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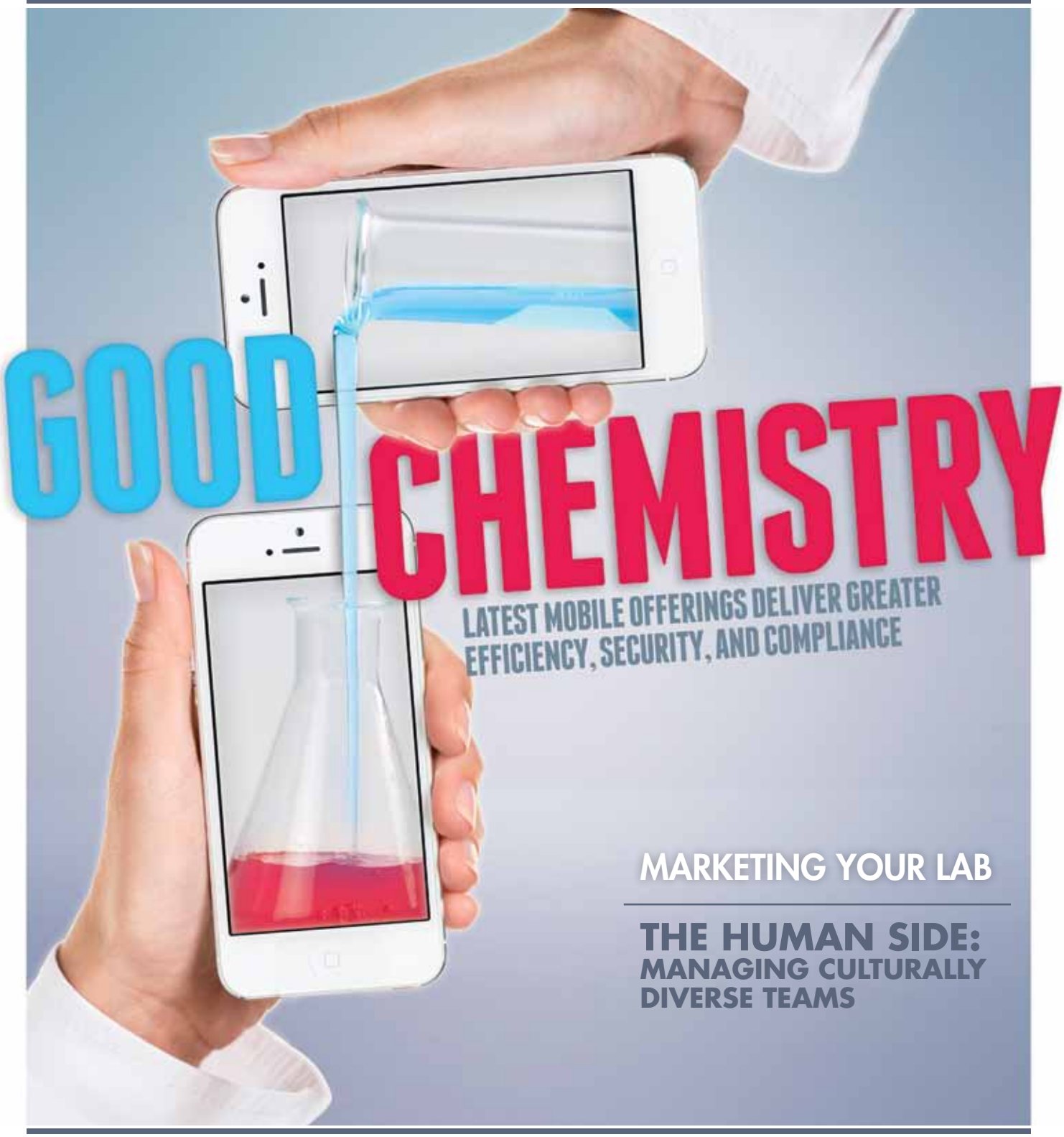

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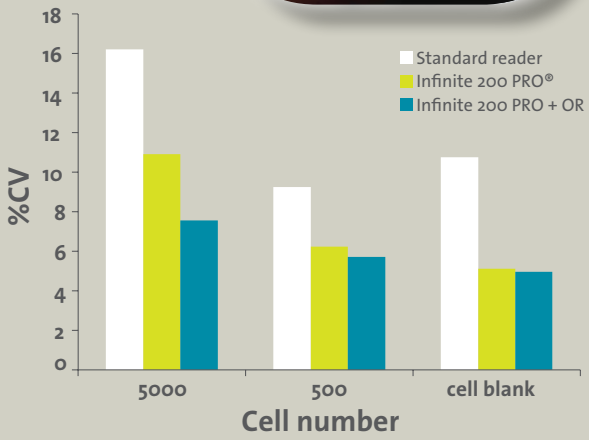

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A recent incident at UCLA highlights just how important it is to be vigilant about safety in the lab. In that accident, a student was burned on his face and neck after a lab oven exploded during an experiment in April. Though the student was lucky his injuries were not life-threatening, proper safety procedures likely could have prevented the incident from happening altogether. Could this have happened in your lab? What about your colleagues'? Next month, we will find out how well our readers enforce safety procedures in their labs as we release the results of our Fifth Annual Laboratory Safety Survey. Last year's survey showed a significant backsliding in lab health and safety practices. Here's hoping for better results this year!

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Breaking Down Silos

It is not news that the research workplace has changed considerably over the past decade. As with many businesses, laboratories have come under pressure to generate better results with ever greater efficiency. This in turn has led to greater emphasis on interdisciplinary collaboration, which has necessitated the breakdown of previously isolated silos of knowledge and ways of working. And whether research entities like it or not, cross-disciplinary and cross-cultural teams aren't going away any time soon. The challenge for managers has been how to make these new collaborations productive, dynamic, and clash free. This month we try to provide a bit of guidance.

Beginning with "The Human Side: Managing Culturally Diverse Teams," author Peter Gwynne introduces a particularly effective approach to managing diverse teams referred to as "fusion." "Fusion is based on two fundamental elements of collaboration: coexistence of differences and meaningful participation," says Jeanne Brett, director of the Dispute Resolution Center at Northwestern University's Kellogg School of Management. "Managers set up their teams to fail because they themselves fail to help the team anticipate cultural differences and so see conflict in cultural, as opposed to personal or organizational, terms and fail to set norms for dealing with cultural differences," Brett explains. Turn to page 26 to learn more.

As for cross-disciplinary collaboration, Mark Lanfear in this month's Science Matters column (page 16) says, "Merely bringing everyone together on a project isn't necessarily going to do the trick. Meaningful cross-functional connections must be made." In addition to good communication and making sure that everyone knows they are no longer working 'separately,' managers need to start thinking in a more interdisciplinary fashion. "This involves knowing that different perspectives on a single project are the key to inspiring new ideas," which, Lanfear believes, will make the work being done "more efficient, dynamic, and ultimately of higher quality."

If the existing organizational structure of a lab could be considered a kind of silo, then this month's Lab Manager Academy author, Steve Epner, suggests breaking that down as well. "Most lab operations need to understand the difference between leaders, managers, and doers. This lack of understanding is the reason so many labs are structured around people based on their longevity and personalities instead of their performance." He argues that successful organizations start with a clean sheet of paper. No names, just an understanding of where you need leaders, managers, and doers." Turn to page 18 for more.

Whether your management challenges are cross-cultural, cross-disciplinary, cross-generational, or structural, you are still in the business of increasing revenue for your lab, and for that you need a marketing plan. Turn to this month's Business Management article, "Marketing Your Lab," to learn some easy, inexpensive, and practical suggestions for doing just that. "Marketing your lab can be accomplished with a little elbow grease and some legwork, often at little cost. By doing research up front on potential customers, and planning your marketing based on the targeted audience, you will be more successful reaching your customers with the right message," says author Lynda Seeger.

This month's issue also provides the latest information on laboratory imaging systems (INSIGHTS, page 62), the challenges of managing a dairy lab (Perspective On, page 56), and product-specific articles on gas generators, microplate readers, mass spectrometers, viscometers, and LIMS, all beginning on page 42.

All in all, some good information we hope you find useful.

Best,

Pamela Ahlberg
Editor-in-Chief

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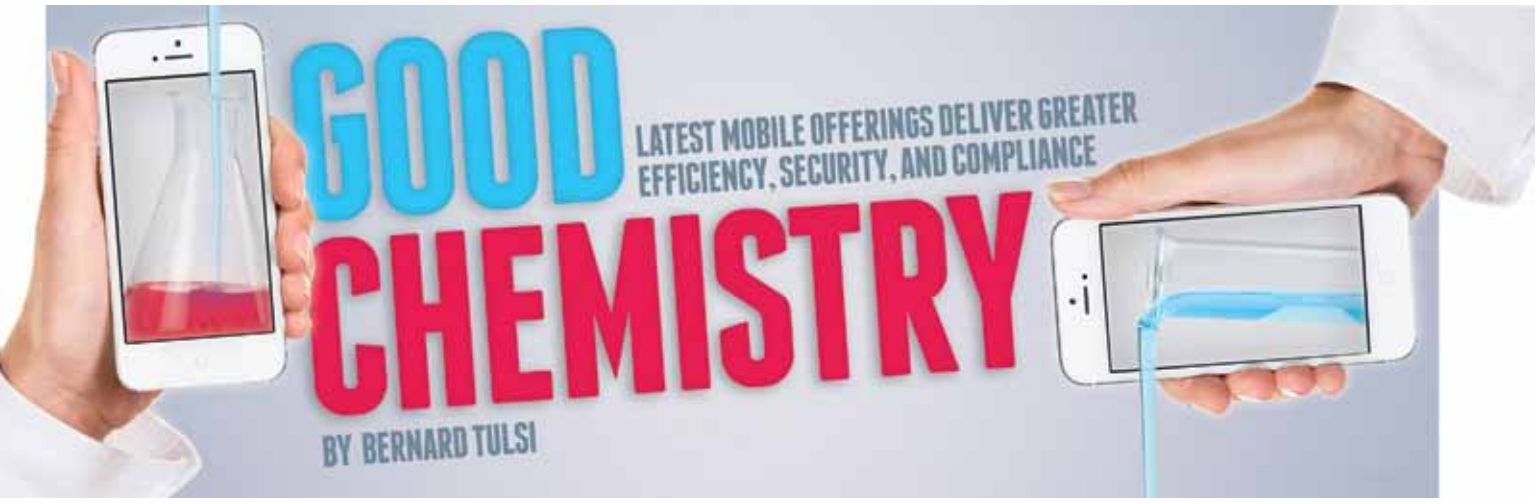

A quick glance at the display screen of the average smartphone will provide clues about the ubiquity of the mobile app. Talk to the phone's user, and you will likely get regaled with accounts about the indispensability of apps in the conduct of modern life. With expanding roles in helping design experiments, collect samples, replenish consumables, monitor projects, access literature, overcome software limitations, and collate data along with many other functions, apps are fast becoming indispensable in the laboratory also.

While definitive data are not readily available on the numbers of apps downloaded specifically for laboratory use, it is a reasonable expectation that information technology-savvy lab staffers were responsible for a sizeable portion of the 102 billion total app downloads in 2013. IT research and advisory company Gartner, Inc., estimated app revenues at $26 billion last year; 83 billion downloads (91 percent) were free. Gartner estimates that total downloads will grow to approximately 139 billion in 2014.

By many end-user accounts, apps help improve personal efficiency and group coordination and assist in the smoother operation of the entire laboratory enterprise. Conveniently designed into compact software packages with highly specialized capabilities, apps appear to be a natural fit for mobile smartphones (which had greater global sales than their less brainy predecessors for the first time last year) and mobile tablets, the heir apparent of the once-dominant but bulkier notebook computers. Apps running on smartphones or tablet devices have emerged as a convenient yet potent tool to access complex underlying digital systems that required considerable skill, time, and financial resources to build.

In operations that many end users may now consider routine, apps are downloaded into mobile devices that are capable of functioning in a detached, stand-alone manner. These devices can be readily connected and synchronized within a lab's network, typically to upload test data obtained from instrumentation in the lab or in the field. By any measure, this is a boon to lab staffers because it increases flexibility, facilitates movement between work stations and across functional areas, and enables related functions such as accessing references and standards—all without interrupting the primary work flow.

> "Capabilities embedded in mobile apps running on a smartphone could store the time the sample was taken and the GPS coordinates of the location."

An app with precisely this in mind was released by Grand Interactive, which develops customized mobile applications for use with instrumentation in the biotechnology and life science areas. Designed to obtain real-time performance data from the ProFlex PCR System from Life Technologies, the PCR Essentials app allows lab personnel using iOS- and Android-based mobile devices to monitor, review, and share data as well as to perform other tasks remotely. The app also provides instant access to master mix calculators and pertinent how-to videos.

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The typical lab layout features a number of function-based stations, including weighing, media preparation, pH meters, centrifuges, and colorimeters, among others. Researchers and technicians generally visit and use the tools at these stations and record data in paper lab notebooks. The replacement of the paper notebooks with smart mobile devices equipped with specific apps enormously increases efficiency, accuracy, and the ability to interact on a real-time basis with a larger network. Among other benefits, this also reduces transcription errors because, unlike with paper records, technicians need to input data only once into mobile devices.

When the time and location where a sample was collected are important, such as in wastewater monitoring, capabilities embedded in mobile apps running on a smartphone could store the time the sample was taken and the GPS coordinates of the location. This information can then be uploaded into the laboratory information management system (LIMS) and become available across the enterprise.

Security and compliance—such as avoiding the download of extraneous, noncompliant data or the unauthorized or inappropriate release of critical, sensitive results—are among the major benefits end users derive from the deployment of smart apps. Apps that alert researchers about the qualification status of instrumentation or the need to obtain standards or recalibrate equipment also help ensure both compliance and good laboratory practices.

Gene Tetreault, senior technical director of analytical development, quality, and manufacturing at Accelrys, which has developed mobile data recording apps for lab informatics, says, "The intention is to be running on a mobile device while walking around the lab while conducting procedures." Accelrys Capture, the first mobile app the company has created for the Windows 8.1 mobile operating system, was designed to enable scientists to move around their labs and record information in conjunction with their electronic laboratory notebook (ELN) experiments. Tetreault says this app facilitates the capture of observations, pictures, and annotations, among other information.

Accelrys refers to Capture as next-generation mobile: "We are taking advantage of the fact that finally the hardware has caught up to us, and everyone now has a mobile device, a tablet, or an iPhone or an Android device—and it is very accepted now to have an app that does specific functions," says Tetreault. "This next generation of apps will do a lot of the same functions we do today—managing procedures, capturing data, integrating with equipment, performing calculations—but in the next-generation format."

Tetreault says that laboratory informatics focus on planning, managing, executing, and reviewing relevant work processes, which follow the same flow as overall laboratory operations. He says the impact of mobile technologies is really felt in the execution phase of laboratory projects. "This is where the researchers are up from their desk; they are moving around and picking up their assignments, samples, and materials."

He notes that in the lab today, lab staff will likely have tablet devices on which they will see a listing of the work to be done. Right on the smart device, they can open up the work order and follow the associated procedures—preparation of a sample or equipment or execution of an analytical test, all of which are considered lab work. According to Tetreault, "Traditionally, that lab work was done on paper and in some cases on our first-generation laboratory execution system (LES), but this represents the greatest role for our mobile application systems."

> "The pioneering work of Apple focusing on particular tasks and ease of use might have helped to reduce generational differences in the use of certain apps."

Accelrys Capture is used to collect information on experiments in progress. Tetreault continues, "An experiment might involve preparing a solution, collecting the pH, and mixing the solution with a variety of different liquids. To execute this, technicians will open the Capture app, which will allow them to take a picture of the solution, add in notes on the procedure they are following, and input voice recordings, among other steps. Capture allows all these inputs at the same time as the experiments are being updated." Tetreault notes that with the Capture app, data is collected immediately and will not need to be transcribed—tremendously improving accuracy.

Capture works very closely with the Accelrys ELN as an add-on capability for a relatively modest additional cost, according to Tetreault. He foresees the app working as an add-on to other vendors' ELNs or LIMS in the future.

Tetreault acknowledges that older and younger people may approach apps differently. He says that the pioneer-

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ing work of Apple focusing on particular tasks and ease of use might have helped to reduce generational differences in the use of certain apps. "In the laboratory, we have a similar challenge with our prior technology—people were okay with using it because of the benefits, but the learning curve was relatively high.

"Now, though, you can see someone picking up our Capture app, and even though they may not be comfortable with an onscreen keyboard, they can handwrite into the app, and their handwriting is automatically converted into digital text for storage in the database." He adds, "Features like those make the adoption easier and fun; there is a coolness factor, and the time it takes to learn and use the app is almost zero. We stress functionality, but usability is also a very high priority for us."

Tetreault says, "The vision for the future is to continue to build focused applications to aid laboratory operations so that all aspects of lab activities are done electronically through apps—for managing inventory, calibrating equipment, collecting data, providing dashboards, and [managing resources], among other functions."

User-friendly apps with a growing range of functionalities could help increase sales of the underlying products, as in the case of the Sensorex PH-1 Meter accessory for iPhone and iPod and the next-generation SAM-1 meter, which was launched at Pittcon 2014. Both apps are available as free downloads. Launched eighteen months ago, the PH-1 is essentially a pH meter for a smartphone or a smart device. Ben Barker, sales manager at Sensorex Corp., says that Apple devices were selected because of their prominence on the market. The PH-1 essentially entailed plugging a pH module into an Apple device, which converted the analog signal from the module into a digital signal on the smart device, and accessing its rich array of features, including GPS capabilities and email.

Barker says that following considerable success with the PH-1, Sensorex looked for ways to expand its sensors and to use this approach on the Android platform. This resulted in the SAM-1 app. Instead of plugging in the pH module via the thirty-pin jack on the bottom of the Apple iPhone, the SAM-1 goes through the audio jack of the Android devices. Barker says, "We have also expanded the sensors. We now have the pH electrodes and conductivity sensors, and we are looking to add dissolved oxygen sensors and some specific ion electrodes in the future."

This is consistent with the broader direction these days when almost everyone has a smartphone, says Barker. "The question becomes, do you want to buy a stand-alone meter, or do you want to use a lot of the features that are in the smartphones, including their fantastic displays? In any case, to develop a stand-alone device that comes even close to the technology in the smartphone will incur huge costs."

Barker says, "What is interesting about these apps is that they have expanded our end-user sales. We are now going into environmental monitoring applications, any industrial processes that need product quality control in portable units, homes, commercial settings, pool and spa testing, aquaculture, horticulture, and hydroponics—which is a huge industry now—municipal water sampling, wastewater for clients, municipal testing, school and college labs, and industrial labs, among others."

"Compliance testing is another area in which we have a lot of requests. Smart-

phones actually save the data so there is no need to write it on paper. By doing that, the numbers can be validated versus someone using a test strip, writing what they think the result is, or even fudging the numbers. This approach actually gives [the person] a device that stores the data and saves it without allowing anyone to make internal adjustments."

Barker says that there is little doubt that apps increase efficiency. "You have more information available to you, and there is a fun factor as well when you can pull up data right on the smartphone.

"Apps provide end users with a number of functionalities right on the phone, at their fingertips—and most apps are extremely user-friendly—they are so intuitive, there's no need for manuals to tell you how they work."

Still, there is definitely a bit of a generational divide in the use of apps, according to Barker. "We see younger people quickly taking to the SAM-1 at our trade show booth. They take instantly to the PH-1 because they do everything on their smartphones these days. We hear those comments from the younger crowd all the time."

Some people in the older crowd use and understand the new technologies also, but some have an older, more reluctant approach, says Barker. He notes that some older lab folks still have flip phones or no cell phone at all. "They look at our product and ask, why would I use that? I have pen and paper, and [they do] the job for me. There is a bit of a divide, but still we see increasing numbers of people going for these devices."

"We try to make them as user-friendly as possible so that anybody could use them. By incorporating features that make jobs easier, everyone, young and old, could quickly derive the benefits."

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

TECHNIQUES FOR MANAGING CROSS-DISCIPLINARY TEAMS

By Mark A. Lanfear

By now we all know that the life sciences industry is radically changing. For decades we had been comfortable working within rigid boundaries. Within our own little silos, we shared space with like-minded colleagues—people who studied and worked on the same projects. Our ideas flowed between one another but rarely outside the confines of our discipline. We produced very high-quality work. But unfortunately we didn't necessarily know how to relate to others whose work radically—or even just slightly—differed from ours.

What changed this dynamic in the life sciences (and continues to inform the evolution of the workplace) was the need to become more efficient. Huge corporations basically needed to be more cost-efficient, and they realized that collaboration and the breaking down of the traditional silos would help them do that. A welcome side effect is that we're all learning how to collaborate better with colleagues who may approach their disciplines very differently—but who have the same goal. We all want to develop better products and tools, and sharing our knowledge helps us do just that.

For managers, this new dynamic has been especially challenging. The question remains: How do you effectively manage cross-disciplinary teams? Surprisingly, there is little research out there on how to do this. It's a relatively new phenomenon, especially in the life sciences. Hopefully, managers are working with team members who are competent and intelligent in their approach to their daily jobs. But getting them to work together effortlessly and synergistically toward the same goal is nevertheless a difficult task.

Merely bringing everyone together on a project isn't necessarily going to do the trick. Meaningful cross-functional connections must be made. True collaboration may arise organically and in surprising ways with no plan. But people who are used to working in formerly isolated departments may not know how to adapt at all, leaving group dynamics on a cross-disciplinary project open to negativity and stifling knowledge flow.

> "People who are used to working in formerly isolated departments may not know how to adapt."

In this situation, managers must take lessons from the general playbook for all new workplaces that are being informed by a need to work in a more cross-disciplinary mode. It is critical, for instance, for managers themselves to start thinking in a more interdisciplinary fashion. This involves knowing that different perspectives on a single project are the key to inspiring new ideas. A so-called "common front" of different perspectives from team members will most certainly take a project to a higher level. And if managers want their team to think in a more interdisciplinary way, they must first be willing to do it themselves.

Also important is for a manager to be an effective "enabler" of cross-disciplinary work. It's not enough to simply put ten experts in a room and expect them to spontaneously work together toward a goal. Communication is key, keeping the big picture in mind and letting the team know throughout the course of the project that it is critical to work together and share ideas. Be sure that everyone understands the cross-disciplinary nature of the project—and that they are no longer working "separately" but together. Make sure they know how the work of the other team members may affect their own. And make sure they know the importance of this new type of interaction between their colleagues.

It may seem as though a spirit of working together would happen naturally, but the manager of a project must actually take deliberate steps toward this goal, especially with professionals who are so used to working on their own. The old way of working in silos is clearly gone. The sooner managers are able to effectively lead cross-disciplinary teams, the sooner the work that we all do could become more efficient, dynamic, and ultimately of higher quality.

Mark Lanfear *is a global practice leader for the life science vertical at Kelly Services, a leader in providing workforce solutions. He has operated clinical trials around the world for almost two decades. In addition, Mark is a featured speaker at many life science industry conferences and a writer for life science periodicals. He can be reached at MARL773@kellyservices.com or 248-244-4361.*

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ORGANIZING PEOPLE

By Steve A. Epner

As a consultant and professor, I see it all of the time. Organizations are structured to fail. We make it almost impossible for some people to succeed.

One simple example (which we can detail in another article) is mixing short term and long term oriented groups under one manager. Consider sales and marketing. Marketing is all about brands and getting someone to call for information down the road. Sales departments are all about closing new business today. As the end of a quarter approaches do you think the manager is thinking about next year? No way. S/He is focused on making the current sales quota.

