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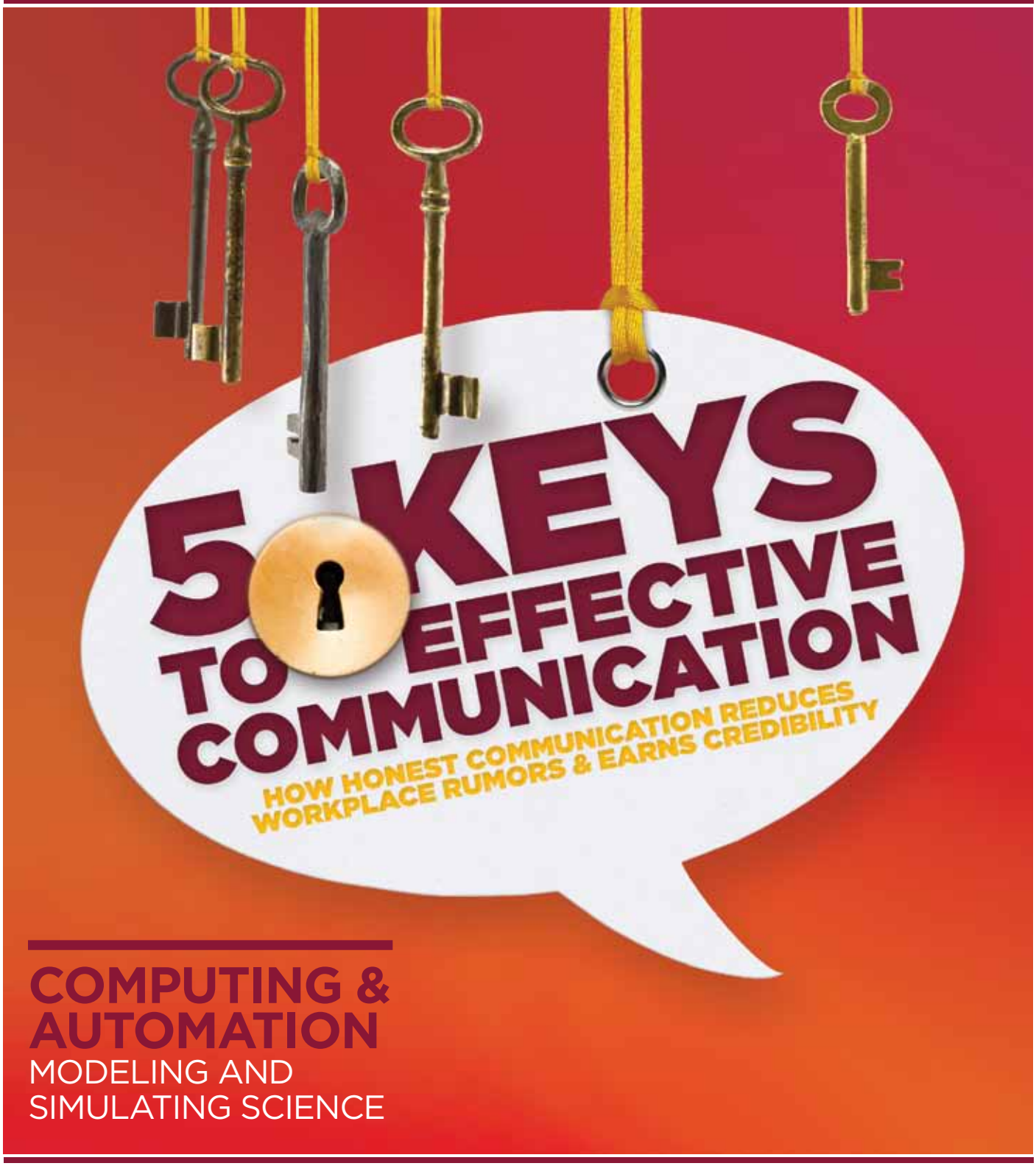

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Going Automated

Lab Manager Magazine recognizes the importance of automated systems in today's laboratories and we are committed to providing relevant editorial to help keep readers abreast of all the changes and new developments in this area of technology. With the SLAS show in San Diego coming up in January, we will be paying special attention to lab automation in our January/February 2013 issue and a number of LabX Media Group staff will be attending the show to find out what's new in this important technology sector. One of our product focuses in that issue will check out what's new in automated liquid handling and the January/February issue of our *INSIGHTS* supplement will focus on automated sample prep. So, if your lab is thinking of going automated, or if automation is already a critical part of your lab, our January/February issue will definitely be worth a read.

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"What we've got here is failure to communicate"*

Talking to your staff, your customers, and to upper management is common sense, natural and instinctive, right? Think again. "Effective communication requires thought and constant effort." So says John Borchardt in this month's cover story, which revisits the oft-covered and always important topic of effective communication with some fresh insights and new approaches. That importance is echoed loudly in "Perspective On: An Academic Clinical Lab" (page 68), in which Lisa Wright, QC and regulatory specialist as well as lab manager at Indiana University School of Medicine, discusses the need to communicate effectively with "current and future clients regarding laboratory processes," with staff members in order to "keep the flow of work moving," and with "clientele to ensure that accurate results are given in a timely manner." She does that with an awareness of each unique relationship and the intended purpose, which certainly requires thoughtfulness and effort.

Inefficient processes? Outdated procedures? Inexperienced analysts? Turn to this month's Management article, "Investing to Save" (page 18) to learn how certain return on investment (ROI) calculations can help you decide which investments are best for your lab. The same need for smart financial focus and calculation is reiterated in this month's Technology & Operations article, "It's All in the Planning" (page 38), which discusses laboratory layout as another way to improve efficiencies. "Optimizing the space for efficiency of the experimental or technical process can yield increased ROI. For that reason, lab design is essential to improved process management."

And if laboratory design and layout are important topics to you, please take a look at this month's 22-page INSIGHTS supplement that covers everything from what to expect when planning a new design or retrofit, to trends, to energy consideration, plus expert feedback from those actively involved in the design process. "Develop a good working team, and develop it early on," says expert Arthur Brings.

For more expert advice, turn to page 46 to find out what Dr. Amanda Capes-Davis, independent cell culture consultant and Founding Manager of CellBank Australia, has to share when it comes to setting up a cell culture lab. For example, "When you are choosing equipment for a new lab, you have to remember that you are going to be living with those choices for years. So you want to have things that can be cleaned easily and you should know where to get them serviced or calibrated if there is a problem." She also says, "All labs should think about having an emergency power supply to run fridges and freezers that contain irreplaceable samples," which brings us to Sandy.

For those of you in the northeast U.S. who may have been affected by last month's "super storm," please let me know what, if any, impact it had on your facility, staff, or research. Were you prepared? What would you do different in terms of planning for such an event going forward? In our January/February issue, we plan to include an article on preparing your lab for power failure and into 2013 focus considerably more attention to this new area of concern. For myself, eight days without heat, electricity or hot water was certainly a wakeup call to better preparedness. I'm sure I'm not alone.

Whether effected by Sandy or not, I hope you are well, warm and looking forward to a joyful holiday season.

Pamela Ahlberg
Editor-in-Chief

* A quote from the 1967 film, *Cool Hand Luke*.

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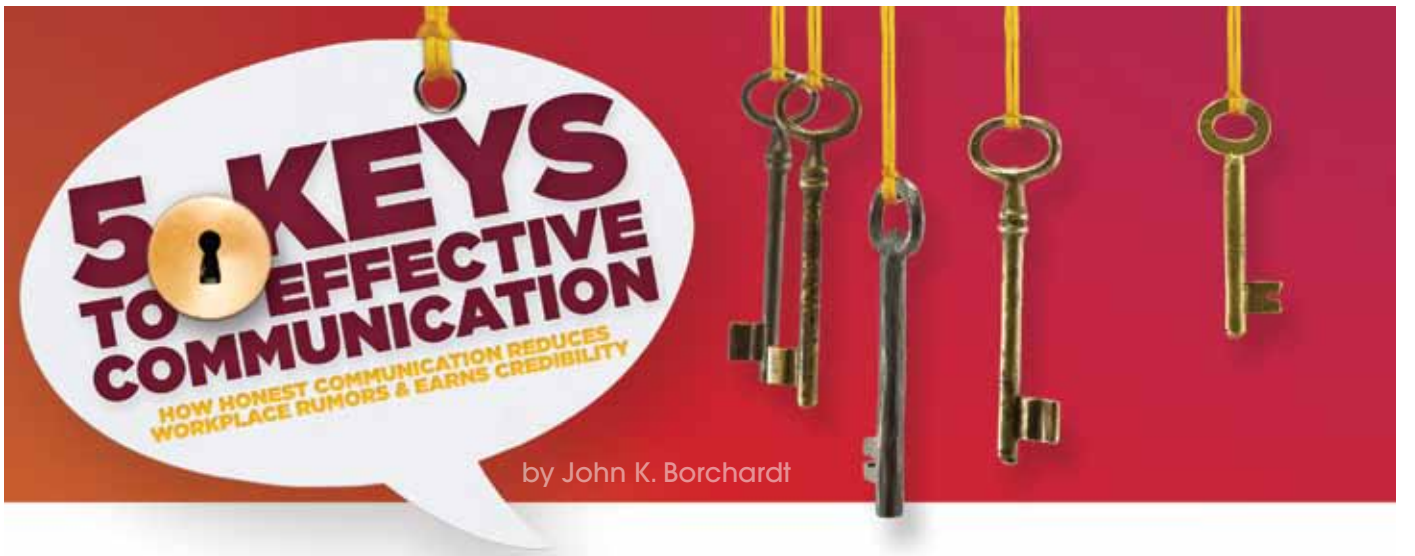

