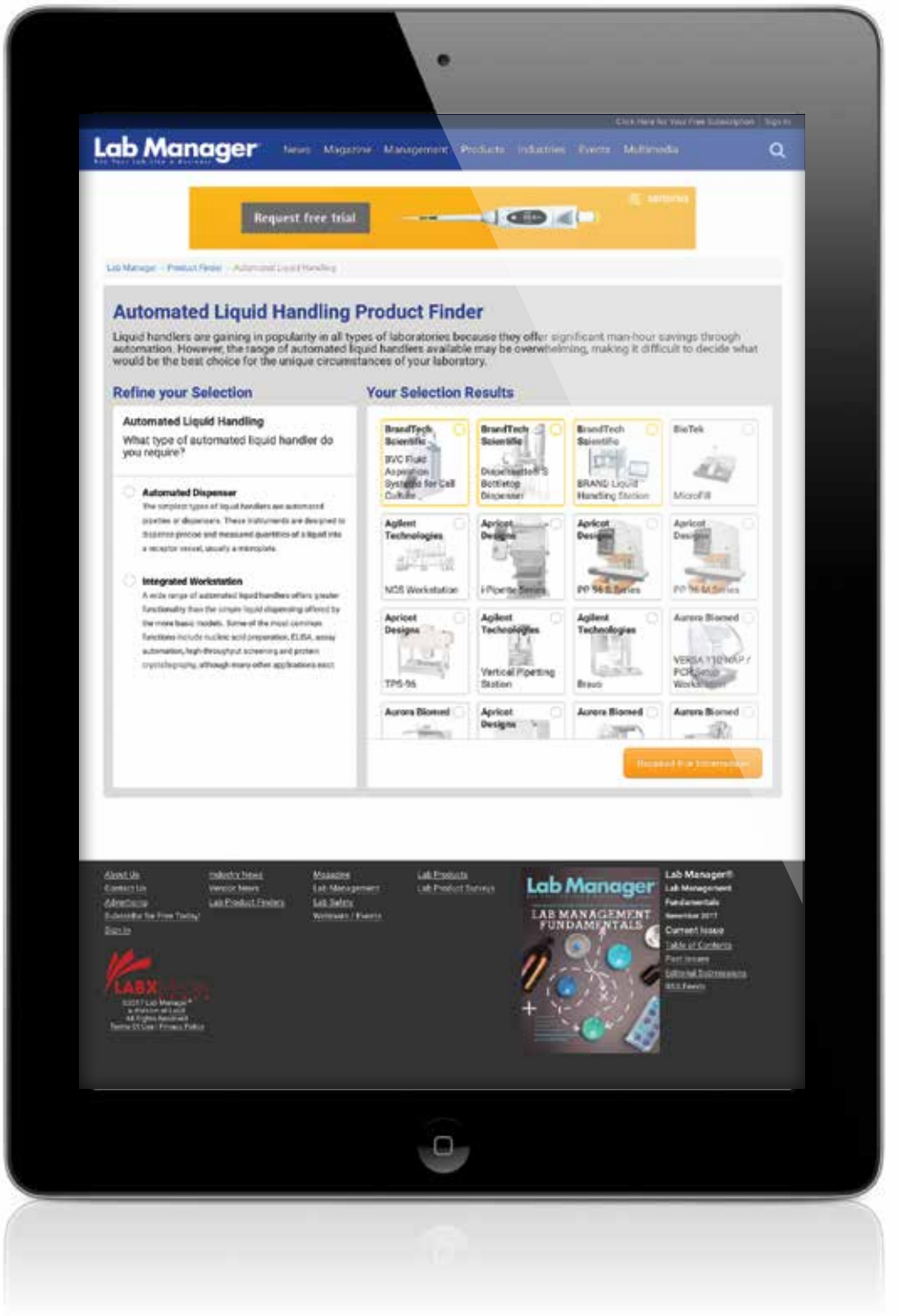
Conical tubes are often delivered to labs arranged nicely on Styrofoam. As Styrofoam is composed of 95% air, it is unsuitable for recycling because it takes up lots of space in bins. One creative use of Styrofoam packaging is as a rack for storing used conical tubes (Fig. 2c). In this way, it stops people from fighting over racks, promotes bench neatness, and reduces environmental waste. What a way to kill three birds with one stone!

▲ *Fig. 2c: Styrofoam rack for storing used conical tubes. Photo credit: Nina Chang.*

Many of you might not have realized how creative you can be when it comes to creating alternative uses for common lab supplies.

Do you have a story to share? The editors at Lab Manager *would love to hear it. Simply submit a 40 to 50-word description along with a photo of an innovative use of a lab inventory item to Pam Ahlberg at pam@labmanager.com for inclusion in a future article on this topic.*

Andy Tay *is a postdoctoral fellow in bioengineering at Stanford University. He can be reached at andy.csm2012@gmail.com.*



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A Formula for Formalin Safety

NAVIGATING AND CONTROLLING THE HAZARDS OF FORMALDEHYDE

by Vince McLeod

Although ubiquitous, formaldehyde is one of the most hazardous chemicals used today. It is widely used in many everyday products like hair-straightening products and other cosmetics, as well as manufactured wood products such as flooring and furniture. Formaldehyde is also one of the most-used chemicals in research laboratories, where we encounter it in everything from tissue fixation to benchtop perfusions to instrument sterilization and use it to preserve everything from cell cultures to whole-organ specimens. Therefore, potential exposures can come from many sources.

This is important because improper or careless use can cause serious health problems. Read on to get a closer look at the hazards of formaldehyde and how to safely use this common sterilizer and preservative.

The use of pure formaldehyde is uncommon. In laboratories, it is typically used in an aqueous solution known as formalin, which contains 37 percent formaldehyde. Formalin is also oftentimes mixed with other chemicals to make embalming fluids or preserving solutions.

Acute health effects

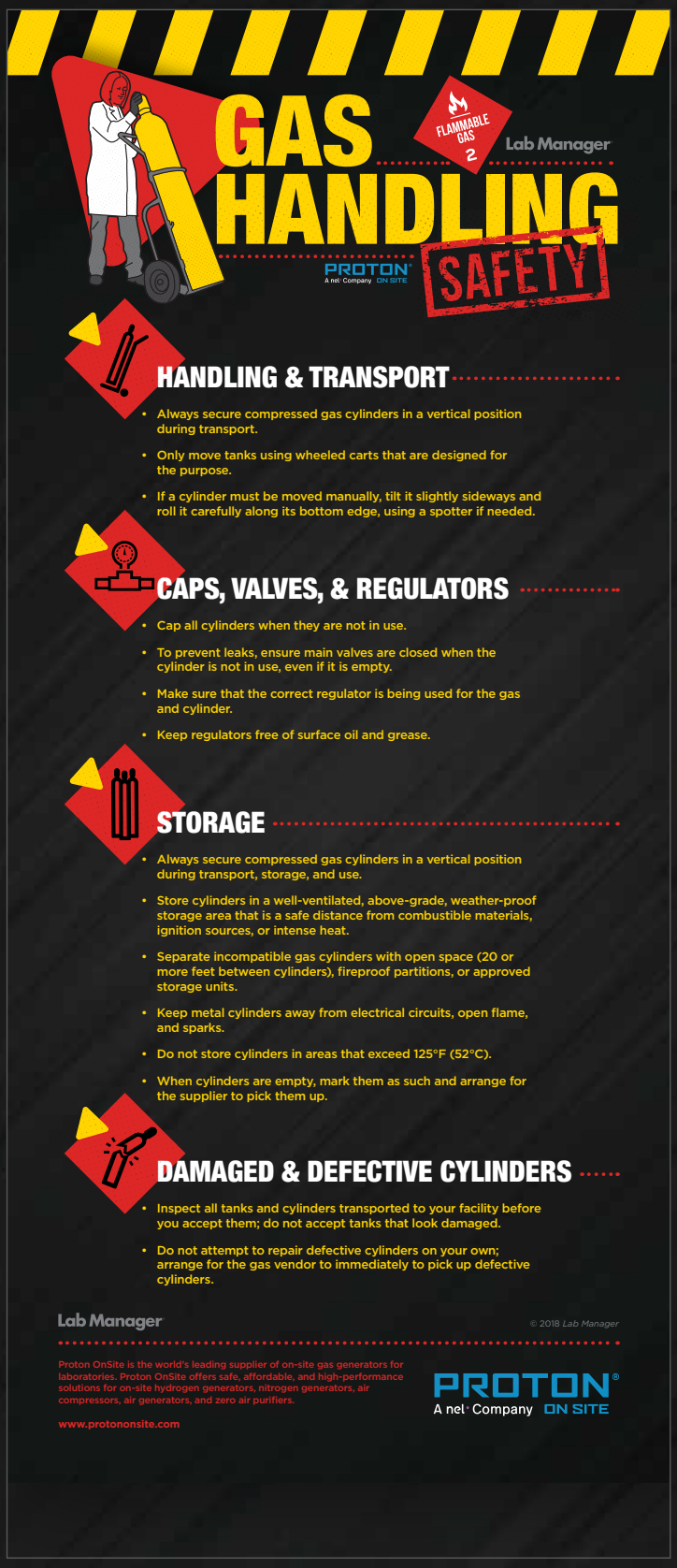
Let us take a look at the physical and chemical properties and the acute (short-term, immediate) health effects.[1] Formaldehyde is a flammable, colorless gas with a pungent, suffocating odor due to its extreme reactivity. It is classed as both a powerful irritant and sensitizer and is intensely irritating to mucous membranes. Its presence is easily felt even in concentrations well below one part per million (ppm). Published studies have also shown the odor threshold to be well below one ppm.[2,3] It is first felt in the eyes, nose, and throat as tingling and then irritation. Concentrations above five ppm are not tolerated by most individuals, with severe tearing in the eyes as well as coughing and irritation of the upper respiratory tract resulting from exposure.

It is important to note that formaldehyde is also a sensitizer. This means that even with continued exposure to low-level concentrations, the senses become fatigued and the chemical's numbing effect takes over with the irritating effects gradually subsiding. Unfortunately, we have encountered employees—not wanting to be labeled complainers—who tell us they just "tough it out" for a few minutes and the feeling goes away. They simply do not understand that they are still being exposed.

Formaldehyde is also a skin irritant and may cause dermatitis and possible allergic reactions from repeated exposures due to skin sensitization. Vapors or solutions may cause pain, white discoloration, roughness, and burns. In exposed individuals, subsequent exposures may result in a sensitization dermatitis characterized by the sudden eruption of blisters on the eyelids, face, neck, scrotum, and arms. Prolonged or repeated exposures may cause burns, numbness, itching rash, fingernail damage, hardening or tanning of the skin, and sensitization. Absorption through the skin also adds to the total exposure.

Possible severe chronic harm?

Potentially serious health effects can result from chronic (long-term) formaldehyde exposure. Where the mucous membrane and skin effects are largely reversible upon removal from the exposure, formaldehyde can cause chronic biological effects. These range from central nervous system depression to kidney and liver damage, reproductive and fetal effects, and cancers. Repeated or prolonged low-level exposure may cause respiratory impairment, kidney injury,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and pulmonary sensitization. Neuropsychological effects may include sleep disorders, irritability, altered sense of balance, memory deficits, loss of concentration, and mood alterations. Menstrual disorders and secondary sterility have occurred in women.

Formaldehyde is now listed by the International Agency for Research on Cancer (IARC), the National Toxicology Program (NTP), and others as a known human carcinogen.[4] However, the EPA still considers formaldehyde a probable human carcinogen (cancer-causing agent) and has ranked it in the EPA's Group B1. Long-term exposure may increase the risk of upper respiratory-tract cancers, including those of the nasal cavity and sinuses, and possibly leukemia.

Exposure prevention

Begin by determining where and how formaldehyde is used in your facility. Inspect all use areas while activities are ongoing. Note any odors. Interview employees on their procedures. Note the type of formaldehyde products used.

The Safety Guys recommend consulting the OSHA formaldehyde standard, 29CFR1910.1048, for regulatory requirements and guidance.[3] This standard covers all occupational exposures to formaldehyde, including gas, solutions, and any materials that release formaldehyde.

First you must determine employee exposures by conducting appropriate monitoring. If in-house capability is not available, a competent industrial hygienist or similar professional can handle the job. OSHA has established an action level of 0.5 ppm and a permissible exposure limit (PEL) of 0.75 ppm, both based on eight-hour time-weighted averages (TWA). There is also a short-term exposure limit (STEL) of 2.0 ppm, a 15-minute average that employees shall never exceed. Periodic monitoring must be conducted every six months for employees exposed at or above the action level.

Review monitoring results and ensure employees potentially exposed above the limits are placed in a medical surveillance program. Collect initial medical history information and perform a baseline physical. OSHA provides considerable guidance in the rule appendices and on their website.

Safety and health training is essential for all employees falling under this standard. Training should focus on the signs and symptoms of exposure, the possible health effects of formaldehyde exposure, proper personal protective equipment, medical surveillance, monitoring, exposure controls, and first aid.

Summary

The best and most essential exposure control is properly designed and adequately maintained engineering systems (e.g., ventilation). We have all experienced facility spaces changing uses over time. We find anatomy labs in

what was office space, or surgeries performed out on the benchtop without any exhaust. That is why it is important to review ventilation in all formaldehyde use areas and ensure adequate exhaust and proper design. Attempt to capture vapors as close to the source as possible through use of snorkel exhaust or fume hoods. And, most importantly, make sure formaldehyde use areas are on dedicated single-pass ventilation systems.

Our number-one goal is protecting our employees and providing a safe workplace. Formaldehyde, essential to successful research in many applications, is potentially hazardous and, if used carelessly, can produce serious harm. But with careful planning, safe procedures, personal protective equipment, and exposure controls, we can use formaldehyde safely and protect employees.

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THE SCIENCE OF TASTE

FLAVOR COMES FROM A COMPLEX COLLECTION OF CHEMICAL CHARACTERISTICS, AND MORE

by Mike May, PhD

During the holiday season, around the world families and friends sit down to meals made with love and, hopefully, packed with flavor. In most cases, cooks build the flavor from experience and the trial and error behind recipes passed down over generations. In some labs, meanwhile, science takes over as the driver of flavor analysis, and the experiments can cook up some unexpected results.

Analyzing flavors is complicated, and there are many reasons for this. Sheryl Barringer, professor and chair of the Department of Food Science and Technology at The Ohio State University, says, "One reason is simply that you want to know the important flavor compounds, not just the list of chemicals in a food."

The sheer number of volatile compounds present—there can be 300 to 500 compounds in one food—also makes flavor analysis tricky. Plus, those compounds can create complex analytical situations. "Flavor compounds vary widely in their molecular properties, including structure, polarity, and boiling point, and it is difficult to extract the full range of flavor components using a single flavor-isolation technique," says Xiaofen Du, flavor chemist and assistant professor of nutrition and food sciences at Texas Woman's University in Denton. "The interaction between flavor components and a complex food matrix causes additional difficulty in flavor isolation."

▲ *The volatile chemicals of various foods can interact to create or destroy compounds, which changes flavors.*

The overall chemical milieu impacts a food's flavor. "Flavor chemicals interact," Barringer says. A sulfur compound in rotten eggs, for instance, creates a horrible odor, but the same sulfur compound at a lower level and mixed with other chemicals creates a desirable flavor in blue cheese.

ANALYTICAL CHALLENGES AND SOLUTIONS

With some chemicals, it doesn't take much to change the flavor of a food. Many volatile compounds impact the flavor at concentrations of parts per billion or parts per trillion. Such low levels push the detection limits of analytical techniques, and environmental contamination can creep into the tests. "You can get parts per trillion of some volatiles just out of the air," Barringer explains.

Also, flavor compounds tend to be very reactive. That can make them difficult to extract from a sample. For example, a flavor compound might react with a metal in the detection system and not show up in the results.

Other experts agree that extraction creates a challenge in analyzing the flavors in foods. "The extraction technique must be capable of isolating and extracting all the compounds of interest without causing the formation of compounds that are not actually present in the sample," explains Katherine Thompson-Witrick, assistant professor at the Fermentation Science Institute at Southern Illinois University, Carbondale. "This can be difficult since a number of extraction techniques require the sample to be heated at some point during the process."

The extracted elements that matter the most tend to be at very low concentrations. These low levels drive the need for advanced sample processing and analytical instrumentation. "Sample preparation for flavor analysis is always a challenge," says Vadoud Niri, assistant professor of chemistry and director of the chemistry graduate program at SUNY Oswego in New York. "Extracting the flavors from the sample without losing them before analysis is a concern." He adds, "Quantitative analysis of flavors with standards is

also a challenge." For many components of flavors, chemical standards for calibrations are not available or are very expensive.

To dig deeper into flavor, scientists use a variety of approaches. As an example, headspace solid-phase microextraction (HS-SPME) coupled with gas chromatography–mass spectrometry (GC-MS) is a fast and easy approach for extraction and analyzing flavors in food samples. Niri says, "HS-SPME has a minimum sample preparation, and with GC-MS a variety of flavors can be analyzed with one run."

▲*HS-SPME is being used here to analyze Scotch samples from different regions of Scotland. (Image courtesy of Shaun Henderson.)*

In looking ahead, Niri wants to speed up the processes. "Shortening both extraction and analysis times is our main focus to improve flavor analysis," he says. The sensitivity of the instruments could also stand some improvement.