More importantly, most lab operations need to understand the difference between leaders, managers, and doers. This lack of understanding is the reason so many labs are structured around people based on their longevity and personalities instead of their performance.

At the most simple level, leaders set direction. They want to be "loved" or followed because people buy into their ideas. They have vision and the conviction to lead a company into the future.

Managers like to get things done through others. They do not care what anyone thinks of them. They plan, assemble teams, and execute in a way that will move the organization in the direction set by leadership.

Good leaders love strong managers—even if most could not work for one. Strong managers appreciate strong leaders who give them clear direction and then get out of the way.

Doers like to get things done. They want to be given a task and then allowed to do it. The best doers often are the "go to" people everyone else relies on to solve the most difficult issues.

> "Lab operations need to understand the difference between leaders, managers, and doers."

Doers love strong managers who can give them a clearly defined task, target, and resources, then clears the way for them to be successful. Good managers want to keep their best doers to the point they will pay them above their "standard grade" to keep them happy and the company productive.

The most successful organizations start with a clean sheet of paper and design the best possible organizational structure. No names, just an understanding of where you need leaders, managers, and doers. There are some times when you need a strong leader who is also a doer.

Perfect. Put a capital "L" and a lower case "d" in the box. Do this for the whole organization.

When you are done—and only then—step back and look at the people you have. Evaluate each as to their leadership, management, and doer capabilities. Now you can start to put names in the boxes. If you are like most, you will run out of appropriate names before you run out of places to use them.

Consider training, coaching, and other support to keep good people. BUT, do not strangle the operation with too many of the wrong people. If I can paraphrase Jim Collins (*Good to Great*): get the right people in the right seats on the right bus. It will be much easier to succeed.

***Steve A. Epner**, CSP. Steve is the founder of BSW Consulting Group LLC. During his 40+ year career, he has built a reputation for assisting clients with the integration of strategic business planning, information systems and tactical requirements. Visit www.BSWLLC.com or call 1-888-279-2792.*

LABCAST Be sure to attend Steve Epner's Lab Manager Academy webinar, "Why Are Some Labs More Productive than Others? Understanding LMD Is the Answer," on Wednesday, June 4 (or afterward at **www.labmanager.com/LMD**, to watch the archived video).

MARKETING YOUR LAB

ANALYSIS, ELBOW GREASE, AND LEGWORK CAN BRING IN NEW BUSINESS AT LITTLE OR NO COST

by Lynda Seeger

As budgets for agencies tighten, available grant money shrinks, and money for lab testing becomes less of a priority, it is increasingly important for labs to draw in new business to increase revenue. While there is no quick fix, labs must figure out who their potential clients are before trying to market their services. By identifying these clients—who they are, where they can be found, and what they need—labs can specifically target their marketing to these clients.

To determine who the clients you are trying to reach are, first look to your current client list. Are they new home owners, pregnant mothers, small businesses, water utilities, etc.? Are they located locally, in your state, or all over the country? What kind of testing are they requesting? If you are unable to easily answer these types of questions, consider revamping your chain of custody (COC) forms by adding a few questions with check boxes. This way when future samples are brought in, you can tally results to see who uses your lab services the most. If possible, modify your LIMS to capture this data so it can be more readily accessed.

If a large percentage of your samples come from private citizens or local small businesses, consider adding similarly worded questions to your COC. Where did you collect your sample: house, apartment, or business? What made you decide to test your water today: bought a new home, selling a home, someone in the household is pregnant or you have an infant living in the home, annual testing, to check the safety of your drinking water, it tastes funny, your water has an odor, the water isn't clear or has a color or solids present, or discoloration noticed in sinks, toilets, or laundry? Lastly, ask your clients how they heard about your lab's services. Did they find you on the Internet? Did the newspaper or other media mention your lab or services in a story? Did their doctor refer them or was it a neighbor or a friend? Did a business like a realtor or well driller recommend they get their water tested?

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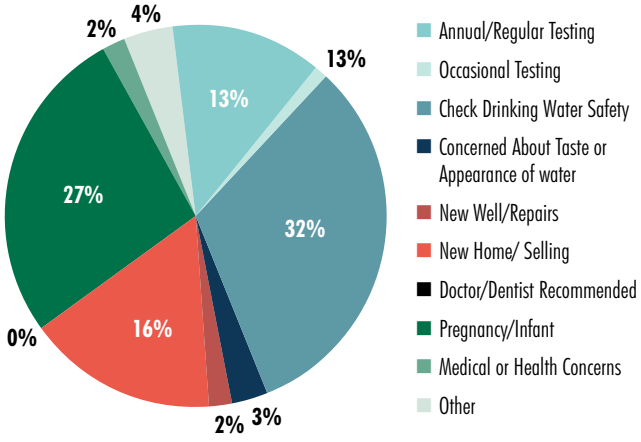

▲ *Source: Public Health Madison & Dane County (PHMDC) Laboratory.*

If your clients are more businesses and municipalities, consider them a good source of information. Ask them how they heard about your services. Find out if they know others who need the same testing. Ask why they do the testing—is it required, grant-funded, or for safety concerns?

By asking some of these types of questions you will learn how clients became aware of your lab services and why they are performing the testing. Once you have this information, you can more effectively focus your marketing to reach new clients that may have the same needs or concerns.

A strong marketing plan will consist of a multifaceted approach. First, an easy-to-use website is essential. Have someone outside your agency act as a potential client

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and see if that person has problems locating or navigating your website. Make sure specific keywords bring your website to the front when lab services are searched for. Check that contact information for your lab is readily located. Lastly, feel free to include pictures, videos, and articles that describe your lab and services.

Consider developing pamphlets or brochures that address specific concerns that private citizens and small businesses may have. Provide suggestions for selecting tests on the basis of specific circumstances (for instance, age of home/plumbing, potential of farm/industrial runoff to groundwater). For water quality or safety issues, discuss the importance of regular testing and how your lab can be of service. There are many different ways to get these brochures into the hands of these potential clients.

"Consider developing pamphlets or brochures that address specific concerns that private citizens and small businesses may have."

Contact local dentists, doctors, and hospitals about your testing services. Ask if you may drop off a packet explaining your testing options. If they have their own contract lab that handles their work, don't be afraid to ask them whether there is a bidding process for their testing that you could enter. Also, ask whether there is a time when you could give the staff a short presentation or brochures about your lab services. Use this time to educate the staff on the importance of environment and water quality to patient health. Explain how your lab can help their patients ensure that they do not become sick from materials in their homes (radon, lead paint, etc.) or water. Ask if there is a place where you may leave brochures for patients to pick up.

Contact doctors or clinics that specialize in pregnant women. Find out if they have Lamaze or parenting classes at which you can make a presentation or pass out information about testing options for homes that have infants or small children. Take the time to educate the parents about why they should test their water, air, and paint.

Find out whether there is a professional group for local realtors or well drillers to which you could talk about your lab services. Ask if they give out packets or brochures to homeowners and if they'd be willing to include something from your lab.

Offer to speak at a home-buying seminar or set up displays at a home-improvement shows or county/community fairs. Educate current homeowners on the importance of water quality and environmental health in their homes to encourage testing. Consider doing quick checks using screening kits for nitrate or lead to show how "clear" water can actually be unsafe to drink. Pass out or place coupons in programs for discounted testing.

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Libraries and schools often have display areas or allow the posting of presentations to the general public. Check to see if you can take advantage of this low-cost option for promoting your lab services while educating the public on matters of local interest.

▲ *Sample display marketing the importance of drinking water testing. Source: PHMDC Laboratory*

Contact public offices (assessors, clerk offices, city hall, etc.) to inquire about their display cases or areas that you may be able to utilize to draw attention to your lab. Also, many municipalities have bill stuffers with annual tax statements or utility bills. This may be another opportunity to advertise your lab services.

If a higher percentage of your samples come from businesses, contracted clients, researchers with grants, etc., a different approach is needed. You will need to find the best way to reach your audience. Once again, look to your current client list and figure out what other similar businesses are out there. If you have a large amount of potential clients located close to you, consider holding an open house or lab tours and inviting these clients. Consider placing virtual tours or short educational videos of your services or your lab equipment on your website.

Networking with others in the sciences is another good way to meet prospective clients. As we all know, instruments break down or a project may require analyses that a lab is not able to handle. Those labs will need

someone to do the testing for them, and if they know you from professional meetings, they may turn to you when they need help.

A less well-known and underutilized method for advertising your lab services is offering to speak to groups about topics relevant to your work. Speak at board and council meetings about concerns in their districts. For example, if spring flooding is an issue in your area, prepare a short presentation about the impact of flooding on drinking water quality and the importance of testing. Many civic groups like the Rotary or the Lions Club have guest speakers. Members of these groups are often local business leaders who at some point may need your lab services. Use these groups as a way to talk about testing that could be done while presenting information on topics of local concern. Also, don't forget about youth groups such as the Boy Scouts, Girl Scouts, 4H, and Future Farmers of America. These are your future clients. Use the opportunity to educate these youth while promoting your business.

"Consider placing virtual tours or short educational videos of your services or your lab equipment on your website."

Lastly, whether your future clients are businesses or private citizens, don't underestimate the use of the media. Don't be shy about bragging about your successes and drawing attention to your lab services. Contact the media with potential stories when your lab helps in a newsworthy situation. Don't be afraid to write articles for local newspapers, magazines, community newsletters, or trade journals. Sometimes even letters to editors about specific topics can bring business. Make sure that when staff are quoted or write articles, your laboratory name is included. When your staff become known as experts on topics, people are more likely to use your lab when they need testing.

Marketing your lab can be accomplished with a little elbow grease and some legwork, often at little cost. By doing research up front on potential customers, and planning your marketing based on the targeted audience, you will be more successful reaching your customers with the right message.

I would like to thank my coworkers and supervisor at PHMDC for their support, ideas, input, and feedback.

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THE HUMAN SIDE

MANAGING CULTURALLY DIVERSE TEAMS by Peter Gwynne

When French company Groupe Bull prepared to merge with American firm Zenith Data Systems, American and French engineers working for Bull discussed the difficulties of working with each other. As the Americans saw it, their French colleagues took an "analysis paralysis" approach to problem solving: They insisted on analyzing the problem completely and correctly before taking any action. Americans, in the French engineers' view, insisted on action from the start, often at the expense of fully understanding the problem.

Cultural disagreements of that type aren't necessarily insoluble. When an American software engineer started to work with a team of Israelis, for example, he was shocked by their argumentative approach toward him—until he realized that they took the same approach to each other. He adapted by imposing some structure on the team's work while allowing himself and his colleagues to express themselves naturally.

In another case, American and British members of a research team had violent disagreements over the speed at which they worked on a project; the Americans wanted to go full steam ahead while the Brits wished to advance more slowly in case they met serious pitfalls. Management accommodated both groups by setting an in-between speed that kept the project moving while allowing it to foresee problems.

And when a group of Japanese engineers encountered huge challenges cooperating with Indian engineers on a project for Infosys, they organized some training materials designed to stimulate the two groups to talk about their assumptions and experiences. The materials helped the two groups of engineers to understand each other's worldviews and to collaborate more effectively.

The fusion approach

In each case, leadership had unwittingly hit upon a particularly effective approach to managing diverse teams. Jeanne Brett, director of the Dispute Resolution Center at Northwestern University's Kellogg School of Management, and Maddy Janssens of Belgium's Catholic University of Leuven, who devised the approach, call it fusion. They coined the term because of the concept's similarity to fusion cooking, which combines ingredients or cooking methods from different cultural traditions while preserving their distinct flavors, textures and forms of presentation.

In the management context, Brett explains, "Fusion is based on two fundamental elements of collaboration: coexistence of differences and meaningful participation." Those elements ensure that teams reach their goals most effectively. In addition, Brett says, "We think we have some evidence that teams with fusion teamwork systems are more creative."

Managers of R&D groups—in North America and elsewhere—face multicultural situations with increasing frequency. In those situations, they must deal with the potential for multiple cultural clashes among team members. The fusion approach has the basic goal of allowing every member to make his or her contribution to achieving the team's goals. "Fusion teamwork allows differences to coexist and be talked about," Brett explains. "Then the ideas can be packaged."

Traditional collaboration

Dealing with multicultural teams is hardly a new experience for R&D managers. Most organize collaborations in one of two ways. In the dominant (or subgroup)

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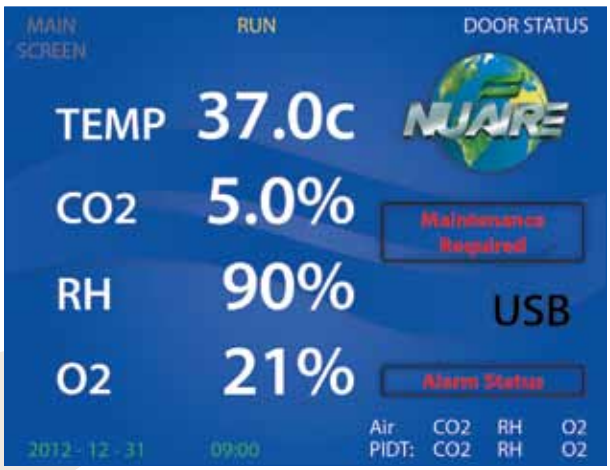

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coalition model, a specific set of team members—which may or may not make up a majority of the team—directs the team's collection of information and decision making.

"[A] dominant coalition sets the scene, overrides differences that are not in line with its logic, and suppresses other perspectives," wrote Brett and Janssens in the journal *Group & Organization Management* (31, 1, 2006). "This creates a less culturally intelligent team model because it discourages meaningful participation in information extraction and decision making."

The most common alternative approach, the integration and/or identity model, requires all team members to sublimate their cultural identities to that of the entire team by adopting "superordinate goals" based on their common interests. The approach has the advantage of encouraging every team member to participate. However, it carries two risks. In the interest of unity, team members might submerge their cultural identities, and hence their ability to think differently. And the effort to include everyone in decision making might cause the team to function at the level of its least-creative member. In studies of the two approaches before and since publishing her original research, "We found problems with communication, confrontation, and commitment, as well as norms for problem solving, work behavior, time urgency, and pace, and violation of norms for status and intergroup prejudices." Those problems typically stem from the top.

"One of the ways to get people to participate is to make the size of the group smaller."

"Managers set up their teams to fail because they themselves fail to help the team anticipate cultural differences and so see conflict in cultural, as opposed to personal or organizational, terms and fail to set norms for dealing with cultural differences such as meaningful participation and coexistence—the two basic elements of fusion," Brett explains. "Managers also fail to come up with integrative, creative ways of dealing with the differences in ideas that meaningful participation and fusion generate. Instead, they revert to dictating the team's solutions or letting a dominant subgroup take over. That leads at a minimum to a lost opportunity for the team to manage its own cultural problems."

Every member contributes

The fusion concept aims to overcome that type of problem by ensuring that every member contributes his or her expertise to the team's discussions. That takes careful organization and management. "One of the ways to get people to participate is to make the size of the group smaller," Brett explains. "In one example I studied, the group contained 16 people from four different geographical areas. They split the task into four parts and assigned a four-person multicultural team to each part of the task. In another example, there were maybe 12 people on the team,

and part of the problem was that the lower-level people from one culture would not contribute when higher-level team members from their culture and area of the company were present. Here, the team was split into a couple of lower-level working groups with mixed cultures, and these teams reported up to the higher-level members. It took the Americans a while to accept this solution as they were less status oriented; but they found that this structure released a lot of knowledge from the status-sensitive lower-level counterparts, and so they went along."

Brett offers another way to ensure full participation in team discussions: seeding the group with someone who is likely to support the team member who has not been participating. A seeded member of this type who has a comprehensive understanding of the strengths and knowledge that each other member brings to the team can give the nonparticipant opportunities to contribute his or her expertise to discussions.

To deal with disagreements in a neutral way, Brett and Janssens suggest team leaders should put the issues to a vote. And if one cultural group consistently wins the votes and threatens to overpower other team members, Brett recommends that team leader should intervene—for example, by encouraging more questioning among team members or appointing individuals or, again, setting up small groups to work on particular problems and share their solutions with the entire team. To take maximum advantage of individuals' specialist knowledge, team leaders should continually reconstitute the small groups.

Breaking through the language barrier

The small group concept has particular value when some members of the main group are less fluent than most in the group's *lingua franca.* In some circumstances, the team leader can organize small common-language groups to brainstorm problems and have the most fluent member of the subgroup report back. Alternatively, Brett and Janssens wrote, the leader can "encourage team members to speak in their own native language and have other team members collectively translate." While that strategy requires bilingual team members and may be cumbersome in large teams with several different native language speakers, the pair adds, "it has the very nice secondary effect of making the task of passing the language hurdle a team task, not an individual task."

Brett summarizes the strength of the fusion concept with a simple example. "Look at greeting behavior," she says. "Kissing, bowing, and shaking hands all achieve greeting effectively. In fusion, team members realize there's a different way of doing things over there and how the team can use those differences to be more creative."

Peter Gwynne *is a freelance science writer based in Cape Cod, Massachusetts. He can be reached at pgwynne767@aol.com.*

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DOCUMENT OR DIE

WHY KEEPING TRACK OF EVERYTHING IS ESSENTIAL IN THE CELL CULTURE WORLD

by Rachel Muenz

Documentation is something all scientists learn to do when they first start taking science classes in elementary school. But keeping track of everything is especially critical in the cell culture field, as illustrated by a recent case in Japan, where on April 1 Haruko Obokata, a prominent stem cell researcher from the RIKEN Center for Developmental Biology in Kobe, was found guilty of misconduct after other scientists questioned her research findings. Those findings, published in two papers in January, were subjected to a committee investigation made up of a group of independent researchers from RIKEN.[1,2]

Obokata's research involved a technique known as stimulus-triggered activation of pluripotency (STAP), which claimed to allow for easier creation of stem cells using regular cells. However, other researchers were unable to replicate the experiment, and problems were found with the presentation and handling of the stem cell images, data, and text in the papers, leading some to claim they were altered or faked.[1,2]

From this incident, it's clear that proper documentation is essential, to ensure that the data from cell culture research is accurate and to prevent incorrect information from being published.

"If you don't accurately document what you've done in your experiment, then you can't accurately publish that material—or if you do, then it could have some flaws in it," says Philip H. Schwartz, PhD, director of the National Human Neural Stem Cell Resource at the Children's Hospital of Orange County Research Institute (Orange, CA). "Documentation and writing in your lab notebook, etc., is something that we train our scientists to do even when they're in middle school."

Documentation is also necessary to allow cell culture labs to solve any problems they may encounter in experiments, as it lets them trace such problems back to their source. That means that everything these labs use in their experiments, such as reagents and even plasticware, must be tracked, as there are differences in how those supplies and equipment are manufactured that could impact cell culture capabilities, Schwartz explains.

"If we did not keep accurate documentation of the equipment and reagents and supplies that we use, we couldn't [backtrack to find problems]," he says. "We'd be stumbling around in the dark when things went wrong."

Documenting everything is also critical for Sandro Matosevic, senior scientist at Akron Biotech (Boca Raton, FL), for those same reasons.

"Proper documentation is crucial in maintaining a record of experimental procedures during research and development, and particularly when working with a new product or technique," Matosevic explains. Such tracking is important at Akron—a global supplier that manufactures and distributes components and raw materials for the cell therapy industry—for two other reasons.

"Documentation is also important for reproducibility and to allow different scientists to share experimental details and procedures, which helps in maintaining consistency and for training purposes," Matosevic says. "Finally, thorough documentation is of critical importance for regulated labs such as ours, as it is a crucial part of meeting regulations."

For Simin Zaidi, vice president of operations and bioprocessing at Stamford Bioprocess Technologies (Santa Ana, CA), documentation is critical to the company's cell culture lab, which develops cell lines or processes that are used in clinical product manufacturing.

"Cell line traceability and traceability of design data, why we have selected a certain process parameter for manufacturing, need to be properly documented," she says. "In the case of our preclinical and diagnostic protein production customers, proper documentation

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ensures the ability for Stamford Bioprocess to repeat the process consistently. This ensures that product quality doesn't change from batch to batch."

How it's done

The way documentation is carried out varies from lab to lab, but most use a combination of hard-copy notebooks and files and computer systems. It also depends on what exactly is being documented.

"For most of the reagents, we keep a logbook, where we simply put a hard copy of the certificate of analysis and data sheets associated with a given reagent," Schwartz says, adding that reagents are organized by type. Along with those reagents and supplies used, Schwartz and his team must keep track of the many cell lines they generate, which involves another approach.

"There are many different kinds [of cell lines], and they have been treated many different ways, so we have a fairly elaborate tracking system for those," he explains. "Otherwise, in order to identify what a particular cell line is, you'd have to go back through the logbooks, essentially page by page, and identify everything that's happened to that cell line to make it what it is."

Schwartz's lab's documentation process for its cell lines involves a nomenclature system that describes the history of each line from beginning to end, along with a computer-based inventory system with bar code labeling.

At Stamford, for similar processes such as media formulation or analytical methods, the lab uses forms that are filled out by the scientist, while logbooks are used for equipment, such as pH meters, to record the relevant data. Researchers use lab notebooks when they are developing or optimizing a process, and for developed processes, a Stamford scientist or engineer fills out batch records, Zaidi says.

Stamford uses Excel spreadsheets and printouts from some of its analytical equipment, and they record some data on computers, but Zaidi says electronic technologies haven't taken over her lab.

"I haven't found any electronic systems that can fully replace notebooks just yet, particularly in a lab where development is being performed and activities can vary greatly," she explains.

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The Akron lab also uses both paper and digital record-keeping methods, depending on what is being kept track of.

"In the lab, we use standard laboratory notebooks to record experimental details," Matosevic says. "We also use digital tools, such as file-sharing systems, as well as networked drives to keep a record of laboratory information, such as raw data, images, and files. When it comes to regulatory documentation, we do it exclusively using computers."

While such software and digital tools make documentation easier, they do pose some challenges to researchers and managers. Matosevic says one of the biggest issues the lab at Akron faces is standardizing laboratory record keeping across the spectrum of its laboratory operations and finding a digital platform that will let workers maintain the lab more efficiently than they've been able to do with lab notebooks.

"This relates to keeping track of laboratory operations as our lab grows and maintaining the same level of control as multiple scientists work on multiple projects," he says. "I think the key is to have consistency in the way multiple users record their data. We work through this by training and evaluating our laboratory personnel in efficient and thorough record keeping."

> "If we did not keep accurate documentation ... [w]e'd be stumbling around in the dark when things went wrong."

Currently, Akron is evaluating LabArchives and similar electronic platforms to determine how well researchers' needs will be handled in terms of digital file storage, note taking, data analysis, etc.

Schwartz also faces some technology-related challenges in his lab, mostly dealing with software updates or having to switch to a new operating system.

"For us, Windows XP is going away, so we have to go to Windows 7—and now the software doesn't work on Windows 7," he says. "There's always a struggle with keeping the software up to date and keeping it communicating with the operating system without having to buy this stuff over and over again."

However, he says the main challenge for his lab is simply making sure documentation is being done, and done properly.

"The biggest challenge, really, is to make sure that your staff is adequately trained to keep track of the documentation in the appropriate manner and understand the importance of doing so," Schwartz says. "Ultimately, all of this depends on somebody doing something. If somebody doesn't do that something, it doesn't get done and the system fails."

Making sure it's done

"Ensuring everyone consistently captures all pertinent information" is also the main challenge in Zaidi's lab, one that Stamford Bioprocess tackles through proper training and having staff review each other's work, she says. "Our scientists know the importance of documenting the work, as we will often be asked about a particular detail of the project. If they don't have the requested information, then it can cause their work to come into question. No good scientist wants to be in that situation, and management emphasizes this aspect."

For Schwartz's lab, maintaining an air of transparency is the key to ensuring that staff members are documenting everything.