Effectively communicating with staff members, customers, and suppliers is a critical skill for laboratory managers. In particular, staff members have to feel that the manager is providing valid information, is not withholding information, and is available to listen. If the manager can accomplish this, there is no need for staff members to go elsewhere for information. Timely communications can reduce the number of destructive rumors. As President George Washington noted, "Serious misfortunes, originating in misrepresentation, frequently flow and spread before they can be dissipated by truth." Negative rumors can reduce productivity and corrode workplace morale. Effective, honest communication can reduce the number of negative rumors that seem to circulate when employees don't trust what they are being told. So what can lab managers do to earn communication credibility?

1. Honesty is the best policy

When you talk to employees, always be honest with them. The truth behind lies and deceptions is usually found out sooner or later. When it is, the manager loses all credibility and instantly becomes an ineffective leader. Newspaper headlines are replete with examples. I observed something similar much closer to home, in the laboratory of a previous employer. The department manager called everyone into a meeting and told us that a capable young chemist had been laid off because he was the most recently hired. Instantly several heads swiveled toward another chemist who had been hired more recently. Before the hour was out, all the staff knew the truth; the manager had protected the job of the more recently hired chemist because they had gotten their Ph.D.s at the same university. The manager was transferred to a staff job two months later and then was himself laid off. He had lost all capacity to lead, and department productivity suffered greatly as a result.

As a manager, make only such promises as are within your power to keep. For example, I once heard a department manager promise his staff there would be no laboratory staff layoffs. Less than a month later, there was a 10 percent staff reduction. The manager lost all credibility with me. Other staff members and I began working more independently, no longer going to the manager for guidance.

Don't be afraid to admit that you were wrong. Even more powerful for building credibility is stating, "You were right and I was wrong." If you don't know something, admit your ignorance. For instance, many staff members worry about layoffs during a poor business environment. At three different employers, I observed managers reacting to questions from laboratory staff members concerning the possibility of layoffs. In two of these cases, several managers promised there would be no layoffs. It turned out they had been out of the loop; staff reduction decisions were made at a very high level, and lower-level managers were informed only at the last minute before people were let go. In the other case, the president and owner of the company said that every effort would be made to avoid layoffs but that there could be other cost-cutting measures such as salary freezes or temporary pay cuts. It developed that there were salary freezes—these lasted about six months—while the president and vice-presidents took substantial pay cuts. Despite the situation, staff morale and productivity were maintained.

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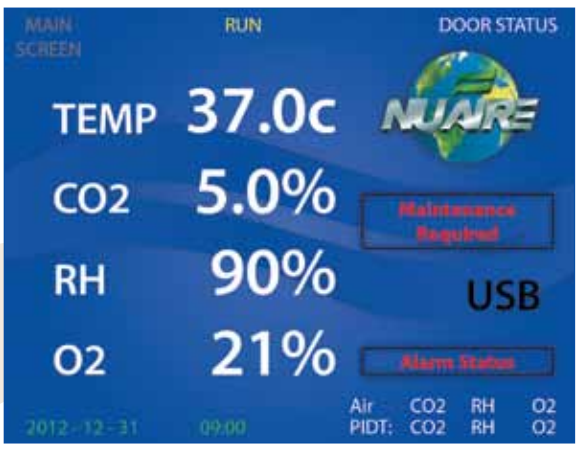

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Be sure your employees get credit for their accomplishments. Never claim credit for a staff member's suggestion. Nothing is more likely to make staff members squirm in their seats during a meeting than seeing you take credit for a staff member's work. Doing the opposite and giving staff members credit for their work breeds loyalty and respect, which is often reflected in greater productivity. Even if the staff member isn't in the room, he or she probably will hear about what you did. My first supervisor at Shell Chemical was a master at giving her staff members credit for their work. As a result, her work group developed a reputation for achieving rapid promotion compared with other work groups. Her people were more willing than most of their peers to go the extra mile to achieve goals.

Avoid the "need-to-know" syndrome. Employees like to know what is going on. Keep them informed to the maximum extent you can. Sometimes this means saying, "I don't know, but I'll try to find out," when asked a question for which you don't know the answer. Sometimes, as in connection with questions concerning the possibility of staff reductions, it means admitting that you don't know the answer and aren't likely to be able to find out. While staff members won't like the answer they hear, they'll be more likely to accept the situation.

2. Speak directly to people

Don't rely on electronic communications, except to back up what you've told people in person. When I worked for Tomah Products, confusion was rife when Tomah acquired Shell Chemical's specialty surfactant business. To dispel this confusion and set people's minds at ease, the president and owner of the company, Steven King, met personally with all the employees who would be joining his company as part of the acquisition. He and I (as manager of pulp and paper research and sales) visited all our major customers to assure them there would be no interruptions in services or changes in the products they were purchasing from us. While our competitors made very serious runs at these customers, Tomah Products held on to all of them, thanks to effective communications.

When the message affects a global work group or department, the entire laboratory, or several laboratories around the globe, speak to employees directly using modern communications technology. Rebroadcast your presentation to allow for time-zone differences. Choose a location and a time that will minimize distractions.

3. Practice active listening skills

Be an active listener during discussions with employees. Adopt a posture that indicates active listening, and maintain eye contact. Ask open-ended questions to verify that they understand the message you are trying to send. Nod or make affirmative gestures or comments to indicate that you understand what they are saying.

Take notes, if necessary. This indicates your strong interest in what other parties in the conversation are telling you and your interest in what they have to say.

Be open-minded and respect the ideas and opinions of your staff members. Control unintentional message senders such as letting your eyes wander, folding your arms, or leaning away from someone. These imply disagreement, disinterest, or lack of respect. Remember, body language can speak volumes about your attitude.

4. Adopt a participatory management style

Participatory management is the practice of empowering employees to participate in organizational decision making. Because they are actively involved in the decision-making process, employees are more likely to be active listeners themselves and to turn communication into a two-way process in which information flows both to and from the manager.

"Interacting with your staff members increases their sense of responsibility in meeting deadlines and achieving goals."

Actively seek advice from your employees. Being "in the trenches," they have a perspective that is different from yours. This means they can provide important perspectives on research problems, customers' needs and attitudes, and what is happening among your firm's suppliers. Gaining this information is often essential in identifying new business opportunities or in spotting problems brewing in the business. By actively seeking input and advice from your staff members, you are demonstrating your respect for them and their opinions and thus are more likely to gain their respect.

Encourage your employees to ask questions. Then be sure that their questions are answered.

Make yourself available to your employees. Practice "managing by walking around" (MBWA). MBWA isn't just a stroll through labs and offices; it's a determined effort to understand what your staff does and to learn how you can help them do it better. Casual discussions can be very illuminating and motivating. MBWA can also be a very effective way to prevent workplace rumors or limit their harmful effects.

MBWA also promotes two-way communication. When your staff sees you as a person and not just a boss, they'll be more likely to tell you what's going on. You'll get the chance to learn about issues before they become problems. You'll gain a better understanding of your staff members' work processes. As your staff gets to know you better, they'll trust you more and be more likely to share information on a timely basis.

Interacting with your staff members increases their sense of responsibility in meeting deadlines and achieving goals. Many creative ideas arise from casual exchanges, and MBWA increases the frequency of these exchanges.

When practicing MBWA, be sure you apply the technique to all staff members. Don't ignore some staff members to spend more time with your favorites. Also, once you establish the habit, maintain it. MBWA is not something you can turn on and off. You need to practice it consistently for it to be an effective technique.

5. Choose your words carefully

Precision and clarity are essential to both oral and written communication. Precision means saying exactly what you intend to say. Clarity means saying it in such a way that it will be understood by the person receiving the message. Precision and clarity overlap, but it is possible to be precise without being clear or vice versa. Simple, straightforward sentences are much easier to understand than long, complex ones.