Everyone "owns" one great instrument—their human sense of smell. "The human nose can be much more sensitive for some compounds that GC-MS may not identify," Du notes.

DETECTING THE UNEXPECTED

A compound's impact on a food's flavor depends on the complete chemical makeup and the processing, which even includes chewing. The mechanical breakdown of a food during chewing and mixing it with saliva impacts the flavor. "There's always a food matrix," Barringer explains, "and the matrix hides flavors."

To study how foods taste after chewing, Barringer studies people's breath. If someone chews food and then exhales into selected-ion flow-tube mass spectrometry (SIFT-MS), for example, the results show what chemicals the person actually created.

A few years ago, one of Barringer's students wanted to see whether anything could deodorize garlic. Barringer expected that eating mint after garlic would simply cover the latter with a minty taste, not really eliminate garlic's volatiles, but she let the student explore the concept. Using the chewing-and-exhaling technique, the student found that some foods, such as apple, mint, and parsley, do in fact deodorize garlic. "It was not that the foods masked the garlic," Barringer explains. "The other food is probably reacting with garlic's volatiles and creating other chemicals." She adds, "The volatile is no longer in

your breath." This is all good news for someone on a date, but maybe not as comforting to someone trying to ward off a vampire.

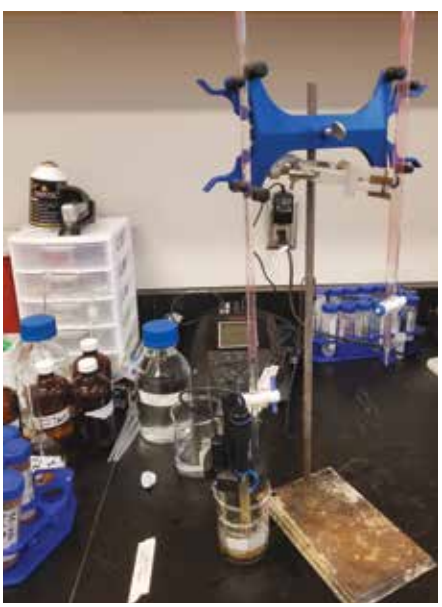
Beyond the chemistry of taste, neurobiology comes in as well. The sensation—the actual interaction of food chemicals with sensory receptors, including taste and smell—matters. So does perception—the brain processing that turns the sensory signals into an experience. That processing can make things more complicated and more interesting.

> "Extracting the flavors from the sample without losing them before analysis is a concern."

In Björn Ivens's lab at the University of Bamberg in Germany, scientists analyzed how packaging a food impacts its flavor. "Packaging does, for sure, impact a person's perception of a food's flavor," says Kristina Kampfer, a research assistant in Ivens's lab. "However, research has not yet fully explored how different senses interact with each other." These scientists found that when buying packaged food, its weight impacts the perceived flavor. That is, a sample of steak from a package that contains 1 kilogram might taste better than a comparable sample from a package that contains only 0.5 kilograms. "This effect has been demonstrated for both food and beverages, and it occurs even for subtle differences in weight," says Kampfer.

BELIEVING IN BEER'S FLAVOR

Speaking of subtle differences, nuances in beer matter to many people around the world. The growing market for microbrews makes flavor analysis all the more important, given that a greater number of beers seem to come out every year. "Beer itself is quite complex, despite being made up of only four basic ingredients: water, malt, hops, and yeast," says Thompson-Witrick. "There are carbohydrates and proteins present in the sample, which can interfere with the extraction process." Extracting compounds from beer poses such a problem that Thompson-Witrick is not always confident that what she finds in analysis was actually in the product. "Pure compounds are expensive, and databases only allow for tentative identification," she says.



▲ *A range of instrumentation contributes to the analysis of flavor, and some basic chemical methods go a long way. (Image courtesy of Katherine Thompson-Witrick.)*

The type of beer also impacts the likely analysis. In lambic beers, for example, scientists often study the microbiota. Although traditional beers usually go through two stages of fermentation—the primary fermentation that develops the alcohol and some carbon dioxide, and so-called bottle conditioning—lambic beers go through four stages based on enteric bacteria, saccharomyces, lactic and acetic acid, and brettanomyces. So, the latter kind of beer can contain more microbes than traditional beers contain.

In her doctoral research, Thompson-Witrick analyzed the flavor compounds in lambic beer. She compared two extraction techniques—solid-phase microextraction (SPME) and simultaneous distillation extraction coupled with solvent-assisted flavor evaporation (SDE-SAFE)—that are commonly used in the flavor industry. "They each have their strengths and weaknesses," she says, "but at the end of the day neither technique based upon my research was truly superior to the other." So, in this situation, researchers can use the technique that they like the best.

The analysis of the extracted components in lambic beer also creates some challenges. "Sulfurs play an important role in the flavor and aroma profile of the beer that I worked with for my dissertation; however, it is very difficult to identify and quantify them," Thompson-Witrick says. So, she used a pulse flame ionization detector with a specific sulfur filter. "It would be ideal to have a machine that would be able to identify all the compounds of interest without having to run the sample through multiple pieces of equipment," she says. "Not all flavor compounds are volatile enough to pass through a GC, and a number of the organic acids are not." The latter situation requires high-performance LC (HPLC).

THE FLAVOR FUTURE

Tomorrow's flavor chemistry will probably dig deeper while suffering less from contamination. "I would love it if you could eliminate environmental contamination," Barringer says. "Plus, if you could lower the detection limit to parts per trillion without background contamination, that would be fabulous."

Looking ahead, Du can think of at least a couple of improvements that she would like to see. One, she says, is "specific flavor-isolation techniques for specific groups of flavor compounds, making results more reliable and accurate." Plus, she would like to have "more powerful and faster instrumental analysis techniques."

Other experts interviewed here expressed similar concerns about the challenges in flavor analysis, including getting to the right compounds and being able to measure them with high sensitivity. In addition, some scientists seek ways to explore the volatile compounds in more natural conditions—the way people do when they eat the food. Only then can scientists really know which compounds have the greatest impact on how a food tastes.

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Wayland Rushing, PhD

ASK THE EXPERT

CHALLENGES AND TRENDS IN ANALYTICAL METHODS TRANSFER

by Rachel Muenz

Wayland Rushing, PhD, the director of scientific affairs at EAG Laboratories, is an expert in Chemistry Manufacturing and Controls (CMC) analytical program design, analytical development, and regulatory submissions. Dr. Rushing has led CMC development programs for a wide array of pharmaceutical products, including parenteral and inhalation drugs, drug/device combinations, and other therapies with complex delivery systems. Dr. Rushing is a subject matter expert in HPLC and GC method development and validation, extractables and leachables program design, and analytical regulatory submission requirements, and he has drafted multiple IND and NDA submissions. Dr. Rushing is a coauthor of the Parenteral Drug Association (PDA) Technical Report No. 65 Technology Transfer.

Q: Which industries do you most commonly deal with when it comes to analytical method transfer?

A: EAG provides analytical services to just about every industry you can think of, so it's a wide range—pharmaceutical, biotechnology, agrochemical, industrial chemicals, medical devices, packaging, consumer products, electronics—you name it. Some require testing against industry-standard or fairly straightforward methodologies, such as ISO methods or compendia methods. However, in my particular role at the Columbia, Missouri, facility, I focus on pharmaceutical and biopharmaceutical development. In this field, methods are mostly proprietary and unique to the product. Transferring a method can be a complex process, and if not done correctly, can lead to costly delays.

Q: Which analytical technologies do you deal with most often?

A: When we're dealing with the pharmaceutical side, it's a wide range. Of course, it's very heavy in chromatography, so HPLC, GC, UPLC, and capillary electrophoresis, but then we also get into other techniques during the method transfers, either from titration methodologies, water content methodologies, or ELISA techniques on the biotech side—there's a variety of additional analytical technology that we bring in.

Q: What are some of the key trends or changes in methods transfer today?

A: Overall, from a regulatory standpoint, there's ever-increasing scrutiny to ensure methods are being appropriately and scientifically transferred in. For example, we have observed the FDA in the pharmaceutical and biotech areas have a greater focus on the scientific design and acceptance criteria to ensure that the transfer is meaningful and that the method can be executed appropriately.

Q: How are those changes affecting labs?

A: It is really pushing the labs to give a more significant amount of thought and effort to planning the method transfer exercises. Historically, it was common to treat transfers as a simple check-box exercise. It was just assumed that if the method was validated, it would transfer with ease. This led to multiple issues in terms of transfers failing, or running into issues after the method was transferred inappropriately, jeopardizing the validity of the data. With these new expectations, and with the complexity of some of today's analytical techniques, there's a big driver to spend more time up front in looking at how the methods actually perform, what the areas of concern of the method are, and what design should be used to transfer the method to ensure validity of the data.

Q: What are the most common challenges labs run into with method transfer?

A: One is a lack of communication. That doesn't mean the two sides aren't communicating, [but] that the key information sometimes is not being communicated effectively. Either there is key information that is not housed in the analytical method—sometimes there are references to other external documents, in-house SOPs, or other techniques that one facility will use that the other facility does not—or there is, for example, a misinterpretation on how to perform part of that analytical method. I see it commonly in terms of how people interpret certain instructions, for example, if the instructions say to make a 5 ppm solution. Well, there are two different definitions of ppm—the volumetric and the gravimetric. Which definition is being used by the transferring facility? The biggest issue is ensuring that both sides, the sending unit and the receiving unit, are communicating effectively and all the key information required for a successful transfer is executed. The majority of the issues we find are preventable. They're actually not method performance issues—the methods work fine—it's that some piece of key information, something that is vital to the performance of the method, isn't getting transferred appropriately.

Q: How can labs avoid such challenges?

A: The first step is coming up with the understanding of why you are transferring this method. The second part is gathering all the required information that the receiving unit is going to need to execute [the method], and that typically starts a review of the analytical method. Is it written in a way that anyone who is external to your company can read and understand, since it's typically between companies or between laboratories that you're doing [method] transfer? Is there any instruction that's unclear, or does it rely on a different procedure that is used in-house that defines how that procedure is performed? We recommend putting together a transfer package. This will include the original validation report, method development reports, a detailed list of known issues (no method is perfect—all methods have some performance issues), and real-world examples of the data, for example, actual chromatograms, if it's a chromatographic method. This will ensure that all the information is effectively transmitted to the receiving unit.

The other big thing in how to prevent those issues is on the training side. A lot of transfers are done by what I refer to as "paper training." You simply hand over the method and the receiving unit reads through it, trains themselves, and executes it. That's a fairly ineffective way to perform method training. It can be done on simple methods, but with more complex methods, it really requires a hands-on training session where someone who is experienced in how the method is performed on a day-to-day basis physically trains an analyst wherever you're transferring that method to. The experienced person walks the receiving analyst through the method and they generate data; that way you can ensure that the techniques being used by that current facility are being appropriately transferred.

Q: What can happen if method transfer isn't done properly?

A: There are a number of issues. The first is just from a regulatory standpoint. Many industries require that the transfer occur under applicable regulatory guidelines—it is executed under a protocol so if you end up with a failure, you then need to run through the regulatory investigation process. Why did you have a failure? Does the failure impact any data that's been generated at the other facility? Is this a method-related issue or is it a training issue? It becomes a quality assurance or regulatory-driven investigation, which of course can lead to delays and timeline issues in terms of how quickly you can complete that transfer. The other issue is from a timeline execution standpoint in that method transfers are typically done as a precursor to some key milestone coming up—release of new products, initiation of stability studies, release testing of actual drug product, or manufacturing starts. Any delays that are encountered in transferring that method can have an impact on those next steps of the development process, which can then delay the overall development process and the potential drug development timelines.

Q: What are some of the resources you've found to be most helpful for method transfer?

A: There are several documents that are available; the WHO guideline on technology transfer and USP <1224>, which is very informative in terms of the types of method transfers that can be performed. The PDA (Parenteral Drug Association) has issued white papers (TR 56 and 65), which are a very detailed process of how to perform technology transfers. While there are a lot of different guidelines out there covering a wide array of industries, they all explain the same basic process. One of the key resources will be to establish a standard operating procedure that you can refer to as "This is how we perform transfers," not just "Here's how we do it this time and we do it a different way that time." By establishing the standard procedure, you can ensure that all the right questions are being asked and answered.

Q: How do you expect method transfer to change further into the future?

A: I think there's going to continue to be increased regulatory scrutiny of method transfers. Method transfer now is already complicated enough, because of the number of different places that require method transfers. In this virtual age, companies are embracing outsourcing [of] their work to contract research organizations or they have multiple different laboratories or they are a virtual pharmaceutical company that has no laboratories, so you end up with an analytical method being transferred up to six times or more over the lifetime of that method. This adds complexity into the process for the future, because this trend is just continuing to increase as more companies embrace the outsourcing or modular-type system. It's fragmented, in that [these companies] have manufacturing done here, stability done there, release testing done here for the drug product, another drug product done in this manufacturing site, API over here—so you end up testing in a lot of different places. I think there will continue to be an increase in oversight of the method-transfer process, especially for the regulated industries, to ensure that the method transfers are being performed appropriately.

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AUTOMATED SAMPLE PREPARATION

SO MANY CHOICES, SO LITTLE TIME

by Angelo DePalma, PhD

The operational space of sample preparation is huge, with tens of thousands of possible starting materials and hundreds of relevant methods. The desired readout adds a third dimension to the decision matrix. In all cases, the objective is to "clean up" the sample, so the analyte of interest is preserved to the greatest degree possible, while removing potential interferences. Within that context, automation seeks to reduce human contact at critical points, thereby gaining speed, throughput, and reproducibility while eliminating human error.

"Our customers are the 90 percent that currently do everything by hand."

Preparing samples for chemical analysis involves routine methods (or a combination thereof), for example extraction, digestion, grinding, preparative chromatography, filtration, dilution, reagent addition, crystallization, distillation, and other processes. Many of these operations are fully manual, while some occur nearly completely within robotic platforms. In either case, sample prep is straightforward and familiar.

Molecular analytic workflows present a different set of challenges, notes Mark Dupal, global portfolio manager for microfluidics and automation at PerkinElmer (Hopkinton, MA). Although many of these methods are already automated, sample collection and preparation are labor- and resource-intensive due to sample complexity.

Sample prep leading to next-generation sequencing, for example, usually involves the collection of human tissues or body fluids. That's all well and good when the objective is quantitation of the obvious, for example plain vanilla genomic DNA. "There is plenty of genomic DNA in whole blood," Dupal says.

Sequencing gets interesting when the object is detecting or quantifying circulating tumor cells or tumor DNA from plasma, or fetal DNA in a mother's blood. These applications stand sample prep on its head, as "normal" patient DNA becomes not the target but an unwanted obfuscator to detecting rogue genes from cancer cells.

Moreover, the capture and analysis of such diagnostic DNA is confounded by the presence of circulating nontumor DNA arising from a patient's healthy cells, and the fact that their concentration varies significantly with different cancers and stages of disease.

For pulling such low-abundance analytes from plasma, PerkinElmer offers the chemagic™ purification instrument and accessories. Like many gene-preparation techniques, chemagic uses magnetic beads coated with probes for cell-free DNA. Incubation proceeds normally, but instead of applying a magnet to the outside of the sample vial to collect the beads, chemagic inserts magnetized rods into the sample, withdraws them, and then dispenses the beads into a wash flask by demagnetizing the rods.

PerkinElmer claims high yields and purities, which is a requirement for medical diagnostics based on sequencing. "Finding these DNA fragments is like looking for a needle in a haystack," Dupal says. "Plus with all the other cell-free DNA present, you have to extract as much target DNA as possible."

Sample prep for molecular analytical workflows carries the same conundrum as for chemical-analysis workflows, namely whether to purchase a complete analytical system, including sample preparation, from one vendor or to cobble something together with components from several manufacturers.

Dupal makes a good case for the former:

"The choice typically depends on the end market. Basic researchers are more adept at tinkering, so they often don't mind having components from several vendors. But in clinical settings, time is money. Relying on a single vendor for troubleshooting—a vendor that can support the entire system—is critical. There's also comfort

in knowing that a manufacturer that designed an analytical workflow has tested it extensively, including taking samples, extracting DNA, quantifying it, and delivering it to the sequencer. Many users appreciate that they're not working with untested methods."

What cost barrier?

Small companies and academic labs cite high costs as justification for sticking with manual sample preparation. With its line of liquid-handling robots, Opentrons (Brooklyn, NY) has broken the price barrier. "Our basic system is one-tenth to one-hundredth the cost of premium robots from well-known vendors," says Opentrons cofounder Will Canine.

The secret is in the sourcing of technology and components. Opentrons has tapped into the extensive and growing hardware supply chain in Shenzhen, China, and embraces open-source technology. The global growth of desktop 3-D printers has made things like precise stepper motors and 3-axis controllers more affordable and higher quality than ever before.

Those same components are available to top-tier robotics companies; and given that, why don't those companies use them? Canine suggests that companies with high-margin products cannot afford to cannibalize their own products; this is an idea posited by the highly successful book by Clayton Christensen, *The Innovator's Dilemma* (https://goo.gl/s8uANp).