"By having complete transparency, accountability follows, because if you're not doing your job and everything's transparent, everyone knows it," he explains, adding that his lab has staff meetings once a week to discuss in detail what everyone's doing and how they are doing it.

Along with training in proper lab record keeping, Akron also has regular meetings and checks from lab management to ensure that documentation is always proper and up to date.

"Preparation of batch records for regulated processes is always done from 'raw data'—i.e., the contents of the lab notebook—which makes laboratory personnel aware of the importance of keeping the lab record up to date," Matosevic adds.

For those new to documentation in the cell culture world, proper planning is essential to avoid a potential mess.

"Assess your needs and never forget about regulations," Matosevic advises. "If you are starting out, consider a digital (e-notebook) platform, as it allows you to keep a close eye on every user in the lab and address issues promptly. Train personnel in record keeping and ensure they follow standards."

Zaidi adds that scientists should always write everything down and keep lab notebooks simple, limiting the information recorded to the purpose, equipment, materials, parameters, raw data, and observations, rather than including complicated calculations for resulting data analysis.

"These extra calculations add more for the reviewer to check, and it wastes time," she explains. "The raw data can later be entered into a pre-established spreadsheet, such as Excel, which performs the calculations and graphing for you. This way, you can be relatively sure of the accuracy of the data and spend time focusing on the interpretation, not crunching and reviewing data."

Schwartz says having a plan in place for documentation right from the start is essential.

"That is a much easier way to do things than to decide a year or two down the line that you really should be documenting things better—because then you have to go and dig through all these old records to bring them up to speed," he says. "The single best piece of advice I would give is to make it a priority of the lab, such that it's done right from the beginning."

Not doing documentation properly can lead to much bigger problems than having to retrieve and update old files.

"It would be detrimental to our R&D and potentially harmful to the development of a new product," Matosevic says about what would happen if Akron didn't document everything correctly. "Regulations require detailed experimental procedures to be recorded, so not having that would be a big issue."

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Steve Thomas

ASK THE EXPERT

SELECTING THE RIGHT INFORMATICS MANAGEMENT SYSTEM

by Tanuja Koppal, PhD

Steve Thomas, an investigator within the Drug Metabolism and Pharmacokinetics department at GSK, talks to contributing editor Tanuja Koppal, PhD, about his experiences implementing a database of metabolic knowledge that helps the company store, share, and search data around the globe. The process involved analyzing internal needs, evaluating several options, and finding the right informatics solution to give GSK scientists access to each other's findings to prevent error, repetition, or inefficiency.<

Q: Can you tell us a little about your department and the work that you do?

A: I am in the Biotransformation and Drug Disposition group at GSK, with about 40 scientists at our location here in Ware, UK. In drug development we are a hub for drug metabolism and pharmacokinetic (DMPK) studies, looking to make sure that a benign drug hasn't been turned into something toxic as the body tries to get rid of it. We have a mix of chemists, biochemists, and biologists, and many are analytical specialists for the spectral identification of the structure of small molecules. So, many people with whom I work have expertise in mass spectrometry (MS) or nuclear magnetic resonance (NMR) or both.

We work with fairly high-end NMR instruments that are powered with cryoprobes that give us exquisite sensitivity to be able to get information from very small amounts of material that we get back from clinical trials. For MS, we have matrix-assisted laser absorption/desorption (MALDI) and time-of-flight (TOF) instruments, as we need the power of these instruments to be able to tease out the materials from the complex biological matrices that they come buried in.

Q: Working with different types of instruments and data, what kind of informational challenges do you face?

A: For us to be able to get a coherent picture of what the body does to our drug molecules, we need to be able to bring all the data together into one place, just like humans bringing together pieces of a jigsaw puzzle. We have two techniques that are complementary to each other. We have the sensitivity of MS along with the selectivity of NMR, and we need all that data put together to be able to find the molecular structure. Prior to 2009, that place was an analyst's head. We had a very talented analyst who had been with the company for decades, and when he retired we realized just how reliant we were on people's memories. The call then went out to get a database approach to try to replace that dependence on human memory.

Q: What did getting this database involve?

A: We had to involve ourselves in a due diligence process to go out and see what was available in the marketplace at that time that fitted our workflow and the success criteria we were looking to achieve. We looked at a number of different vendors and found that ACD/ChemFolder Enterprise and ACD/SpecManager Enterprise from ACD/Labs fitted our workflow best. It was a work in progress since the two pieces of software managed structural schema and spectral data in two separate databases. We wanted it to hold integrated structural and spectral data for a complete biotransformation map—the body produces upwards of 50 metabolites. So we wanted to push the software further than it was intended. We did a pilot trial and the software held up, giving us the possibility to store the data with a biotransformation map, which included a schematic of the complete metabolic fate of a drug as a top-level executive summary. So the people who were interested in just knowing what happens to the drug in our body could look at the top-level summary, and people who were more interested in the analysis to prove those structures could dig down deeper in the database.

One of the things that became apparent was that this database could be searched from various angles. As you associate data with a molecule, you are building up metadata as well as an information-rich environment around its basic structure. People were interested in this data for many reasons. Some wanted the NMR data to help with their analysis, while others needed the fragmentation data from MS or wanted to know which liver enzyme caused this metabolite to be produced. So what people really wanted was a data cube—a database that could be picked up and turned around to look at the facet that you were interested in. They wanted something that could be drilled down from the angle or perspective that you asked your question from. So that's how we started using ACD/ChemFolder Enterprise, which has now morphed into a single integrated chemical and analytical knowledge management solution on their latest offering—the ACD/Spectrus Platform.

Q: How did you go about defining the success criteria for what you were looking for?

A: You have to speak to internal customers to find out what is required now, and then you need a crystal ball to see if this solution can grow to fulfill your requirements in the years to come. One of the first criteria we had was ease of putting data in. If putting data into the database is

Steve Thomas has a degree in chemistry from Warwick University, UK. Always intrigued by puzzles, he gravitated to analytical chemistry, choosing a third-year project in mass spectrometry under Prof. Keith Jennings. Steve graduated in 1990, taking a position in the NMR department of Merck's Neuroscience Research Centre at Terlings Park. While gaining a wealth of experience in medicinal chemistry support, he became analytically bilingual, speaking both NMR and mass spec, to tackle the most challenging aspect of the role: the structural identification of drug metabolites. He expanded on this role, leaving Merck in 2006 for GSK, to join the Biotransformation and Drug Disposition group as an investigator within the Drug Metabolism and Pharmacokinetics department at Ware in the UK. The seamless combination of analytical techniques to generate reliable definitive structures was even more vital as he was moving from a discovery to a development environment. To facilitate assignments and add confidence to results, ready access to past analyses and knowledge proved invaluable but elusive. It became clear that the company was generating far more data than any one individual could keep in their head. Steve led the efforts to find a suitable platform to store, search, and share their data globally. Such a database mitigated the risk of duplicated effort, but required a deep dive into the dark arts of informatics. His success was measured by the quality of the resulting repository of knowledge that didn't forget, go senile, retire, or leave the company for a competitor.

as painful as pulling teeth, then you end up with compliance issues. Getting away from the power of memory was the second criterion, and with moving to a database that was a given. We also needed the internal processes and backups in place to make sure that if the data became corrupted we could "wind back" a couple of days and retrieve the stored data. Other criteria for selection included ways to speed up the process of interpretation by being able to look at and interrogate the data belonging to a colleague who is located across the Atlantic. This would be akin to looking into his lab notebook to see what he has worked on in order to help with a similar problem that I am facing. Other criteria included improving the confidence we had in the hits we got from the database, reducing the likelihood of making mistakes in elucidating the data, and increasing our ability to share the data when we wanted to conduct a richer peer review.

Q: So is it easy to share the data using this database, and how secure is it?

A: Data security is taken care of by our IT personnel, and we have a licensed access to the database from an Oracle-based server that has a firewall. If you need to share your data with external customers such as contract research organizations (CROs), you need to put special procedures in place. You could sanitize a certain space in your database and give the external customers access to it so that they don't get access to your entire database, although that's not something we do here.

Q: Is there something that is lacking or can be improved upon?

A: The ability to share our data with the rest of the organization still requires licenses to the software. This is currently changing; soon anybody in the company who could benefit from the data can get access to it. Just as the power of the biotransformation map that links the parent molecule to its metabolites works for us, I can see other groups, such as degradation chemists, benefitting from this as well. They also have clusters of molecules where the active ingredient is broken down over time or by the environment, so they would benefit from a similar approach.

Q: Were you able to customize the database to fit your needs?

A: It's almost scarily flexible! You have carte blanche to rename bits of metadata, including what species you saw the chemical structure in, what biological matrix was used, when the analysis was done, the instrument it was done on, and the name of the analyst. You are just creating areas on the database that you can then control, and as the database grows you can use all this information to do a very specific search. We are happy with the speed with which we can search. However, there is a lag when you work directly with the remote database. So we first have to create a local database as a part of our workflow. The idea is to do all the work locally and then export the data to the remote database at the end of the day or when the job is done.

Q: Is the database fairly intuitive or did you have to undergo extensive training to use it?

A: The first criterion was the ease of getting data in, so the intuitive nature of the software was a priority. However, ACD/Labs did provide the necessary training and we have had subsequent training on the various releases of the software as it has evolved. We tend to run with our core users who are more experienced in using the database, and for our part-time users, who use the database for some spectral identification, we have our in-house resource work through any issues with them. We have training manuals and user guides online that people can use, allowing most problems to be very easily resolved.

Q: How do you justify the return on investment for this database?

A: The thinking we have embraced to justify our investment is to remind ourselves that this approach could save an error from being made or stop an interpretation from being wrong. If clinical trials "go wrong" because an incorrect interpretation was used, then the ramifications can be severe. This database is a rich resource that can "link up" our organization; it can save us from suffering the possible negative outcomes from continuing to rely on human memory, which are really scary.

Q: What is your advice to lab managers in a similar situation?

A: First, talk to your internal customers and find out how much can be gained by linking your data to those of others in your organization. The idea is that your data creates reports and you want those reports to go as far across your organization as they possibly can. Also, you want to get something that works for you. Find a piece of data that is particularly onerous and use that in a demonstration to find the weak links in your current software or system. We did that, and we did end up "breaking" the software when we evaluated it. ACD/Labs was very proactive and reactive to what we had found, and we worked together through the pilot trial to fix it. This did not just involve requests that we were making to suit our workflows, and ACD/Labs understood that what we were uncovering would make their software a better product.

BREATH OF FRESH AIR

RESPIRATORY PROTECTION BASICS

by Vince McLeod

In the mid-1980s there was a fire in a feed and fertilizer store in Gainesville, Florida, where the Safety Guys lived and worked. Large quantities of smoke were generated, and police were called in to assist with cordoning off and securing the area. Many of the officers who were stationed downwind ended up with some significant symptoms of chemical exposure through inhalation of the smoke from these agricultural products. Some of our fire service personnel referred jokingly to these perimeter officers as the "blue canaries," demonstrating the boundary where use of respiratory protection was needed. Shortly after this fire, we were asked to come help set up a respiratory protection program for the police department. To the best of our knowledge, the department didn't have a single functional respirator available at the time of the fire.

Things have come a long way since then, and use of respiratory protection in hazardous atmospheres is the norm. Yet there are still many misunderstandings and misconceptions surrounding the use of respiratory protection, whether it is in response to a possible chemical spill incident in the lab, processing chemical wastes in confined spaces, or just dealing with routine chemicals in your normal activities. So, as they say, let's begin at the beginning.

Respirators are designed to prevent contaminated air from entering the body. There are several basic facepiece designs. Typically, one sees "half mask" respirators, which cover just the nose and mouth; "full face" respirators, which cover the entire face; and "hood" or "helmet" style respirators, which cover the entire head.

Respirators can protect the user in two basic ways. The first is by cleaning the "dirty" outside air that passes through a filter or adsorption bed or both when one inhales. This type is known as an air-purifying respirator (APR). The other main type of respirator protects the user by supplying clean breathing air from a remote source. The clean air can either be delivered via a supply line (supplied air respirators—SARs), or the clean air is packaged and carried with you in a tank (a self-contained breathing apparatus—SCBA), such as by a scuba diver.

When using APRs, one must first have a good idea of the nature and concentration of the contaminants against which one needs protection. For example, are you seeking protection against actual chemical hazards or simply avoiding exposure to unpleasant odors? In addition, one should ensure that there is adequate oxygen (at least 19.5 percent by volume) in the air, because the APR simply cleans the air and will not provide extra oxygen. If there is inadequate oxygen, as one might find in confined spaces, APRs cannot be used, and one must use a supplied air type.

> "APRs should be used only for materials that have good sensory 'warning properties' such as odor or irritation."

For non-particulate contaminants, APRs should be used only for materials that have good sensory "warning properties" such as odor or irritation. This alerts the user to respirator failure either through seal leakage or cartridge overloading. OSHA requires use of cartridges/canisters with end-of-service-life indicators (ESLIs) or establishing cartridge change-out schedules to reduce the likelihood of contaminant breakthrough. These schedules will vary with

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SAFETY TIP

MAKE LEARNING HOW TO BE SAFE AN INTEGRAL PART OF EDUCATION, WORK, AND PLAY

By James. A. Kaufman

For too many years at academic institutions and some companies, health, safety, and the environment have been something extra. It's time that they become part of the process. At Dow Chemical we were told that we were being paid to do three things: 1) work safely, 2) conduct active research programs, and 3) publish the reports and patent disclosures resulting from our research. Safety was part of the job—not something extra.

The slogan at the Bell System is: "No job is so important and no service so urgent that we cannot take time to perform our work safely." At Dow, it was each person's responsibility to be sure that their work could be performed safely. If you don't think it's safe to do, don't do it. LSI has paraphrased the Bell System slogan in one of ours: "No lesson is so important and no task so urgent that we cannot take time to teach, learn, and practice science safely."

These kinds of attitudes and values are built over time by companies and institutions that make it very clear that they value safety. Educators need to have the time—as part of their regular working day—to set-up and test experiments, to look up the hazards of chemicals, and to find out what protective equipment and protective facilities are needed. This IS the job.

There's an interesting quote from Jacob Riiss:

> *"When nothing seems to help, I go and look at a stone cutter hammering away at his rock perhaps a hundred times without so much as a crack showing in it. Yet at the hundred and first blow it will split in two, and I know it was not that blow that did it—but all that had gone before."*

Source: Kaufman, James A., Laboratory Safety Guidelines - Expanded Edition, The Laboratory Safety Institute, www.labsafetyinstitute.org.

the type of work done, the effort expended by the user, and the nature and concentration of contaminants encountered. The technical assistance group of your respirator manufacturer can help establish these change-out schedules. A certified industrial hygienist (CIH) can conduct exposure assessments to determine contaminant levels and establish change-out criteria through actual sampling of representative processes.

We must emphasize that respirators only reduce the amount of contaminants within the breathing air but don't eliminate them altogether. Each type of respirator carries an "assigned protection factor," which can be considered the theoretical amount of protection a properly fitted respirator might provide. The highest protection factor for APRs is only 50, according to NIOSH. APRs should be used only in relatively low-hazard areas where a single face respirator seal break might be unpleasant but not dangerous.

For high-hazard areas where atmospheres are oxygen deficient or otherwise immediately dangerous to life and health (IDLH), the use of supplied air or SCBA is required. Although one may still find some demand-type units where negative pressure with respect to the outside of the mask is created when taking a breath, these provide much less protection than the pressure-demand units. With pressure-demand supplied air, the space within the mask is maintained at a higher pressure than that of the outside air. Thus, if there is a break in the respirator seal, air should rush out of the mask, preventing the entry of any contaminants. The use of SCBA should be required for initial entry into clandestine drug labs due to the multitude and unknown concentrations of chemical hazards that may be present.[1]

A few words on OSHA regulations regarding respirator use.

The two basic requirements are that no one may use a respirator unless he or she is first given a medical evaluation and then tested to ensure that the respirator provided will actually fit to provide protection. In addition, anywhere respirators are used to protect one's health against respiratory hazards, OSHA requires development of a respiratory protection program in accordance with 29 CFR 1910.134.[2] Where respirators are used on a voluntary

basis, fewer program elements are required to prevent hazards associated with respirator misuse. Suffice it to say that if your organization is using respirators, you should have a written program and an administrator well versed in this OSHA standard.

Before a user ever puts on a respirator, OSHA requires (and it makes good sense) assurance that users are physically capable of wearing a respirator. OSHA 29 CFR 1910.134 states "The employer shall provide a medical evaluation to determine the employee's ability to use a respirator before the employee is fit-tested or required to use the respirator in the workplace." It goes on to say, "Employees that use any respirators, including respirators such as air-supplied positive pressure face masks or hoods, must have a medical evaluation before use."

One must also ensure that the respirator fits the wearer. A respirator that does not fit properly simply gives the false impression of protection and may be more dangerous than no respirator at all. There are specific fit-test protocols that are accepted by OSHA. The following is an excerpt from an OSHA compliance directive:

1. Respirators must be fit-tested.
2. A "test atmosphere" must be applied to assess the quality of fit.
3. The fit-test must be applied to each and every employee required to wear a respirator.
4. The fit-testing requirement applies to all negative-pressure respirators, including SINGLE-USE RESPIRATORS.

Respirators allow us to go where we could not normally enter safely. The use of respirators should not be taken lightly or in a cavalier manner. When used improperly, they can put people in greater jeopardy. Remember, respirators should be used only as a last line of defense when other control systems, such as adequate ventilation or hazard containment, are not feasible.

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Vince McLeod *is an industrial hygienist certified by the American Board of Industrial Hygiene and the senior industrial hygienist in the University of Florida's Environmental Health and Safety Division. He has 25 years of occupational health and safety experience at the University of Florida, and he specializes in conducting exposure assessments and health hazard evaluations for the university's 3,000-plus research laboratories.*

LABORATORY GAS GENERATORS

RELIABILITY, CONTROL KEY ISSUES

by Angelo DePalma, PhD

For David Hemmig, director of equipment sales at Matheson Tri-Gas (Basking Ridge, NJ), the key word in on-site gas generation is reliability. He explains that a major problem with gas generators that incorporate some sort of compressor is that eventually that component fails.

Nitrogen and zero air generators, for example, often use compressors to bring air into the system. The zero air generator "fine tunes" the product by removing hydrocarbons. "But the compressor is the weak link," Hemmig says.

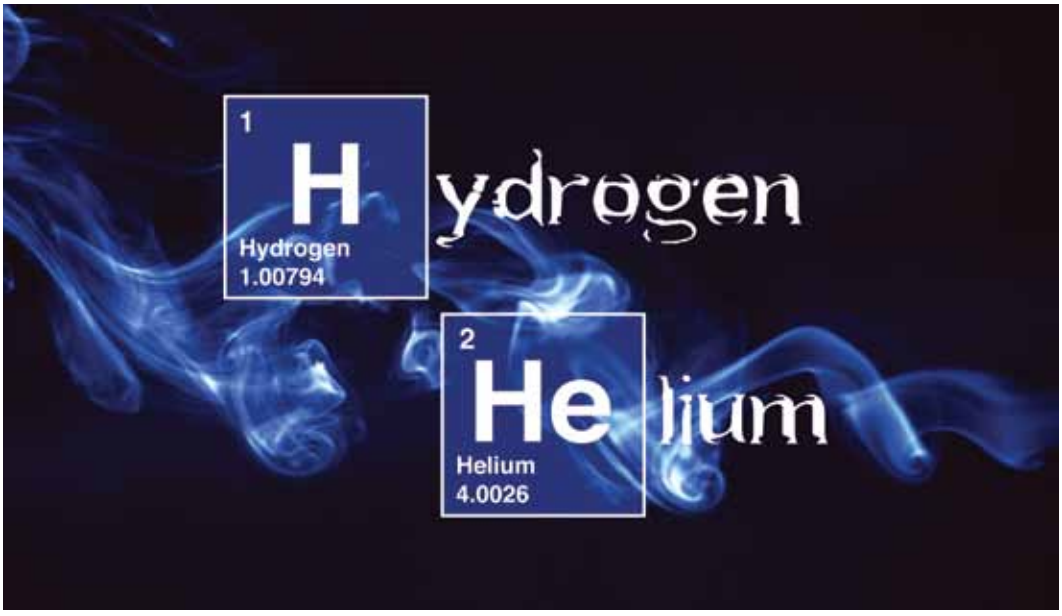
For nitrogen generators, the compressor serves a similar purpose, but separating pure nitrogen from air (which is 78 percent nitrogen) is slightly more difficult. Membranes represent the established technology, while units from Air Products (Allentown, PA), for example, use pressure swing adsorption. Regardless, when the compressor fails, nitrogen generation ceases.

"Failure rate is why we avoid compressors," Hemmig emphasizes. "We do have models that use them, but we prefer to sell the ones without compressors because they'll work forever."

> "The key word in on-site gas generation is reliability."

The alternative to compression is bringing in tanks of compressed air, which Hemmig says is no big deal. "Companies are used to gas cylinders. We believe a gas generator should be at least as reliable as a cylinder."

House air is also a possibility, but users must first remove ubiquitous pump oils before allowing house air into generators. "Systems need to be as oil-free as possible." Matheson and other firms sell in-line purifiers to remove oil in house air.



Together, we can conserve non-renewable helium by converting GCs to hydrogen.

Helium is a non-renewable resource. There is a global shortage of helium that has caused prices to increase significantly. Many GC users are considering switching to hydrogen as a carrier gas.

Hydrogen provides many advantages over helium including, higher resolution, shorter run times, longer column life, and cost savings. Many instrument manufacturers now provide resources to make switching carrier gas easier.

A hydrogen generator is a safe, convenient, and inexpensive solution to storing hydrogen cylinders.

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Hydrogen generators to the rescue

Reliability is a theme in hydrogen generation as well, although these systems work on the principle of water electrolysis and do not require gas compression. The ongoing helium shortage has created a robust market for hydrogen in gas chromatography.

> "GC has a heater and a small enclosed space, and the gas is not burning off as it does in FID. People think 'Boom!'"

Hydrogen was always part of GC instruments that used flame ionization detection (FID). Today, with helium in short supply, companies are turning to hydrogen as a carrier gas, which has caused a boom in gas generator sales.

"The shortage remains a hot topic," says Kim Myers, global product manager at Parker Hannifin (Haverhill, MA). "Many companies today are rationing helium or have no access to it whatsoever. Those who can get it are paying five times as much as a few years ago."

Thanks to helium's scarcity, vendors of gas generation equipment are enjoying unexpected assistance from instrument companies that now write articles and make presentations on the benefits of hydrogen carrier gas.

Myers explains, "Think about it. GC has a heater and a small enclosed space, and the gas is not burning off as it does in FID. People think 'Boom!' But because they want to keep selling instruments, those companies are now singing the praises of hydrogen and are helping customers switch over from helium. Companies like Shimadzu, Thermo, and Agilent are blazing a trail for us."

Several vendors, including Agilent, provide hydrogen leak detectors.

In the past year, Parker has launched products with higher flows and pressures, greater reliability, and interconnectivity, which help labs replace cylinders with generators. The company has also innovated with system software that allows load balancing, which benefits primarily high-volume users. Load balancing allows multiplexing up to 32 hydrogen generators into a single manifold with simultaneous independent control.

If one generator fails, the remaining units pick up the slack to rebalance back to the original aggregate production rate. No generator works harder than any other.

> "The ongoing helium shortage has created a robust market for hydrogen in gas chromatography."

Load balancing also enables control and performance monitoring of a network of hydrogen generators through a USB connection to a computer.