Achieving both precision and clarity is more challenging when English is a second language for some of your staff members. Adjust your vocabulary to your audience. Slang and idiomatic phrases depend on cultural context. Immigrants to the United States and Canada may not understand the cultural context of slang. In some cases, even with English as a common language, Americans and Canadians can misunderstand each other when the cultural context for a phrase is different. For example, slang associated with American football, basketball, and baseball is often used in discussions. If your listeners are not fans, these analogies will confuse them.

Context may depend on the individual listener's interpretation of what you say. For example, "as soon as possible" can mean different things to different people. So it helps to attach specific dates to deadlines.

Effective communication requires thought and constant effort. However, it's well worth the trouble.

Dr. John K. Borchardt *is a consultant and technical writer. He is the author of* Career Management for Scientists and Engineers *and often writes on career-related subjects. He can be reached at jkborchardt@hotmail.com.*

TEN TIPS FOR NEGOTIATING SUCCESSFULLY IN 2013

By Ed Brodow

The ability to negotiate successfully in today's turbulent business climate can mean the difference between success and failure. With this in mind, here are Ed Brodow's Ten Tips for Successful Negotiating—updated for the year 2013:

1. **Don't be afraid to ask for what you want.** Successful negotiators are assertive and challenge everything—they know that everything is negotiable. I call this "negotiation consciousness."
2. **Shut up and listen.** Negotiators are detectives. They ask probing questions and then shut up. The other negotiator will tell you everything you need to know. All you have to do is listen.
3. **Do your homework.** Gather as much pertinent information prior to your negotiation. What are their needs? What pressures do they feel? What options do they have? Doing your homework is vital to successful negotiation.
4. **Always be willing to walk away**. I call this "Brodow's Law." In other words, never negotiate without options. When you say to yourself, "I will walk away if I can't conclude a deal that is satisfactory," your inner resolve will encourage them to make concessions.
5. **Don't be in a hurry.** If you rush through the negotiation, you are more likely to make mistakes and leave money on the table. Whoever is more flexible about time has the advantage. Your patience can be devastating to the other negotiator if they are in a hurry.
6. **Aim high and expect the best outcome.** Successful negotiators are optimists. If you expect more, you'll get more. A proven strategy for achieving higher results is opening with an extreme position. Sellers should ask for more than they expect to receive, and buyers should offer less than they are prepared to pay.
7. **Focus on the other side's pressure, not yours.** Successful negotiators ask, "What is the pressure on the other side in this negotiation?" If you discover that they are under pressure, which they surely are, look for ways to exploit that pressure in order to achieve a better result for yourself.
8. **Show the other person how their needs will be met.** Instead of trying to win the negotiation, seek to understand the other negotiator's perception of the deal and help them to feel satisfied. They will be more inclined to help you satisfy your needs.
9. **Don't give anything away without getting something in return. Whenever you make a concession, get a concession in return.** Always tie a string: "I'll do this if you do that." If they have to earn your concession, they will derive a greater sense of satisfaction than if they got it for nothing.
10. **Don't take the issues or the other person's behavior personally.** Obsessing over the other negotiator's personality, or over issues that are not directly pertinent to making a deal, can sabotage a negotiation. If someone is rude or difficult to deal with, try to understand their behavior and don't take it personally.

***Ed Brodow** was dubbed the "King of Negotiators" by SEC Chairman Harvey Pitt. Ed is the bestselling author of* Negotiation Boot Camp: How to Resolve Conflict, Satisfy Customers, and Make Better Deals *(Doubleday).*

Ed can be reached at www.brodow.com; ed@brodow.com; and 831-372-7270

LABCAST Be sure to attend Ed Brodow's Lab Manager Academy webinar, "Negotiation Boot Camp®" on Wednesday, January 9th, or afterwards at **www.labmanager.com/negotiation to watch the archived video.**

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HOLDING THE LINE ON GOOD LABORATORY PRACTICES

By Mark Lanfear

The mistakes we all made coming up in the industry—the "freshman effect"—were almost unavoidable. Checking and rechecking kept us in check, and this was our go-to strategy as we became experts. That safety net all comes down to the three schoolhouse Rs, and it can save our industry a significant amount of money.

"Be thorough with everything you write in your laboratory notebook."

Why? The biggest pharmaceutical companies spent billions on research and development last year, and the money was largely invested in the three main processes needed under the stringent controls of the manufacturing of medicines: lab testing, preclinical testing, and clinical trials.

On average, the development of a single drug can cost a pharmaceutical company between US$800 million and US$1 billion and take eight to 16 years to research. Despite such a significant investment, success is never guaranteed. Failure means big losses. As we all look for innovation in our industry to save money and deliver quality, it's extremely important to remain true to the basics. Going "low tech," which really means just paying attention to the high-tech fundamentals, can be a big win for your organization.

Reading and safety

Don't put off refresher training and updates. Yearly refresher training may seem redundant, but it serves a very important purpose: to ensure that all quality assurance managers, quality control managers, coordinators, etc., are on the same page when it comes to safety, conduct, and responsibility. This training keeps important topics fresh in your mind. Wearing proper protective equipment ensures that in the rare event of an accident you will be protected. Eyewear and other equipment are required and inexpensive, especially compared to loss of great work, loss of time, or failure of the products that are so important to us.

son of one experiment to another. Always making complete entries helps you make sense of what you did in the past; "See network drive for data file" is great as long as you note which file it is.

"The control sample did not work" is ambiguous until you describe the type of control sample and the experimental conditions. Give yourself a helping hand and be thorough with everything you write in your laboratory notebook. Good laboratory practice (GLP) studies require adequate and permanent documentation of everything involved in an experimental test, from staff qualifications and SOPs to the individual summary of data.

Consistent records are a must, and at the end of a project your supervisor will want to review procedures and data from beginning to end. Just as in school, this is show-and-tell time for anything you've done in the lab,

"Effectively prepared process documents keep companies on track and compliant."

Writing

Revise and contribute to your process "notebook" not in an abbreviated way but with detail. Projects are revisited for details prior to rerunning the experiment for validation or comparison of one experiment to another. Always making complete entries helps you make sense of what you did in the past; "See network drive for data file" is great as long as you note which file it is.

and one good rule to live by is "If it wasn't written down, it probably didn't happen." While the regulations tell companies what they need to do and document, remember that they don't tell us exactly how. Effectively

prepared process documents keep companies on track and compliant.

It's simple arithmetic—it really is all about the basics! Practice the habit of double- and triple-checking your work. Before mixing up that expensive batch of media, review units and calculations to see that your numbers make sense. Accuracy and precision in measurement analysis ensure appropriate conclusions in experimental results, including between and within laboratory variation results. This also means running control samples. Controls serve two very important purposes. They show whether your chemistry worked appropriately, and they serve as the basis by which you can make a definitive comparison between groups of samples. The cost of innovation in the life sciences has risen greatly over the past two decades.

"Practice the habit of double- and triple-checking your work."

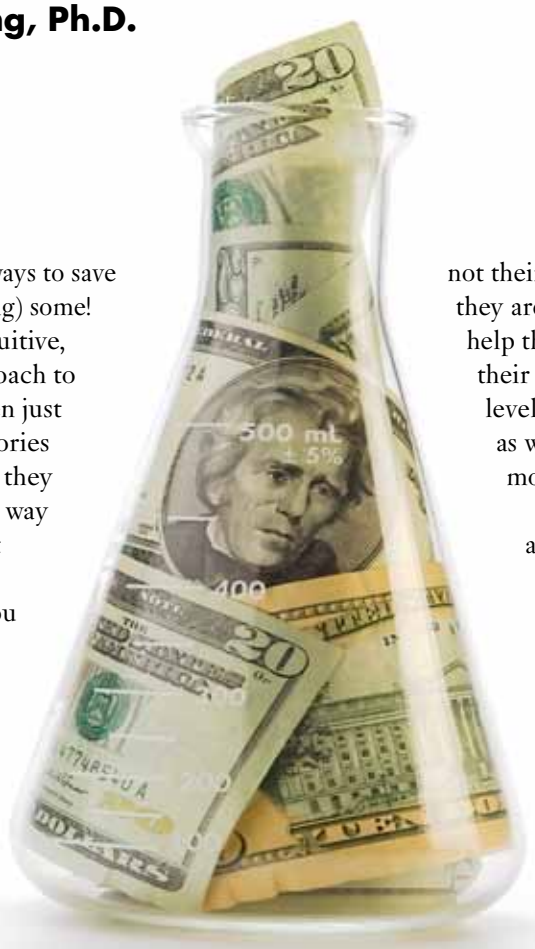
Alternative models of development and testing will need to be embraced, requiring streamlining of regulatory and organizational approaches and necessitating precision in richness of the data collected. Things such as the Wii were innovative because they were less complex and easier to understand, and getting back to basics with a slight twist may be what keeps us competitive in the current business environment. Bill Gates said that the way to get innovation is to fund research and learn the basic facts. The new Rs in GLP have been said to be reliability, reproducibility, and recording of results. These foundational concepts to ensure success are always in practice when you are practicing the best lab practices you can.