"But even this argument is an apples and oranges proposition. The big automation vendors serve laboratories conducting highly complex assays in high throughput. Our customers are the 90 percent that currently do everything by hand."

In other words, these are small companies and academic groups with modest budgets that could benefit from the time savings and reproducibility of automated sample preparation.

Next-gen proteins

Emerging protein therapeutics present the usual challenges of sequencing and higher-order structures, but often incorporate nongeneric chemical modifications. Agilent Technologies (Santa Clara, CA) introduced its AssayMAP peptide sample-prep system in 2013, perhaps in anticipation of the growing interest in next-gen protein drugs, whose sequencing and mapping is required for full characterization.

The system provides automated protein affinity purification, protein digestion, peptide cleanup through micro reverse-phase chromatography, and fractionation in preparation for mass-spectrometric (MS) analysis. AssayMAP also prepares samples for discovery and analysis of protein and peptide biomarkers. The platform includes Agilent's Bravo liquid handler and single-use, ready-to-use cartridges for peptide cleanup and fractionation.

AssayMAP achieves the principal goal of sample prep: eliminating workflow bottlenecks, creating walkaway time, and providing reproducibility. The relevance in today's proteomics environment is that sample preparation has become a rate-limiting step.

"AssayMAP facilitates peptide affinity purification and fractionation," says Maryann Shen, PhD, LCMS global marketing program manager. "When a specific antibody is available, operators can use a streptavidin cartridge to immobilize the antibody, followed by affinity capture of the peptide of interest. Multiplexing the capture step is also possible. Once captured peptides elute, they fractionate on the AssayMAP before LC-MS analysis. AssayMAP is appropriate whenever there is a need for affinity purification, fractionation, and desalting."

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FOR ADDITIONAL RESOURCES ON AUTOMATED SAMPLE PREPARATION, INCLUDING USEFUL ARTICLES AND A LIST OF MANUFACTURERS, VISIT WWW.LABMANAGER.COM/SAMPLE-PREP

WHAT TO LOOK FOR WHEN PURCHASING A **TITRATOR**

Modern titrators can be simply classified as one of two types: potentiometric and Karl Fischer, with the latter available in both coulometric and volumetric versions. While titration may be considered a basic analytical method, modern titrators are far from simplistic. Many titrators offer a variety of automation options and can perform titrations with great accuracy with minimal operator intervention.

Types of titrator used by survey respondents:

Potentiometric	62%
Karl Fischer Volumetric	35%
Karl Fischer Coulometric	29%
Other	15%

Titrator components used by survey respondents:

Autosampler	50%
Karl Fischer Oven	24%
Homogenizer	17%
Evaporators	13%
Other	23%

Nearly 42% of respondents are engaged in purchasing a new titrator. The reasons for these purchases are as follows:

Replacement of an aging system	61%
Addition to existing systems, increase capacity	23%
First time purchase	9%
Setting up a new lab	7%

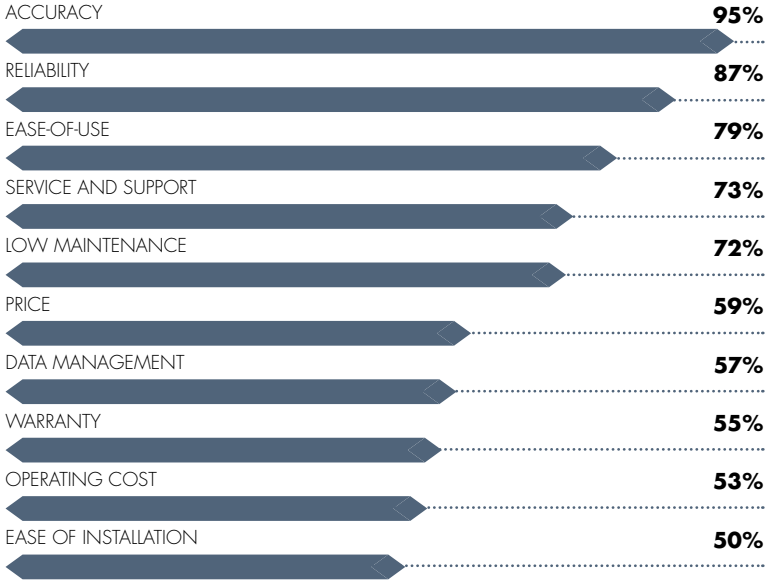
TOP 6 QUESTIONS

You Should Ask When Buying a Titrator

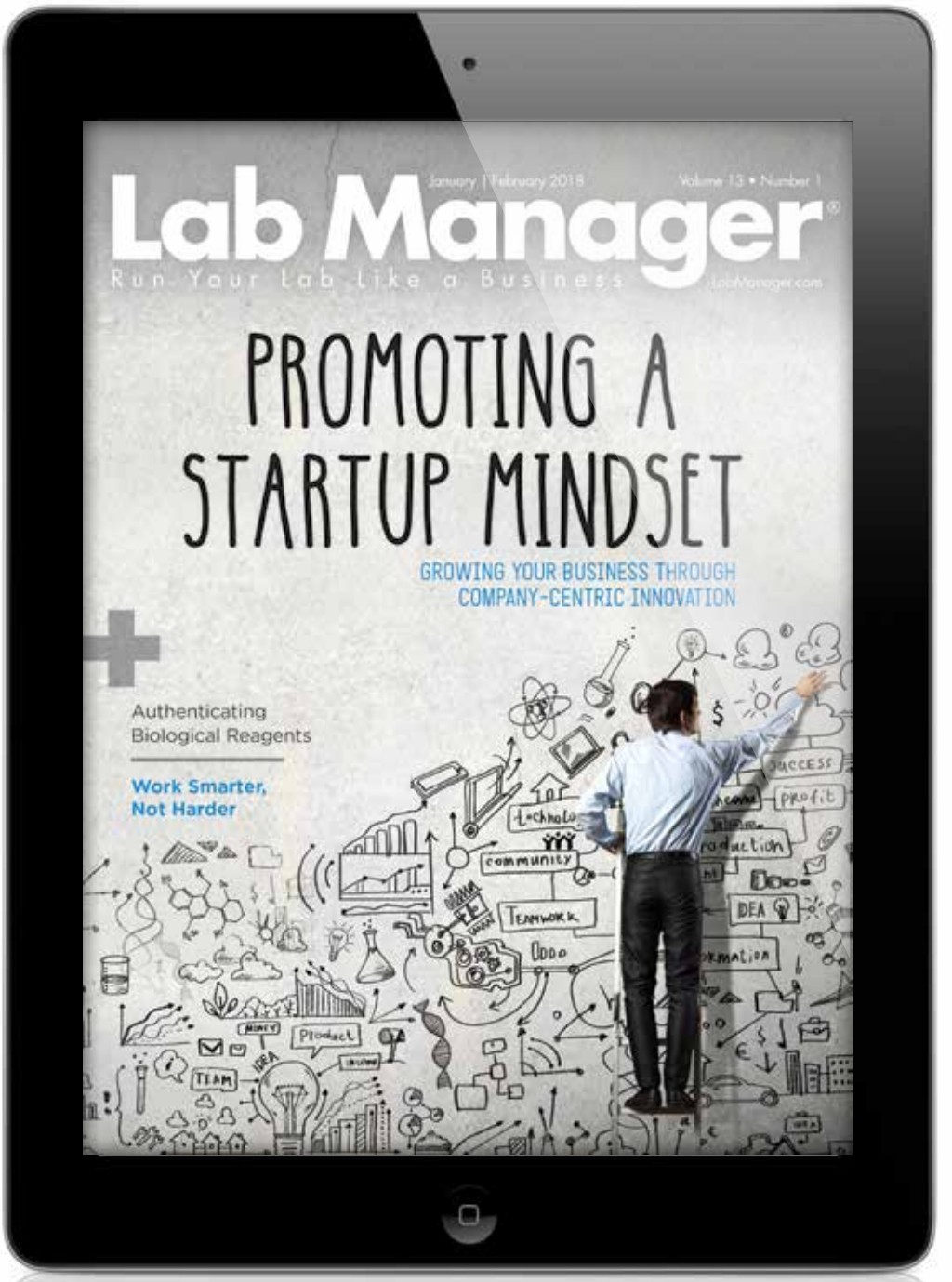
1. How precise is the titrant delivery system? Is the titrant delivery system certified for accuracy?
2. Can additional titrants be used without having to purge burettes?
3. What information is included in the titrator's display and reports?
4. Is the titrator limited to proprietary electrodes? What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

TOP 10 FEATURES/FACTORS

Respondents Look for When Purchasing a Titrator



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



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Lab Manager
Run Your Lab Like a Business

Sarah Boswell, PhD

ASK THE EXPERT

INNOVATIONS IN SINGLE-CELL ANALYSIS

by Tanuja Koppal, PhD

Sarah Boswell, PhD, director of the recently established Single-Cell Sequencing Core at Harvard Medical School, talks to contributing editor Tanuja Koppal, PhD, about her efforts to bring inDrops single-cell RNA sequencing (scRNA-seq) to the greater Boston scientific community. She talks about the different types of scRNA-seq technologies that are currently available, her experiences working with and helping investigators understand the best practices for sequencing, and how sequencing can be put to use when addressing certain biological questions.

Q: Can you provide some background on why and how the single-cell RNA sequencing core lab came to be established?

A: Our core lab started in July 2016. Allon Klein's lab in the Department of Systems Biology at Harvard Medical School is part of the team that developed the inDrops technology for scRNA-seq, and he had too many people interested in collaborating with him to use this technology. So, I was brought on as someone with a lot of sequencing expertise and experience to get the core lab started. Currently in the core we use only inDrops technology, which is similar to other microfluidics-based techniques for scRNA-seq like Drop-Seq and the one by 10x Genomics. inDrops is a microfluidics-based technology where you make a suspension of single cells that are captured and barcoded in nanoliter droplets on a chip. Each droplet has a hydrogel carrying photocleavable combinatorially barcoded primers. Reverse transcription takes place within each droplet to generate single-cell mRNA transcripts labeled with random cell barcodes as well as unique molecular indices to identify each transcript from a cell. The transcripts from thousands of individual cells are then pooled to prepare the RNA sequencing library, which is analyzed using next-generation sequencing. After we do the library prep, we hand the samples and all library information back to the user so they can get the sequencing and bioinformatics done at any center they choose. 1CellBio is currently commercializing the inDrops technology.

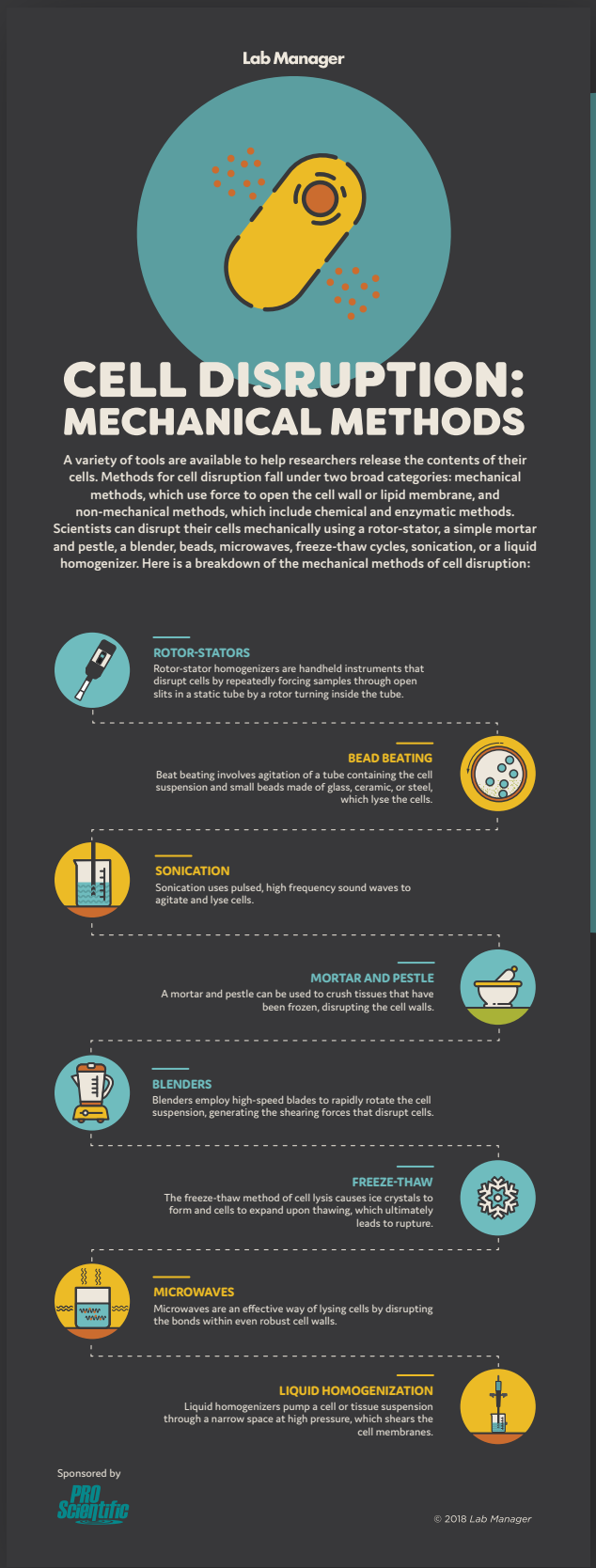
Q: How do the different technologies for scRNA-seq compare against each other?

A: There are lot of comparative studies going on right now with these different methodologies. We are looking at some of that data as well, along with our collaborators, to see how these different microfluidics-based platforms compare and perform. The microfluidics-based scRNA-seq instruments from commercial vendors like 10x Genomics are certainly easier to use, but they are also more expensive than inDrops. When inDrops is used optimally, the prices at our core lab can drop to around 7 cents per cell, while other methods can be as high as 25 cents, and that is even before you get to the sequencing. On average, our users are looking at about 3,000 cells per sample. Even though the inDrops technology is not that expensive, when you look at thousands of cells it can still get costly.

Besides the microfluidics droplet-based technology, people use plate-based methods where single cells are usually flow-sorted into 96 or 384 well plates containing lysis buffer, and then RNA sequencing libraries are prepared using protocols like Smart-seq2. These methods can give you the full-length transcript information, but they are also more expensive per cell. With plate-based technology, it's difficult to collect and store thousands of cells; that is much easier to do with droplet-based methods. Using a flow sorter can sometimes also lead to a higher dropout rate. However, microfluidics-based single-cell technologies require thousands of cells in order to work well and give good data. If you have a rare cell population with a few hundred cells, you probably should consider a plate-based method. Hence, we sometimes recommend that people bring us more cells for analysis by using some broader criteria for cell sorting, if possible.

Q: What are some of the applications that people are using scRNA-seq for?

A: When the sample is limiting, such as with single cells, you can't get as much information out as you would in a traditional RNA sequencing experiment. The more RNA you can extract from the sample and input into your library preparation, the more information you can get about the whole transcriptome at the back end. With single cells you get information about only a small percentage of the transcriptome, and this can vary further by cell type, the sample prep method, and the scRNA-seq technology used. That said, we have used the inDrops technology on a lot of different cell types, from the fly and sea worm to induced pluripotent stem (iPS)-derived cells and patient samples.



CELL DISRUPTION: MECHANICAL METHODS

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PRO Scientific

Lots of people are using single-cell technologies for looking at heterogeneity in immune cells and immune populations in response to different conditions or treatments. In patient samples, this may have to do with looking at various disease states. We have people looking at different organisms to see how their cells function. We have many users working on iPS cells and organoids, hoping to understand how these models compare when looking at disease pathways and the effects of various treatments in healthy donor or patient cells. Hence, single cells are being used to answer a lot of different types of biological questions.

Q: What are some of the challenges that you have run into with scRNA-seq?

A: The real challenge is for the user to bring us the sample that is ready to go on the instrument. Dissociating the sample into a single-cell suspension, keeping the cells viable, and not altering the transcriptome during the sample processing can be very tricky. Many questions, such as what does a three-hour dissociation process do to the transcriptome, still need to be answered. Some cells are definitely more challenging than others because many of them die during processing, and that creates a bias among the population of cells that survive. We are very much aware of these challenges and make sure our users understand them, too. We cannot do the sample prep for every user, as it would be hard to optimize protocols for each sample and would add to the cost of analysis. We also don't have many papers published with our technology yet, so we try to connect our users so they can exchange protocols for sample prep. Can different labs using different sample prep protocols get the same results? A lot of this has yet to be determined.

With inDrops, we can work on only one sample at a time. So, we must coordinate well and make sure the samples are not sitting on ice for too long before being analyzed. Each sample is loaded into the microfluidic chamber, where it undergoes gentle lysis in the hydrogel and reverse transcription takes place with the barcoded primer. Each single cell, still encapsulated within a droplet, is frozen as a DNA:RNA hybrid that can be used for library prep along with all other samples at a later date. This helps eliminate some of the batch effects by prepping all the user's libraries on the same day, even if the samples were collected on different days. We run about six to eight samples a day, depending on the sample and how many cells we are collecting. Some instruments, such as the one from 10x Genomics, have parallel channels on the chip so you can run many samples at the same time, although it may not always be feasible for the user to prep and hand over all the samples at once.