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

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MICROPLATE READERS

CELL-BASED ASSAYS REQUIRE COZY NEW FEATURES

by Mike May, PhD

Life scientists started using microplates in the 1950s, with some of the first ones literally machined from solid blocks of plastic. You don't need to wander around a molecular biology lab long today to see the progress in microplates, some now including thousands of wells. Beyond the number of wells, biologists also use many plates. To analyze the contents, scientists use microplate readers, and they are advancing just as rapidly as the plates—probably even more so.

The most sophisticated microplate readers help scientists take care of their samples while they analyze them. In addition, advanced devices provide more analytical capabilities.

Staying alive

When asked about the most interesting new features in microplate readers, Xavier Amouretti, manager, product marketing at BioTek Instruments (Winooski, VT) says, "Cell-based assays drive most of them." He adds, "More and more, people in research labs are working with live cells in microplates." In many cases, a life scientist selects the live approach because it replicates biology in more realistic conditions.

To maintain healthy conditions for live cells, some microplate readers now control the sample environment for carbon dioxide and oxygen. Live cells often need other pampering, such as shaking them in just the right way. So scientists can select a microplate reader that provides a range of shaking options. As an example, Amouretti says, "Yeast tend to grow when in suspension, so you need a reader that shakes continuously while you make the measurement."

In addition, the surge in cell-based assays spawned other advances in microplate readers. For instance, some vendors now make a microplate reader that includes a microscope. "So you can make a measurement in a well and image the cells," says Amouretti.

In Salvatore Pizzo's laboratory at Duke University in Durham, North Carolina, for example, lab research analyst Maggie Kennedy uses the BioTek Cytation 3 plate reader, mainly for cell-based assays. She says, "I look for versatility in a plate reader, something that can perform multiple functions in one machine." She also appreciates that this microplate reader allows more than one mode of detection. She says, "I love the microscope function. Being able to visualize individual cells in addition to getting a general fluorescent signal of a well will be very beneficial to our research."

"More and more, people in research labs are working with live cells in microplates."

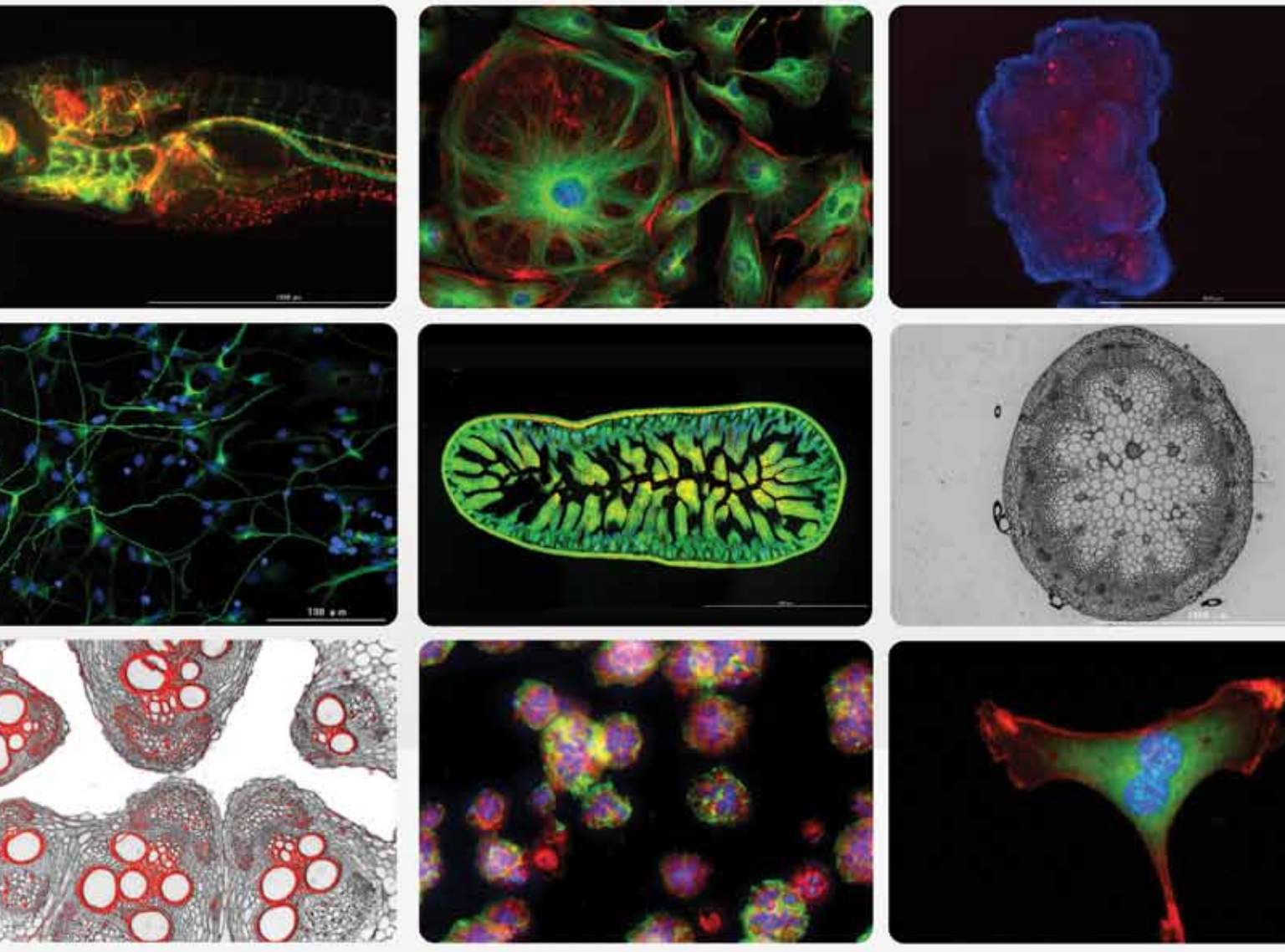
Dialing in sensitivity

Despite the advances available in microplate readers, not every user runs complicated experiments. "Many of the assays that have been run in microplate readers are still used, like simple concentration measurements or looking at characteristics of a specific molecule," Amouretti explains.

Some users, though, need more options. As an example, Ronald L. Earp, president of BMG LABTECH (Cary, NC), describes using a linear variable filter (LVF) monochromator. "It offers essentially an infinitely adjustable filter," he says. "You can set the center wavelength and set the bandpass. Traditional monochromators have only one, or few, specific bandpasses." In Earp's instrument, he says, "You can increase or decrease the bandpass of the LVF monochromator with a click and drag of a mouse."

This capability proves incredibly valuable when working with fluorescent proteins with various emission characteristics. "There are multitudes of them," Earp says. "You'd need more than thirty filters to measure them all." An LVF monochromator can just be adjusted for different fluorescent or luminescent labels. It's also possible to incorporate an LVF dichroic that enhances a microplate reader's sensitivity. "This combination," says Earp, "helps when you have a weak emitter or fluorescent proteins with a small Stokes shift."

CYTATION 3
imaging reader



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Beyond adjusting emission and detection of fluorescence, some users will want a microplate reader that provides as many options as possible. For example, a microplate reader in a core lab might be applied to a range of experiments. In such a situation, a reader that works in various ways could be the best choice. For example, some microplate readers work in fluorescence and luminescence modes, plus absorbance in some models. As Earp points out, moving from one mode to the other can be easy. "In ours," he says, "you just click a button in the software. Then, it's all handled automatically." A core lab might also seek that level of ease of use to accommodate users of various levels of experience.

"As well volumes decrease and cell-based assays diversify, the features of microplate readers keep increasing."

Shrinking the size

For people looking at DNA, RNA, or protein quantification, says Michael Fejtl, market manager of detection at Tecan Austria in Groedig, "they like small volumes, like two-microliter volumes." He adds, "There are several low-volume plates available from different vendors." Sometimes, though, the measurement spots require the reader to calibrate the path length—the distance to the sensor—for every spot, and that can slow down the acquisition rate. To address that challenge, Tecan developed the low-volume NanoQuant plate with 16 spots, and each one, he says, "is exactly the same path length from the sensor and does not need to be calibrated." As a result, Fejtl says, "This is great for customers using low volume and for fluorescence labeling."

Getting smaller cell numbers in microplate readers can also require higher sensitivity, or being able to pick up smaller signals. "Cells can clump in the wells or grow nonhomogenously, but you need to be able to read them," Fejtl says. "Some of our new readers increase sensitivity by a factor of twenty with the optimal read function." He adds, "That's a key feature for cell-based assays."

As well volumes decrease and cell-based assays diversify, the features of microplate readers keep increasing. As Fejtl says, "There's a whole range of readers." With a little shopping, you can find just the one for you. But make sure to evaluate all the features now available, because they keep changing, offering new ways to automate and enhance the process of analyzing microplates.

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

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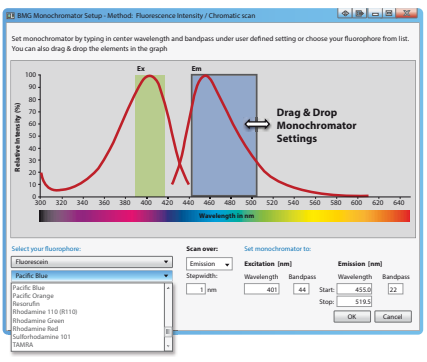

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MASS SPECTROMETERS

GROWTH FUELED BY LIFE SCIENCES, MINIATURIZATION

by Angelo DePalma, PhD

According to a report from Persistence Market Research, *Mass Spectrometry Technologies Market Assessment Report—Global Size, Share, Competitive Landscape, Future Prospects and Forecast from 2013-2017*, mass spectrometry (MS) is one of the few instrumentation markets that has recovered fully from the last recession. The study estimated the total market for MS at $3.175 billion in 2012 and expects it to reach $4.84 billion by 2017, a growth rate of 8.8 percent per year.

North America and Europe comprise more than half of current demand, 32 percent and 29 percent, respectively, with Asia-Pacific close behind at 27 percent. Top players are AB Sciex, Thermo Fisher Scientific, Agilent, Waters, Bruker, and Shimadzu. Growth in life science markets, particularly in pharmaceuticals and biotech, are fueling the growth in MS.

The report specifically cites miniaturization as a factor in the success of MS. A key consequence of MS instruments getting smaller and more feature-full but less costly has been the adoption of MS as a detector for high-performance liquid chromatography (HPLC) and gas chromatography.

The "mass detector"

Mass detectors for chromatography systems, while not quite ubiquitous, are steadily gaining ground in analytical labs, particularly in regulated industries as a complementary detector to UV. MS confirms the identity of peaks seen in ultraviolet traces and quantifies and identifies compounds lacking a UV chromophore. MS has become the go-to detector where science or regulation calls for lower limits of detection for impurities or target analytes. The knocks against MS, however, have been high cost and its requirement of specialized expertise.

Waters (Milford, MA) has recently introduced a new mass detector, the ACQUITY QDa Detector, for chromatography separations. According to Howard Read, senior product manager for mass spectrometry, the ACQUITY QDa Detector was a response to customer needs, particularly in pharmaceuticals.

"The driving trends here are risk mitigation, quality management, compliance, productivity, and cost control," Read says. "We were responding to these ongoing needs of generating enhanced data for every sample analyzed, particularly for laboratories that do not currently employ mass spectrometry. Now they can make scientific decisions without having to send samples out or bring in an MS expert."

This is only possible if the transition to MS from traditional detectors is seamless. MS had to be as familiar and accessible to analytical scientists as their optical detectors are. When designing the ACQUITY QDa Detector, Waters attempted to duplicate users' familiarity with optical detectors with respect to use, size, affordability, and software integration.

"The knocks against MS … have been high cost and its requirement of specialized expertise."

From an end-user's perspective, achieving ease of use is perhaps the most significant hurdle to adopting MS, which is still, for many, an intimidating technology. Unlike conventional MS instrumentation, which requires optimization and tuning for different separations, the ACQUITY QDa Detector is pre-optimized and runs without adjustments or tuning for most samples. "Users have very little to do except turn it on. The ACQUITY QDa Detector is as close as you can get to out-of-the-box MS," Read tells *Lab Manager*.

Competitive threats?

MS detection adds anywhere from $100,000 to $500,000 to the cost of an LC or GC system, according to Jason Weisenseel, PhD, technical leader at PerkinElmer (Orlando, FL). That puts it outside the scope of many laboratories that expect to pay a great deal less for the separations platform itself. The immediate benefits, depending on the type of MS, are additional mass and fragment information and about ten times the

sensitivity of UV. Higher-end triple quad MS provides the quantitative precision of a UV detector—below 2 percent—and sensitivity close to the LC lower limit.

The emergence of alternatives to MS for companies that rely on high sensitivity and ultralow limits of detection could somewhat deflate the market projections cited earlier. In other words, all is not lost for chromatography labs that cannot afford MS. Sensitivity is constantly improving for ultraviolet and photodetector array (PDA) detectors, whose flow cells are evolving toward lower-volume, lower-dispersion, higher-sensitivity detector cell designs.

For analytes lacking a UV chromophore, such as sugars and most amino acids, evaporative light scattering (ELS) is becoming more prevalent and is sometimes used alongside MS detection. "ELS is sensitive and provides an important alternative to the older refractive index detectors, which cannot be used with gradients," Weisenseel says.

LAESI solution to sample prep woes

A relatively new technique is changing the way mass spectroscopists view sample preparation. LAESI (laser ablation electrospray ionization) is a variant on standard electrospray ionization (ESI), long considered a "gentle" ionization technique for analyzing large, delicate biomolecules by MS. LAESI performs direct extraction and ionization for stand-alone samples or for profiling the distribution of biomolecules in a variety of sample types.

For example, researchers talk about merely "waving" samples before a LAESI device and achieving sufficient ionization for MS analysis. Says Haddon Goodman, LAESI platform marketing manager for Protea Biosciences (Morgantown, WV), "LAESI's main advantage is operation at ambient pressure with no sample prep and no addition of matrix."

Because it occurs at ambient pressure, LAESI allows users to analyze bacterial and fungal colonies for interesting natural products that may be channeled into, say, a drug development pipeline. "LAESI enables investigators to search through hundreds of thousands of colonies to find specific molecules of interest," Goodman tells *Lab Manager*. A group at the University of Oklahoma is screening fungal colonies for secondary metabolites, for example. "LAESI is just about the only way to analyze them at this level of throughput," Goodman adds. "It allows users to submit samples that could previously not be analyzed by mass spec."

Goodman describes LAESI as a "post-sample introduction method." Unlike LC, it does not take "heart cuts" of peaks. And by itself LAESI does nothing—it requires an MS to work its magic. "It's a front end for MS," Goodman says.

The no-sample-prep aspect of LAESI results from its operation. It uses a 2.94-micron laser tuned to the absorption lines of water. When the laser strikes the sample, it induces rapid boiling by exciting the OH bonds in water, thereby generating an uncharged ablation plume that ionizes in contact with charged electrospray and sweeps into the MS.

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

VISCOMETERS

THE RANGE OF MEASUREMENT CONDITIONS KEEPS EXPANDING UP AND DOWN

by Mike May, PhD

The ease of adding ketchup from a squeeze bottle to an order of French fries, the trouble that it takes to press toothpaste out of a tube, and many other common needs depend on viscosity. If toothpaste, for example, is not viscous enough it would just pour out of control from the tube; if it's too viscous, you might need a steamroller to get something on your brush. In discussing the measurement of viscosity overall, Bob McGregor, manager of global marketing and high-end instrument sales at Brookfield Engineering (Middleboro, MA), says, "It's a huge area. In any industry with materials that physically flow, you can be sure they've been tested for viscosity."

The options for measuring viscosity are just as numerous as the applications, and growing. When asked about exciting trends in viscosity measurement, Eric Swertfeger, director for viscosity products at Anton Paar (Graz, Austria), turns immediately to temperature. "They want to see how far they can push it—high and low—and still get reliable data," he says. For now, the desirable range starts higher than 100 degrees Celsius and goes down below –20, with some people looking to drop that even more. In addition, says Swertfeger, "People want to take traditional methods and make them faster."

At Core Laboratories Canada in Calgary, Ken Chong, general manager and vice president, uses a viscometer for hydrocarbon samples of from light to very heavy oils. When asked about the most important features of a viscometer, he says, "Density and viscosity over a range of temperatures on a single charge, and the minimal volume it requires to accomplish this." He adds, "The former makes it very efficient, and the latter is very important for heavy oil where sample volumes can be limiting."

The features that matter most, though, depend fundamentally on the materials being tested. So setting up the best viscosity measuring system will vary from lab to lab.

Reasons to be unreliable

"With older technology," says Swertfeger, "sample handling and maintenance are huge factors in getting repeatable results." He adds that newer, more automated devices usually just need to be kept clean. "If you make measurements in a dirty environment, you tend to have more problems," he says. For any viscometer, though, he recommends regular maintenance. He says, "For anything that requires a specific temperature, you need a reference to check it against. That way you can verify the operation of your instrument."

> "People want to take traditional methods and make them faster."

Newer technology can also be more accurate. For example, Anton Paar offers a frictionless technology that provides more accurate results.

Today's viscometers can also be easier to use. As an example, McGregor points out the touchscreen interface. "You can use it like a handheld device," he says. "It also provides the ability to see live graphical information in terms of what's being measured."

In many cases, companies can save money by placing a viscometer in a production line, making measurements in real time. "This way," says McGregor, "they can monitor viscosity continuously and make process changes if they see deviations."

When shopping for a viscometer, McGregor encourages customers to "try to do what others are already doing, because they've established test procedures on known parameters." That way, you can find the right instrument and figure out how to use it without starting from scratch.

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

LIMS

CENTRAL DATA REPOSITORIES REINVENT THEMSELVES

by Angelo DePalma, PhD

Despite having been available for close to 30 years, laboratory information management systems (LIMS) are about to undergo a metamorphosis characterized by greater utility, accessibility, and availability—at lower cost.

The first LIMS implementations resided on mainframe computers at large companies, a situation that permeated the product platform for several decades, even after personal computers became ubiquitous.

"LIMS technology has lagged behind other software at several levels," says Aubree Hoover, senior product manager at GenoLogics Life Sciences Software (Victoria, BC, Canada). GenoLogics specializes in LIMS for proteomics and genomics, particularly next-generation gene sequencing.

Overcoming deployment difficulties

LIMS's reputation for difficulty of use, high cost, a steep learning curve, and spotty accessibility is about to change, as GenoLogics and other firms are offering web-based LIMS and expanding accessibility to portable devices such as smartphones and tablets.

GenoLogics released a cloud-based product in 2013 and now supports tablets as well.

Which raises the question of accessibility versus feature set. "To some degree the software must be simplified for use on mobile devices," Hoover admits. Applications requiring significant keyboard input, for example, are inappropriate for tablets. GenoLogics has instead focused on a level of utility for which handhelds excel, such as sample tracking, and other uses that make sense for tablets.

Many LIMS vendors now provide some level of service "in the cloud"—known as "software as a service" (SaaS). The idea makes sense for many industries, particularly those that are highly science-based, such as GenoLogics' next-gen sequencing customer base. "Many start-up diagnostics companies have no interest in managing their IT in-house," Hoover tells *Lab Manager*. "They want a LIMS, they need one, but they don't want the overhead."

Luckily for them, their data is much more secure at a data center than on-site, and the service is less expensive than an in-house installation. Downtime is also significantly reduced, as the LIMS company does not need to travel to the customer for troubleshooting.

GenoLogics services its cloud customers through Amazon Web Services, whose commercial tagline, "Launch virtual machines and apps in minutes," illustrates another significant benefit for cloud-based LIMS customers: virtually no start-up time. "Deploying a LIMS used to be like starting a major construction project," Hoover says.

These benefits have contributed not only to lower prices for functionality equivalent to the most sophisticated systems of a few years ago but also to a "democratization" of LIMS.

One repository

That is not to say that high-end LIMS installed at the customer's brick-and-mortar facility are going away any time soon. Mike Kelly, sales director at LabWare (Wilmington, DE), notes that over the years many organizations have added layer upon layer of LIMS. Kelly notes a large pharmaceutical customer he visited—a potential customer—already had seven LIMS installed.

The situation, which arose due to the "siloization" of data segments at large companies, is not unique, Kelly says. "But it flies in the face of what a LIMS is supposed to do, which is to provide a single repository for all data."

Today's life sciences organizations, however, are beginning to recognize the benefits of collaboration across research, development, diagnostics, and patient care. "Creating a single log-in, integrating as much data as possible with the same accuracy checks on all data, facilitates collaboration," Kelly adds. "You can't merge seven tasks into one when the LIMS can't see five or six of those tasks."

The importance of "one LIMS, one log-in, one repository" to highly integrated teams is exemplified by hospitals that conduct translational medicine. These organizations house laboratories that conduct basic research, patient records, diagnostics labs, and clinicians. Making sense of projects that flow "from the benchtop to the bedside" would be impossible with seven LIMS but enhanced by one such overarching, all-encompassing product.

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

How LIMS Are Enabling the Mobile Lab of the Future

By Matthew Grulke, Thermo Fisher Scientific

Imagine that you're a field technician for a public water provider. Your company is committed to supplying clean, safe drinking water to millions of people, so it has implemented a sophisticated water sampling program to ensure water is free of contaminants. Across this water company's territory, technicians just like you are collecting and testing samples from reservoirs, water treatment facilities and even customers' homes.

Today you're collecting samples from various points around a lake that supplies water to one of your company's main processing facilities. After filling each sample bottle, you transcribe its barcode into your notebook. You check your watch and jot down the time. You remember to add a preservative that ensures the sample gives accurate readings after it has been transported to the lab. Finally, you pull out a GPS unit and note your exact location coordinates. When you get back to the lab, all of this information – recorded manually – will need to be re-entered into a database and combined with the test results.

As you pack up your notebook and GPS, it hits you: All of this data could more easily be collected – not to mention transmitted back to the lab – on a single device; for example, the iPhone in your pocket.

"Combining mobile devices and a LIMS brings a sampling program's entire chain of custody under one secure umbrella."

Mobile devices are an increasingly critical component of modern life, and that trend holds true for laboratories as well. Regardless of industry, the incredible (and constantly evolving) features on these devices can enable technicians to easily capture new types of data more accurately and from more remote locations, but they also pose an interesting challenge. How do laboratories ensure that all the data collected via mobile devices is accurate, secure and organized? The answer is a Laboratory Information Management System (LIMS). Just as a LIMS enables an automated, paperless environment inside the lab, it can integrate with mobile devices in the field to ensure that data collection, transmission and analysis are fully optimized.

New Devices, New Opportunities

The most straightforward benefit mobile devices bring to the lab is, quite simply, more data. The more data that labs have available, the more effective they can be, provided that the data is organized and accurate. That's where the LIMS comes in. A LIMS enables users to transmit information directly from the field into the database, eliminating error-prone manual transcription. The ability to go completely paperless is no longer bound by the physical constraints of the laboratory itself. The LIMS ensures that location information, barcode reading, precise timing and any other data the technician collects are linked directly to the test results. In other words, combining mobile devices and a LIMS brings a sampling program's entire chain of custody under one secure umbrella. This enables improved regulatory compliance, traceability and auditing, of course, but it also makes for better management.

One of the greatest advantages of mobile devices is that they're a two-way street. Not only can users submit data to the LIMS, they can examine and look at data on a device without physically entering the lab. Today's state of the art LIMS such as Thermo Scientific SampleManager offer connectivity with mobile devices that allow lab personnel to visualize results from high-level trends down to granular details.