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 of the Life Science industry conferences and a writer for its periodicals. He can be reached at MARL773@kellyservices.com or 248-244-4361.*

INVESTING TO SAVE

A SIMPLE TOOL FOR CALCULATING ROI CAN DETERMINE WHICH INVESTMENTS ARE BEST FOR YOUR LAB

by Merlin K. L. Bicking, Ph.D.



Is your laboratory looking for ways to save money? Try spending (investing) some!

This idea seems counterintuitive, doesn't it? The traditional approach to cutting expenses has always been just that—cutting. Very few laboratories will even consider the idea that they can spend, actually invest, their way to an improved bottom line. Yet there are opportunities to make cost-saving improvements if you look in the right places.

Over the past 20 years of visiting testing labs in nearly every industry, we have noticed a common problem—many labs have inefficient processes that are costing them a significant amount of time and money. Sometimes the problem is an old piece of equipment that once was state of the art but now is a few generations behind current technologies. In other cases, you have an outdated procedure. Maybe you developed it 15 years ago, or maybe you were given it by your customer. Either way, it takes too much time and uses too many resources. Finally, in the quest to lower staff costs, companies have lost their experienced laboratory leaders, who used to mentor junior staff on how to do things the right way. We see many labs filled with young, inexperienced analysts, and few who can be resources to them for solving problems. As a result, they make more mistakes or are just less efficient in everything they do, which is not their fault. Most are a joy to work with; they are eager to learn and appreciate the help that we give them, because it makes their jobs easier and reduces their stress levels. Of course, the laboratory benefits as well when its staff are happier and more efficient.

Why don't more laboratories make an effort to fix these situations? Today's laboratories face many challenges, and each case is unique, but there is a common theme. Many supervisors and managers have technical backgrounds that rarely focus on the financial aspects of running a lab. They have not been trained to recognize that improvements in processes are not just another expense. Such process improvements are an investment that resides in another location on the company's balance sheet. We will consider a case study from chromatography laboratories to illustrate this idea.

Using smaller HPLC columns

High-performance liquid chromatography (HPLC) has become one of the most useful analytical tools in the modern laboratory. Since its development in the 1970s, the technique has matured into a necessary tool for laboratories in almost every industry, but especially in pharmaceuticals, food, chemicals, and petroleum. There are more than a dozen major and minor manufacturers, and literally

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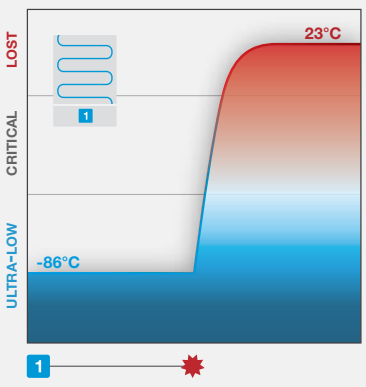

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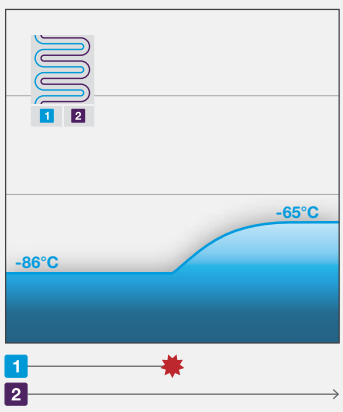

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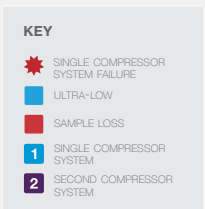

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hundreds of column choices. The equipment is expensive ($40,000 to $50,000 for a typical entry-level system) and requires the use of high-purity (HPLC-grade) solvents.

Acetonitrile, the most common solvent, costs about $350 for a 4-liter bottle (including shipping and other handling fees), or a little less than $0.09/mL. If you are using this solvent at 1 mL/min. for eight hours a day, over the course of a year you will use about 120 liters of this solvent and spend $10,500 on purchase costs alone. Note that chemical disposal costs are an additional expense that we won't factor in at this point, but they are often similar to the purchase cost and add to the laboratory's total costs of operation. Now, suppose that I told you that you could save about 50 percent of those acetonitrile (and other HPLC solvent) costs by changing to a different column. Would you be interested?

Column manufacturers have made numerous improvements over the past 15 years. In addition to new phases with better stability, the suppliers have also been able to prepare identical columns with smaller diameters and shorter lengths. A smaller diameter means a smaller cross-sectional area, and you need to push less mobile phase through the system to get the same flow velocity inside the column. As a result, you use less solvent.

A typical change might involve replacing a column with a 4.6 mm diameter with one that has a 3.0 mm diameter. The smaller column has about half the cross-sectional area of the original, so you could reduce your flow rate by about 50 percent. Using the above assumptions, your new solvent costs would be $5,250 a year, for an annual savings of $5,250. If you have a relatively modern instrument (less than 10 years old), you should be able to implement these changes with little or no modification of the equipment. Only a change in operating parameters is required.

Calculating your ROI — a simple process change

As is always the case, nothing is free in the lab, so we will start by looking at making a simple change in column diameter for an existing method in a typical lab. To incorporate this change, it will require some additional time by a staff member to install the column, verify performance and/or make adjustments, evaluate real samples, and complete the documentation for the revised procedure. We will also assume that these activities require 40 hours of staff time and 40 hours of instrument time. Fully loaded costs for one staff member and an instrument together might be $100 an hour, which means the total internal cost is $4,000 to make this change. Using these estimates and the cost savings above, we can calculate the ROI as:

ROI = 100*(5,250 – 4,000)/4,000 = 31%.

This is a favorable result, and suggests that there is a long-term financial benefit to making this change. Yes, you will invest one staff member and one instrument for a week, but a year later your financial performance for this process will have been 30 percent better. Also, remember that we did not factor in disposal costs. With the new method, your disposal costs are also lower, which means another expense item is reduced and the actual ROI would be greater. In subsequent years your process continues to operate with this performance improvement, without the associated costs, providing added benefits from the investment.

Calculating your ROI — a more complex process change

Not every situation is so simple, so it is instructive to consider a somewhat more complicated scenario. Imagine

Return on Investment (ROI)

ROI is a "performance measure used to evaluate the efficiency of an investment."[1] It is calculated using the following general equation:

$$ROI = 100^* \frac{Benefit - Cost}{Cost}$$

This equation is used to evaluate many different kinds of investments, including stocks and bonds, but also more general activities such as determining the relative success of different marketing programs. There are no universally accepted benchmarks for identifying a "good ROI" because the ROI will vary depending on what assumptions are used and, therefore, what values are entered into the equation. However, an ROI of 20 percent would generally be considered a good result.

1. http://www.investopedia.com/terms/r/returnoninvestment.asp#axzz28jjB60gx Return on Investment (ROI)

that we have two instruments running a process similar to the one described above. Just implementing the above changes could save $10,500. However, suppose that you also want to minimize the overall use of this solvent by optimizing startup, equilibration, and other nonproductive usage activities, resulting in a further 10 percent reduction in use. Such a change will either increase overall capacity or reduce instrument "on" time. That is, you want to reduce your total use of acetonitrile by 60 percent, realizing a total savings of $6,300 for each system, or $12,600 for both systems.

This optimization is going to require an outside expert, because your staff does not have the time or expertise to do this kind of evaluation. The expert will cost about $6,700 to evaluate the process and recommend changes, assuming that the changes are relatively straightforward. However, this is a regulated lab (i.e., GMP-compliant), so additional staff time will be needed to validate the new method and complete the paperwork. This modification will require 20 hours of instrument and staff time (at $100 an hour total) to collect the data and another 40 hours of staff time (at $50 an hour) to write the reports and process the paperwork. The total costs are $10,700, and the ROI is:

$$\mathbf{ROI = 100^{*}(12{,}600 - 10{,}700)/10{,}700 = 18\%.}$$

The ROI is not as favorable as the simple example, but this is a more complex situation with more demanding requirements and additional costs for the regulatory issues. Still, the number is positive, and it does not include other savings such as reduced disposal costs. These improvements continue into the future, but without the substantial investment of the first year, so the benefits are significantly larger.

Other applications

HPLC is not the only place where significant savings can be realized. Capillary gas chromatography operates under similar rules. Helium is the most common carrier gas, but it is a nonrenewable resource and the world's known supplies are running out. As expected, costs are already rising at a rapid rate.

There are several different column diameters available from all manufacturers, and the savings are just as dramatic as in HPLC. If you reduce your column diameter from 0.32 mm to 0.25 mm, your helium usage can decrease by about 40 percent. If you are using 0.53 mm columns now, the reduction is almost 80 percent when changing to a smaller column.