Q: Do you see some of these challenges being overcome soon?

A: There is a lot that can be done to move the field forward. The long sample prep required to make single-cell suspensions on some samples can lead to nonuniform processing, and many cells die in the process. Many sample types cannot be frozen if you want to look at cellular heterogeneity, and there is work being done on cryopreservation for single-cell analysis. So far, that seems to work well only on certain robust cell types. Similarly, people are working on encapsulation and freezing for high-throughput, multistep analysis. Sample coordination, especially when it comes to patient samples, can be tricky. These cells must be drawn from the patient, stored, and processed properly and quickly. We have now managed to optimize this protocol so we can accommodate more patient samples, but if freezing cells were possible it would make things much easier.

Many labs are working on optimizing technology so you can capture more genes per cell. If we can develop inDrops to accommodate multiple samples, that will be a big step forward. A lot of innovation is also being done in the data analysis because the single-cell data is quite different from the standard RNA sequencing data. It's far sparser, and we need the right replicates and well-controlled experiments to understand what we see in the cell population data. Before jumping on the single-cell bandwagon, we need to do good science and be sure to follow up on results with secondary methods. However, as far as looking at patient data and understanding the heterogeneity in cell response to various drugs and treatments, the single-cell technology can certainly prove to be very powerful.

Sarah Boswell is a staff scientist specializing in RNA sequencing (RNA-seq) at Harvard Medical School. She is the director of sequencing technologies within the Laboratory of Systems Pharmacology (LSP) and the director of the Single-Cell Sequencing Core recently established at HMS to bring inDrops single-cell RNA-seq to the greater Boston scientific community. She advises users on experimental design and optimization, as well as managing core operations. She works closely with the Laboratory of Systems Pharmacology (LSP) bioinformatics core and the Harvard Chan Bioinformatics Core to ensure a seamless transition between experiment and analysis. Sarah completed her PhD at Rensselaer Polytechnic Institute and did her postdoctoral training at Massachusetts General Hospital. She later joined LSP as a staff scientist specializing in sequencing technologies. She continues to carry out experiments, publish scientific papers, and give lectures on RNA-seq methodologies.

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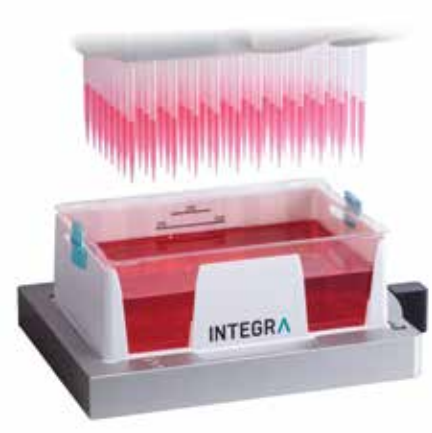
NEW AUTOMATION FRIENDLY RESERVOIRS SAVE REAGENTS AND REDUCE PLASTIC WASTE



INTEGRA has expanded its Clear Advantage™ product family to include automation friendly reagent reservoirs designed to save reagents and reduce waste while simplifying pipetting activities. The new reagent reservoirs – available in 150 and 300 ml volumes – offer the lowest possible dead volumes, and are compatible with INTEGRA's VIAFLO 96/384 hand-held electronic multichannel pipettes, as well as other liquid handling platforms. The Clear Advantage design also gives scientists a clear view of the tips during pipetting operations, helping to ensure the best liquid handling results.

As automation becomes more and more important, the design of labware consumables, such as reagent reservoirs, becomes increasingly important. Reagent reservoirs offer a convenient solution for the temporary storage of liquids during pipetting applications, but it is essential that they are carefully designed and manufactured to ensure smooth automation of liquid handling processes and minimize wastage of reagents. The use of automation friendly ANSI/SLAS-formats also helps to extend walkaway time by simplifying logistics and allowing robotic grippers to move the reservoirs.

INTEGRA's Clear Advantage™ product family is designed to enable scientists to benefit from walkaway automation while saving reagents and reducing plastic waste. The company's recently launched automation friendly reagent reservoirs combine the lowest possible dead volumes – saving on reagents – with reduced plastic waste to offer a more application and environmentally friendly solution for automated liquid handling. The system consists of disposable, virgin polystyrene inserts that fit into reusable, ANSI/SLAS-format bases with clearly visible volume markings. Users simply choose between 150 or 300 ml reservoir inserts, which can be replaced as required, saving both precious lab space and money.

Each flat bottom insert benefits from INTEGRA's revolutionary SureFlo™ anti-sealing array, which prevents pipette tips from sealing off and stops liquid from 'popping' into tips, filters or the pipetting head. A specially formulated surface treatment avoids pooling of liquids, resulting in a dead volume of less than 3 ml. For ease of use, the reservoirs feature clearly visible integrated volume graduations, allowing rapid, accurate filling with the required reagent volume. Unused reagent can be conveniently returned to the source container via the pour back spouts, or a latching lid can be attached to the reservoir, enabling short-term storage while preventing evaporation and spillage. Unique dual viewing windows ensure optimal positioning of the pipette tips, and a space-saving, stackable design significantly reduces storage requirements.

The inserts are available in two volumes – 150 and 300 ml – in either individually sealed or bulk packaged options, and are compatible with INTEGRA's VIAFLO 96/384 hand-held electronic multichannel pipettes, as well as other liquid handling platforms.

Visit www.integra-biosciences.com to request your free trial pack or to watch the product video.

INTEGRA

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FLOW CYTOMETRY

ADDING A DIMENSION TO DISEASE DIAGNOSTICS

by Angelo DePalma, PhD

Flow cytometry, like mass spectrometry 20 years ago, has a reputation for inaccessibility and user-unfriendliness. The democratization of flow methods has added a new dimension—an extra level of specificity—to cell-based diagnostics, opening new paths for molecular techniques on individual cell types.

NeoGenomics Laboratories (Ft. Myers, FL), which specializes in cancer genetics testing and related information services, offers the usual array of current-generation diagnostics, but the company's strength is the ability to combine any of those assays with flow cytometry.

"For clinical trials, we can adapt any of our tests on our clinical flow cytometry menu, but human studies often require customization; that is, adding or removing markers to a flow cytometry panel," says Gina Wallar, PhD, VP of pharma services sales.

> "Where pure genomic methods give you DNA or RNA levels from a bulk sample, flow cytometry quantifies specific phenotypes."

The NeoGenomics flow cytometry platform identifies activation state of cells, expression of biomarkers of interest, and quantification of specific cell populations. Assays may be directed toward diagnosis, response to drug treatment, or disease progression.

Once separated, cells may be tested further through any of 160+ additional assays for specific mutations, including by next-generation sequencing or any of the various PCR varieties. Downstream testing can be done to confirm, validate, or add to results from the flow cytometer.

"Where pure genomic methods give you DNA or RNA levels from a bulk sample, flow cytometry quantifies specific phenotypes," Wallar says. Next-gen sequencing is extremely valuable in research settings, but flow cytometry has a faster turnaround time and is often less expensive. "Flow cytometry provides a rapid measure of a patient's response to drugs, including phenotypic responses that may not yet be apparent through DNA analysis. That's one reason for using flow cytometry along with genomic testing in a clinical trial."

Solid tumor capability

Last year, IncellDx (Menlo Park, CA), which calls itself a "single-cell diagnostics company," released the OncoTect iO® Lung Kit, a flow cytometry-based assay that quantifies programmed death ligand 1 (PD-L1) on tumor cells and immune cell subtypes in non-small cell lung cancer (NSCLC) tissue samples. OncoTect iO Lung Kit also quantifies tumor infiltrating lymphocytes (TILs).

OncoTect iO represents a new family of multiparametric molecular analysis systems for immune-oncology suitable for clinical research, pharmaceutical discovery, and the study of malignancies expressing PD-L1, which include those of the bladder, head and neck, and prostate.

OncoTect incorporates a non-enzymatic single cell tissue homogenization process, incellPREP™, for unfixed tumor biopsy samples. Suspended cells are labeled with antibodies, stained with a cell cycle dye, and analyzed via flow cytometry to enumerate cells of interest, particularly PD-L1 and its expression at various stages in the tumor cell cycle.

Quantifying PD-L1 in tumor and immune cells may allow prediction of patient responses to novel PD-1 immunotherapies.

"We heavily promoted small, fluorescence-based cytometers in diagnostics that didn't require a biophysicist to run," says Bruce Patterson, MD, CEO and founder. "Luminex did us a big favor because their instrument is basically a cytometer, a fact that assisted in adoption of user-friendly models for clinical assays."

IncellDx goes several steps further to detect not just cells but proteins, DNA, and mRNA in cells. By freeing cells from their tissue environments without

chemicals or enzymes that might compromise salient features, incellPREP extends the range of useful flow methods to cells from solid tumors, which is a huge achievement since flow cytometry is normally associated with blood-based analysis.

Together, the company's detection and sample preparation platforms enable cell-by-cell analysis, which adds a new dimension to molecular cancer diagnosis.

Molecular techniques like PCR and NGS are fine for detecting or confirming the presence of specific abnormalities, for answering the question: Is this mutation or translocation present anywhere in my sample? Cell-by-cell analysis provides that information, plus the source or origin of the abnormality.

"With NGS you put all your cells into a blender but you've lost the denominator," Patterson explains. Actually, the denominator exists, but it is usually a nondescript entity with no real information on how a patient is faring. One could report, for example, on the number of mutations per unit volume of sample, or as a percentage of total (mutated plus wild-type) genes, but such knowledge is limited by the power to discriminate one cell from another, which in solid tumor homogenates is zero.

Solid tumors are as diverse cellularly as any other tissue, so which cells are affected could theoretically guide therapy or provide a prognosis. "With flow cytometry the denominator is the cell type," Patterson continues. "You can identify the cell independently of whatever analyte you're looking for, and determine exactly which cells carry that feature."

What about the data?

With all the talk of multicolor, multiparameter flow experiments, it becomes easy to lose sight of the inevitable data overload. Last year, FlowJo (Ashland, FL) partnered with Becton Dickinson to apply FlowJo's cloud-based data platform, Envoy, to the BD FACSymphony™, a cell analyzer that measures up to 50 characteristics in a single cell. FlowJo provides cloud-based storage of copious flow cytometry data plus onboard calculations and sharing of single-cell analysis data.

FlowJo CEO Mike Stadnisky, PhD, explains the need. "Flow experiments often involve two or more people, knowledge of instrument configurations and quality controls, generation of several different file types, and multiple analysis iterations. Keeping this information together is critical to drawing the correct conclusions about an experiment."

Stadnisky is reluctant to call his product a laboratory information management system (LIMS) or electronic lab notebook (ELN). "Envoy holds the same details as an ELN but also retains communications between lab personnel and revisions to data analysis, and enables the users to share files—which an ELN does not." LIMSs do a good job of storing data but the result is a massive database, access to which involves remembering keywords or aspects of a particular project. "Envoy provides similar storage capacity but unhindered access to its directory via search functions for finding any file, workspace, result, or communication."

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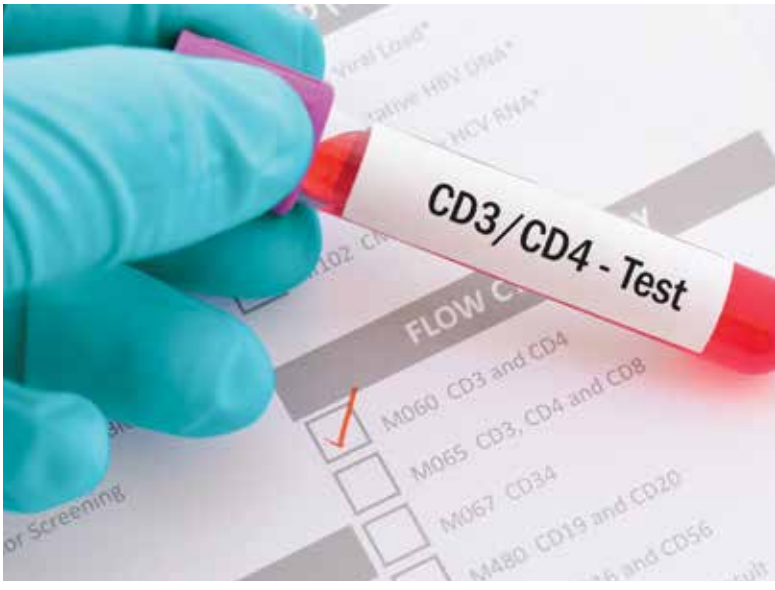


FOR ADDITIONAL RESOURCES ON FLOW CYTOMETRY, INCLUDING USEFUL ARTICLES AND A LIST OF MANUFACTURERS, VISIT WWW.LABMANAGER.COM/FLOW-CYTOMETRY

8 QUESTIONS YOU SHOULD ASK WHEN BUYING A MICROPLATE READER

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

Types of microplate reader used by survey respondents:

Absorbance	62%
Luminescence reader	38%
Microplate spectrophotometer	35%
Multi-mode reader	35%
Fluorescence polarization	22%
Time-resolved fluorescence (TRF)	16%
Time-resolved fluorescence energy transfer (TR-FRET)	11%
AlphaScreen	5%
Other	9%

Microplate reader components used by survey respondents:

Microplate washers	30%
Centrifugation	30%
Barcode scanner	23%
Microplate robotics	14%
Microplate handlers	14%
Microplate sealers	13%
High-speed robot	9%
Bulk dispensing	8%
Additional stacker cassettes	8%
Labeling and sealing	5%
Microplate stackers	5%
De-lidding stacker cassettes	3%
Other	22%

Nearly 36% of respondents are engaged in purchasing a new microplate reader. The reasons for these purchases are as follows:

- Replacement of an aging system 62%
- Addition to existing systems, increase capacity 28%
- Setting up a new lab 6%
- First time purchase 4%

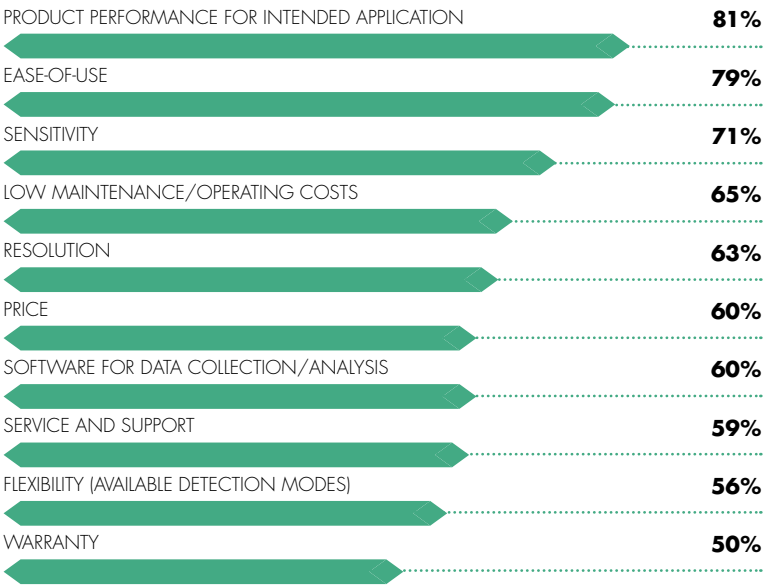
TOP 8 QUESTIONS

You Should Ask When Buying a Microplate Reader

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

TOP 10 FEATURES/FACTORS

Respondents Look for When Purchasing a Microplate Reader



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

RELY ON THE UNIQUE STABILITY OF TUNING FORK TECHNOLOGY

Travel Creates a Dilemma

If you talk about portability and analytical balances in the same breath, it seems like an oxymoron. Most balances are sensitive to being transported due to shock damage, as well as thermal changes. Most analytical balances like to be positioned carefully and left there. But what if you needed to move your balance, not just to the next room in the lab, but to the next country or halfway around the world? What do you do then?

This was the dilemma faced by a major pharmaceutical company that wanted to calibrate equipment which had been installed in several different countries. To do this, they would send their own specially trained technicians, along with their equipment (including a 4 place 0.0001 g analytical balance), but they would need to fly them by commercial airlines.

What to do? It seemed there were no options available that would keep the equipment safe from damage while traveling, and yet be available for use almost instantly after unpacking. The company eventually called in Intelligent Weighing Technology.

An Unconventional Solution

Enter the HT 224R analytical balance. This 4 place instrument made in Japan, uses a different, double ended tuning fork technology to measure changes in the vibration of the sensor, set up by load on the platter. Unlike conventional force restoration or hybrid technologies, tuning fork technology is not affected by the shock damage associated with shipping or by temperature changes. Therefore, it is ready to weigh almost instantly. What is more, the weighing chamber is built of specially treated antistatic plastic, which will not break during travel.

Intelligent Weighing Technology also built special flight cases that can be safely shipped as checked baggage. The HT 224R balances can be shipped around the world and after removal from their case, can be positioned and calibrated, within minutes.

Now, the balances can be shipped anywhere in the world, accompanying the technicians, ready to be used quickly. The savings in time and money alone have made this effort worthwhile.