For labs performing extensive chromatography runs, for example, data must constantly be monitored to ensure results match up with reference data. Scientists aren't interested in general results alone, they want the ability to drill down to the level of individual components and peaks. A LIMS provides access to interactive data – not just a static image such as a JPEG or PDF – from a mobile device, allowing the lab to run far more efficiently. The same goes for automated alerts on sample runs: Mobile devices linked to the LIMS allow users to make a decision from a remote location about whether an outlying result requires a retest or a full investigation, preventing unnecessary delays. Because of these visualization and connectivity advances, laboratory personnel are free to be far more creative as they design workflows. Data management is no longer a limiting factor in the laboratory; instead it is a driving force for innovation.

Learn more
about LIMS and The Mobile Lab

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Matthew Grulke is the Director of Product Development and Technology for the Informatics business at Thermo Fisher Scientific.

MILK TO CHEESE

STARTING AT THE FARM, THIS LAB KEEPS AN EYE ON QUALITY

BY IVAN BARTAKOVIC

Situated in rural Weyauwega, Wisconsin, the Agropur Dairy Cooperative plant continues the rich cheese-making tradition of the state through its production of both cheddar and feta cheese. The laboratory is at the center of all the action in the facility, which also produces lactose powder and a whey protein called reduced lactose. The laboratory is involved in every step of production, starting with testing samples arriving from the farmers' fields, continuing through production, and finishing with releasing the product for shipment to customers.

▲ *Lab supervisor Jerry LaBelle.*

Jerry Labelle, the lab supervisor at the facility, explains, "The primary function of the lab is testing: ingredient testing and a lot of finished product testing." However, the lab is involved in much more.

From the farm to the table

The entire process starts at the 150 farms that the facility receives its milk shipments from. In the dairy industry, it is a requirement that every load of milk must be tested for antibiotics before unloading, and if antibiotics are found, the entire shipment is rejected. As a result, the laboratory is involved with the farmers long before the milk arrives in tankers at the facility. The laboratory accepts samples from farmers that the lab sends away for antibiotic testing to ensure that the cows' milk has no traces of antibiotics in it. If a farmer had a sick cow that was being treated with antibiotics, the testing would give farmers the information they need to be confident the milk they send to the facility would be accepted. The quality of milk is also important to Agropur, and farmers are able to have samples sent away for somatic cell testing through the lab.

When the milk arrives, it is first tested for antibiotics by an intake receiver who is trained to use the Charm three-minute test. If the milk tests positive for antibiotics, the sample is sent to the lab and tested a second time. The lab at the Weyauwega facility is certified to test for antibiotics, and if milk tests positive in this second test, the load of milk is rejected, and the lab work continues with further testing to determine which farm was responsible for contaminating the load of milk.

During processing, the lab performs analyses on cheese and powder samples pulled from production,

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▲ *Lab tech Dan Tellock testing milk sample on milk analyzer.*

and depending on the sample, the lab can monitor the moisture, fat, salt content, pH, and/or ash (mineral content). There is also a microbiology lab on-site, which is responsible for analytical and microbiological in-process testing, running standard plate counts and performing coliform, yeast, and mold analysis on all of the cheeses and powdered products.

A day in the life

The lab has three full-time and three part-time technicians, with Labelle filling in whenever necessary. All of the technicians rotate responsibilities weekly, moving between cheese, lactose, or whey-concentrate product analysis, and they can be given additional duties such as running milk samples, environmental swabbing, or taking air samples. The plant is a 24/7 facility, but the technicians start the day at five o'clock in the morning. The first technician to arrive gathers samples that need to be sent out for external lab testing, whether they are samples from farmers for somatic cell and/or antibiotic testing, or environmental swabs or powder samples for pathogen testing. The technician also generates reports for production, reporting which products need retesting and which products are ready to be released for shipping. The remainder of the shift is spent performing routine analysis on the cheese and whey, and entering the data from the analysis into Oracle.

The next technician who arrives works in the microbiology lab and is responsible for protein analysis, ash testing, and pH testing, and running all of the microbiological work for production on that particular day. Testing starts with ensuring that the milk is suitable for the cheese being produced. To help production workers standardize the milk, the technicians run the samples (milk and cream) through a milk analyzer. To ensure that the milk is producing a high product yield, vat samples made that day are run through the milk analyzer so that the lab can keep track of butterfat and protein for that day's production. The results are provided to the production staff, and the milk is adjusted accordingly. To ensure that the consumer receives the best-quality product, the laboratory tests the product as it moves through production, ensuring that it meets customer specifications.

"As customers make more demands for food safety programs, we look at the resources of the plant and work to meet the new requirements."

Throughout the day, samples are prepared for shipping out the following day, and any antibiotic test results that come from the external lab are relayed to the farmers by the technicians. When the night shift comes in, they continue the work done in the microbiology lab. All the technicians maintain records of analysis and enter the data into Oracle, which allows them to compile information about the product and gives Labelle all the information he needs before he approves the product for shipping. All documentation and analysis is sent to the state of Wisconsin, which has a split-sampling program in place with the facility and that audits the lab to ensure that the lab meets the requirements to be certified. In addition to monitoring production, the lab monitors air quality in the plant, as well as monitoring central sanitizing systems and foot foamers, and performs environmental swabbing.

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Roles and responsibilities

The employees in the lab have a variety of experiences and degrees, and although a degree is not required to work in the lab, some employees have bachelors' degrees in microbiology or dairy technology. The technicians receive training beyond basic lab responsibilities and techniques as they undergo HACCP (Hazard Analysis Critical Control Point), GMP (Good Manufacturing Practice), and safety training, along with a month of hands-on training in the lab before they are left to work independently. The technicians also obtain water and antibiotic testing certification and licenses, since the lab at Agropur must meet the requirements of a certified lab.

Labelle has experience in research and development and quality assurance, and has worked as a lab supervisor and lab manager. He has been with Agropur for seven years and says that the role of the lab has changed in that time as customer quality and safety requirements have led to increased

▲ *Jerry LaBelle working with protein analyzer.*

responsibilities. "As customers make more demands for food safety programs, we look at the resources of the plant and work to meet the new requirements," Labelle explains. The increase in responsibility has led to hiring more staff. There has also been an increase in data entry into Oracle and various spreadsheets, with two to three hours spent on data entry daily.

The role of the lab supervisor has also changed, "It used to be that the lab supervisor just supervised the lab and handled the reports," Labelle says, and now, along with the quality assurance manager, the two are responsible for approving and releasing the product for shipment. The Oracle system assists with the approval process, since the system does not allow the product to be released unless standards are met. Labelle also works closely with the field staff in other plant locations, and although there is a member of staff who performs HACCP record reviews in conjunction with the QA manager, Labelle is ultimately responsible for HAACP reviews pertaining to milk coming into the plant.

"Making sure everything goes smoothly is the important thing," Labelle says regarding the day-to-day operation of the lab and facility, but there can be some unexpected challenges such as equipment that fails and requires immediate repair while the lab still needs to complete testing. Labelle also describes the importance of coordination between production and the laboratory, because trucks could be delayed by waiting for the release of the product because testing is not complete.

Most communication in the lab is face-to-face, and Labelle interacts with staff on all the shifts. Notes are left on a lab whiteboard if there is important information to

▲ *Lab tech Jenny Meyer testing samples in microbiology lab.*

▲ *Lab tech Deanne Togstad testing samples in microbiology lab.*

pass on, and issues are communicated by e-mail. If there are new requirements for analysis, Labelle will hold an informal lab meeting to address the topic and discuss how lab workers can accommodate the requirements as a team, and he will get immediate feedback from the technicians.

Labelle says that he does little supervising and acts as more of a resource for staff, filling in for people who may be away or assisting them with any problems they may have. Like many lab managers, he is responsible for many duties with regard to the maintenance and operation of the lab. Labelle is responsible for troubleshooting any equipment that breaks down, and he performs preventive maintenance and calibration as required, e.g., the calibration of the milk analyzer on a monthly basis. His duties also include maintaining inventory, ordering supplies, and keeping the workers motivated. Labelle enjoys working with and training his staff; there is not a high turnover in the lab, and the atmosphere is positive as all are happy to help out when they can. He is available to his staff if there are any problems, and the biggest challenge he faces is keeping staff motivated and excited about their work. Labelle also says he "enjoys the challenge of getting a piece of equipment up and running," and he has learned to become self-sufficient by doing his own troubleshooting and working with manufacturers over the phone.

The lab has acquired a host of new equipment over the last few years including a microwave oven, a milk analyzer, and a Babcock centrifuge, and Labelle hopes that he will be able to update the lab with the next budget. Many things have changed in the lab over the years, but one thing that does not change often is the staff.

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MAIN TECHNOLOGIES USED

- Combustion protein analyzer
- Lactoscope
- Microwave moisture analyzer
- Chloride analyzer
- Muffle furnace
- Babcock method
- Forced air oven
- Moisture balance
- Charm test reader

INSIGHTS ON IMAGING SYSTEMS

MAKING SMALL THINGS VISIBLE

by Angelo DePalma, PhD

▲ *BX63 / Automated Fluorescence Microscope Olympus / www.olympus.com*

"Chemical mapping of materials, tissues, and cells has become the leading edge of microscale imaging."

Imaging encompasses a wide range of techniques that enable visualization of hidden features of samples, structures, or organisms. Imaging occurs at many scales, from medical magnetic resonance imaging of patients to individual atoms. This *INSIGHTS on Imaging Systems* focuses on the lower end of size domains in the typical operating range of—but not limited to—microscopy.

Microscope-based imaging used to be the domain of core facilities and dedicated operator-directors. Today, imaging has become routine—not quite to the "technician" level for all techniques but moving in that direction. Motorized stages and other automation tools are enabling unattended imaging of multiple samples. Confocal systems that once required a dark room now sit on fully lighted laboratory benches.

But as microscopy advances and the "heart cut" methods become more democratized and accessible, the leading edge becomes more complex in terms of science and instrumentation. Together these advances "change how people address questions in biology," says Brendan Brinkman, senior product manager for laser scanning confocal microscopes at Olympus (Center Valley, PA). "The same individuals who might have used a benchtop fluorescence microscope several years ago now have access to imaging systems that were the exclusive tools of research labs."

Microscopic imaging has come a long way during the past decade, Brinkman adds. "Confocal microscopy has become established to the point where people view it as routine." Brinkman cites multiphoton imaging as another "routine" technique, particularly for visualizing in vivo processes. The National Institutes of Health BRAIN (Brain Research through Advancing Innovative Neurotechnologies) Initiative relies heavily on these two methods. Interest in fixed tissue imaging has not slackened either, according to Brinkman.

Pittcon 2014 saw the debuts or formal introductions of at least 25 microscopes, most of them suitable for imaging applications; for example:

- EDAX demonstrated its EBSD (electron backscatter diffraction) for SEM. With a focus on analysis of materials with crystalline structures, EBSD allows users to analyze orientation, grain morphology, material deformation, and distinct crystal phases.
- Carl Zeiss introduced the EVO SEM for materials characterization and quality assurance.
- Thermo Fisher showed the DRX™xi Raman microscope, described below.
- Olympus unveiled its BX63 imaging microscope with full motorized control, a unique focusing mechanism, and cellSens Dimension software for cell imaging.

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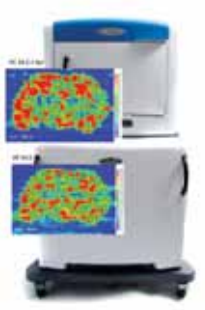
Microscopy is an ideal imaging platform, because it operates in size domains that are generally invisible to the naked eye. The application of spectroscopy (e.g., Raman, infrared, ultraviolet, fluorescence) to microscopy further expands microscopic visualization of chemical components that appear identical with visible light microscopy. Chemical mapping of materials, tissues, and cells has become the leading edge of microscale imaging.

To illustrate the importance of microscope-based imaging across size domains of many orders of magnitude, consider that a fair amount of diagnostic imaging today occurs not on arms, legs, and livers or on tissues or cells but at the molecular level—for example, fluorescence in situ hybridization (FISH), which is described in greater detail below.

IMAGING BY MASS SPECTROMETRY

Microscopy is not the only imaging platform suitable for microscale samples and events. The ability to discriminate on the basis of molecular weight is what confers similarly useful imaging capabilities on mass spectrometry. Although MS is not microscopy, techniques that combine sampling of very small regions on samples, gentle ionization, and software that renders mass data and physical coordinates into composition maps have pushed MS to the forefront of advanced imaging technologies, albeit one that involves greater capital expenses than light microscopy.

Because of its mild ionization mechanism, MALDI (matrix-assisted laser desorption ionization) has been the mass spectrometry imaging technique of choice for years. All major MS companies sell MALDI systems. Both commercial and public domain image software exists as well.



▲ *Mass Spec Imaging Services / LAESI-MSI Protea Biosciences https://proteabio.com*

▲ *SpiralTOF MALDI TOF / TOF System JEOL / www.jeolusa.com*

MALDI imaging takes place on thin tissue samples where the mass of one or more target molecules is known. With assistance from software, MS creates 2-D distribution images of drugs, natural products, or metabolites along a tissue cross-section. The sample is first treated with a matrix solution that assists in volatilization and ionization. Then a laser focused on tiny "pixels" vaporizes a bit of sample, which is swept into the spectrometer. Software then creates a 2-D distribution image for the molecule of interest.

MALDI may be combined with other imaging methods—for example, magnetic resonance—or by taking successive tissue slices, in order to create 3-D images.

MS imaging of large, complex molecules would not be possible without gentle ionization. Otherwise, ionization would destroy or disrupt proteins and other large, labile molecules. An emerging MS imaging platform, LAESI (laser-assisted electrospray ionization), is based on mild electrospray ionization (ESI) but has several advantages over MALDI.

For one, LAESI essentially eliminates matrix addition and, more significantly, sample prep. "Matrix addition can create artifacts that can be bypassed by eliminating sample prep entirely," observes Haddon Goodman, LAESI platform marketing manager at Protea Biosciences (Morgantown, WV).

Unlike imaging methods that require contrast agents or labeling with radioactive compounds and sophisticated image acquisition instrumentation, "molecular imaging" exemplified by MALDI and LAESI relies only on the masses of target analytes, which are "filtered" by the spectrometer. LAESI can create multiple chemical maps of a surface simply by filtering a panel of masses.

The critical difference between molecular imaging and, say, MRI is that the latter usually takes place in living organisms, whereas MS methods cannot. "You need a slice of tissue," Goodman says.

Where both LAESI and MALDI create 3-D images through sectioning, LAESI alone is capable of tunneling through samples from point to point. This technique has been demonstrated for plant tissues, where cell walls maintain structural integrity. Goodman says his company is working on a similar method for animal tissue.

LAESI's most interesting imaging strength has to do with rapid screening of surfaces without sample prep. In addition to plant and animal tissue, LAESI is capable of scanning surfaces of cultured cells in plates or Petri dishes. Researchers are using this technique to investigate biomarkers and the effects of drug treatments among microbial colonies, to identify natural products

for drug discovery, and to visualize downregulation and upregulation of genes. "You can tell if transfection worked by imaging regions where proteins encoded by that gene are expressed," Goodman says.

LAESI enhances the capabilities of conventional medical imaging techniques as well. In September 2013, Protea entered a collaborative research agreement with Virginia Commonwealth University's Center for Molecular Imaging. The collaboration will combine LAESI with the university's in vivo molecular PET, SPECT, and MRI/MRS medical imaging capabilities to investigate the molecular basis of cancer, Alzheimer's, and other human diseases.

MS has brought about changes in imaging-based diagnosis of tissues that microscope-based imaging could not. For example, researchers from Imperial College, London, use MS data from a tissue sample to create an image of the sample's chemical composition. The technique maps chemical components of interest and may help medical researchers differentiate tissues that appear similar under ordinary light microscopy. For example, mass spectral imaging could indicate differences between cancer subtypes.

This advance pushes the limits of conventional pathology/histology, which over the past 50 years have relied on dyes, stains, and light microscopy and take many days. MS imaging will enable chemical composition data mapping but, more important, make this type of data accessible to clinicians and researchers. Dr. Zoltan Takats at Imperial College calls MS imaging a paradigm changer. "Instead of defining tissue types by their structure, we can define them by their chemical composition. This method is independent of the user—it's based on numerical data rather than a specialist's eyes—and it can tell you much more in one test than histology can show in many tests."

RAMAN MICROSCOPY—UNVEILING THE INVISIBLE

Raman microscopy complements optical microscopy and other imaging tools by providing chemical and morphological analysis at the same microscopic level of detail. Because Raman measures molecular bond vibrations—essentially chemical fingerprints—users obtain information that is inaccessible via light microscopy.

"Raman reveals otherwise invisible information to increase understanding and solve problems in a wide range of materials, from pharmaceutical tablets to graphene monolayers to minerals," says Scot Ellis, marketing manager for Raman spectroscopy and microscopy at Thermo Fisher Scientific. "Raman is becoming an essential competitive tool in academic and industrial research."

▲ *Raman Imaging Microscope / DXR™xi / Thermo Fisher Scientific www.thermoscientific.com*

Because it resolves objects at submicron levels, Raman is used for a wide variety of scientific problems, from verifying chemical composition and finding/identifying contaminants in products to optimizing production processes.

According to Ellis, the Thermo Scientific™ DXR™xi Raman imaging microscope is a new approach to Raman imaging. "It differs from traditional systems by working at the problem level, that is, an entire chemical image, rather than depending on a user to work with individual point spectra to build an image up."

The DRXxi rasters images by collecting spectral data at a very high rate, statistically processing and interpreting behind the scenes and displaying results during collection. Color staining with chemical or morphological information reveals "many dimensions of data," Ellis says. "Chemical identification and distribution, physical information such as materials strain, and relative concentration information all are conveyed visually."

The DXRxi supplements many microscopic techniques that provide visual or topographical information and that often require expertise, subjective interpretation, or additional measurements that must be correlated to the microscopic image to be meaningful.

"More important, the DXRxi replaces traditional Raman microscopes by operating in an entirely different way," Ellis says, by delivering meaningful chemical images nearly instantaneously. "It's really microscopy powered by spectroscopy, whereas historically, systems have worked the other way around."

A TWIST ON FLUORESCENCE

Through its use of fluorescently labeled tags, fluorescence microscopy provides a means of targeting specific structures inside cells.

Fluorescence in situ hybridization (FISH) is a technique that images abnormal genes that are indicative of disease. In cancer disease management, for example, FISH detects targeted DNA abnormalities and is widely used for diagnosis, prognosis, and treatment selection.

Microscope manufacturers are particularly interested in FISH because it uses fluorescence to image very small objects. In 2013 Nikon Instruments entered an agreement with Cancer Genetics (Rutherford, NJ) to distribute FISH DNA probes for oncology. The deal brings together the two ingredients necessary for DNA-level diagnostic imaging: fluorescent FISH probes (from Cancer Genetics) and a suitable microscopy-imaging platform (from Nikon). In this instance, the genetic tests will take advantage of a technique Nikon has developed for performing simultaneous, multicolor FISH testing and complex image analysis.

▲ *Multipoint Scanning Confocal Microscope Opterra / Bruker / www.bruker.com*

▲ *Stereomicroscope / SMZ25 / Nikon Instruments / www.nikoninstruments.com*

While the technology behind FISH is not new, fluorescence-based techniques are rapidly evolving, together with (and because of) instrumentations; for example, multicolor FISH. A variation on this theme is two-photon or multiphoton fluorescence.

Bruker's (Billerica, MA) acquisition of Prairie Technologies last autumn afforded Bruker an entry into multiphoton fluorescence microscopy, a microscopy imaging technology in which Prairie was a pioneer. In traditional fluorescence the excitation energy is shorter in wavelength (and higher in energy) than the emitted fluorescence. In multiphoton, two or more photons of longer wavelength (lower energy) strike the target simultaneously, producing an emission of higher energy than the excitation does.

Bruker also gained entry into confocal microscopy, a high-resolution, high-contrast imaging technique that employs point illumination and pinhole masking to eliminate out-of-focus light.

Although the combined excitation energy of the two photons may be the same or higher than in single-photon fluorescence, the impact on living organisms is gentler. Think of being hit by two tennis balls traveling at 25 miles per hour versus one ball at 50 miles per hour. Consequently, dual-photon fluorescence is ideal for imaging live cells that are able to withstand just so much excitation. Cells survive longer, so analysts can extract more information from them.

Multiphoton fluorescence enables exotic-sounding experiments such as uncaging, optogenetics, simultaneous electrophysiology, and photoactivation techniques such as photostimulation and photablation. All these involve selective, targeted interaction between light and matter, usually with cells, resulting in perturbations detected by image-capture and rendering elements.

Jeff Stuckey, PhD, product marketing manager for fluorescence microscopy at Bruker Nano, formerly of Prairie Technologies, explains that photoactivation does not actually move sample constituents in space. "For that you need laser tweezers, which we don't do. Instead, we activate molecules using laser light." In caging experiments, for example, lasers cause the release of neurotransmitters from nerve cells. In another form of photoactivation, optogenetics, neurons are stimulated to mimic naturally occurring neuronal activity, which allows investigators to image neuronal connections and activity.

"[Because] fluorescence occurs only where photons arrive simultaneously, fluorescence is limited to tiny, well-defined regions," Stuckey explains. The analogous confocal imaging technique results in diffuse fluorescence above and below the desired location, resulting in photobleaching, which contributes to out-of-focus light.

Another advantage of two-photon fluorescence excitation involves its use of infrared lasers, which penetrate more deeply than visible light into tissue. Where visible wavelengths image to a depth of about 300 microns, two-photon systems reach five times as deep, to 1.5 millimeters. Through the use of clearing agents that render opaque tissues clear, scientists have achieved imaging depths of eight millimeters.

DON'T FORGET INDUSTRIAL IMAGING

Industrial imaging includes nondestructive macroscale techniques for visualizing defects, composition, and other relevant features of materials or structures. In keeping with the spirit of this article, we will limit the discussion to microscope-based imaging, for which several dozen optical and nonoptical techniques exist.

FEI (Hillsboro, OR) focuses mostly on scanning electron microscopy (SEM), dual-beam focused ion beam/SEM (FIB/SEM), and transmission electron microscopy (TEM). Through its acquisition of Germany-based Till Photonics, FEI has recently invested in light microscopy as well. In early 2014 FEI announced that it had acquired Australian firm Lithicon, which provides pore-scale micro-computed tomography (μCT, or microCT) equipment to oil and gas companies.

A significant segment of FEI's business involves atomic-scale imaging, which encompasses molecules as well as atoms. Relevant instrumentation includes TEM and scanning transmission electron microscopy (S/TEM). TEM uses a focused beam smaller than the atoms themselves to sample along a group of atoms. Bert Freitag, director of product marketing for FEI's materials science business unit, compares STEM to a "slide projector" that illuminates a larger area to collect data and transmit it to a CCD camera.

TEM in particular has evolved as a cutting-edge technique for atomic imaging, but it was limited to visualizing atoms in "black and white." It is now possible through advanced imaging to assign "colors" to atoms based on spectroscopic properties. "This allows us to visualize chemical information," Freitag says. The two techniques employed by FEI are energy-dispersive X-ray analysis (EDS) and electron energy loss spectroscopy (EELS).

Another advanced STEM technique, differential phase contrast, allows measurement of electric fields between atoms, which are directly linked to the physical properties we experience in the macroscopic world. The technique also visualizes electric fields between atoms, which are significant in polar ceramics such as gallium nitride, used to manufacture light-emitting diodes. "These fields are directly linked to light-emitting properties, so understanding them can help in the design or improvement of these materials," Freitag says. "Information at the atomic scale provides many significant insights into the macroscopic properties of materials." The observation of variation of atomic distances can provide information about strain, for example, in silicon lattices of nanodevices, which directly relates to electron mobility and faster-switching transistors.