Although these examples are specific to chromatography-based methods, it is important to note that this general approach can be applied in many other instrument types and processes as well. Improvements in efficiency and reduced operating costs are almost always possible if you are willing to make the investment. The ROI calculations can then be your guide to deciding which investments are the best choices for your laboratory.

Conclusion

Today's laboratories are under stress from many directions, and there is constant pressure to be more profitable. However, we should not assume that the only way to be more profitable is to simply reduce existing expenses. With continuing advances in laboratory technologies, it is possible to improve both time and expense costs by upgrading to more contemporary technologies or even just training your staff how to use them. You do not have to choose the most expensive, or even the most recent, option, but you should evaluate the potential benefits and costs by calculating ROI for the investment.

Calculating ROI for laboratory activities is not common today, but mostly because many lab managers are not familiar with the idea. They have been trained in the technical requirements of the job, not the financial aspects. ROI is a common way to evaluate any business activity, and this approach is recognized as an appropriate tool even when applied to laboratory operations.

Our intent is not to suggest that such a simple strategy is appropriate for evaluating a complex multimillion-dollar project. Rather, we want to show laboratory managers how to look at their current systems and procedures and to give them a relatively simple tool for estimating the value from making improvements in the laboratory's operations. Incorporating an ROI calculation into your proposal is going to give your ideas additional credibility because you are now speaking in the language that business managers and CFOs understand.

Dr. Merlin K. L. Bicking *is president and senior analytical scientist of ACCTA, Inc., a company he founded in 1993. As a consulting analytical chemist, he provides technical problem solving and training to testing laboratories around the world. He has authored more than 20 publications and given more than 50 presentations at local, national, and international meetings in his 30 years of experience. Dr. Bicking holds a B.S. in chemistry from the University of Wisconsin-River Falls and a Ph.D. in organic-analytical chemistry from Iowa State University. He can be reached at mbicking@accta.com.*

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ACCELERATING THE PATENT PROCESS

NEW U.S. PATENT SATELLITE OFFICES CREATE HUBS OF INNOVATION AND ECONOMIC ACTIVITY

by John K. Borchardt

"Patents are the fuel for American innovation," said Acting U.S. Commerce Secretary Rebecca Blank. The overhaul of the U.S. Patent and Trademark Office (USPTO) mandated by the September 2011 passage of the America Invents Act is aimed at promoting innovation. One statute of the 2011 America Invents Act requires the establishment of at least four satellite offices around the country in addition to the main facility in Alexandria, Virginia, just outside Washington, D.C. The first opened in July 2012. "By opening the doors to America's first-ever satellite patent office in Detroit, we are going to put more patents in the hands of entrepreneurs throughout this region and across the country," stated Blank.

Two more satellite offices will open in 2013, and there will be additional offices later, in or around Dallas, Texas; Denver, Colorado; and Silicon Valley, California. By having satellite regional offices in multiple states, the USPTO may receive broader congressional funding support. Competition for the additional satellite offices was heavy, with more than 600 communities submitting applications.

The objective of the satellite offices is to promote the formation of hubs of innovation and creativity, helping protect and foster American innovation in the global marketplace, helping businesses cut through red tape, and creating hundreds of highly skilled jobs in each of the local communities.

Why is this important to lab managers?

Creating satellite offices is part of a broad effort to speed up the nearly three-year-long patent application process, which encourages face-to-face meetings between inventors and USPTO patent examiners. Currently the USPTO has a backlog of more than 700,000 patent applications. Face-to-face meetings between patent examiners and patent agents are a key way to clarify and resolve differences of opinion concerning patent applications. This resolution can greatly reduce the time required for patent issuance. Regional patent offices could also reduce the inconvenience and travel cost of these meetings, which is particularly important for small firms and independent inventors with limited financial and time resources.

"By opening the doors to America's first-ever satellite patent office in Detroit, we are going to put more patents in the hands of entrepreneurs throughout this region and across the country."

According to David Kappos, the undersecretary of commerce for intellectual property and director of the USPTO, an additional advantage is that the satellite offices will facilitate hiring and retaining patent professionals. Thus the satellite offices should result in an increased number of patent examiners. This will also enable more timely review and issuance of patent applications. The satellite offices may also decrease the high turnover rate among patent examiners by offering alternatives to living in the high-cost greater Washington, D.C., area. Reduced turnover means patent applicants will be working with more experienced, more efficient patent examiners. This, in turn, should make faster pat-

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ent application examination possible, accelerating the patent issuance process.

Why does speeding up the patent application review and approval process matter? Owning a patent is often an important step in commercializing a newly invented product or process. Accelerating the patent application process will enable laboratories to bring their products to market sooner.

Not all the patent professionals will continue working for the USPTO satellite offices forever. As time passes, some will probably leave to work in the private sector. Laboratory managers will find it more convenient and probably easier to recruit these professionals to work in various intellectual property positions. Today such USPTO professionals usually have to undertake a long-distance move to accept a job in the private sector. Such would not be the case for some of the patent professionals working in USPTO satellite offices.

> "Accelerating the patent application process will enable laboratories to bring their products to market sooner."

Lawmakers and governors from California to Massachusetts competed for the other regional offices. Why? They believe the USPTO satellite offices will create hundreds of high-paying jobs; generate millions of dollars in economic activity; and attract technology companies, law offices, and other ancillary businesses to areas where the branch offices are located.

Selection of the first four sites was based on a comprehensive analysis of criteria, including geographical diversity, regional economic impact, potential ability to recruit and retain employees, ability to engage the intellectual property community, and extensive public

comment. For example, the Detroit area is home to Fortune 500 companies, large law firms, and outstanding research institutions and boasts a low cost of living and skilled talent pool. The selection team developed a model to evaluate more than 50 Metropolitan Statistical Areas based on the previously stated criteria to assess operational cost and feasibility, ability to improve patent quality, and ability to employ U.S. veterans.

USPTO – Detroit

The recently opened (July 13, 2012) USPTO-Detroit is expected to create about 125 high-paying, high-skill jobs in its first year while providing a boost to the area's innovation economy. Most of these positions should be filled by the end of 2012. The Detroit office is located in 31,000 square feet of rented office space in a remodeled building at 300 River Place, the former home of drug company Parke-Davis Laboratories and the Stroh's Brewery headquarters.

"The ability to innovate is critical in enabling cities to grow their economies in the wake of the 'Great Recession.'"

Detroit had to meet a variety of criteria to land the first branch office. It already has a high percentage of scientists and engineers in the workforce; provides access to major research institutions, particularly leading universities; and supports a high volume of patenting activity with significant numbers of patent agents and attorneys already living in the area. While bad economic news about Detroit dominates the media, the population of college-educated residents between the ages of 25 and 39 increased a whopping 59 percent in the past decade, making for a highly educated workforce.

According to Azam Khan, USPTO deputy chief of staff, work at the Detroit office initially will focus on patent applications focused on mechanical and electrical engineering innovations.

Final thoughts

Bruce Katz, vice president of the Brookings Institution, notes that the ability to innovate is critical in enabling cities to grow their economies in the wake of the 'Great Recession.' What Katz calls a "strong innovation ecosystem" facilitates the development of new products and production processes. The USPTO branch offices can become part of this innovation ecosystem.

Dr. John K. Borchardt *is a consultant and technical writer. He is the author of the book* Career Management for Scientists and Engineers *and often writes on career-related subjects. He can be reached at jkborchardt@hotmail.com.*

MODELING AND SIMULATING SCIENCE

COMPUTATION UNRAVELS OLD AND NEW QUESTIONS IN BIOLOGY AND CHEMISTRY

by Mike May, Ph.D.

Scientists use models to unravel how something works. If you've ever taken variously sized balls and arranged them as the planets in our solar system, then you've made a model. If you put that model solar system into motion, with the planets traveling through their orbits, then it's a simulation. Although many people define modeling and simulating in very specific ways, many experts use the terms interchangeably. In any case, the interest comes from the results, not the definitions of the processes. Furthermore, this field is on fire.

It's one thing to make a model that you can see, but imagine making a model from numbers. In computational modeling and simulation, you'd define your planets by size and weight. Then, you'd use an equation to describe each planet's motion. Using the laws of physics, you could put the solar system into action. Even more interesting, you can perturb the system, by tipping a planet off its axis of rotation, for example, and see what happens.

Some of today's most exciting modeling is taking place in the fields of chemistry and biology. Part of the interest comes from exploring some of the oldest questions in all of science, such as "What makes something burn?" Modeling and simulation also take on some of the newest questions, such as "How does an organism's entire genome control its biochemistry?" To answer these questions, teams of scientists often work together.

Making mechanisms from "magic"

To provide an analogy for modeling and simulation, Jeff Hammond, Ph.D., assistant computer scientist at Argonne National Laboratory in Lemont, Illinois, described a magic trick. "If you go to a magic show, the magician will not show you the secret," Hammond says. "All you know, for instance, is that a ball starts in the magician's left hand and ends up in the assistant's mouth." We can attempt to understand the magic trick by trying to re-create it at home, which is a simulation of what was observed. If we can reproduce the whole trick, we have discovered what we couldn't see. In thinking over models and simulations in general, Hammond says, "We're re-creating things in nature that we can't always see."