Weighing Magnetic Materials

Another bonus is that as these balances do not use a magnet to function, as with magnetic force restoration balances. Therefore, they are much less sensitive to magnetic materials, an attribute that has opened up a whole new market. With the use of non-magnetic materials for the platter, the influence of magnetic samples is all but negated.

Priced Right

Finally, this quality designed and built balance is extremely well position in the value market and will meet most budgets.

COLD STORAGE

FOR REFRIGERATORS AND FREEZERS, MANY OPTIONS IMPROVE USABILITY AND RELIABILITY

by Mike May, PhD

To keep lab samples or reagents cool, a lab manager needs not only the right refrigerator or freezer but also the most useful accessories. Those range from devices that keep things in place to techniques for tracking conditions inside the cold-storage device.

As an example, David Hayes, product manager at Cole-Parmer (Vernon Hills, IL), says, "Racks and boxes are popular and go hand in hand. Many options for both are available, depending on the refrigerator/freezer type and the sample vessels—tubes, bottles, vials, and more—scientists will be using." These accessories also keep samples easily accessible and organized.

For boxes, Hayes points out a line of magnetic polycarbonate cryo-boxes. These boxes, he says, include "magnets that securely connect the base to the hinged lid, and this allows one-handed retrieval from freezer racks and ensures samples stay contained in the box." With clear lids on these polycarbonate boxes, scientists can see how samples have been arranged according to colored inserts and numbered grids.

Others agree on the value of organizational tools as accessories. "Racks and cryo boxes are the most popular," says Tom White, ultra-low-temperature freezer product manager at Thermo Fisher Scientific (Waltham, MA). "Maximizing storage is key."

With the large number of samples that go into cold storage, scientists need the most efficient ways to keep track of them and to find them when needed. These organizational accessories should also make it easy to move samples in and out of cold storage. Nonetheless, organization is only one category of accessories worth considering.

Keeping track of temperature and more

The accessories that get the most attention really depend on the application. According to Hayes, the top items of interest "are data loggers equipped with wireless technology and cloud-based monitoring." As an example, he mentions the Digi-Sense data loggers with TraceableLIVE wireless technology. "Digi-Sense data loggers with TraceableLIVE provide a simple, efficient, and reliable way to ensure your critical samples are not compromised due to parameter variations," Hayes explains. "This latest technology is ideal for monitoring critical environments in real time, anywhere, from your smart phone, tablet, or PC." For example, scientists can use this technology to securely monitor current temperatures, control alarm parameters remotely, view data-logging history, and run reports in real time. "No local software is required to use the cloud-based data interface," Hayes notes. Scientists can get mobile push notifications, e-mails, or texts for cold-storage parameters.

Some cold-storage devices come with technology to track data. For example, the Thermo Scientific TSX Series ULTs (ultra-low-temperature freezers) include a seven-inch capacitive touchscreen. This provides an "interface with lifetime product temperature and event data available for download and archiving, reducing the need for an external chart recorder accessory," White notes. In systems that lack such technology, though, many lab managers add chart recorders to freezers.

To be certain the conditions stay on point, White says, many lab managers opt for backup systems. "Our newest LN_2 and CO_2 backup systems provide new redundant temperature probes to help ensure reliability."

In keeping track, some labs also add keycard access to cold storage. This allows a lab manager to know who opened a device and when. In cases where tracking is imperative, like regulated environments, such a feature can be indispensable.

With the right set of accessories, a cold-storage device becomes more than a mess of samples tossed all over in unknown conditions. But the right accessories for a particular lab depend on the cold-storage device and how it's used.

***Mike May** is a freelance writer and editor living in Texas. You may reach him at mike@techtyper.com.*

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

CRACKING THE SEED - PREPARING SAMPLES OF CANNABIS FOR ANALYSIS USING MICROPLATE TECHNOLOGY

With the ever-increasing number ot US states that have legalised the use of cannabis (currently 26 states plus the District of Columbia), the need for accurate analysis of the plant material has dramatically increased. The primary focus is the determination of the active ingredients in the plant material. This information is crucial for taxation authorities, medical regulators and growers alike.

Cannabis plant material contains many different cannabinoids for which the human brain has evolved receptors. The two most important are the psychoactive THC (tetrahydrocannabinol) and the analgesic CBD (Cannabidiol) which has therapeutic uses. In addition, CBD (cannabidiol) and CBN (Cannabinol) may also be of relevance. For revenue and quality control, the ratio of THC to CBD is of importance and is the primary aim of the analysis.

The importance of this ratio is demonstrated by the differing states of medical marijuana and recreational cannabis; Medicinal marijuana typically has a higher CBD and lower THC, typically 21% CBD and 1% THC whereas recreational cannabis typically has higher THC and lower CBD with levels of around 2% CBD and 24% THC. Thus the ratio determines the ultimate fate of the product and may influence pricing and taxation.

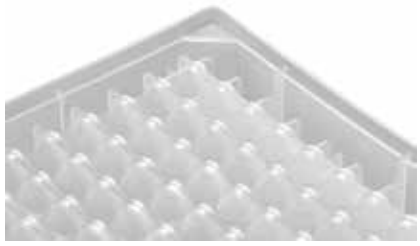
Whilst most cannabinoids are only found at trace levels, all Sativa species are very efficient at biosynthesis of eight main cannabinoids. Of these, the major cannabinoid in the cannabis plant material is THC Acid (THCA) which is thermally labile and converts to THC by decarboxylation during smoking, cooking or other heating.

High performance liquid chromatography (HPLC) can identify the acid components of THCA and CBDA before conversion to their corresponding free forms of THC and CBD and is therefore preferred for tinctures and cannabis products to be taken by mouth. A drawback of analysis by Gas Chromatography (GC) is the destruction of THCA and TBDA in the hot injector which may make the ultimate determination of the THC/TBD ratio inaccurate. For this reason, HPLC/UV or LC/MS should be the preferred methods of analysis.

The problem lies in ensuring that the tough seeds of the cannabis plant are sufficiently macerated to allow the all-important THCA and TBDA to be extracted. While grinding individual samples in a pestle and mortar is possible, it is very time consuming and does not lend itself to full recovery of the residue. In addition the oils in Cannabis tend to coat the mortar and are hard to remove. The solution is to place the plant material into a standards SLAS/ANSI format microplate. This would normally be a 2ml per well deep well storage block. By addition of small steel or nickel grinding balls to each well, the plant material can be broken up quickly and efficiently by clamping the entire plate, with a closing cap mat over the wells, on a laboratory shaking grinder, such as a Spex Geno Grinder or the Mini-BeadBeater-96 from BioSpec. The violent reciprocating shaking action causes the nickel balls to crack open the seeds and reduce the dried plant material to a fine powder.

However, it has been frequently observed that the powerful shaking action with nickel beads inside the wells is too much for some types of microplate to withstand – their bases and side walls often crack and in some cases disintegrate entirely, causing catastrophic sample loss. Independent microplate manufacturer Porvair Sciences applied its R&D process to this problem and has developed a new microplate especially for seed genomics and analysis of plant material. Keeping the standard SLAS/ANSI Footprint, the seed genomics plate has a re-inforced base with extra strong ribs to prevent the base of the wells cracking or disintegrating. This has the advantage that tough seeds and kernels such as those from Sativa, can be routinely broken open without the concern about damage to the plate and leaking wells. The homogenized material can be safely dissolved in organic solvent directly in the new plate, simplifying recovery of the key organic analytes. The plate containing the solution is spun down in a centrifuge and the supernatant is then carefully removed with a pipette and is ready for analysis by HPLC or GC.

In this way the toughened seed genomics microplate from Porvair Sciences can significantly speed up the cannabis analysis process. A more detailed application note is available on request from the company at their website: www.Porvair-sciences.com



porvair sciences www.Porvair-sciences.com

GLASSWARE WASHERS

LABORATORY GLASSWARE WASHERS OFFER NUMEROUS ADVANTAGES WHEN USED RIGHT

by Erica Tennenhouse, PhD

Laboratory glassware can be washed by hand or machine. While machine-washing offers numerous benefits, it is only effective when done properly. Nonetheless, even as manual cleaning of glassware becomes less and less common in the lab, there are certain situations in which it is still useful.

According to David Wasescha, a product manager at Labconco (Kansas City, MO), one of the major benefits of machine-washing is reproducibility. "In an ideal situation, all glassware would be washed by machine to eliminate variability from the washing process. He adds that an automated washing process allows laboratories to easily implement standard operating procedures that can be followed by any given user.

Machine-washing is often a more effective means of cleaning than handwashing. As Lisa Choplo, associate project manager at Miele Professional (Princeton, NJ), explains, with a lab washer, "one can use hotter water and stronger cleaning agents to give a much more intensive wash." In an application note, Choplo cites reports that have demonstrated laboratory glassware washers are even effective for residues that scientists sometimes assume require handwashing with solvents, alcohols, or acids.

The lack of human contact with potentially harmful substances is another advantage of machine-washing, according to Jeff Phillips, senior director of science and marketing at Alconox, Inc. (White Plains, NY). "In a laboratory, the less contact with things that are unpleasant [e.g., mutagens], the better," he says.

> "Even as manual cleaning of glassware becomes less and less common in the lab, there are certain situations in which it is still useful."

Importantly, automating the washing of glassware streamlines the process and frees up technicians to perform other tasks, says Choplo, which serves to increase overall laboratory productivity. She points out that although a laboratory glassware washer is a substantial capital expenditure, the labor reduction afforded by the automation means most laboratories will quickly get a return on their investment.

Still, there are times when washing laboratory glassware by hand might be desirable. For example, certain types of glassware are more susceptible to being bleached or dissolved; these issues are less likely to arise with handwashing, explains Phillips. He notes one advantage of manual washing is that more mechanisms of action may be used to remove residuals, such as emulsification. Larger glassware pieces, which might not fit in a typical under-counter laboratory glassware washer, may also require handwashing, Wasescha adds.

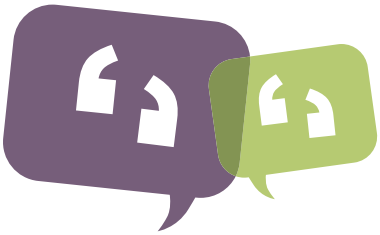
While there are many advantages to washing laboratory glassware by machine, steps must still be taken to ensure an effective wash. Phillips outlines some best practices for machine-washing your laboratory glassware:

- *Know your residues.* Certain glassware residues are soluble in a basic detergent, while others require a more acidic detergent. Combining a basic wash with an acid rinse can provide the best of both worlds.
- *Orient glassware in the washer at an angle.* If a graduated cylinder is placed vertically, water can pool on the top and dry, leaving residues behind. Placing that cylinder at a slight angle will ensure the water comes off.
- *Make sure glassware pieces are not touching, and do not overload the washer.* Sufficiently spacing out glassware enables water and detergent to reach each piece.
- *Get the temperature right.* For sensitive glassware, such as pieces made out of soda-lime glass, the rate at which glassware dissolves increases with increasing temperature.
- *Provide sufficient rinse times.* If rinse times are too short, residuals may not get completely washed away and re-deposition can occur.

"While there are many advantages to washing laboratory glassware by machine, steps must still be taken to ensure an effective wash."

***Erica Tennenhouse**, scientific content editor for* Lab Manager, *can be reached at etennenhouse@labmanager.com or by phone at 647-500-7039.*

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



FACTORS TO CONSIDER WHEN PURCHASING A FREEZE DRYER

Freeze dryers use a combination of refrigeration and vacuum pressure to meet the lyophilization needs of a variety of research and manufacturing environments. They are commonly used for culture storage, food and pharmaceutical processing, and material stabilization. With a wide variety of options available, there is much to consider when purchasing a new freeze dryer.

Types of freeze dryers used by survey respondents:

Manifold Benchtop	34%
Shelf Benchtop	20%
Dry Ice Benchtop	14%
Manifold Console	14%
Shelf Console	11%
Non-Sterile Production	9%
Sterile Production	5%
Other	16%

Freeze dryer applications as reported by survey respondents:

Material stabilization and/or storage	49%
Pharmaceuticals	31%
Food processing	18%
Starters and cultures	16%
Nutraceuticals	7%
Other	16%

Nearly 42% of respondents are engaged in purchasing a new freeze dryer. The reasons for these purchases are as follows:

Replacement of an aging system	49%
Addition to existing systems	36%
Setting up a new lab	9%
First time purchase	6%

TOP 5 QUESTIONS

You Should Ask When Buying a Freeze Dryer

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

TOP 10 FEATURES/FACTORS

Respondents Look for When Purchasing a Freeze Dryer

EASE OF USE	81%
PRODUCT PERFORMANCE FOR INTENDED APPLICATION	74%
RELIABILITY UNDER HIGH PERFORMANCE	67%
LOW MAINTENANCE/OPERATING COSTS	67%
PRICE	66%
SERVICE AND SUPPORT	63%
ACCURATE VACUUM CONTROL	58%
WARRANTY	58%
EASE OF INSTALLATION	52%
VACUUM OR AIR FILLED STOPPERING	49%

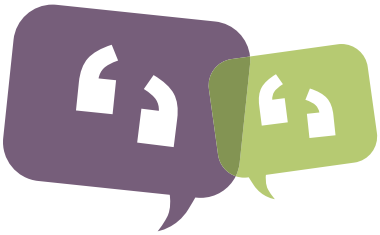
For more information on freeze dryers, including useful articles and a list of manufacturers, visit www.labmanager.com/freeze-dryers

PROTECTING PEOPLE SINCE 1925

Work late, again.

Think of our FreeZone® with end point detection as the time you don't have. Its smart design automatically notifies you when lyophilization is complete. No need to wait around the lab. New freedom to do other very important things. **labconco.com**

LABCONCO®



THE 10 FACTORS READERS LOOK FOR IN THEIR LAB OVENS

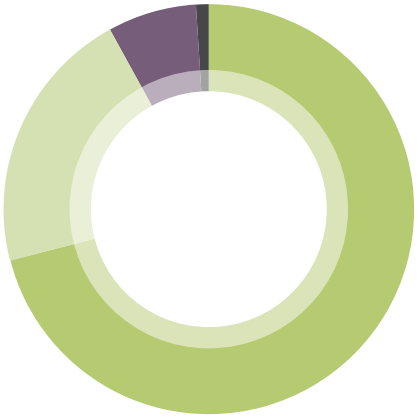
Laboratory ovens are an indispensable instrument in most laboratories as they are used across various scientific disciplines. Lab ovens are most commonly less than 12 cu.ft. in volume, although a great variety of sizes are available in benchtop, stackable, and floor-standing models.

Types of lab ovens used by survey respondents:	
General Purpose Oven	67%
Mechanical Convection Oven	28%
Microwave Oven	25%
Gravity Convection Oven	24%
Vacuum Oven	17%
Safety Oven	6%
Other	5%

Lab oven applications as reported by survey respondents:	
Heating and drying	80%
Evaporating	42%
Temperature-linked experiments	42%
Baking	16%
Sterilization	16%
De-gassing samples	5%
Annealing	5%
Die-bond curing	3%
Distilling	1%
Other	11%

Nearly 23% of respondents are engaged in purchasing a new lab oven. The reasons for these purchases are as follows:

Replacement of an aging system	71%
Addition to existing systems	21%
Setting up a new lab	7%
First time purchase	1%



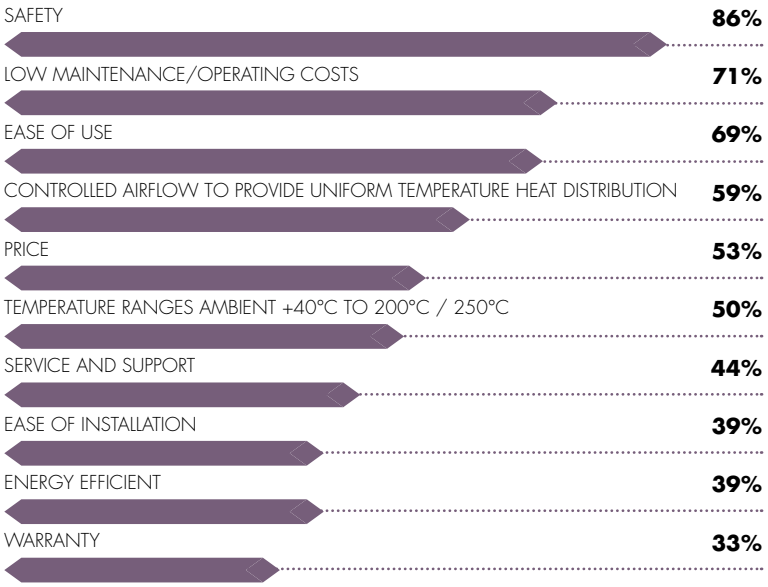
TOP 5 QUESTIONS

You Should Ask When Buying a Lab Oven

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

TOP 10 FEATURES/FACTORS

Respondents Look for When Purchasing a Lab Oven



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

PolyScience

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

POLYSCIENCE TEMPERATURE CONTROL SOLUTIONS

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

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

90 Circulator models including:

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

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

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

PolyScience also manufactures a wide range of specialty products including:

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

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

For more information, visit: www.polyscience.com

PolyScience®
Temperature Control Solutions www.polyscience.com

TECHNOLOGYNEWS

PITTCON CONFERENCE & EXPO 2018

THE EQUIPMENT, INSTRUMENTS, AND SYSTEMS INTRODUCED TO THE LABORATORY MARKET AT **PITTCON 2018**

ANALYTICAL

Methanizer

Jetanizer™

BOOTH 2166

- Designed for drastically simpler analysis of CO and CO_2
- Easy to use and requires no extra plumbing, heaters, gases, or toxic nickel catalysts
- Virtually eliminates most methanizers and calibrations
- Installs in the user's FID like a normal jet to catalytically convert CO and CO_2 to methane for ppb-to-100% concentration detection

Activated Research Company www.activatedresearch.com

3D-Printed Microreactor

Polyarc®

BOOTH 2166

- Enhances new and existing GC/FIDs by converting all organic compounds to methane molecules for universal carbon detection
- By seamlessly integrating this device into existing routines, scientists improve data quality, allow for more economical use of resources, reduce error producing steps, and increase throughput
- This proprietary technology is being used to analyze specialty chemicals, paints & coatings, flavors & fragrances, pharmaceuticals, biofuels, petroleum, and more

Activated Research Company www.activatedresearch.com

TLC-MS Interface

TLC-MS Interface 2

BOOTH 2013

- Allows for rapid and contamination-free elution of TLC/HPTLC zones with online transfer to a mass spectrometer
- Can be installed plug & play with any LC-MS system without adjustments or mass spectrometer modifications
- The chromatogram zones are eluted from the HPTLC plate with a suitable solvent with the flow speed appropriate for the LC-MS system

CAMAG www.camag.com

Hand-Held, Portable Gas Chromatograph

FROG-5000™

BOOTH 2256

- The lightest, most compact gas chromatograph available on the market
- Operates on batteries and uses ambient air for the carrier gas, enabling easy and rapid analysis of volatile organic compounds such as BTEX, TCE, PCE, naphthalene, vinyl chloride, and many other VOCs in water, soil, and air
- Identifies each individual component and provides a concentration of each component down to one part per billion

Defiant Technologies http://defiant-tech.com

Gas Chromatograph

CALIDUS™

BOOTH 2137

- Is an ultrafast, ultra-user-friendly, highly durable, practical, reliable, and economical analyzer
- The patented CALIDUS column module enables analytical cycles 10 to 50 times faster than traditional GCs with superior reproducibility
- Also offers a patented, modular design that increases capability and makes maintenance fast, easy, and economical
- Column and detector modules can be readily changed out for specific applications and for replacement

Falcon Analytical www.falconfast.net

FTIR Fuel Analyzer

MINISCAN IR Vision

BOOTH 1837

- Configured to measure more than 100 different fuel components, gasoline, and jet and diesel fuel parameters
- Developed specifically for fuel blending, quality inspection, specification compliance at the point of sale
- Pre-loaded at the factory with a database of several thousand fuels collected worldwide and measured in accordance with ASTM and EN fuel specifications
- Offers cutting-edge performance and enhanced measurement speed

Grabner Instruments www.grabner-instruments.com

Detectors for Scanning Electron Microscopes

CLUE

BOOTH 2819

- These four new detectors are designed for scanning electron microscopes (SEM) and dual SEM/focused ion beam (FIB) microscopes
- Interface with any SEM, are fully automated, modular for easy upgrade, and offer the widest spectral range available (UV-Vis-IR)
- Designed for use in materials science, mineralogy, geology, life sciences, and forensics applications
- Include the I-CLUE, F-CLUE, H-CLUE, and R-CLUE models

HORIBA Scientific www.horiba.com/scientific

Aerosol Inlet for PTR-TOFMS

CHARON

BOOTH 2709

- The CHemical Analysis of aeRosol ON-line (CHARON) particle inlet, coupled to IONICON PTR-TOFMS instruments, quantitatively analyzes organic sub-µm particulate matter as well as particulate ammonium and nitrate at single digit ng/m³ mass concentration levels in real-time
- In combination with the IONICON PTR-MS technology, detects the most abundant range of atmospheric organic carbon, compared to other analyzers or inlet systems on the market

IONICON www.ionicon.com

Carbon/Nitrogen Analyzer

928 Series
BOOTH 2753

- Maintains the core capabilities and performance of previous generations of LECO macro combustion instruments while possessing key improvements in throughput, uptime, and reliability
- Operates at a low cost-per-analysis and allows users to easily handle the most demanding sample applications
- Features a custom interface designed specifically for touchscreen operation with LECO's exclusive Cornerstone® brand software

LECO www.leco.com

3.5µm PAH HPLC/UHPLC Column

Kinetex®
BOOTH 3053

- Combines a unique selectivity for PAHs with Phenomenex's proprietary Core-Shell Technology to deliver significant performance gains over traditional fully porous media
- Features a proprietary polymerically bonded C18 stationary phase that ensures resolution between critical PAHs
- Combined with a core-shell particle morphology, the Kinetex PAH delivers faster analysis times, better efficiency, and greater sensitivity compared to current fully porous solutions

Phenomenex www.phenomenex.com/PAH

GC Columns

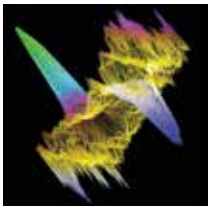
Zebron™ ZB-PAH
BOOTH 3053

- Deliver optimal performance when analyzing EU/EFSA and EPA-regulated polycyclic aromatic hydrocarbons
- Individually tested with an application-specific PAH QC test probe mixture to ensure excellent reproducibility
- Provide baseline resolution of critical PAH isomers, such as benzo[b,j,k]fluoranthene
- Offer exceptional thermal stability and low column bleed at elevated temperatures
- Consistent column inertness promotes accurate separation for isomer pairs

Phenomenex www.phenomenex.com/PAH

Fast Scan Cyclic Voltammetry System

BOOTH 3409



- Designed to simplify the detection and quantification of catecholamines and other electroactive analytes
- FSCV software offers preprogrammed and custom waveforms associated with the commonly studied analytes: dopamine, norepinephrine, serotonin, and adenosine
- Custom waveforms can be easily uploaded and stored

Pinnacle Technology www.pinnaclet.com

Thermal Desorption Systems

TD-30 Series
BOOTH 2634, 2734

- Available for use with Shimadzu's new Nexis GC-2030 gas chromatograph as well as its entire GC-MS product line
- Feature large sample capacities, an efficient workflow, and a robust design
- Ideally suited for the analysis of trace components in such industries as environmental, chemical, food, and automotive
- The series consists of two models, the TD-30 and TD-30R

Shimadzu www.ssi.shimadzu.com

Metals Analyzer

ChemLite™ Plus Metals Analyzer 4240
BOOTH 2603

- A high-performance tool for rugged use in the field
- Developed with laser induced breakdown spectroscopy or LIBS
- Identifies aluminum, magnesium, titanium, iron, copper, and nickel alloys in as little as 1 second
- With no radiation and a Class 1M eye-safe laser, the ChemLite is regulation-free
- Unlike XRF guns, there are no licensing or OSHA worries with the ChemLite

TSI www.tsi.com

BASIC LAB

Ductless Fume Hoods

Purair® Advanced Series
BOOTH 1900-1902

- Designed to protect the user and the environment from hazardous vapors generated on the work surface
- Features Air Science® Multiplex™ Filtration Technology that creates a safe work environment over the widest range of applications in the industry
- Improvements include a new microprocessor controller, new ECM blower motors, more efficient LED work surface lighting, and a broader selection of peripheral products

Air Science USA
www.airscience.com/purair-advanced-ductless-fume-hoods

Pipette Controller

Omega Zen™
BOOTH 2054

- Provides users with over nine hours of continuous and accurate use
- This portable, lightweight, and ergonomic pipette controller can be used with plastic or glass pipettes from 1 to 100 mL
- The controller's balanced design and contoured buttons help prevent hand fatigue even after hours of use
- Includes an auto-charging bench stand that provides quick battery charging

Argos Technologies www.argos-tech.com

Mass Flow Controllers, Meters, & Manifolds

BOOTH 2433

- Provide excellent reproducibility: MFM repeatability +/- 0.01% F.S. & MFC repeatability +/- 0.015% F.S., combined with long-term stability to eliminate the need to recalibrate
- Feature a quick reaction time: MFM 4ms response time and less than 150ms to a stable state for real-time control of gas flows
- Offer an unmatched dynamic range: Turndown ratio of better than 1000:1 to achieve instrument flexibility and reduce controller variants

Axetris www.axetris.com

Evaporation System

TurboVap® LV

BOOTH 3112

- Modern design features many new enhancements, including a well-lit glass tank for much greater visibility, removable/replaceable nozzles on the lid, on-the-fly nozzle adjustment, and easily exchangeable manifolds to extend functionality
- Also offers programmable evaporation flow gradients, an easy access drain port, and user-friendly touchscreen interface
- Can be vented from the bench or placed in a fume hood

Biotage www.biotage.com

Advanced Networking Drives

Masterflex®

BOOTH 2053

- Designed for Masterflex® peristaltic pumps, from Cole-Parmer
- Provide options for popular networking protocols without the need to install gateways or adapters
- Ideal for industrial networking, bioprocessing, plant automation, or water/wastewater applications
- New drive options include either native Ethernet/IP or Profibus bi-directional communication with Bluetooth Low Energy (BLE) connectivity and a downloadable iOS-based mobile app to permit local pump monitoring and control

Cole-Parmer www.coleparmer.com/masterflex-comms

Wireless Technology for Data Loggers

TraceableLIVE®

BOOTH 2053

- Digi-Sense data loggers are now equipped with TraceableLIVE wireless technology
- Ideal for those who want to monitor critical environments and get alerts wherever they go
- The included NIST-traceable calibration at a noncalibrated price provides value, accuracy, and peace-of-mind
- Securely connects to data via Wi-Fi on a smartphone, tablet, or PC

Cole-Parmer www.coleparmer.com

Water Purification System

PURELAB® Chorus

BOOTH 1957

- This modular system allows users to configure a customized solution based on their application, budget, and configuration of their lab
- Three systems are available to meet all quality requirements for the most critical applications: the Chorus 1, Chorus 2, and Chorus 3
- Recently released are the ELGA PURELAB® Chorus 1 Complete, ELGA PURELAB® Chorus 2+ RO/DI, and ELGA PURELAB® Chorus 2+ RO/EDI

ELGA elgalabwater.com

Water Purification Units

PURELAB® Flex

BOOTH 1957

- These reliable water purification units are constructed from the highest quality components to ensure optimal purity
- A rapid and easy sanitization program contributes to an uninterrupted workflow
- Feature real-time TOC monitoring for critical applications, optimal design for the lowest running costs, and ultrapure water filtration through precision volume dispensing

ELGA elgalabwater.com

Metals Digestion Systems

HotBlock® 200 and 300

BOOTH 2052

- Recent redesign allows customers to perform metals digestion at higher temperatures—up to a maximum 200°C (392°F) for HotBlock 200 and 300°C (572°F) for HotBlock 300
- Ideal for use in laboratories that perform environmental testing
- Easy-to-use external controllers feature automatic shut-off, alarms, and the ability to save profiles with ramp and soak settings

Environmental Express EnvExp.com

Metals Digestion Cup

Ultimate Clean™ Cup

BOOTH 2052

- The cleanest 50-mL metals digestion cup with the most robust certification on the market today
- Designed specifically for trace metals analysis
- Manufactured from clarified homopolymer polypropylene, which assures higher working temperatures and greater chemical resistance than commonly used co-polymer polypropylene
- Specially designed packaging ensures all Ultimate Clean Cups arrive ready to use in any clean environment setting

Environmental Express EnvExp.com

Multi-Component Gas Blender

Model 5000

BOOTH 3352

- See a prototype of the new system at Pittcon 2018
- Uses thermal Mass Flow Controller (MFC) technology
- Features an accuracy of +/- 1% set point and repeatability of +/- .05% of full scale
- Can mix and dilute up to 8 gases
- Will come standard with an 8" color touchscreen and offer enhanced communications

Environics www.environics.com

Hydrogen Generators

MARS

BOOTH 1760

- Use PEM technology (proton exchange membrane) which allows the production of compressed, extremely pure hydrogen without the need for external purification or compression systems
- Fed by distilled water and electric current, no caustic solutions are used
- Hydrogen produced by MARS generators is ideal for every laboratory application
- Don't require maintenance and are safe and reliable

ErreDue www.erreduegas.com

Laboratory & Biopharma Equipment

BOOTH 2422

- Esco is a world leading manufacturer of laboratory and biopharma equipment and IVF medical devices, offering tailored solutions that fit the needs of laboratories
- Innovative products support cutting-edge research, helping biopharmaceutical companies make their drugs safer and more cost-effective, enabling lower cost manufacturing of vaccines
- Three divisions support the life sciences, medical, and healthcare industries

Esco Group www.escoglobal.com

Valveless 400 µl Dispensing Pump

STF1-9

BOOTH 2300

- Ideal for medical, analytical, and biotech instrumentation
- Has the identical compact design dimensions as the STH & STF OEM pump lines, but expands dispense and metering capabilities of previous STH designs by 100% while maintaining 0.5% precision
- Available in nine drive configurations ranging from 200 µl through 400 µl in 50 µl increments

Fluid Metering www.FluidMetering.com

Intelligent Programmable Pump

BOOTH 2300

- Combines FMI's precision valveless STH Stepper Pump with integral programmable driver in a compact design ideal for integration with OEM instrumentation
- Driver provides precision servo control of the STH pumps stepper motor for resonance-free, quiet operation
- Features 5 programmable inputs and 2 outputs, making it compatible with multiple programming platforms

Fluid Metering www.FluidMetering.com

Particle Analyzer

BOOTH 2409

- Can determine particle sizes at high flow rates (up to 0,1 m/s), pulsating if required
- Device can be used for on-site in-line process and quality control, for instance, in the efficient preparation and loading of versatile carrier systems
- Features a cost effective design, using only parts that are used in consumer electronics

Fraunhofer www.imm.fraunhofer.de

Planetary Mill

PULVERISETTE 5 *premium line*

BOOTH 2862

- Provides easy and safe operation with the grinding bowls automatically clamped by the mill
- Features extra strong 2.2 kW drive power and extremely high centrifugal acceleration up to 64 g and up to 800 rpm (rotational speed of the bowl 1600 rpm)
- Accommodates sample quantities up to 450 ml, max. feed size up to 10 mm

FRITSCH www.fritsch.de

Visible Spectrophotometer

iris

BOOTH 3137

- Measures all wavelengths of visible light, not just pre-specified wavelengths
- Includes a replaceable energy-efficient tungsten-halogen lamp, a beam splitter with reference detector, and a combined concave grating
- No warm-up time is needed as the intensity of the light is measured and variations corrected, and zero warm-up time results in a longer lamp life

Hanna Instruments www.hannainst.com

Fume Hoods

UniFlow AireStream

BOOTH 3253

- Constructed entirely of chemical resistant, flame retardant, non-metallic composite resin materials
- Feature an exclusive "Unitized" construction that does not require screws, bolts, rivets, or metallic hardware for assembly
- The fume chamber is molded one piece seamless with all corners coved for easy cleaning and light reflectivity
- UL 1805 certified and offered in 48", 60", 72," and 96" widths

HEMCO www.hemcocorp.com/sefh.html

Dosing Pump Graphical User Interface

mzr®-Touch Control

BOOTH 1236

- Provides user-friendly control of micro annular gear pumps (mzr-pumps) via a multilingual graphical user interface
- Can be used for most mzr-pump sizes and series
- Controls one pump each and is easy and intuitive to handle
- Dosage volumes from 0.25 µl and flow rate ranges of 1 µl/min to 288 ml/min can be indicated by the user

HNP Mikrosysteme www.hnp-mikrosysteme.de

Spectrometer Accessories

BOOTH 2819

- HORIBA is now offering an automatic sipper accessory and a 4-sample changer unit for its Aqualog® A-TEEM spectrometer
- The sipper handles sampling from a single source, in addition to rinsing solutions, detergent, and reverse-flow drainage
- Each sample changer unit is compatible with overflow and filtration devices, for up to 4 independent water treatment plant sources

HORIBA Scientific www.horiba.com/scientific

Concentrating Pipette

CP Select

- Allows users to accomplish pathogen concentration and inhibitor removal from liquid samples (up to 5 liters) faster and easier than ever before
- Users can choose from 6 high-flow filtered pipette tips to concentrate bacteria, parasites, molds, fungal spores, whole cells, and viruses
- Recovered pathogens are delivered in seconds with a press of a button ready for analysis using the scientist's method of choice

InnovaPrep www.innovaprep.com

Laboratory Balances

Precisa LS Series

BOOTH 3009

- Provide exemplary temperature compensation and build quality, giving scientists top quality results
- Offer capacities up to 320 g x 0.0001, 1,220 g x 0.001, 6,200 g x 0.01, and 10,200 g x 0.1
- All balances come with internal calibration for consistent results
- Statistical monitoring and recording of results is simple via the RS232 and USB interfaces

Intelligent Weighing Technology www.intelligentwt.com

Helium Leak Detectors

PHOENIX 4

BOOTH 2229

- Equally suited to the demands of research and development as for those of industrial
- Features excellent operating comfort, response times, helium sensitivity, and reliability
- Available in three classes, the PHOENIX Vario, PHOENIX Quadro, and PHOENIX Magno, which are designed for various user applications with their different pumping speed configurations
- Can be operated comfortably via a color touch display