▲ *Ultrafast Electron Microscope / Tecnai™ Femto / FEI / www.fei.com*

FEI has continued its innovation in visualizing ultrasmall, ultrafast events with its late 2013 introduction of the Tecnai Femto ultrafast electron microscope. The device allows observation of events occurring at the atomic and molecular scale, within time frames of femtoseconds (10^{-15} second). These include the absorption of light energy and its transformation into heat, mechanical changes through photoactuation, and crystallization. Tecnai Femto is the first system to commercialize ultrafast electron microscopy technology pioneered by Nobel laureate Prof. Ahmed Zewail at the California Institute of Technology.

David Flannigan, PhD, a former Zewail lab member and now assistant professor of materials science at the University of Minnesota, has noted that "over the last decade microscope manufacturers like FEI have developed instruments that have made observations of objects as small as individual atoms relatively routine. Ultrafast electron microscopy now gives us a powerful tool to look at the movements and changes that occur at this scale. Because the distances are so small, the time scale is also condensed—it doesn't take very long to travel a nanometer or two. Using single-electron pulses, we have measured changes over time periods as short as tens of femtoseconds—those are millionths of a billionth of a second."

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PITTCON PARTNERSHIPS

Collaborations between companies and organizations a trend at this year's show **by Rachel Muenz**

❶

In addition to the products introduced at Pittcon 2014 we've already profiled in our Technology News section, there were plenty of other exciting developments to share from the press conferences we attended in Chicago in March.

One standout from the show was the number of partnerships announced between manufacturers as well as longer-standing collaborations that have generated some new technologies.

For example, Beckman Coulter Life Sciences announced Mar. 4 that it will be partnering with Wyatt Technology. The collaboration combines Wyatt's expertise in protein characterization, light scattering and biophysics with Beckman's know-how in particle counting, particle characterization, and cell viability measurement and will help both companies expand in the particle market. Beckman will also be manufacturing AB SCIEX's CESI 8000 system for biologics characterization, a technology that resulted from AB SCIEX combining the CE business of Beckman Coulter with Eksigent nano and microscale chromatography to form a separations business called SCIEX Separations. The CESI 8000 system took bronze in this year's Pittcon Editors' Choice awards for most innovative product at Pittcon.

Another award-winning technology also involved a collaboration. Texas Instruments' (TI) DLP NIRscan™ evaluation module for spectroscopy, which is built by Keynote Photonics, won gold in the 2014 Editors' Choice awards. The company also announced the first DLP® device optimized for use with near infrared light on Mar. 3. With these technologies, TI hopes to enable spectrometers for use in the food, pharmaceutical, oil and gas, and emerging industries to deliver lab-quality performance in the field and manufacturing environments.

"We continue to push the limits of what DLP technology is capable of, opening it up for use in advanced scientific, industrial and medical solutions," said Mariquita Gordon, DLP Embedded manager at TI.

Two other manufacturers that will be teaming up are Metrohm USA and Waters, Inc. Waters will now develop and release Empower® chromatography data system (CDS) drivers for Metrohm's new 900 series ion chromatographs and its older 800 series modules.

"We are excited to be able to provide Waters Empower customers with access to Metrohm's innovative IC technology," said Edward Colihan, president of Metrohm USA. "The ability to have instrument control and data processing within a single CDS is of paramount importance to the pharmaceutical customer."

Specific modules of Metrohm's new Flex and Vario ion chromatographs are set to be released later in 2014.

❷

Bio-Rad Laboratories had its own collaboration to announce Mar. 4. The company has partnered with the U.S. Pharmacopeial Convention (USP) to create a beta version of the USP Spectral Library™ for raw material identification in the food and drug industries.

❸

"It's really a huge effort in terms of a collaboration to make this concept a reality," said Ed Zhao, USP's vice president of business development and allied compendial programs.

The library, powered by Bio Rad's KnowItAll®software technology platform, allows manufacturers to confirm the identity of active pharmaceutical ingredients and excipients used in their products during routine quality control measures. The new tool also has applications in quality standards development and rapid screening in the field for counterfeit and substandard foods and medicines.

"The USP Spectral Library has the potential to help ensure the quality of medicines and foods throughout the world," Zhao said. ■

❶ Metrohm USA's new 940 Professional IC Vario high-performance ion chromatography system.

❷ The USP Spectral Library™ for raw material identification in the food and drug industries is powered by Bio Rad's KnowItAll® software technology platform.

❸ Texas Instruments' DLP NIRscan™ evaluation module for spectroscopy is built by Keynote Photonics.

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TECHNOLOGYNEWS

This month, we highlight companies who will be exhibiting at **the 62nd ASMS Conference on Mass Spectrometry and Allied Topics (ASMS 2014)**, which will take place June 15-19, 2014 at the Baltimore Convention Center in Baltimore, Maryland. This dynamic scientific conference features a variety of sessions and short courses and will close with an event at the National Aquarium. Please note that the products shown here may not be at the show, but their manufacturers will be.

ANALYTICAL

Multi-Detector Bio-SEC Solution

1260 Infinity
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Analytik Jena www.analytik-jena.com

Micro Gas Chromatograph

CALIDUS™

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Falcon Analytical www.falconfast.net

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HORIBA www.horiba.com/scientific

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- Incorporates unique and powerful research functions in an impressively compact analytical bench footprint
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- The system's SWIFT™ Fast Raman imaging is typically 10x faster than conventional mapping methods

HORIBA www.horiba.com/scientific

MALDI TOF/TOF System Updates

SpiralTOF
BOOTH 107

- Resolving power specification has now been increased to 75,000
- JEOL now offers MSVision software from PREMIER Biosoft for processing the large data sets from MALDI imaging of ultra-high resolution MS data
- Unique ion optics with a 17-meter flight tube in a compact package give high MALDI-TOF resolving power and monoisotopic precursor selection for high-energy CID to probe chemical structure

JEOL www.jeolusa.com

Spectrometer

Maya LSL

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Ocean Optics www.oceanoptics.com

Core-Shell Biphenyl HPLC/UHPLC Columns

Kinetex
BOOTH 116

- Give researchers excellent orthogonal selectivity to traditional C18 phases
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Events

Presentation: Is Social Media the Future of Science?

Elise Andrew
Founder
I F*cking Love Science (IFLS) Facebook page

Lab Design and Furnishings

Jennifer Webb
private architectural consultant

It's All About the Data: What it Takes to Get It, Manage It, and Use It in a Modern Laboratory

Joe Liscouski
Executive Director
Institute for Laboratory Automation

Effective Chemical Management

Vince McLeod
Senior Industrial Hygienist, University of Florida
Environmental Health and Safety Division

Best Practices of Purchasing Lab Equipment

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TESCAN www.tescan.com
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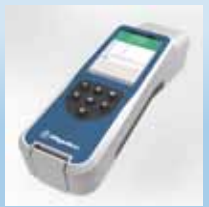

A highlight from Pittcon 2014, in the handheld Raman instrument world, was Rigaku Raman Technologies' release of the Progeny™. The company's latest handheld analyzer is designed to deliver comprehensive and accurate materials identification, and improved ease of use, adaptability, and reliability.

"Today is a pretty profound day for Rigaku Raman," said company general manager Bree Allen at Rigaku's Pittcon press conference on Mar. 4. "Progeny will reset customer expectations in the market because when compared to other handhelds available today, it offers a level of functionality and performance that simply has not been achievable in the past."

The instrument has an advanced miniature VPG-based 1064nm optical engine at its core, offering benchtop-quality analytical performance in a rugged, ergonomic and IP-68 sealed enclosure. Progeny's fully customizable workflow software is 21 CFR Part 11 compliant and boasts a smartphone-inspired user interface which shortens the learning curve, allows rapid implementation of material ID methods, and improves return on investment.

The handheld also features a unique angled-wand shape which is designed to be used with one hand, unlike the heavy, bulky gun-shaped designs of the past.

"The shape of the Progeny facilitates entry into closed spaces," Allen explained, adding that this makes it much easier for incoming material inspection in the pharmaceutical world and for safety and security markets.

The handheld also uses a patent pending high-selectivity algorithm for material ID and has the ability to develop and run advanced quantitative methods, directly on-board. These features ensure accuracy, Allen said.

"When it comes down to it, it improves confidence in testing results," he said.

For more information, visit www.rigakuraman.com

GC Liquid Autosampler

TriPlus 100 LS
BOOTH 127

- Performs liquid injections in a completely automated and reliable manner, regardless of the matrix or the selected technique
- With the addition of optional accessories, the system is capable of automating sample preparation steps such as standard dilution, standard and internal standard addition, and vortexing
- Can handle almost any type of liquid samples

Thermo Fisher Scientific www.thermoscientific.com

Macroion Mobility Spectrometer

MacroIMS Model 3982

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- Offers proven utility in a variety of biochemical applications, including analysis of antibody aggregation analysis, lipoproteins, viruses/vaccines/VLPs, polymers, and nanoparticle colloids
- Boasts a number of new features over previous models, including its ability to perform automated analyses by means of direct connection to LC pumps and auto samplers

TSI www.tsi.com

Mass Spectrometry Integration Solution

ionKey/MS™ System
BOOTH 113

- A new approach for getting exceptional sensitivity, robustness and ease-of-use out of mass spectrometry
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6A03

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- Yellow-colored back plate enhances the readability of scales and minimizes eye fatigue

Dakota Instruments www.dakotainstruments.com

Viscometer/Rheometer on a Chip

m-VROCi

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- Features a rated operating pressure of 1500 psig
- ¼" NPT female side inlet and top outlet are machined directly into the purifier body, eliminating the more fragile connections of previously available units
- Uses new, improved cartridges that can also be used with gas purifier housings already in service supplied by SGD, Matheson and all other companies offering similar purifiers

SGD www.sgd.com

Tube Cooler Module

Asia

- Allows fluoropolymer and stainless steel Asia tube reactors to be used at ambient temperature or cooled to sub-ambient temperatures as low as -68ºC, depending on the cooling medium of choice
- Can be operated for up to four hours before refilling the cooling medium
- Unit can also be used as a standalone module or connected to an Asia heater

Syrris http://syrris.com

Wireless Handheld Thermometer

RTR-601

- Designed to measure the internal temperature of food items and liquids using an insertion probe
- A single press of the REC button allows the user to record not only the temperature, but also the time, date, operator & item ID's and a pre-programmed measurement judgment
- Features a measurement range of -25°C to +235°C

TandD www.tandd.com

Large Capacity Centrifuge System

Sorvall RC BIOS 10
BOOTH 127

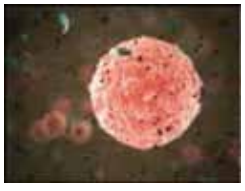
- Offers a new 10-liter capacity for batch bioprocessing with the Thermo Scientific Fiberlite F5-10x1000 LEX rotor
- This durable non-corrosive carbon fiber rotor reduces cycle times by spinning up to 10 1-liter Thermo Scientific Nalgene centrifuge bottles in a single run
- Capacity and design make this unit an ideal solution for numerous applications

Thermo Fisher Scientific www.thermoscientific.com

CELL CULTURE

Device for Removal of Dying & Dead Cells

ClioCell™



- Selectively initiates dead-cell removal, emulating dead-cell clearance mechanisms which operate in-vivo to keep tissues functioning optimally
- Improves viability and quality of cell populations and their subsequent productivity
- Has been successfully tested on many cell types, both human and mammalian
- Provides new opportunities to optimize cell growth, culture and storage

AMSBIO www.amsbio.com

CHEMICALS, KITS & REAGENTS

Immunoassay Kits

GyroMark™ HT
BOOTH 40

- Designed specifically for use on Gyros' Gyrolab™ xP workstation
- Simple, automated, nanoliter-scale assays require as little as 1 μL of sample
- Ready-to-use kits are fully qualified for reliable use in clinical research
- Accuracy and precision meets or exceeds ELISA performance
- Enable clinical researchers and drug developers to generate valuable research data much faster than typical ELISA kits

EMD Millipore www.emdmillipore.com

Total Phosphate Field Kits

CHK8540

- Comes in a cardboard box and contains everything needed to perform 50 tests: 50 ampoules sets, oxidizer powder, neutralizer solution, stabilizer solution, reducer powder, oxidizer powder dispenser cap, 3 mL syringe with tip, tip breaking tool, funnel, and instructions
- Require the use of a digester block and the V-2000 photometer, or a spectrophotometer capable of accepting a 16 mm diameter round cell

Environmental Express www.envexp.com

INFORMATICS

Raman Spectroscopy & Imaging Software

Lambdafire-R™

- Written specifically for Raman microspectrometers running Window 8®
- Designed to collect, analyze and process both Raman microspectra™ and images from CRAIC Raman microspectrometers
- Suited to both industrial processes and scientific research
- Simple to use yet contains many advanced spectroscopic, imaging and data analysis features

CRAIC www.microspectra.com

New GC Software Functions

GC Image
BOOTH 107

- New functions make use of JEOL's AccuTOF GCV 4G's high-resolution MS data
- Allow JEOL data to be imported directly into *GC Image*
- Exact masses and isotopic data provide elemental compositions for molecular ions as well as fragment ions
- High-resolution selected ion chromatograms make it possible to find target compounds and families of chemical compounds in very complex mixtures

JEOL www.jeolusa.com

Data Analysis Software

CytoSure™ Interpret version 4.5.3

- Provides a powerful and easy-to-use package for the analysis of aCGH data, the gold-standard for copy number variation (CNV) detection
- Offers many advanced features, including Automatic Aberration Classification
- Allows the choice of standardized or customized user-defined data analysis
- Enables users to configure the software to automatically perform an initial classification of any detected CNV

Oxford Gene Technology www.ogt.com

PRODUCT SPOTLIGHT

CLOUD-BASED COLLABORATION

ACADEMIC RESEARCH PLATFORM PROVIDES APP-BASED APPROACH TO ELECTRONIC DATA CAPTURE AND SHARING

BOOTH 112

Following the 247th American Chemical Society National Meeting & Exposition, students and researchers now have a new tool for scientific collaborations. PerkinElmer released Elements, its cloud-based, expandable platform Mar. 17.

Elements is a first-of-its-kind tool for academic scientists that changes how they collect and share data and information in the lab and classroom. The platform provides a cost-efficient solution for safe, secure record-keeping that eliminates the need for investment in digital infrastructure.

"Despite the wide range of technology offerings available in the marketplace today, a recent study we conducted revealed that more than 75 percent of research academics still use a paper notebook for recording lab notes," said Michael Elliott, CEO and chief analyst at Atrium Research & Consulting. "Electronic lab notebooks are changing this practice in how labs at major universities embrace electronic data capture, cloud-based applications and collaborative tools to modernize their research environments."

Elements' expandable platform delivers an application framework for deep scientific support through modular apps that can be combined into sophisticated scientific experiments. Being 100-percent cloud-based also allows users to be up and running in minutes without the need for lengthy deployment and installation steps. The new tool features electronic data capture and ChemDraw integration as well.

"The Elements tool matches workflows with the needs of each type of science and scientist," said Daniel R. Marshak, chief scientific officer at PerkinElmer. "This technology empowers academics to work more effectively toward advancing their research in human and environmental health. We will continue to launch additional platform enhancements in response to the insights we receive from the scientific community."

For more information, visit www.perkinelmer.com

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- Full system automation means there is no need for adjustments after startup

GE Healthcare www.gelifesciences.com

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Syngene www.syngene.com

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INTEGRA www.integra-biosciences.com

Water Purification System Cartridges

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Micronic www.micronic.com

ARE YOU IN THE MARKET FOR... COLD STORAGE EQUIPMENT?

Freezers and refrigerators are an integral part of any laboratory that requires temperature controlled storage. Maintaining samples at an optimal temperature while in storage is vital for many lab professionals and this makes choosing the right freezer or refrigerator a crucial task. While the average kitchen freezer operates at about -20°C, laboratory variants have a much wider range of options depending on the storage conditions needed.

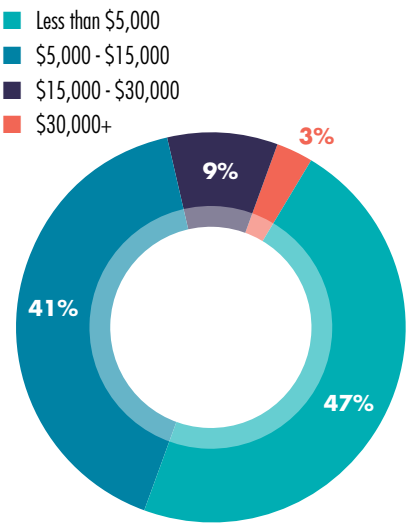
Types of cold storage used by survey respondents

Blood bank and plasma	6%
Explosion-proof	7%
Flammable materials storage	6%
Upright general purpose lab freezers	26%
Under-counter general purpose lab freezers	10%
Low temperature chest lab freezers	6%
Low temperature upright lab freezers	14%
Upright ultra-low temperature freezers	17%
Chest ultra-low temperature freezers	5%
Other	3%

For service and repair, survey respondents report using the following

In-house service department	28%
Third-party contract	19%
Third-party time/material	16%
Instrument manufacturer time/material	11%
Instrument manufacturer service contract	8%
Multi-vendor service provider	6%
Don't know	6%
Our department	5%
Other	1%

Nearly 44% of respondents plan on purchasing cold storage equipment in the next year. The budget ranges for these purchases are as follows



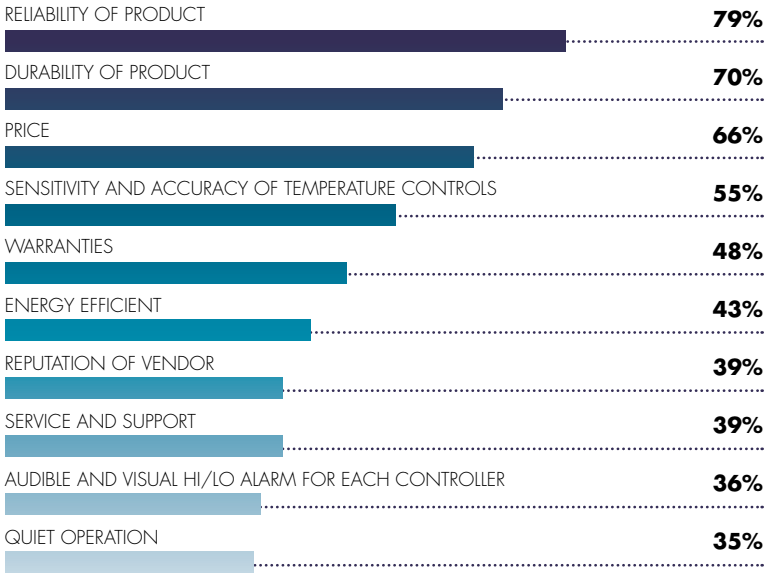
TOP 5 QUESTIONS

You Should Ask When Buying Cold Storage Equipment

1. How is the product manufactured? Ask about the quality of the materials used and the product life.
2. What is the warranty? What does it include and for how long? Will anything void the warranty?
3. How green is the product? Ask the company to provide details on energy efficiency and have them relate it to your return on investment (e.g. in four years will you save enough money in energy costs to pay for your freezer/fridge?).
4. How much sample capacity are you getting for your space?
5. What are the optimal voltage/wiring conditions for running the fridge/ freezer? If the building is older, will low voltage or voltage fluctuations affect the performance of the freezer/fridge?

TOP 10 FEATURES/FACTORS

respondents look for when purchasing cold storage equipment



Completed Surveys: 340

For more information on cold storage equipment, including useful articles and a list of manufacturers, visit www.labmanager.com/fridges-freezers

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

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

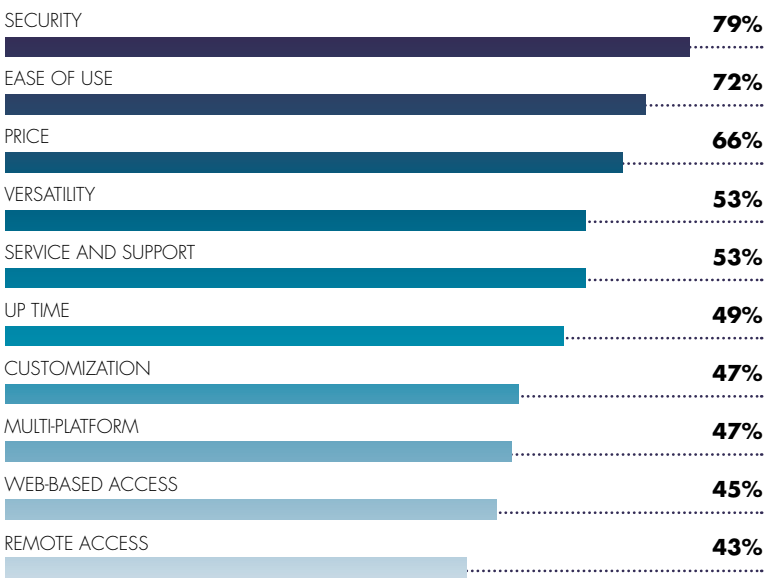
TOP 6 QUESTIONS

You Should Ask When Buying an Electronic Lab Notebook

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

TOP 10 FEATURES/FACTORS

respondents look for when purchasing an ELN



Completed Surveys: 270

Types of ELN installations used by survey respondents

Web-based	38%
Stand-alone	14%
Thin client/server	1%
Client/Server	37%
Other	10%

Primary purpose for ELNs as reported by survey respondents

Centralized data repositories	8%
Infrastructure for capturing, accessing and sharing experimental information	21%
Improved communication between instruments and related software	4%
Accelerating the documentation and reporting of experimentation	15%
Enabling scientists to collaborate effectively on multi-stage projects	10%
Workflow coordination across geographic and business boundaries	3%
Streamlined regulatory compliance	1%
Intellectual property (IP) protection	6%
Patent evidence creation	0%
Improve productivity	4%
All of the above	27%

Nearly 56% of respondents plan on purchasing an ELN in the next year. The reasons for these purchases are as follows

Infrastructure for capturing, accessing and sharing experimental information	19%
Accelerating the documentation and reporting of experimentation	16%
Setting up a new lab	12%
Centralized data repositories	12%
Enabling scientists to collaborate effectively on multi-stage projects	8%
Improved communication between instruments and related software	7%
Upgrading existing ELNs	6%
Addition to existing systems, increase capacity	6%
Streamlined regulatory compliance	4%
Web-based access	4%
Workflow coordination across geographic and business boundaries	4%
Other	2%

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

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

Pipettes can be found in almost every laboratory and, if you're looking to buy one, there are many options— manual or electronic, single or multi-channel. Luckily, a few main considerations can help in deciding whether or not to buy the latest pipette technology.

Types of pipettes used by survey respondents

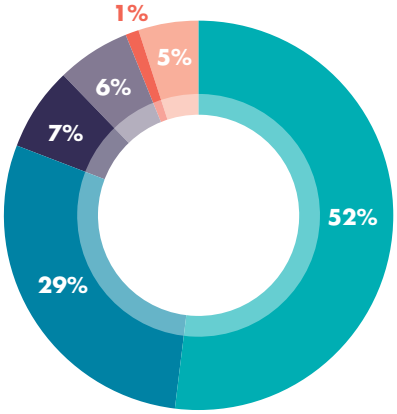
Manual: Single-channel	32%
Manual: Multi-channel	19%
Manual: Fixed volume	14%
Electronic: Single-channel	10%
Electronic: Multi-channel	8%
Electronic: Fixed volume	3%
Repeater	13%
Other	1%

Estimated daily time spent using a pipette as reported by survey respondents

Less than 1 hour	25%
1 - 2 hours	31%
2 - 3 hours	23%
over 3 hours	22%

Nearly 40% of respondents plan on purchasing a pipette in the next year. The reasons for these purchases are as follows

- Replacement of aging pipette
- Addition to existing systems, increase capacity
- Setting up a new lab
- Moving from a handheld pipette to an automatic pipette
- Other
- Need a more ergonomic pipette



TOP 5 QUESTIONS

You Should Ask When Buying a Pipette

1. What differentiates the pipette from others offered in terms of performance and ergonomics?
2. Is the product compatible with other manufacturers' consumables (tips)?
3. What types of services are offered for this product? Calibration? Repair?
4. Does the company offer application support and technical phone support before and after product purchase?
5. What is the product life expectation? What is the product's warranty period? If the company discontinues the product, for how many years do they provide accessories and parts for the instrument?