> "The science that we're enabling and the people who attack it with our code need large computing capabilities to get their answer fast."

Many models explore fundamental processes. For instance, Hammond says, "Fire is basically the oldest human technology." Consequently, scientists know that combining gasoline, oxygen, and a spark creates fire. "But even today we don't have anything to really take the type of snapshot of burning flames that we'd like, to really understand how to, say, distinguish burning gasoline from ethanol or wood from coal," Hammond says. As a result, simulating combustion remains a high priority, especially given its impact on our energy systems.

Methods of energy storage are common processes to model or simulate. As an example, Hammond mentions IBM's Battery 500 project, which focuses on creating lithium-air batteries. This project includes experts from IBM as well as scientists from Argonne and the Oak

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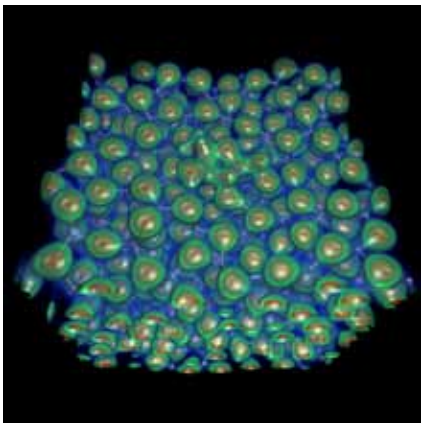
Ridge National Laboratory in Tennessee. Hammond says, "We used two different levels of theory in trying to deeply understand the mechanics of lithium-air batteries." He adds, "A battery is an incredibly complex system, and people who develop batteries want to know the basic chemistry going on in there."



This image shows the electron density obtained from a density functional theory calculation performed with the grid-based projector-augmented wave method code. This visualization—run on the Intrepid and Mira supercomputers at the Argonne Leadership Computing Facility—was used to model batteries and other materials. (Image courtesy of Argonne National Laboratory.)

The researchers working together on that battery project reflect a trend in today's models and simulations: it takes a team, usually composed of applied mathematicians, computer scientists, and domain experts, who know the particular processes being studied.

Developing scientific models

Wibe de Jong, Ph.D., chief scientist at Pacific Northwest National Laboratory in Richland, Washington, manages the ongoing development of NWChem, a software package that he describes as a "computational chemistry tool that can model molecular systems and materials and determine [their] properties." Many people use this software, which went open source about two years ago, and the users come from academia, industry, and U.S. national labs. Nonetheless, most users need some background in computational chemistry and a little knowledge of quantum mechanics. Still, de Jong points out that some people have developed simpler interfaces for NWChem that allow users to run an experiment on this software without understanding the mechanics behind the modeling. "You can use these interfaces to get an idea if a hypothesis is what's really happening," de Jong says, "but to really delve into the details you need to find a computational chemist."

This software runs on Windows and Mac desktop systems, workstations, and even the largest supercomputers. "The primary target is the large scale," de Jong says, "because the science that we're enabling and the people who attack it with our code need large computing capabilities to get their answer fast."

As an example of this kind of science, de Jong says that NWChem can be used to build models of DNA and then simulate the impact of radiation. "To do this," he says, "you need to model a large part of the DNA, not just the little piece that gets hit by light." Hundreds of atoms must be very accurately modeled, perhaps, but tens of thousands of other atoms can be modeled somewhat less accurately. This allows the computation to focus on the key area of interest while simulating the impact on surrounding structures.

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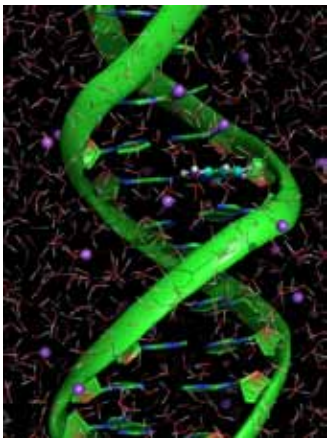

Only computation can show the details behind the impact of radiation on DNA. (Image courtesy of Marat Valiev of Pacific Northwest National Laboratory.)

Modeling molecules and more

"We have very few ways of probing molecular mechanisms experimentally," says Rick Stevens, Ph.D., associate lab director of computing, environment, and life sciences at Argonne. "Once we capture a system in a model, though, we can simulate all sorts of what-if experiments." He adds, "We can get inside the mechanisms at the speed we can come up with the questions, instead of needing an elaborate experimental process."

The subject of scale in biological research covers a wide range, from atoms to societies, and researchers hope to create an equally wide range of computational models. Stevens says that molecular models—such as molecular dynamics and protein interaction—are pretty advanced. "These problems are routinely simulated," he says.

Likewise, biologists build models based on an organism's genome, such as modeling the metabolism of a bacterium. "If you want to use bacteria to make something," Stevens says, "you can use whole-genome models to design a system and optimize the biochemical network to get the product."

In biomedical examples, scientists model tissues or even whole organs. For example, a researcher might model the heart or part of the nervous system. "These run on the biggest supercomputers," Stevens says, "integrating our understanding of various systems." In a heart model, for instance, researchers must consider mechanical characteristics, electrodynamics, fluid mechanics, and so on. "Then, you can use that model and simulations to study a heart attack or heart disease or to develop artificial valves," Stevens says.

Focusing on folds

In biology, an ongoing question involves the importance of folding in proteins. Composed of chains of amino acids, the primary structure of a protein bends back on itself—or folds—making a three-dimensional shape that plays a crucial role in its function.

More than a decade ago, Vijay Pande, Ph.D., professor of chemistry at Stanford University, started a unique method of studying protein structures called Folding@home. This project enlists everyday people to contribute computing cycles from their home computers, and Pande says that the number of people is "almost 10 million since inception, but about half a million at any given time." Pande and his colleagues combine those computing cycles to perform the calculations that simulate how proteins fold. Just as important, learning why proteins sometimes fold wrong intrigues scientists, because such mishaps contribute to many disorders, including Alzheimer's and Parkinson's diseases.

Making so many computers work together, Folding@home can simulate protein folding over longer time scales than ever before—in fact, thousands or maybe even millions of times longer. After the simulations, Pande and his colleagues try to replicate the findings in experiments to

validate the computational results. For example, a protein-folding simulation from Folding@home suggested a new target for treating Alzheimer's disease, and Pande is working on compounds to attack this target.

Modeling for the masses

Although some chemical and biological modeling requires computational experts and a supercomputer, many models pull in the masses. "The vast majority of the tools are available as programs that run on a laptop or desktop," Stevens says. "In some cases, the simulation runs through a web browser."

Likewise, researchers can turn to commercial software, such as SimBiology from MathWorks in Natick, Massachusetts. Asawari Samant, senior application engineer, describes this as "a modeling and simulation platform for analyzing dynamic systems, focusing on pharmacokinetic/pharmacodynamic and systems biology models." She adds, "The graphical nature of the tools enables scientists without prior programming experience to quickly build and analyze complex models." These models range from simple bacterial growth dynamics to complex signaling pathways.

> "Once we capture a system in a model, though, we can simulate all sorts of what-if experiments."

This software's drag-and-drop interface lets users quickly create models. Samant adds, "Powerful built-in tasks enable scientists to perform mathematically intensive operations—such as parameter estimation, dose optimization, and 3-D visualization—with the click of a button."

For example, a pharmaceutical company used SimBiology, along with MATLAB, to reduce drug discovery time by 80 percent. According to Samant, "The company used this software to build detailed computational models of biochemical pathways for a range of diseases, including cancer. Being able to model such pathways enabled researchers to make more accurate and informed decisions throughout the drug-discovery process."

In the next decade, or maybe sooner, Stevens expects that high school students will experiment with modeling. To get these students modeling, they need easily accessible and inexpensive tools. As an example, Stevens points to the Raspberry Pi—a $25, credit-card-sized computer that plugs into a TV. "Some modeling tools would run on this," he says.

Those tools will train tomorrow's scientists, who will use modeling and simulation in ways that we can't even imagine.

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

BUYING A LIMS

HOW A THOROUGH AND DISCIPLINED APPROACH CAN HELP BUYERS AVOID UNFORESEEN COSTS AND OTHER SURPRISES by John Boother

Buying a laboratory information management system (LIMS) is a major undertaking, and it is critical that the system selected fulfils not only all of the laboratory's current requirements but also allows for future development. Surprisingly perhaps, there are very few LIMS available today that are flexible enough to be good in five years, in ten years, and so on. This article provides an overview of the selection and implementation process. It should be remembered that software offers a flexibility found in few other products, so it is essential that customers ensure that the software in its delivered form can really meet the required specifications. It is no good if you find that the software is capable of doing something that you want but only at extra cost! Similarly, many people just assume that the software has a particular feature or function when comparing software specifications from different vendors. In addition, it should be realized that the responsibilities for a successful LIMS project do not lie solely with the supplier—the customer also has significant responsibilities as well!