Leybold www.leybold.com

High Count Fiber Bundles

BOOTH 3153

- Molex-Polymicro combines fiber manufacturing, assembly expertise, and design support for high count fiber bundles
- Fused fiber bundles with ~95% packing fraction and low loss characteristics make this assembly ideal for use in high temperature applications, and allow for an epoxy-free end face
- Designed for superior power throughput in diverse operating conditions

Molex-Polymicro www.molex.com/polymicro

Microscopes

Panthera Series

BOOTH 2326

- Represent a new generation of smart microscopes, designed to provide maximum convenience and streamline workflow
- Boast never-before-seen, smart features, such as ImageOnDevice, which instantly produces digital images without need for a computer
- Whether you want to use a tablet, or an HD monitor, Panthera microscopes with ImageOnDevice will be able to easily connect via Wi-Fi or HDMI to display your sample

Motic http://motic.com

High Efficiency Fume Hood

NovaGuard™

BOOTH 3200

- Designed to deliver competitive containment performance and energy efficiency
- Has passed standard and modified ASHRAE procedures at face velocities as low as 50 fpm
- Provides the operator with a secure and reliable operation environment while providing considerable capital and operating cost savings
- Standard features include: Full view sash for unobstructed view, self-lowering sash for enhanced operator safety and energy efficiency, and much more

Mott Manufacturing www.mott.ca

Total Organic Carbon Analyzer

1080
BOOTH 1439

- Allows users to test even the most difficult samples, including those high in salts, accurately and easily without the need for expensive options or add-on kits
- This combustion TOC analyzer is easy to use and maintain and provides the lowest total operating cost of any combustion TOC available
- Ideal for drinking water, wastewater, industrial effluent, petrochemical, environmental lab, and food and beverage applications

OI Analytical (Xylem) www.oico.com/1080TOC

Dispensing Station

FORTUNA® OPTIMAT® 3
BOOTH 2805

- Features a new design and large touchscreen
- New software offers the choice of several languages
- Allows users to accurately and reliably carry out serial dispensing in volume ranges from 0.05 - 300 ml
- Even aggressive liquids, such as strong acids, can be easily handled with the dosing pumps that are made out of high quality materials such as borosilicate glass and PTFE

Poulten & Graf www.poulten-graf.de

Specialty Gases & Gas-Related Equipment

BOOTH 3024

- PurityPlus is a nationwide partnership of select independent specialty gas companies, unified under one brand that guarantees certified quality product and unparalleled local service
- A full line of specialty gases and specialty gas related equipment such as high purity gas regulators, gas manifolds, gas purifiers and filters, etc., is offered
- Have over 150 producers and distributors and over 600 locations across North America

PurityPlus www.purityplusgases.com

Balance

TE Series
BOOTH 3552

- This NTEP approved balance creates an effortless user experience complete with a wide variety of functions, glass breeze break, and configurable user keys
- Equipped with the unique mono-metal tuning fork sensor, this balance brings rapid response time and stability to many settings
- Patented tuning fork technology provides consistency with an extremely small margin of error
- Features advanced programming flexibility

Rice Lake Weighing Systems www.ricelake.com

Titration Electrode

OptiLine 6
BOOTH 1439

- Automates photometric titrations in one compact, yet versatile instrument
- While connected to SI Analytics' TitroLine titrators (models 7000, 7750, and 7800), the OptiLine 6 can conveniently be used with any titrator or pH meter, thanks to its additional analog BNC/DIN connector
- Features a 100% solvent-resistant titanium shaft, making it a reliable and easy-to-clean instrument for multiple applications

SI Analytics (Xylem) www.si-analytics.com/no_cache/en/home.html

Autoclaves

BOOTH 2307

- Can be used in all laboratory applications, even for sophisticated sterilization processes: sterilizing liquids (such as culture media, nutrient media), solid bodies (such as instruments, pipettes, glassware), waste (sterilization of liquid waste in bottles or solid waste in waste bags before destruction), and biologically hazardous materials in safety laboratories

- Utilize chamber volume from 23 to 1580 liters
- Over 70 types of steam sterilizers offered

Systec www.systec-lab.com

Benchtop Instrument

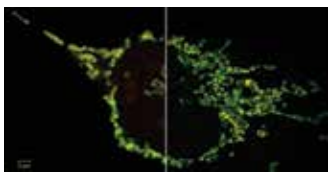
EcoSense pH1000A
BOOTH 1439

- An economical, accurate, and easy-to-use solution for basic, routine pH or mV measurements in the lab
- Includes a large, high contrast LCD display that will display pH/mV and temperature simultaneously
- Calibration is simple with automatic buffer recognition and the calibration is stored in the memory
- Instrument's auto-stable feature will lock in stable measurements for improved repeatability

YSI (Xylem) www.ysi.com/pH1000A

2D Superresolution Mode for Microscopes

BOOTH 3029

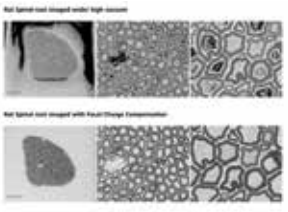


- A new imaging mode for the ZEISS LSM 8 family with Airyscan
- Uses this additional information from the LSM 8's 32-channel GaAsP array detector to create an optical section of 0.2 Airy units (AU) and resolves structures down to 120 nanometer laterally in a single image
- Allows scientists to perform gentle live cell imaging experiments

ZEISS www.zeiss.com

Focal Charge Compensation Module

BOOTH 3029



- For ZEISS field emission scanning electron microscopes
- Created in collaboration with the National Center for Microscopy and Imaging Research at the University of California San Diego
- Provides high resolution 3D block face imaging for biological samples with fast acquisition rates and minimal sample damage

ZEISS www.zeiss.com

CHEMICALS, KITS, & REAGENTS

DNA Kits

Chromatrap®

BOOTH 1932 (PORVAIR)

- These affordable, easy-to-use kits are suited for routine molecular biology applications
- Free from salts, contaminants, and inhibitors, providing scientists with the high recovery of top quality DNA perfect for downstream applications
- New DNA and Gel Purification kits introduced by Chromatrap are designed to be quick and easy to use
- Range also includes the DNA Extraction kit and DNA Purify & Concentrate kit

ChromaTrap www.chromatrap.com

Residual Solvents Standards

BOOTH 2018

- These multicomponent Class 3 residual solvents standards can simplify standard preparation significantly and reduce variability
- The only premixed Class 3 reference standards available
- Standards' verified composition and stability bring confidence and consistency to residual solvents analysis
- Pair Restek's new Class 3 standards with their full line of USP <467> standards, GC columns, accessories, and sample vials for a complete residual solvent testing solution

Restek www.restek.com

Reagents for DNA Purification

MagMAX DNA Multi-Sample Ultra 2.0

BOOTH 2353

- Provide genetic testing companies, labs, and service providers with fast, hassle-free, and high-throughput DNA extraction from blood, saliva, buffy coat, and buccal swabs
- Can purify DNA from 96 samples in 45 minutes on Thermo Scientific KingFisher instruments using a simplified protocol for either small- or large-volume sample input
- Feature enhanced speed and a hassle-free process

Thermo Fisher Scientific www.thermofisher.com/magmaxultra

INFORMATICS

Informatics Platform

Version 2017.1 of ACD/Spectrus

BOOTH 3541

- New updates to the software improve customers' ability to collect and explore chemical, structural, and analytical data in meaningful ways
- Instrument format support across analytical techniques—a foundation of the platform—has been expanded and enhanced
- MetaSense updates bring new metabolic pathways into the prediction algorithm and provide easier navigation of data
- Now includes the impurity data management solution, Luminata

ACD/Labs www.acdlabs.com/home

AFM Analysis Software

Tosca™

BOOTH 2602 (ANTON PAAR)

- Designed for industrial Tosca™ 400 AFM users
- Based on Digital Surf's Mountains® surface analysis technology
- Provides real-time 3D multi-channel imaging with overlays
- Offers state-of-the-art geometry and morphology analysis at the nanoscale
- Includes powerful automation features for demanding applications
- Features co-localization of surface data from other analyses for correlative analysis
- Available in 11 different languages

Anton Paar www.anton-paar.com
Digital Surf www.digitalsurf.com

Spectral Libraries & Software

KnowItAll®

BOOTH 2553

- Bio-Rad will feature the most recent additions to their KnowItAll® Spectroscopy Databases & Software – Infrared (IR, FT-IR, ATR), Raman, NMR, Mass Spec (MS), UV-Vis at Pittcon 2018
- Unique combination of spectral software and over 2.3 million spectra—the world's largest collection—provide the best tools for fast, accurate spectral analysis
- Bio-Rad will also feature their new SpectraBase™ cloud-based spectral repository

Bio-Rad www.knowitall.com

Chromatography Software

Clarity

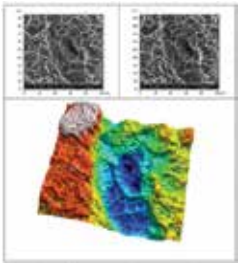
BOOTH 2432

- Enables users to control 600+ different instruments (including Agilent, Hitachi, Shimadzu, etc.) from one environment
- Supports six languages—English, Chinese, Russian, Spanish, French, and German
- Provides easy operation, unmatched free user support including free software updates, optional extensions that support a variety of applications (PDA, MS, GPC, NGA, DHA, SST, etc.), and competitive pricing

DataApex www.dataapex.com

Software for SEM Image Analysis

TopoMAPS
BOOTH 2353 (THERMO)



- Designed for SEM image enhancement, 3D reconstruction, and metrology
- Now available on Thermo Scientific SEM and DualBeam systems
- Powered by Digital Surf's Mountains® software platform
- Makes SEM image colorization easy
- Easy-to-use interface includes: user-friendly ribbon with intuitive icon-based tools, quick report generation, and automatic analysis routines, ideal for speeding up production

Thermo Fisher Scientific www.thermofisher.com
Digital Surf www.digitalsurf.com

LAB AUTOMATION

Sample Prep Automation Accessory

AutoBlock® Fill
BOOTH 2052

- Safely and accurately automates the most dangerous step of sample prep for metals digestion—the addition of acids and reagents
- Fits any size HotBlock® digestion system to provide automation at an affordable price
- Ideal for any laboratory performing its own unique metals digestion method
- Dispenses from up to five reagent bottles at a time

Environmental Express EnvExp.com

Modular Laboratory Robot Platform

MiniTasker®
BOOTH 1862

- This general purpose modular lab robot is designed for such everyday tasks as analytical weighing (4 or 5 place), sample ID (1D or 2D barcodes), sorting, dilutions, internal standard addition, standard prep, un-capping & re-capping, transfers, and aliquoting
- Features a large sample capacity (max. 20 microplate racks or custom equivalent)
- Includes easy-to-use interface with 21CFR11 compliance options

Sirius Automation www.siriusautomation.com

Tube & Rack Barcode Readers

TubeScan2D® & FlashScan2D®
BOOTH 1862

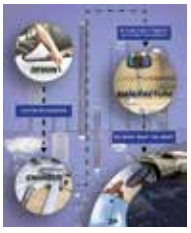
- Both fit into a USB port; the TubeScan® installs seamlessly and the FlashScan® integrates into LIMS easily
- The TubeScan incorporates a patented 'anti duplicate' processing system, thereby avoiding mistakes, and registers into the data field in under a second
- The FlashScan is a whole rack 2D reader incorporating a high speed camera and can accommodate standard SBS microplate arrays

Sirius Automation www.siriusautomation.com

SERVICES

Precision Glass Components Design Services

BOOTH 1332



- Richland offers on-site engineering teams dedicated to providing solutions to customer design challenges
- Provide specialized custom design, development, and sample qualification lots
- Made-to-order components to customer approved specifications for communications, defense, instrumentation, and medical applications
- Offer industrial, medical, and diagnostic glass components for lasers, flow restrictors, pumps, diagnostic devices, and drug delivery systems
- Richland is an ISO 9001-2008 certified, ITAR registered manufacturer

Richland http://richlandglass.com

SUPPLIES & CONSUMABLES

Polycarbonate Cryostorage Boxes

Magne-Box™
BOOTH 2054

- The first cryostorage boxes of their kind to offer a magnetic lid closure
- Feature magnets that securely connect the base to the hinged lid
- Magnetic lid closure allows for easy one- handed retrieval from freezer racks and ensures that samples stay safe
- Available in 25-, 81-, and 100-place configurations and accommodates 2.0 mL cryovials

Argos Technologies www.argos-tech.com

Solenoid-Operated PTFE Media Isolation & Pinch Valves

BOOTH 2205

- Ideal for use with sensitive or corrosive media
- Provide an excellent alternative to traditional mechanical valves when media contamination is a concern, as they interact with tubing or PTFE, and never touch the material being dispensed
- Feature low power consumption, superior design, zero dead volume, high cycle life, fast response, and more

Clippard www.clippard.com

Consumables & Accessories for Elemental Analyzers

BOOTH 3204

- Consumables and accessories offered for all brands of elemental analyzers (CHNOS)
- From sample encapsulation, quartz/SS furnace tubes, reagents, and standards to wear parts, EA Consumables offers high quality products, significant cost savings, and very fast delivery

EA Consumables www.EAConsumables.com

AUTOMATED PHOTOMETRIC TITRATIONS

Problem: Titration is a versatile analytical technique used in various industries to quantify analytes of interest. During a titration, a titrant that reacts with the analyte is added until an equivalence point is reached. At this equivalence point (EP) there is an equal amount of analyte and titrant. Since the reaction between analyte and titrant is known, the amount of the analyte can be quantified using the volume of titrant that has been added.

Historically, titrations were performed manually with hanging burettes. The indication of the titration end point was determined visually by the addition of a color indicating compound that changes the color of the solution at the EP. There are several challenges when performing manual colorimetric titrations. The determination of the equivalence point is subjective and can vary from operator to operator. A neutral background is needed to accurately distinguish the color change. The original color of the sample can also inhibit the operators' ability to view the end point. If the EP is exceeded, a back titration with additional calculations is necessary to determine the concentration of the analyte.

To overcome these obstacles, titration systems with potentiometric equivalence point indication were developed. These systems accurately dose the titrant with microliter accuracy and utilize potentiometric electrodes that electrochemically determine the EP. This type of end point indication increases accuracy and repeatability. Although potentiometric titrations have become quite popular, there are a considerable amount of industries with standard methods (United States Pharmacopeia, European Pharmacopeia, American Society for Testing and Materials, et al.) that require colorimetric EP indication.

Solution: A photometric sensor can be used to automate colorimetric titrations. The use of a photometric sensor offers the operator all of the advantages of potentiometric titrations with the mandated color indication. The photometric sensor works as an in-beaker spectrophotometer to determine precisely the equivalence point based on detected light absorbance.

Metrohm offers the Optrode photometric sensor. It is equipped with LEDs that produce light at eight different wavelengths ranging from 470 to 660 nanometers. The electrode shaft is completely made of glass making it 100 percent solvent resistant. It requires no maintenance and can be used on all of Metrohm's titration platforms.

Prior to a titration, the desired wavelength is selected on the electrode or within the instrument software. During a titration, the Optrode's optical window is immersed in the sample solution. As the titration proceeds, titrant is automatically added to the sample solution containing the color indicator via an accurate dosing device and burette. The absorbance is measured within the optical window and converted to a millivolt signal. This signal is then plotted versus the titrant volume added. At the equivalence point there is a drastic change in measured absorbance that corresponds to an inflection point in the titration curve. The software can then use the volume of titrant added to calculate the concentration of the analyte of interest.

▲*Metrohm's Optrode photometric sensor requires no maintenance and can be used on all of Metrohm's titration platforms.*

The Optrode allows for automated titration with colorimetric equivalence point detection. With this sensor, higher accuracy and repeatability can be achieved. The sensor is robust and requires no maintenance.

For more information, go to: www.metrohm.com

WATCHING CELLS BREATHING

How do cancer cells extract energy? How do cells survive an infarction? A new technology from BMG Labtech extends the possibility to study cell metabolism in microplate readers at oxygen conditions matching those found within the body.

Oxygen is essential for human life, because this vital molecule is employed to generate energy. It assists in the generation of adenosine triphosphate (ATP), a molecule that contains a high energy bond. Cleaving that bond releases the energy and makes ATP the perfect energy transfer molecule. Despite oxygen's significance in energy metabolism, it potentially harms cells. Oxygen contributes to the formation of radicals that are highly reactive and can damage cell components. The most sensitive target of so-called reactive oxygen species is DNA. Reactive oxygen species can oxidise DNA bases, which potentially leads to erroneous base pairing and mutations. Given the crucial and ambivalent role of oxygen, it is not surprising that it impacts on energy metabolism and gene expression.