TOP 10 FEATURES/FACTORS

respondents look for when purchasing a pipette

CONSISTENT PERFORMANCE AND ACCURACY OF PRODUCT	90%
DURABILITY OF PRODUCT	81%
AVAILABILITY OF TIPS AND ACCESSORIES	75%
LOW MAINTENANCE / EASY TO CLEAN	63%
DESIGNED TO PERMIT RECALIBRATION	58%
PRICE	58%
SERVICE AND SUPPORT	49%
WARRANTIES	48%
ERGONOMIC OPERATION	47%
LEAK DETECTION	43%

Completed Surveys: 907

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

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CENTRIFUGES

DAILY CLEANING AND INSPECTION KEEP THINGS SPINNING

by Rachel Muenz

As you can imagine with a piece of lab equipment that spins at high speeds, maintenance is important not just to keep a centrifuge running properly, but also to prevent accidents.

Wiping the centrifuge down after each use to prevent contamination, ensuring there is enough space around the unit for proper venting, and looking after the rotor are especially critical, according to manufacturers.

"It's extremely important that the user keeps an eye on the status of the rotor, maintains it properly, cleans it, and prevents aggressive chemicals from getting in," says Maurizio Merli, global product manager at Thermo Fisher Scientific. "A rotor which is not properly maintained is a rotor that could explode and can cause damage to the unit and potentially … to the people around."

He adds this only applies to metal rotors—carbon fiber rotors, for example, are maintenance-free as they "are designed to basically last forever."

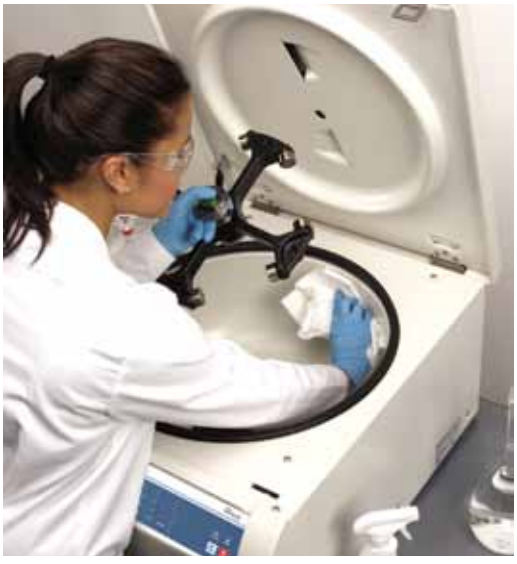
"In general, keeping it clean every time you use it or at least weekly" is important, says Randall Lockner, marketing manager, Americas Centrifugation, at Beckman Coulter Life Sciences. Wiping down the interior portion of the centrifuge, the rotor chamber, and also any of the surfaces that have electronic components, such as touchscreens or keypads is a good idea when doing daily cleaning, he adds. Many users, however, often fail to clean the chamber.

"Most customers don't really like cleaning the chamber because it's dirty or because it contains chemicals—it contains spills from blood, or urine, you name it—but also because it's difficult to access the chamber because there's a rotor in place," Merli explains, adding the latest centrifuges have features that make rotor removal easier. A major issue, Merli says, is users' assumption that the next user will clean the centrifuge.

"You end up discovering that the centrifuge has never been checked or maintained for months and months," Merli says.

WHAT TO KNOW BEFORE SIGNING UP FOR A SERVICE AGREEMENT:

- Is coverage on-site or off-site? How much downtime can the user expect?
- What is the usual turnaround time on repairs?
- Is the manufacturer using original parts or used/refurbished?
- What is the limit to the total cost of repairs covered by the agreement?
- Does the agreement entitle users to any software or other upgrades made to their centrifuge after purchase?
- What is the number and location of trained field service engineers?
- Vendors offer a number of programs, from simple preventive maintenance, to more intensive agreements, to inspection programs like Beckman Coulter's Field Rotor Inspection Program



▲ Simply cleaning out the rotor chamber is important in keeping centrifuges in top form. Some of Thermo Scientific's models have a feature that allows users to remove the rotor with the push of a button.

One way users are solving this issue is by having a chart next to the centrifuge similar to those found in public bathrooms showing when it was last cleaned and who cleaned it.

Another key to a happy unit is inspecting components such as O-rings.

"Our standard practice is every time you're going to use a centrifuge, especially floor-model or ultracentrifuges, is to inspect all of the critical components, look at the O-rings and gaskets," Lockner says. "Look at the hub for any signs of wear or unusual marks." Any strange noises or vibrations might warrant a service call.

Lockner says that many of the mistakes people once made with centrifuge maintenance have been eliminated with the features of the latest models, but most of the remaining centrifuge problems are caused by imbalance.

"It's important that users are trained on the proper use of the systems," Lockner says. "User-error is often the root cause of most problems with operating a centrifuge. That is typically imbalance, maybe not paying enough attention to the balance of the samples across the axis."

Many of these issues can be avoided by reading the user's manual or consulting with the manufacturer and taking advantage of any training programs they have available.

Merli says that centrifuges are advancing to a point where very little maintenance will be required.

"The best way to do maintenance is not only instruction from the manufacturer, [but it] would of course be to have a system that doesn't need any maintenance at all," Merli says.

Be sure to check out our upcoming June Maintenance Matters where we'll bring you great tips on looking after your lab washer.

▲ A good time to check O-rings, gaskets and other parts for wear is when installing or removing rotors. Photo of the Optima MAX-XP ultracentrifuge is courtesy of Beckman Coulter Life Sciences.

3D CELL CULTURE AND FLUORESCENCE IMAGING

Problem: Assays using immortalized cell lines and plastic labware have been used for decades as an in-vitro mimic of how a putative drug may work in the human body. The last decade has seen attempts to improve the physiological relevance of these assays by the incorporation of human primary cells that better reflect human biology both from a drug efficacy and toxicity perspective. At issue with the use of primary cells is the relative difficulty in tissue culturing and maintenance for long-term studies relative to immortalized cell lines.

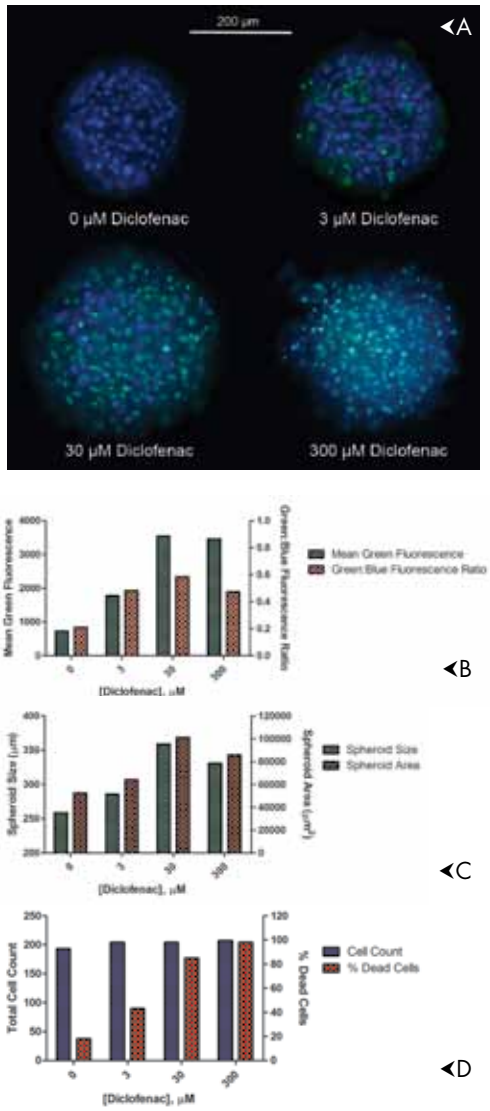
Solution: 3D cell culture methods that involve cell aggregation either by self-assembly into spheroids or the use of scaffolds to build tissue-like structures can enable long term experiments spanning a week or more. Peter Banks and Brad Larson of BioTek have shown that human hepatocytes demonstrate excellent plasma membrane integrity and enzyme activity (i.e. cytochrome P450, isotype 3A4) over a period of almost two weeks when contained in a spheroid liver microtissue. This allows for drug toxicity testing over the same period.

The spheroids consist of aggregations of about 1,000 – 2,000 cells and have a diameter of about 200 – 400 µm. Larger size spheroids tend to necrosis due to the lack of nutrients accessing the core. Most assays involving spheroids are conducted in microplates where there is one spheroid/microplate well. Spheroids are small in relation to the well dimensions and only cover about 0.2 percent of the surface area at the bottom of a 96-well microplate. Using conventional PMT-based plate reader optics, assays utilizing spheroids tend to be problematic as these instruments are designed to capture as much light from the well as possible. This causes issues with background as the signal is confined to such a small part of the detection volume. Fluorescence microscopy, however, limits the field of view depending on the magnification desired and thus enhances signal to background ratios (S/B) allowing for robust assays. Furthermore, image analysis provides additional data for a better understanding of what is occurring in an experiment. Figure 1 illustrates this point, using the affect of the non-steroidal anti-inflammatory drug diclofenac on liver microtissue spheroids after ten days repeated treatment under various doses (0 – 300 µM). Images (Figure 1A) and image analysis (Figure 1B-D) were provided by BioTek Instruments' Cytation 3 cell imaging microplate reader using its fluorescence microscopy module under 10x magnification.

Gen5 software's image analysis capability allows the images to be processed in many ways, providing greater detail on how diclofenac affects the spheroid. The mean green fluorescence in the field of view can be plotted (Figure 1B), providing a relative impression of increasing toxicity based on the disruption of the plasma membranes of the cells comprising the spheroid. A fluorescence ratio of green (dead cell fluorescence) to blue (total cell fluorescence) can also be plotted, which yields a different profile at higher diclofenac concentration. These data are equivalent to that obtainable from PMT-based optics, but with improved S/B which suggests that diclofenac toxicity reaches a maximum at 30 µM. Ratiometric data is rather confusing as it suggests that diclofenac toxicity is inexplicably reduced at higher concentration. Upon examining the spheroid images in Figure 1A, it is evident that the spheroids are expanding with increasing diclofenac concentration. Gen5 can use image analysis routines to compute spheroid size, based on a diameter and spheroid area which is plotted in Figure 1C. Quantitative data indicate that the spheroids do increase in size up to 30 µM diclofenac, but at the highest dose, it appears the integrity of the spheroid is partially ruptured and the size and area is reduced. These data suggest an explanation for the ratiometric data seen in Figure 1B. Finally, cell counting in a focal plane that bisects the spheroid can be performed for both blue (live cell) and green (dead cell) fluorescence channels using Gen5. Quantitative data presented in Figure 1D indicates that while the total number of cells counted in the spheroids is consistent across all diclofenac concentrations, increasing toxicity is evident across the concentration profile of diclofenac reaching almost 100 percent toxicity at 300 µM.

Fluorescence microscopy and the image analysis capabilities of Gen5 provide multiparametric data that allows for a complete understanding of long-term diclofenac toxicity on spheroid microtissues.

For more information, visit www.biotek.com.



▲ *Figure 1: Images and image analysis of liver microtissue spheroids after 10-day incubation under several doses of diclofenac. A: 10x images of spheroids showing live (blue) and dead (green) cells. B: Mean green fluorescence is computed from each pixel of the 16-bit CCD camera; green:blue fluorescence ratio is computed from mean fluorescence intensities of each channel. C: Spheroid size is the diameter of the spheroid and spheroid area represents the area drawn by Gen5 around the spheroid. D: Total cell count represents the total number of cells in the field of view using the blue fluorescence channel; % dead cells represents the percentage of the total cell count containing green fluorescence.*

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INCREASED LAB EFFICIENCY WITH MOBILE DATA CAPTURE

Problem: Scientists who are still using paper in the lab might be doing so because they consider it the easiest way to work. But paper doesn't allow the benefits of electronic solutions like automated data transfer and sharing that can make them more efficient in the lab. Even scientists who are already using an electronic laboratory notebook (ELN) still have to walk out of the lab to enter data into their ELN. To remember the data they write them down on sticky notes, paper sheets or forms...even on the palms of their hands. This process is disruptive, time-consuming, error-prone and adds no value. Scientists also typically print out workflow procedures on paper and then have to bring this documentation into the lab, which is not efficient.

Although some laboratories have "kiosk PCs" for data entry in the laboratory, scientists still have to walk to these PCs as they are anchored. They also need to share them and might have to switch between different applications running on these PCs, which adds non-value added steps to the process.

Large tablet PCs loaded with full applications are an option for "going mobile" in the lab. However, they too have not been successful as they do not allow for quick data entry ("fat fingers" syndrome) and they are not as easy to carry as small mobile devices. Also, the hardware requirements for some labs (ruggedness, resistance to chemicals, etc.) might not be fulfilled.

Solution: The most effective and efficient solution to this lab informatics challenge is to capture data on smaller mobile devices that can easily be carried around (like in a lab coat pocket). This requires a dedicated application with a clean and intuitive user interface.

For example, the new Accelrys Capture mobile data recording app for laboratory informatics offers one of the simplest, most intuitive mobile ELN interfaces on the market today. Accelrys Capture is as easy to use as paper while providing the additional advantages of an integrated electronic solution. Scientists get a quick overview of their tasks and experiments. They can look up current procedures and enter data using a single device right at the lab bench where the work is performed. Eliminating data transcription improves data quality. Additionally, scientists can take advantage of advanced usability features commonly found on mobile devices such as voice recognition, camera, swipe UI, etc. Accelrys Capture is directly connected to the Accelrys Enterprise Platform, enabling instantaneous data transfer, high data integrity/security and powerful search capabilities.

With apps such as Accelrys Capture, scientists can eliminate non-value-added workflow steps to work faster, more flexibly and intuitively in the lab, ultimately focusing more of their attention on the science at hand. Lab managers will see better quality, improved data security and integrity, fewer workflow bottlenecks and enhanced staff motivation. Overall, scientists equipped with such an app will see improved productivity and faster experimentation with shorter cycle times, enabling them to make better informed decisions.

For more information go to: www.accelrys.com

▲ *Data recording with Accelrys Capture directly at the bench improves efficiency, flexibility and data quality.*

Save Time and Improve Safety in Shared Laboratories

Shared laboratory facilities often have a number of unique users with varying levels of centrifuge experience. This presents challenges to lab and facility managers responsible for ensuring safe operation, maximizing uptime, and minimizing maintenance costs. It's easier to accomplish this with features, such as password protection, user-defined programs, and Mobile operation, which are built into Beckman Coulter Life Sciences ultracentrifuge and high performance lines, including the new Avanti JXN.

This gives shared laboratories the reliability and performance of a leading centrifuge brand, with the functionality they need for today's research applications.

Sample prep made easy

Users find it easy to learn, read and navigate the large LCD touchscreen on Optima and Avanti series centrifuges. Setting up a manual run to prepare a sample for your research is as simple as inputting speed, time and temperature.

The Windows®-based user interface makes training and use intuitive, while reducing setup time and the possibility for errors. The help screen built right into the screen's context makes it simple to navigate.

A low deck height makes the Optima and Avanti centrifuges comfortable to use for people of all heights. The hands-free lid swings up and out with the tap of a foot pedal. Switching our rotors is quick, simple and safe.

Protected Access

Users can be given appropriate access, including administrator, superuser or operator. Limiting centrifuge access only to users that have been properly trained increases overall safety, maximizes uptime, and minimizes repair costs caused by user error.

Detailed Run History and Rotor Tracking

The system tracks your rotors by serial numbers, eliminating the need for rotor log books. It also ensures that details of every run are recorded and linked to a specific user, which adds a level of accountability. Detailed run tracking builds an archive that includes the user operating the centrifuge, date/time, run parameters, and any diagnostics or run errors.

Users also can track the number of cycles accumulated on specific rotors used with the centrifuge. Then, just choose the rotor by serial number from an on-screen rotor library. The centrifuge tracks the cycles, so the life of the rotor can be serviced as necessary, and retired before it becomes unsafe. Beckman Coulter offers the widest range of rotors and accessories designed, manufactured and tested as a part of total centrifuge systems. The Avanti JXN is is backward compatible with Avanti J series rotors, so you can maximize your investment.

Freedom

The MobileFuge feature, means users can control and monitor runs from their mobile device With remote monitoring and control of Optima XPN and Avanti JXN Series centrifuges. Users can access the centrifuge from virtually anywhere via computer or mobile device using the MobileFuge app available for iOS and Android™ devices. With email diagnostic alerts, lab managers are notified if their run needs attention.

BECKMAN COULTER

Life Sciences

www.beckmancoultercentrifugation.com

A COMBINED METHOD FOR QUANTITATIVE AND QUALITATIVE CELL-BASED RESEARCH

Biochemical and cell based assays using a microplate reader provide quantitative data on ex vivo cell behavior, while viewing cells with a microscope allows researchers to see cellular and intra-cellular processes via fixed cells or with live cell imaging. Both methods are equally important to life science research and the drug discovery process. Together, these methods provide valuable, content rich data that otherwise requires the expense of multiple instrumentation. The Cytation™3 Cell Imaging Multi-Mode Reader from BioTek Instruments, Inc., combines both methods in one compact, affordable instrument. With this unique combination, BioTek brings microplate detection analysis and automated digital microscopy to researchers without the need for separate, expensive and complex imaging systems. Additionally, cells may be grown directly in Cytation3 to reduce environmental variation due to manual intervention. Now, researchers can culture cells and subsequently glean almost simultaneous quantitative and qualitative data. Cytation3's combination of technologies also helps to streamline cell biology research for improved lab efficiency and increased throughput.

Cytation3 is modular, so labs can select only the modes that they need, and can upgrade at any time as their needs evolve. Microplates from 6 to 384 wells, and microscope slides may be used, for a variety of throughput needs. Optional dual reagent dispensers may be used for inject-and-read assays, and the optional BioStack3™ Microplate Stacker has a plate transfer time of about 8 seconds per microplate, for increased throughput and walk-away automation of up to 50 microplates.

CELL-BASED ASSAYS

Patented Hybrid Technology™, incorporated in Cytation3 or available as an upgradeable option, combines filter- and monochromator-based fluorescence optics in one compact unit for power and flexibility in assay choice. The filter optics use direct, fiber-free light paths to maximize light delivery to the sample and detector, and dedicated filter optics are optimized for live cell assays. Monochromator optics use quadruple diffraction gratings to concentrate and purify the selected wavelength, thus optimizing spectral discrimination. User-selectable monochromator optics also allow for wavelength scanning and kinetic measurements. Multiple parallel detectors decrease measuring time, and both optical systems may be read from the top or bottom of a microplate for increased assay versatility.

CELL MICROSCOPY

Cytation3 automates cell microscopy throughput compared to manual fluorescence microscopy, and also allows simple assay validation before moving to high-content screening. An inverted fluorescence microscope with brightfield capability and autofocus is integrated in Cytation3 or available as an upgradeable option. Fluorescence microscopy and color switching are available through red (Texas red), green (GFP) and blue (DAPI) LED filter cubes, and brightfield images are taken with a simple white light. Additionally, 2.5x and 4x objectives allow researchers to view and read entire microplate wells, while 10x and 20x objectives allow viewing and reading of intracellular details.

CELL PROPAGATION

Cytation3 offers uniform temperature control up to 45°C across the culture chamber, and variable orbital shaking to keep cells in suspension, even during long experiments. An optional gas control module regulates CO2 and O2 concentrations for optimal physiological conditions and pH buffering. Adding these environmental variables directly to the reading and imaging chamber reduces cell culture exposure to unregulated lab atmospheres and fluctuating temperatures that may adversely impact results.

The combination of multi-detection reading and microscopy, along with integrated cell incubation, allows for endpoint, time-lapse and montage information to simplify research and assay development, and increase throughput in cell biology research.

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Microscope to Microplate Reader - Increasing the Throughput of Live Fluorescent Protein FRET Assays

Introduction

Filters vs. Monochromators - When using a microplate reader, these are the two options to filter light into monochromatic wavelengths. Filters offered higher performance because of greater light transmission and wider bandwidths; monochromators offered greater flexibility, no new filters were needed for each new assay.

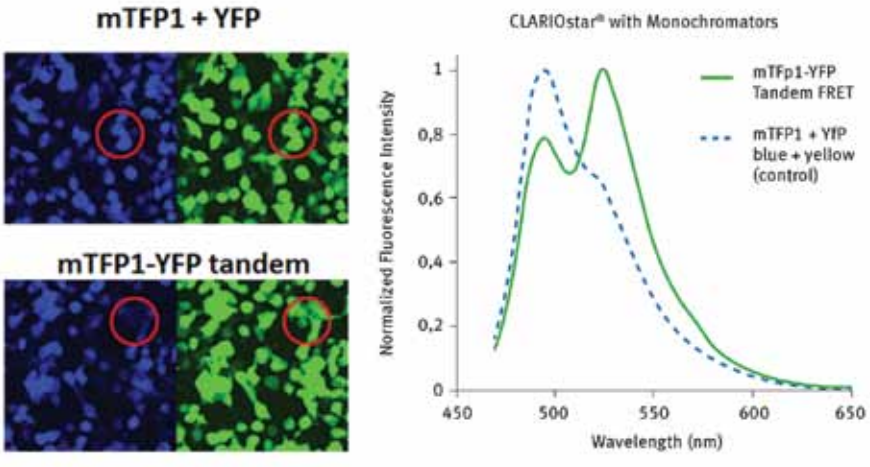
However, researchers state that monochromators cannot perform many assays (1). Fluorescent protein assays like GFP, mCherry, or CFP-YFP, do not perform well on monochromator-based microplate readers. The same holds true for FRET and BRET assays. One main reason is that wider bandwidths are needed. Some FRET or BRET assays require an emission bandpass up to 100 nm and current monochromators only have fixed or limited bandwidths up to 30 nm.

New LVF Monochromators™ Have Filter-like Performance

Realizing the need for a more sensitive, broader bandwidth monochromator in a microplate reader, BMG LABTECH's German engineers created the CLARIOstar® multimode microplate reader with new innovative LVF Monochromators™. Consisting of linear variable filters separated by a linear variable dichroic mirror, LVF Monochromators™ filter light into definable wavelengths and **bandwidths up to 100 nm wide.**

Confocal Microscope to Microplate Reader – No Filters Needed

Researchers routinely try to adapt their fluorescent protein assay from a confocal microscope to a microplate format. Now with LVF Monochromators™ no filters are needed. The figure shows an mTFP1-YFP fluorescent protein FRET response in HEK293 cells as measured on a confocal microscope and on the CLARIOstar®. This FRET assay requires the measurement of two emission signals with bandwidths of 30 nm and 45 nm for the microscope (2), which were the starting points for the CLARIOstar®'s LVF Monochromators™. With further optimization, the same percent change is seen (figures table), making it an almost seamless transition to a higher throughput method without buying new filters.