Where to start?

Given that a detailed, thorough, and disciplined approach is required in the purchase of a LIMS, it makes sense for the customer to appoint an internal "LIMS champion" for the project who documents all actions and activities. It is good practice to have a backup person in place who is kept up to date on the project and can step in should the champion be unavailable because of illness or even leaving the organization. The first activity is to identify the benefits that a LIMS would bring to the organization. These should not be restricted to improvements in laboratory-based functions, as a LIMS is potentially a business management tool if the correct one is purchased. This list of benefits can be converted to a requirements document that specifies the features and functions needed. Inputs from laboratory staff and others likely to benefit from the implementation of a LIMS should also be encouraged. Benefits that are quantifiable are those that will most help the case for investment in a system.

Below are just a few examples of benefits that should be considered. A much more detailed example list is available elsewhere.[1]

- It reduces/eliminates the need for paper and laboratory notebooks.
- It speeds up the retrieval of information.
- It allows fast production of regular laboratory reports that can be used to identify the workload by person, by instrument, by test, by customer, etc. It can also include other data such as laboratory costs, data trends, outstanding work, and sample turnaround times.
- Clients can register their own samples, monitor sample status, and search for approved results using a web interface to the LIMS. Make sure that the LIMS can safely segregate the data for each customer.
- Transcription of data can sometimes be eliminated. High sample throughput instruments/systems can link to the LIMS for direct capture of data. Bidirectional links allow the transfer of a sample list to the instrument/system.
- It introduces intuitive, easy-to-use workflows to match all workflows used in the laboratory. The system should allow new workflows to be added easily without dependence on the vendor.
- Tracking the location of each sample and each sample movement effectively creates a chain of custody. The location of each sample is known at any given time.
- Time, date, and operator ID stamping of all data and result entries lead to improved traceability, adherence to enhanced quality procedures, and regulatory compliance.
- Management has immediate access to all data, reports, statistics, etc.
- The LIMS can be integrated with other software packages used by the company.
- The LIMS provides for phased and evolutionary changes over time, extending the useful life of the system and maximizing the return on investment as well as protecting historical data.

These inputs can be used to produce a requirements document that eventually will be sent to a number of suppliers as part of the purchasing process.

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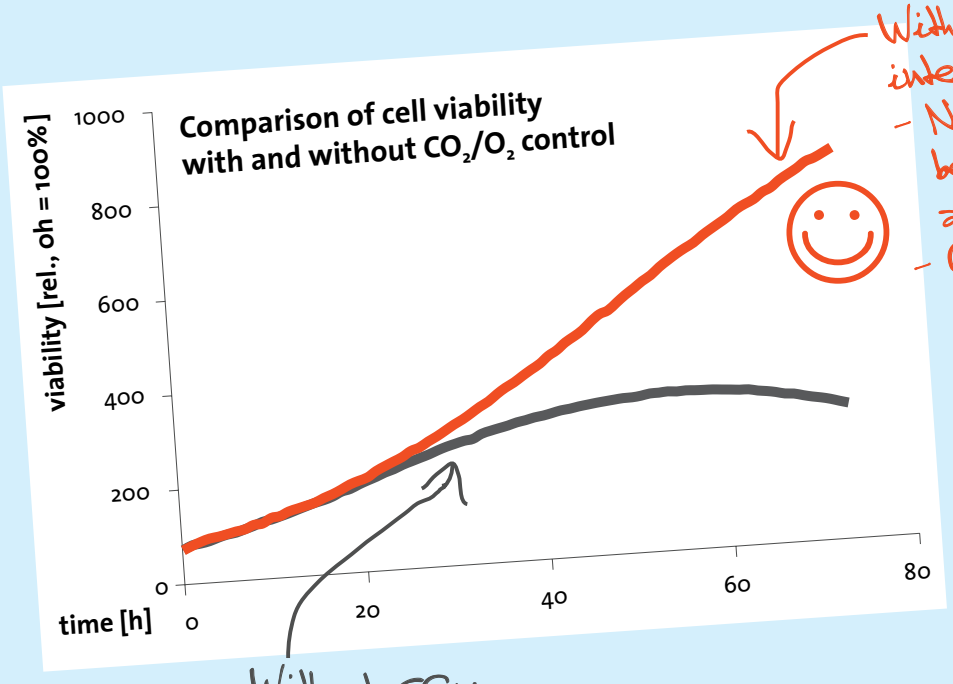

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▲*Figure 1. Workflow considerations.*

Setting out the requirements

The requirements document mentioned above should cover what the system should do now and in the foreseeable future, giving a clear idea of the initial number of concurrent users and likely expansion over the next five years. This document should be thorough and succinct and should avoid the use of qualitative terms such as "user friendly," "flexible," or "integrated," as these are ambiguous. Everything should be aimed at providing as much quantifiable detail as possible. The document should concentrate on the software. Although the hardware represents a significant part of the total expenditure and it is sensible to indicate the preferred hardware platform and operating system(s), it is the software that defines what can and cannot be done with the computer system.

If the software is easy to use and is just right for what is needed, all other considerations (the hardware, the support, etc.) become much less relevant; less training, less support, and fewer alterations will be needed, and the implementation will be easier and faster. The requirements document should naturally set out the LIMS technical requirements, which should include topics such as the requirements for sample registration (login and receipt), label generation, and work lists and worksheets (allocation of work to analysts). A section on acquiring analytical results should detail both keyboard (manual) entry and automatic (online) entry, specifying the instruments that will be connected online. Other key considerations are validation and approval of data, reporting, statistics and general calculations, graphics, communications, security, and archiving tables of reference information.

Evaluating the available LIMS

Armed with an appropriate requirements document, the next stage is to identify potential suppliers and begin the product evaluation process. At this point some people might enlist the help of an "independent software consultant." Since this can be an expensive exercise in itself, customers should satisfy themselves that any consultant used is truly independent and has no affiliation with one particular supplier, that he/she has a thorough understanding of LIMS software in particular and not just software in general, and that he/she does not have any ulterior motive such as providing implementation services for the system he/she recommends for purchase. Talking to potential suppliers is the very first stage, and even over the telephone they should be able to grasp customer needs and give ballpark costs. Be wary of suppliers who claim that their software is "approved"; there are no relevant BS or FDA standards or anything similar for LIMS software!

> "[Potential suppliers] should be able to grasp customer needs and give ballpark costs."

A preliminary meeting with a supplier in advance of a demonstration enables the customer to brief the supplier on an outline of requirements and allows the supplier to present the highlights of the product and explain details of the company and operation. A visit to the supplier's premises offers the chance to meet the team, including development people, support people, and top management, and even to conduct an audit or get an overview of the supplier's quality management system and support systems. The next stage is the system demonstration, using a demo checklist based on the requirements document. It is essential that "live software" be demonstrated and that there is sufficient time for the supplier or even the customer's own staff to do some live configuration exercises, as system configuration is likely to be an important issue, as indicated in Figure 2. If the demonstration has been preceded by an initial meeting, it is reasonable to expect that it should relate directly to the customer's requirements rather than be a "standard" demonstration. Ideally, customers should try to have demonstrations from all the selected suppliers over a short period such as a week so that everything is fresh in their minds as they make their choice.

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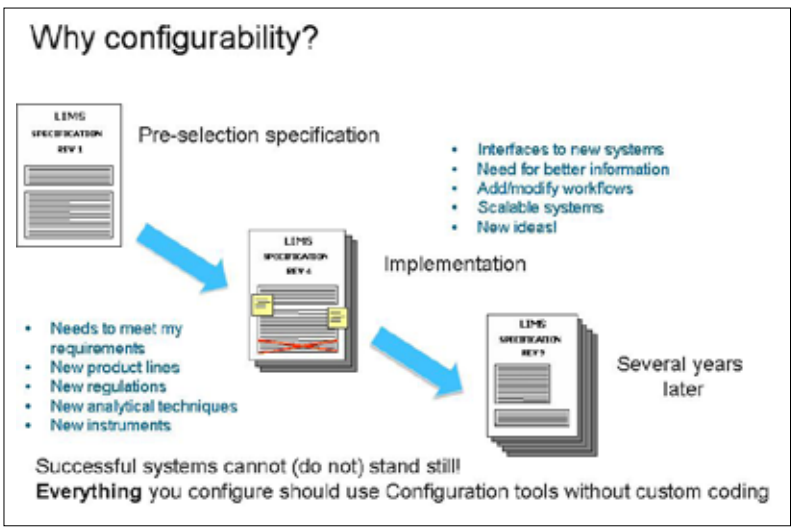
One powerful and effective method of evaluating systems after demonstration is to evaluate up to three systems for at least one month on-site. This will involve at least a partial configuration of the systems by the suppliers and therefore is likely to be chargeable. This is an excellent test of the configurability of the evaluated system and its ease of use. If it is intuitive, then training can be minimized. Following up customer references once a preferred system has been chosen is completely acceptable. Another good indication of responsible supplier activity is the existence of a supplier-organized user group to encourage exchange of user experiences and knowledge. An evaluation of the support and maintenance offered by the supplier is also important. Another vital issue is the upgradeability of the software. Some suppliers do not have an upgrade path commitment, others charge for upgrades, and some introduce new versions that are incompatible with previous versions. Customers should check the reputation of suppliers in this most important area, as it dictates how long a life the system will have.