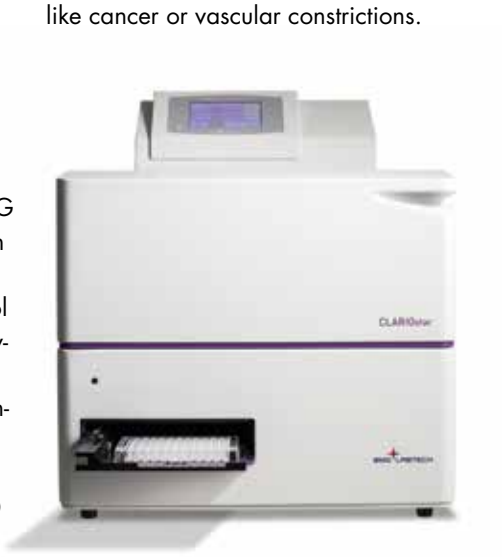
To study these impacts, different oxygen levels need to be considered in experiments. The air we breathe contains approximately 21 percent of oxygen, but, within the body, the oxygen concentration experienced by our cells is only one to 14 percent. Moreover, fluctuations in oxygen levels are implicated in diseases such as myocardial infarction, stroke and cancer. However, the majority of experiments are conducted at constant 21 percent oxygen. Therefore, new experimental setups are required that study biological effects at oxygen conditions matching those found in the body.

Perfect atmosphere in a microplate reader

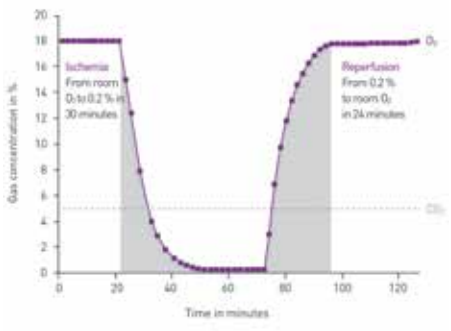
The Atmospheric Control Unit of the Clariostar microplate reader from BMG Labtech was engineered to mimic such physiological oxygen levels and oxygen changes. The Atmospheric Control Unit employs nitrogen to decrease oxygen concentrations in the microplate reader. Nitrogen displaces the oxygen-rich air inside the microplate reader. This way, oxygen concentrations can be brought down to 0.1 percent in 30 minutes. In order to re-oxygenate the reader chamber, air is actively vented into the device. Ambient oxygen conditions can be recovered in 30 minutes.

All these changes can be set up-front in the software according to the researcher's needs, eliminating hands-on intervention. As a matter of course, constant oxygen pressures can be maintained just as carbon dioxide can be regulated, which is required to stabilize the pH in hydrogen carbonate buffered cell culture media.

As the changes of gas conditions take place directly at the site microplate reading, the set-up is ideal for cellular real-time assays. Of particular interest are assays that report on metabolic conditions. In short, the new technology opens doors for new research approaches in life sciences and drug development for wide-spread diseases like cancer or vascular constrictions.



▲ *CLARIOstar microplate reader with Atmospheric Control Unit (ACU)*



▲ *Example of ischaemia/reperfusion conditions mimicked in the CLARIOstar microplate reader with ACU.*

BMG LABTECH
The Microplate Reader Company

BMG LABTECH
Allemdgruen 8
77799 Ortenberg, Germany
Phone: +49 781 96 96 80
Website: www.bmglabtech.com

RAPID CONCENTRATION OF DILUTE PATHOGENS FROM LARGER VOLUME SAMPLES

Problem: **Traditional microbiological methods for detecting pathogens involve an enrichment step because the dangerous pathogens are usually very dilute and the volume used for analysis is so small that the threat is often undetectable.**

The most common methods for enriching samples include 150-year-old-techniques—namely, centrifugation, a process that spins liquid samples at high speeds and causes the particles/pathogens to separate from the fluid into a concentrated pellet. This method requires time to spin, manual transfer steps that require some skill, and is restricted to smaller sample volumes. The most common enrichment method is culturing. Culturing is performed by combining the sample with a growth media and incubating over days or weeks for the pathogens to multiply enough to be detected. Regarding viruses, centrifugation and enrichment are even more complex, expensive, and time-consuming.

In the last decade, modern analytical methods have advanced greatly, allowing detection to be performed faster and easier than ever before using rapid molecular methods, but the problem remains the same; a technician's time and energy is still spent on the slow and tedious sample preparation steps prior to analysis. Even modern analysis methods most often require a concentrated or "enriched" sample.

Solution: InnovaPrep's Concentrating Pipette *Select* is a small benchtop instrument that allows users to accomplish pathogen concentration and inhibitor removal from large liquid samples with incredible ease and speed. Users can choose from six high-flow filtered pipette tips to concentrate bacteria, parasites, molds, fungal spores, whole cells, and viruses from up to 5 liters of liquid in minutes. Recovered pathogens are immediately delivered with a press of a button into a final sample volume from 150 microliters to 1 milliliter containing the concentrated pathogens in a clean buffer fluid ready for analysis using your method of choice.

The system effectively saves a technician's hands-on time at the bench, days waiting for growth, and provides consistency and exponentially improved detection. That directly translates to considerable monetary savings, and more importantly, reduced incidences of infection.

Fields of application include, but are not limited to: drinking water, pharma and consumer products, industrial and environmental monitoring, biodefense, human and animal diagnostic research, and spoilage screening in beverages.

InnovaPrep's 30 pending and awarded patents apply to highly effective collection, concentration and recovery of particles and pathogens from air, surfaces, and liquids. InnovaPrep's Wet Foam Elution™ enables recovery of particles from filters, membranes, surfaces, and objects to greatly improve detection of contamination, harmful pathogens, and spoilage organisms.

The Concentrating Pipette *Select* is the new generation of the popular Concentrating Pipette originally launched in 2012 with over 100 systems in use by leading government, industry, and research labs. The new model offers a higher level of efficiency and customization for users with added controls, precision components, and selectable features to provide improved recovery of organisms with higher sample concentration and lower elution volumes.

For more information, please contact info@innovaprep.com or visit www.innovaprep.com

▲*InnovaPrep's Concentrating Pipette Select is a small benchtop instrument that allows users to accomplish pathogen concentration and inhibitor removal from large liquid samples with incredible ease and speed.*

NEW HELIX CT ICP SPRAY CHAMBER

CONSISTENT DAY-TO-DAY ANALYTICAL PERFORMANCE IS JUST A CLICK AWAY

Traditionally, ICP-OES and ICP-MS sample introduction systems have relied on o-rings to form a gas-tight seal between the nebulizer and spray chamber. There are several drawbacks with an o-ring seal, such as:

- Potential for contamination due to dead volume around the o-ring seal
- Chemical resistivity of strong acids and organic solvents
- The o-rings are difficult to replace, often requiring tools
- Bonding to the nebulizer can result in breakage

IMPROVED PERFORMANCE

Glass Expansion now equips all of its glass, PFA, and PTFE spray chambers with the new Helix CT (ConstantTorque) nebulizer interface to provide a constant, reproducible, inert, gas-tight seal between the nebulizer and spray chamber.

The new Helix locking screw with built-in torque control mechanism allows for a consistent seal of the PTFE ferrule against the nebulizer – making it impossible to overtighten or undertighten while ensuring a gas-tight seal each and every time.

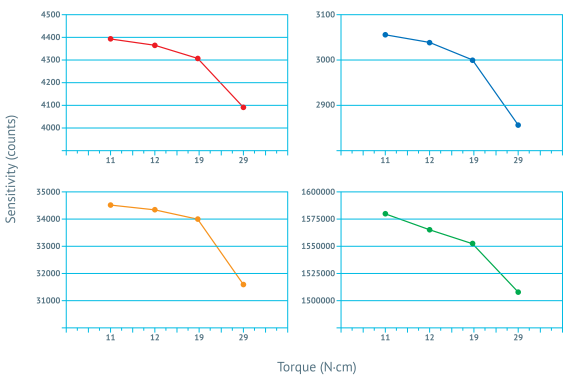
▲ ***Figure 2.*** *Helix CT Interface*

A new PressFit PTFE ferrule provides a chemically inert seal around the nebulizer, which is immune to strong acids and organic solvents routinely used in ICP sample preparation. The new Helix CT cyclonic spray chamber by Glass Expansion, therefore, eliminates all the drawbacks of the o-ring nebulizer seal, while improving user safety by preventing broken nebulizers.

Glass Expansion's new Helix CT design still maintains the original positive stop to ensure that the nebulizer is inserted to the correct and optimum depth within the spray chamber.

▲ ***Figure 1.*** *Helix CT ICP Spray Chamber*

However, the torque applied to the nebulizer seal is also critical. Consistent nebulizer depth combined with constant torque provides the ICP analyst with unparalleled, reproducible day-to-day analytical performance. In addition to improved performance, the Helix CT is the only nebulizer-spray chamber interface that significantly reduces the dead volume around the nebulizer. This unique design minimizes washout time with highly concentrated samples, reducing sample-to-sample carryover and improving sample throughput.



▲ ***Figure 3.*** *Helix CT Interface Sensitivity vs. Torque*

Achieving consistent day-to-day analytical performance in your ICP laboratory is just a click away with the new Helix CT cyclonic spray chamber. If you already have a Helix spray chamber, you can easily upgrade to the Helix CT interface. The new Helix CT locking screw and PressFit PTFE ferrule are fully compatible with all Glass Expansion Helix style spray chambers. Learn more at www.geicp.com/HelixCT and upgrade your ICP today.

STARLINE PLUG-IN RACEWAY® – For Flexible Lab Power

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

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

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

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

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

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

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

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

STARLINE Plug-In Raceway Common Applications:

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

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

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

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

STARLINE® PLUG-IN RACEWAY

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

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LAB MANAGER ONLINE

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

1 Lab Safety Rules and Guidelines

Having a strong set of overall laboratory safety rules is essential to avoiding disasters in the lab. *Lab Manager* recently scoured the safety policies of several laboratories to determine some of the most common lab safety rules out there, to help you whether you're developing or updating a set of policies for your own lab.

Read more at **LabManager.com/safety-guidelines**

2 Trending on Social Media: Going Automated

As of Jan. 15, *Lab Manager*'s top December issue article posted to social media was our cover story on laboratory automation. This article shared the lessons learned from those lab professionals who have decided to automate their labs, including the benefits they gained and how they dealt with the challenges.

Read more at **LabManager.com/going-automated**

3 Most Popular Webinar

Last month's top webinar on LabManager.com with 375 registrants was "Managing Lab Chemicals" presented by Vince McLeod. This webinar shared the most important elements of managing chemicals effectively, from beginning inventory to storage to waste collection and disposal. Though it ran on Dec. 13, you can still catch it on demand at the link below.

Read more at **LabManager.com/managing-chemicals**

LabManager.com

NEXT ISSUE ➡ Managing Government Regulations

Recent years have seen a proliferation in the number of laws, regulations, and ordinances, federal, state, and local, that affect laboratories. The individual researcher or laboratory worker cannot possibly be familiar with all of these regulations. The March cover story discusses how lab managers can better stay on top of and enforce these regulations in order to maintain the optimal safety culture in their facilities.

ASK LINDA

MANAGING MILLENNIALS

QUESTION:

Dear Linda,

Our lab has recently hired a number of entry level lab technicians to run some of our simpler processes. What this group has in common is that they all fall within the millennial age bracket. While I have no issues with how they perform their tasks, I am challenged by the attitudes of some of them. Most of those issues have to do with their level of commitment to the job, their reluctance to work beyond their 9 a.m. to 5 p.m. hours, and a sense that they're always looking for better employment elsewhere. I'm hoping you can help me find a way to manage this group and get them more engaged.

Thanks,

Elizabeth

ANSWER:

Dear Elizabeth,

You might be trying to fit square pegs into round holes. Rather than expecting them to live up to your expectations—unique to your generation as well, possibly—you might want to play to their strengths. While not to ascribe these traits to *all* millennials, they do share a few commonalities.

Since they tend to be very flexible and can switch tasks easily, try to mix up their assignments and responsibilities.

Because they value their non-work time and flexible scheduling, you might want to allow them to create their own work hours (provided, of course, your lab allows it).

Being especially tech savvy and willing to embrace new ways of doing things, think about allowing them to participate in informatics and automation discussions and decisions.

Given their communication and teamwork skills, you might want to have team meetings that allow their talent to shine. If such meetings address your company's community and diversity initiatives, all the better.

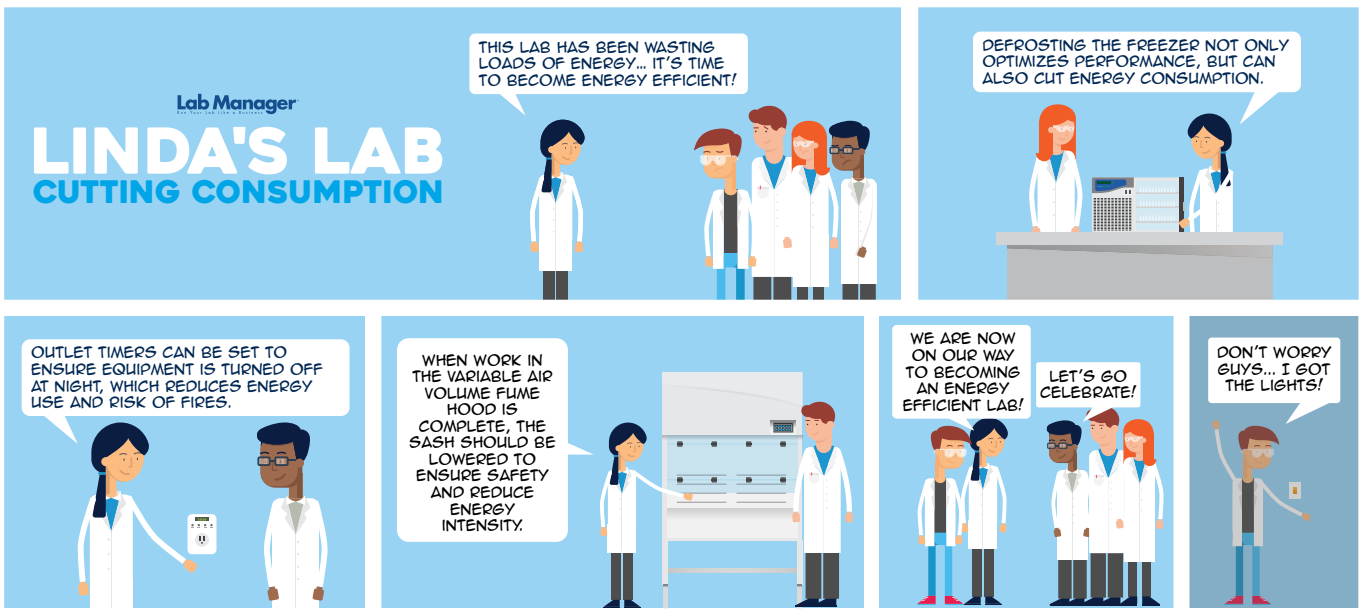
In general, find ways to take advantage of their unique talents and ignore, if you can, what you consider their weaknesses.

Good luck.

Cheers, Linda

HAVE A QUESTION FOR LINDA?

EMAIL HER AT: *LINDA@labmanager.com*



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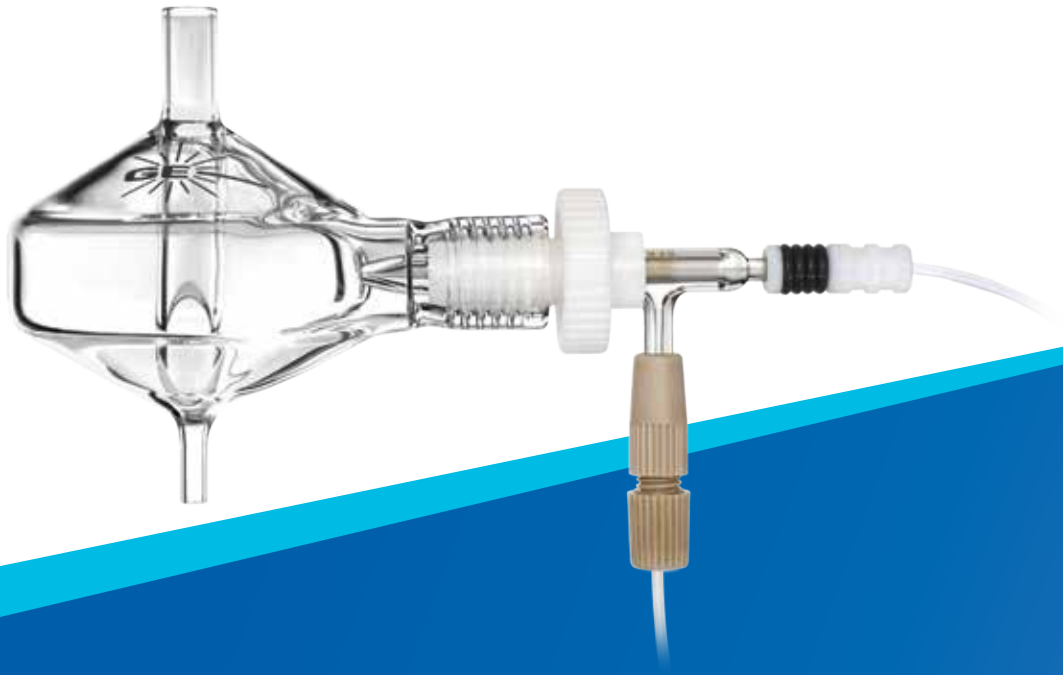

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