Ratio D/A	mTFP1 + TYP (control)	mTFP1-YFP tandem FRET	% Change
Confocal Microscope 480-30/535-45 nm	0.89	0.56	37.1%
CLARIOstar® 485-30/525-25 nm	1.24	0.77	37.9%

References

1) Comley, J. *Monochromator vs Filter-based Plate Readers; horses for courses, or a winning combination?* Drug Discovery World. Fall 2007. http://ddw.net-genie.co.uk/enabling_technologies/347427/monochromator_vs_filterbased_plate_readers_horses_for_courses_or_a_winning_combination.html

2) Padilla-Parra S, et al. *Quantitative comparison of different fluorescent protein couples for fast FRET-FLIM acquisition*. Biophys J. 2009 Oct;97(8):2368-76.

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DART Technology for Cannabinoid Screening

Rapid Identification of Synthetic Cannabinoids in Herbal Samples via Direct Analysis in Real Time Mass Spectrometry— R. A. Musah, M. A. Domin, M. A. Walling, and J. R. E. Shepard, Rapid Commun. Mass Spectrom., vol. 26, no. 9, pp. 1109–1114, 2012.

Introduction:

Dozens of synthetic cannabinoid analogs purposefully meant to circumvent legal restrictions associated with controlled substances continue to be manufactured and promoted as producing 'legal highs'. These designer drugs are difficult to identify in conventional drug screens not only because routine protocols have not been developed for their detection, but also because their association with complex plant matrices during manufacture generally requires labor-intensive extraction and sample preparation for analysis. To address this new and important challenge in forensic chemistry, Direct Analysis in Real Time Mass Spectrometry (DART-MS) is applied to the analysis of these designer drugs.

Methods:

DART-MS was employed to sample synthetic cannabinoids directly on botanical matrices. The ambient ionization method associated with DARTMS permitted the analysis of solid herbal samples directly, without the need for extraction or sample preparation. The high mass resolution time-of-flight analyzer allowed identification of these substances despite their presence within a complex matrix and enabled differentiation of closely related analogs.

Results:

DART-MS was performed to rapidly identify the synthetic cannabinoids AM-251 and JWH-015. For each cannabinoid, three hundred micrograms (300 µg) of material was easily detected within an excess of background matrix by mass.

Conclusions:

New variations of herbal blends containing a wide range of base components and laced with synthetic cannabinoids are being produced, making their presence difficult to track by conventional methods. DART-MS permits rapid identification of trace synthetic cannabinoids within complex biological matrices, with excellent sensitivity and specificity compared with standard methods.

Maximizing Reproducible Biological Sample Prep

Routine pipetting tasks across a larger number of samples can often be inefficient, complex, time consuming, and expensive. These hurdles can lead to increased training requirements, preparation time, procedural errors and ultimately hold back the pace of your experiments. When preparing biological samples, you need an assistant you can trust and PIPETMAX™ is the ultimate lab assistant – focused on consistency.

Maximize qPCR assay reproducibility using PIPETMAX

Download the full application note: http://www.pipetmax.com/pcrqpcr/

PURPOSE:

- Maximize qPCR sample prep accuracy and eliminate inherent variability
- Enhance sample purity

RESULTS:

- Gene expression of CAB was greater in PVY infected plants than in healthy/mock-inoculated plant leaves
- PVY viral RNA levels increased >15-fold in 3 days demonstrating a rapid spreading of the viral infection
- No PVY expression was detected in mock-inoculated plants (no contamination)
- Enhance sample purity

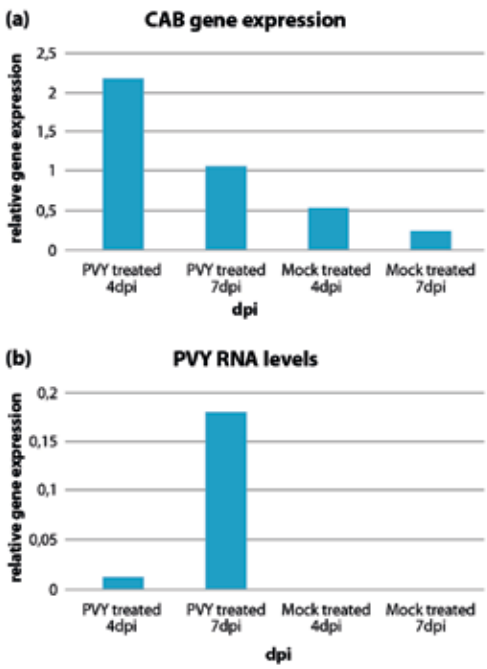
Though it's a fundamental process that enables most life science research, the pipetting operations required to setup PCR can be quite monotonous for technicians conducting the process manually. This can lead to procedural errors and inconsistencies, not to mention decreased time and energy for researchers to make valuable and intellectual contributions to their research labs.

Automating your qPCR sample preparations, and other processes, can happen right out of the box. The intuitive qPCR assistant operates directly from the PIPETMAX touchscreen interface, allowing researchers to import sample information, configure reaction proportions, set up single or multiplex assays, and even export plate files for common thermocyclers. PIPETMAX does the rest by generating pipetting protocols based on your configurations and performs them quickly and efficiently.

Once you've automated your qPCR sample preparation, you can add additional kits that allow PIPETMAX to perform other processes, such as Next Generation Sequencing, ELISA, nucleic acid cleanup and cell-based assays.

You can also add the PIPETMAX protocol builder software to create completely custom protocols and import them into PIPETMAX for solutions that are unique to your needs.

With PIPETMAX, the possibilities are endless.



▲ *Sample Analysis with qPCR (a) Expression of CAB gene normalized to COX and EF1 in infected compared to non-infected (mock-inoculated plants) (b) levels of PVY RNA in samples.*

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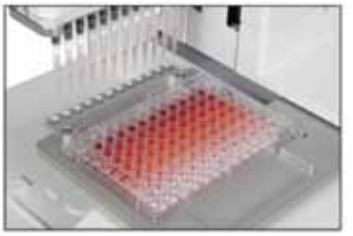
Automate your multichannel pipettes

Multichannel pipettes are invaluable when working with multiwell plates. However, prolonged and repetitive pipetting sessions bear the risk of strain and fatigue, often resulting in repetitive strain injuries (RSI) and less reproducible results. VIAFLO ASSIST together with INTEGRA's VIAFLO II electronic pipettes form the perfect symbiosis to prevent users from RSI and to significantly increase the reproducibility of prolonged pipetting protocols such as serial dilutions, plate filling and reagent addition. By mounting a VIAFLO II electronic pipette on the VIAFLO ASSIST, the pipette's protocols can be carried out fully automatically.

TYPICAL APPLICATIONS

Serial Dilutions

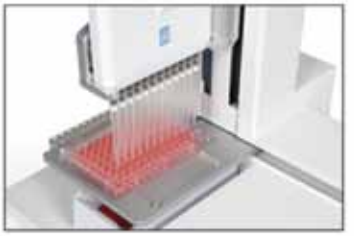


Serial dilutions can be tedious due to the many mixing steps that are required. VIAFLO ASSIST carries out your serial dilution protocols automatically. Simply define the number of mixing cycles, speed and mix volume.

Serial dilutions are often carried out with the plate in portrait orientation. This allows more samples to be diluted. VIAFLO ASSIST allows working in landscape and portrait format.

The concentrated sample can be drawn from a reagent reservoir, a PCR tube strip and the plate itself (e.g. First column). In addition, the sample can also be aspirated with the pipette from an external source before placing it on the VIAFLO ASSIST and starting the protocol.

Plate Filling



Filling multiple plates might not be a difficult task but is strenuous nonetheless. In order to improve pipetting ergonomics, manual pipetting should be minimized.

VIAFLO ASSIST helps you to fill microplates without risking repetitive strain injury.

Reagent Addition

Draw reagent from the reagent reservoir, a PCR tube strip , the plate itself or an external source to add it to the target plate.

An optional mixing step helps to achieve a homogenous distribution of the sample.

For a precise liquid transfer and to make sure that no remaining liquid clings to the tip end, performing a touch off is common practice. VIAFLO ASSIST allows both a touch off on the side wall of the well or inside the liquid.

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How To: Protect Clinical Researchers & Testing Analysts

In clinical lab environments, as in any laboratory using chemicals, work processes pose an inherent risk of hazardous chemical exposure for operators and for the lab environment. This problem is made more difficult to mitigate due to the budget-focused nature of many hospital and clinical laboratories. So how do we go about protecting our technicians from the chemicals they have to use on a daily basis – and do so without breaking the bank?

Labconco has two options: the **Fume Adsorber** and the **Protector Work Station**.

For those troublesome stains and nuisance odors, the Fume Adsorber offers a compact footprint (only 30" wide and 15.4" tall) and flexible ductless filtration on a reasonable budget. The Fume Adsorber is available with Organic Vapor (for xylene, toluene, organic stains, or their substitutes), formaldehyde, or ammonia carbon-based filters.

When analyzing or preparing tissues for storage, technicians use more than "minute" quantities of chemicals. For these procedures, something more robust is required. Enter—the Protector Work Station. It is the ideal enclosure for clinical pathologists and histologists. It also has a small footprint (29" deep x 43" wide), but uses stackable carbon filters for larger chemical capacity or mixing of chemical uses (pair two identical filters or two different filter types).

When small-scale protection is needed, going to a large fume hood isn't always a suitable option. Labconco has the protection of these smaller operations covered with the use of its clinical ductless hoods.

By Brian Garrett,
LEED Green Associate, Product Manager

Five Things to Know Before Buying a Liquid Temperature Control Product

When buying a new liquid temperature control product, there are a number of factors to consider when picking a product.

Pick the Right Product

Make sure you are picking the right product for your application. With so much variation within each product category, determine the differentiating features of the product line and choose the best fit for you. For example, PolyScience® Circulating Baths are available with six different temperature controllers, ranging from basic to sophisticated, with standard features ranging from English/icon controls to operation in 11 different languages. We have options with unlimited programmability options, and multiple connectivity ports. When in doubt, contact the distributor or manufacturer's sales team for assistance.

Think Ahead

If you're in the market for a heated circulating bath, and have room in the budget, consider buying a refrigerated circulating bath if you may be operating at temperatures near or below ambient in the future. It'll save money in the long run as you'll already have the ability to work at those temperatures, without purchasing another unit.

Check for Promotions

See if the company you are buying from has any trade-in promotions or other discounts. PolyScience® will take in your old, used circulator regardless of condition and brand, and will give you a trade-in credit towards your new purchase. All recoverable materials (such as steel, copper, plastic and packaging) will be recycled, and refrigerants reclaimed. PolyScience® also offers discounts for educational facilities and volume purchases.

Consider Maintenance

Like any other piece of equipment, temperature control products require maintenance. Be sure to set up a maintenance schedule (or at least think about it) before buying the unit so you'll know what it entails. Select PolyScience® Circulators include a Service sub-menu, tracks operation statistics and even notifies you when your filters or fluids need to be replaced.

Accessorize

Pick up accessories at the same time to save on shipping and downtime. PolyScience® offers tubing, fluids and other accessories required to make the most of your new purchase. PolyScience® also offers an iOS app called "PolyTemp Remote" which allows you to monitor and set the temperature of Circulating Baths equipped with Advanced or Performance Series Controllers. This is ideal when the bath is located under a fume hood or you are off-site and want to check the status of your Circulator.

Conclusion

Each application has a different set of requirements, so it's important to select the right unit to ensure it meets the necessary requirements. With low profile units, ideal for viscometers, to large refrigerated circulating baths with unlimited programming for accelerated beverage testing, and an extensive list of additional, factory-installed options, PolyScience® offers products that meet almost any need.

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Temperature Control Solutions

www.polyscience.com

PROTON ONSITE HYDROGEN GENERATION SYSTEMS

The Proton OnSite line of hydrogen generators is the simpler, more cost-effective, and less complex approach to supplying hydrogen for laboratory and scientific applications. Offering units that produce from 300 cc/min to 18.8 slpm of gas, these generators use Proton OnSite's patented Proton Exchange Membrane (PEM) electrolysis technology to produce gas at +99.99995 percent purity without the need for high-pressure liquid hydrogen tanks, or compressed gas storage. It's the safe, cost-effective solution for any lab.

Serving Large Labs with a Complete Hydrogen Solution

Many lab managers understand the value of switching from delivered gas to an on-site hydrogen gas supply. On-site generation offers a pure, constant and safe supply of hydrogen gas as opposed to delivered cylinders. But, for large laboratories that cover multiple rooms and floors, switching to hydrogen gas generators is a tough decision. A large lab may have tens or hundreds of Gas Chromatography (GC) systems which would need many small generators to meet the full demand of FID and/or Carrier Gas requirements, and that is often not economically viable. Lab managers in large facilities can avoid having to invest in numerous gas generators by installing a single, larger Proton OnSite hydrogen generator and plumbing it into each lab as a 'lab server'. That way they can receive a stream of gas at the flick of a switch, anywhere in the building.

A Unique Proposition

Proton OnSite's large PEM electrolyzers are the only generators in the laboratory market with the ability to run as a Lab Server. One S-Series hydrogen generator can supply up to 200 GC units with ultra high-purity hydrogen gas that can be maintained and managed from a single source. Proton OnSite's technology can also ensure that pressure, flow and purity are constant throughout the building, and can be monitored at all times.

Safety First

Ensuring safety is paramount for a facility that deals with thousands of liters of hydrogen gas each day, considering a single hydrogen cylinder storing 6,300 liters of gas has the explosive potential of 35 lbs of TNT. A facility with hundreds of GC systems fed by cylinders of hydrogen has a tremendous explosive potential, so a lab manager that opts for delivered cylinders has to invest in significant safety infrastructure to mitigate those risks. By replacing those cylinders with a single centralized Proton OnSite hydrogen gas generator that only produces gas when necessary and has a limited capacity, labs can dramatically reduce both the explosive potential and the amount of time and money spent handling heavy, dangerous cylinders.

Making the Helium Switch Make Sense

Most laboratories are facing a future with a less reliable and more expensive helium gas supply, causing them to explore their carrier gas options. Large labs that wish switch to on-site hydrogen gas will have to invest in many small hydrogen generators for each lab, creating upfront costs that can be tough to justify. But, hydrogen is quickly becoming less expensive than helium and is a more efficient carrier gas. The lab server solution allows large labs to justify the switch while providing their practitioners with a carrier gas that offers superior, cost-effective results.

A Proton OnSite hydrogen gas lab server can be installed into a large facility in hours and are easier to maintain than several generators or rooms filled with heavy, dangerous cylinders. The lab server is the only option for large laboratories that need pure and constant hydrogen gas in every room and on every floor.

Proton OnSite S-Series Hydrogen Generator

The Proton OnSite S-Series hydrogen generation systems produce up to 18.8 slpm of ultra-high purity hydrogen gas for multiple use with multiple GC systems. A single S-Series hydrogen generator, when installed into a large lab's gas systems, will be able to serve numerous floors and rooms with a constant, pure stream of hydrogen gas at the flick of a switch.

With a production rate of 4.8, 9.6 or 18.8 slpm, Proton OnSite's compact S-Series hydrogen generator produces the equivalent of four cylinders of better-than-ultra high purity grade hydrogen every day. Proton OnSite hydrogen generation systems help many industries eliminate the cost associated with delivering and using hydrogen.

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Performing Promega's ADCC Reporter Bioassay with Tecan's Infinite® 200 PRO and GCM™

▲*Figure 1: Tecan's Infinite 200 PRO multimode microplate reader and Gas Control Module (GCM)*

Introduction

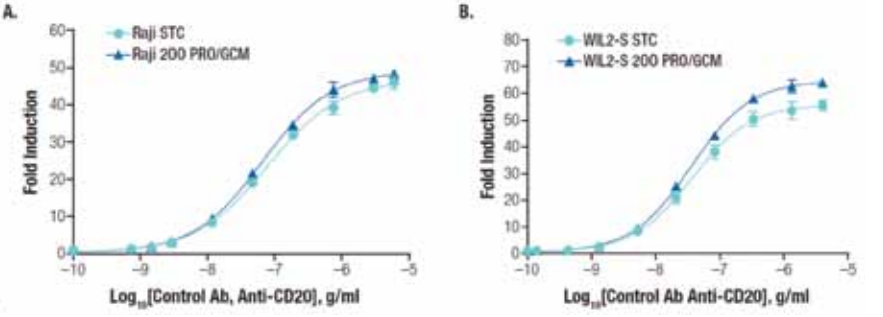
Antibody-dependent cell-mediated cytotoxicity (ADCC) is an important target for antibody-derived biopharmaceuticals, allowing the controlled targeting and destruction of tumor, virus-infected or other diseased cells. Promega's ADCC Reporter Bioassay offers a convenient way of assessing ADCC using frozen, thaw-and-use effector and target cells, eliminating the need for cell culture maintenance. This assay requires a six-hour incubation of cells with the antibody of interest for optimal performance, typically in a standard cell culture incubator. This paper evaluates an alternative method of performing the assay, using Tecan's Infinite 200 PRO and Gas Control Module (GCM) (figure 1). This multimode reader set-up offers rigorous control of the temperature and CO2 and O2 partial pressures within the measurement chamber, allowing in-reader incubation and complete automation of the assay.

Methods

Target cells (Raji cells and WIL2-S cells) were thawed and mixed with assay buffer (RPMI 1640 medium + 4 % low IgG serum), then plated into the inner 60 wells of two 96-well plates (perimeter wells filled with assay buffer). A dilution series of control antibody, Anti-CD20, was added to both plates in final concentrations from 6 µg/ml to 0.73 ng/ml for Raji cells, and 4 µg/ml to 0.14 ng/ml for WIL2S cells. Wells without antibody served as negative controls, and wells containing only buffer served as reagent background controls.

Effector cells were prepared in the same manner as the target cells, and added to the inner 60 wells of both plates, then briefly mixed on an orbital shaker. The plates were then incubated in the Infinite 200 PRO or a tissue culture incubator at 37 °C, 5 % CO2 for six hours.

Following incubation, BioGlo™ reagent (Bio-Glo Luciferase Assay Substrate in Bio-Glo Luciferase Assay Buffer) was added to the experimental and background control wells, and incubated within the Infinite 200 PRO measurement chamber at 37 °C for a further five minutes prior to luminescence measurements.



▶*Figure 2: ADCC Reporter Bioassay, conducted using the Infinite 200 PRO Reader with GCM (200 PRO/GCM) offers equivalent performance to assays incubated in a standard tissue culture (STC) incubator.*

Results

The results of the ADCC Reporter Bioassay with Raji or WIL2-S target cells were comparable in both fold induction and potency whether the incubation was performed in an Infinite 200 PRO with GCM or in a standard tissue culture incubator (figure 2). The potencies obtained were 66 ng/ml and 78 ng/ml respectively for Raji cells, and 36 ng/ml and 37 ng/ml respectively for WIL2-S cells.

Conclusions

The Infinite 200 PRO with GCM is functionally equivalent to a tissue culture incubator for the reporter induction phase of the ADCC Reporter Bioassay. This study showed that the convenience of using a kit containing frozen, thaw-and-use cells was further enhanced by the use of a reader that enabled both temperature and gas control, effectively mimicking the conditions provided by a standard cell culture incubator.

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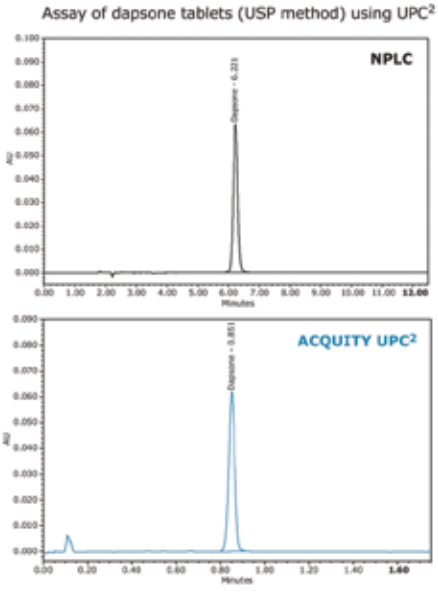
Streamlined workflow, expanded selectivity, and an orthogonal technique for your laboratory

Giving you the power of normal-phase LC, but with the ease of use of reversed-phase LC, convergence chromatography is a broad-based, complementary analytical platform that is taking its place as an essential separation technology for modern laboratory analysis.

Bringing usability to gradients and chiral compounds

With the power to separate both chiral and achiral compounds, as well as utilize gradients, this technique provides another, reliable choice as an analytical platform that is orthogonal to reversed-phase LC, while significantly streamlining the entire analytical workflow.

In convergence chromatography, the separation is achieved by manipulating the density and composition of a supercritical fluid-based mobile phase. Because of the very high diffusivity of the mobile phase, high separation efficiency and fast gradient formation can be achieved. Additionally, the diversity of stationary phase and mobile phase (co-solvent) options provides access to the largest selectivity space available to any separation technique.



Diverse applicability and selectivity

Convergence chromatography utilizes the same eluotropic spectrum as normal-phase LC. The flexibility of this technique, however, also allows the use of some conventional reversed-phase columns, such as C18, yielding similar retention characteristics to reversed-phase LC when analyzing highly lipophilic compounds.

The ability to span this wide range of selectivity is what makes convergence chromatography such a powerful tool.

Convergence chromatography and the ACQUITY UPC2 System

The ACQUITY UPC2 System is a holistically designed convergence chromatography system that utilizes liquid CO2 as the primary mobile phase, and is the first analytical system purposefully designed to manage supercritical fluids. The system leverages the chromatographic principles and selectivity space of normal-phase LC while providing the ease-of-use of reversed-phase LC, enabling you to address routine and complex separations challenges. Built upon proven, low-dispersion, high-efficiency UPLC technology, the ACQUITY UPC2 System offers a level of reliability, robustness, sensitivity, and throughput never before possible.

The advancements made in the ACQUITY UPC2 System, over and above traditional analytical SFC, finally enable normal-phase separations to be done robustly and reproducibly, so that convergence chromatography can be as routinely applicable as any other separation technique.

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PRE-OWNED EQUIPMENT MARKETPLACE

PARTING POINTS

Takeaways from this month's issue:

GOOD CHEMISTRY

With expanding roles in helping design experiments, collect samples, replenish consumables, monitor projects, access literature, overcome software limitations, and collate data along with many other functions, apps are fast becoming indispensable in the laboratory by:

- Improving personal efficiency and group coordination
- Helping make gathering data easier
- Boosting security and compliance
- Making instrument operation and access simpler

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MARKETING YOUR LAB

As budgets for agencies tighten, available grant money shrinks, and money for lab testing becomes less of a priority, it is increasingly important for labs to draw in new business to increase revenue. Labs can do this by:

- Identifying who their clients are, where they're located, and what they need
- Using a multifaceted approach in their marketing plan
- Ensuring they have an easy-to-use website
- Engaging with their communities by speaking at local events, etc.

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MANAGING CULTURALLY DIVERSE TEAMS

Managers of R&D groups—in North America and elsewhere—face multicultural situations with increasing frequency. In those situations, they must deal with the potential for multiple cultural clashes among team members. The "fusion" approach is one way to solve such problems. It allows:

- Coexistence of differences
- Meaningful participation from all team members
- Creativity in dealing with cultural differences
- Better understanding between team members of the others' worldview

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DOCUMENT OR DIE

Keeping track of everything is especially critical in the cell culture field in order to ensure that the data from cell culture research is accurate and to prevent incorrect information from being published. Proper documentation also:

- Allows labs to trace problems back to their source
- Is necessary for some labs to meet industry regulations
- Ensures consistency, reproducibility, and product quality
- Is crucial in maintaining a record of experimental procedures during R & D

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INSIGHTS ON IMAGING SYSTEMS

Imaging encompasses a wide range of techniques that enable visualization of hidden features of samples, structures, or organisms. The latest developments in imaging include:

- Increased ease of use
- Unattended imaging of multiple samples enabled by automation
- Confocal microscopy and multiphoton imaging now routine
- Mass spectrometry pushed to the forefront of advanced imaging technologies

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