▲ *Figure 2. The importance of configurability in the evolution of a LIMS.*

LIMS solutions

One might be forgiven for thinking that all LIMS software is essentially similar. In fact, in addition to "off the shelf" LIMS software, there is bespoke/custom software specifically written to meet the customer's requirements, typically a one-off program representing a "snapshot in time" set of requirements. Although at first this might seem to be an attractive solution, issues of ongoing support, upgrades, enhancements, future configurability, etc., must be carefully considered. In-house software is another bespoke/custom software option where the software is written by an internal or outsourced IT department. This route can often suffer from underestimation of the coding task and peripheral issues such as documentation. Finally, some suppliers of ERP/MRP systems claim that their systems can provide the functionality of a LIMS or even replace an existing LIMS. However, these systems are simply unable to track samples within the laboratory at a level that would meet audit requirements.

Figure 3. Key functional steps in configuring a LIMS.

Hardware considerations

LIMS hardware really needs only to be up to date enough that the system has enough speed and expansion capacity and that the spares are available and likely to be so in the future. It is important that a large portion of the initial investment doesn't have to be written off if the business expands, so customers should find out how much it would cost to double or triple, for example, the number of users, the storage capacity, the number of sites, or whatever else might be required.

Implementation

Once the decision has been made, the order placed, and the system delivered, the work really begins! A typical system implementation process includes:

- Detailed review of project requirements
- Review of functional specifications
- Configuration
- Interfacing of laboratory instruments
- Installation of configured system
- Familiarization training
- Review meetings
- Data loading
- Formal acceptance testing
- Going live

While no two projects are approached in exactly the same way and the implementation process should be adapted to meet local requirements, this provides a proven framework to develop clearly defined responsibilities, goals, and milestones to ensure joint success.

References:
1. "How (and how not) to Buy a Laboratory Information Management System," www.autoscribe.co.uk/how-to-buy-a-lims.

John Boother, *managing director at Autoscribe Limited, can be reached at john.boother@autoscribe.co.uk or +44 118 984 0610.*

IT'S ALL IN THE PLANNING

HOW SMART LAB DESIGN AND LAYOUT ENSURE OPTIMAL PROCEDURES, WORKFLOW, COOPERATION AND PRODUCTIVITY

by Robert B. Skolozdra, AIA, LEED AP

There are varying points of view on the question of the best use of research space. Different stakeholder groups hold differing views, and individuals within these groups will have different sets of priorities. But the same goal is shared by all: arrangement and layout should promote successful scientific research and the well-being of the researchers.

A quick study of best practices in research facility design will reveal how planning the space is integral to a successful research project; having the proper mix of lab, support and office spaces is crucial, as is arranging these in a manner that supports efficient operation of the facility and of the research team. But proper planning can also apply on the micro-level, to the individual research space. Support for the team is good; support for each individual team member is better.

"Awkward or inflexible arrangements of equipment in research spaces can lead to delays."

There's also a valuable body of information available for benchmarking the lab design for optimal procedures, workflow, cooperation and productivity. Layout recommendations will be different for a forensics lab versus a quality-control lab, and for an animal research facility versus a genetics lab. It is one thing to work with clients such as PepsiCo, with its six-sigma productivity goals for a new prototype research lab; it is quite another to work with labs recently developed from a former Fortune 500 R&D building for new nanotech and bioscience institutes at Yale University's School of Medicine.

Yet some universal truths will apply in virtually all labs. For example, the goal is almost always to increase output without adding staff, and to improve productivity while controlling error rates. If a researcher or technician loses time unnecessarily in between individual steps of the experimental process, that is an increment of inefficiency that accrues each time the process repeats. Awkward or inflexible arrangements of equipment in research spaces can lead to delays—very costly over the course of months or years of research—and can even increase errors, accidents and botched experimental trials.

In other words, optimizing the space for efficiency of the experimental or technical process can yield increased return on investment (ROI). For that reason, lab design is essential to improved *process management*. Whatever the goal of the research organization and whether the client stakeholder is a corporate or institutional one, the field of scientific research is too competitive for the organization to forego the attention required to create an ergonomic, properly oriented and arranged workspace for the laboratory scientist.

The modern lab workspace

As we begin to consider how to arrange lab furnishings and equipment to best suit the work that researchers are performing therein, it is vital that we address the trends affecting how research is conducted. As techniques, approaches and behaviors change, so too will functional relationships among equipment and furnishings, leading to new best-case adjacencies and proximities.

The most important such trend we are observing is the movement toward the bench space as a catchall space for nearly every aspect of the research process. Now more than ever, the lab is everything; more scientists are using the bench as the write-up space, to the point that bench and write-up space are one and the same. (This will not only affect the bench setup, but often greatly alters the traditional requirements for office and support spaces as a percentage of the facility footprint.) This trend is concurrent with another: the increased implementation of computers and digital workstations at the bench.

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Office space with equipment at Yale Department of Molecular Biophysics and Biochemistry.

Equipment technology for the lab is itself beginning to change in important ways. Energy-devouring equipment such as fume hoods and associated HVAC infrastructure are being designed for better efficiency, often leading to a smaller profile as well. Other types of equipment are also shrinking, thereby becoming more amenable to placement near the workbench rather than in specialized areas. And in some rarer instances, robotics and automation are finding their way to the bench, where they often assist with and even regulate the processing of samples, handling of glassware and more.

But perhaps most important is the overall change in space requirements. As bench areas remain steady, or in some cases decrease in overall footprint, separate equipment areas gain prominence and importance, with a concomitant increase in space. The traditional ratio of bench to equipment space had been 2:1, and is quickly shrinking to closer to 1:1.

Another important trend is the use of a "collaborative cluster" to allow better input between the principal investigator (PI) and the research team members. In these clusters, lab bench and floor space allocated to team members generally should be kept small to improve productivity: about 8-12 linear feet is ideal, with four feet or more devoted to non-bench needs, such as sinks, write-up space, shared bench space and the like. Lab desks, typically four feet or so in width, ideally are located within the open-plan lab or other lab area.

A 'gold' standard

As we look at the lab space and discuss what constitutes best practices for arrangement of equipment and furnishings, these and other trends will impact outcomes. But input should be considered from a perhaps unexpected analogy, as well: our own kitchens at home. Residential kitchen designers have long adhered to the principle of the "golden triangle," which addresses the functional relationship of the three most important pieces of kitchen equipment: the refrigerator, the stove and the sink. By organizing these three elements into a triangle around the kitchen user, designers minimize the effort required to manage the work of cooking or cleaning up.

In fact, the decades-old golden triangle has been updated recently, as the paradigm of a single person in charge of all kitchen activity is replaced by one of multiple users. But the individual laboratory workspace is still typically occupied by a single researcher, and addressing the functional relationships of the most-used equipment—to arrange those elements into an efficient triangle or quadrangle, for example—will positively impact research efficiency.

Stakeholders should work together to plan an efficacious lab workspace by wrangling varying combinations of fume hood, storage, burner, freezer, incubator, centrifuge and the like. The key for the lab design team aiming to optimize the arrangement is to fully understand the work to be performed and the functional relationships of the equipment components to the work, the researcher and each other.

The benefits of a thoughtfully constructed and arranged workspace are, in fact, several-fold. If the space is designed with as many of the task specifics in mind as possible, we can optimize not only for efficient performance of process, but also for safety and sustainability.

Arranging unique labs

For startup firms and other smaller-budget research organizations, some of this may not be possible. These groups may have to rent facilities and accept the existing layouts of benches, casework and equipment. But whenever possible, the design of a lab interior should begin with a pre-planning-phase workshop. The purpose of this period is to uncover all space needs and process elements, from facility owners and managers, executives or owners of the research organizations, the design team, and perhaps most important, the likely lab occupants.

By engaging the research scientists in this early design phase, designers can tailor the completed project to the requirements and process of the research in question. Even conventional programs fall within categories that have particular requirements; geological specimens are handled differently from biological tissue samples, for example. The lab arrangement should consider which processes need to be close at hand and which do not. Equipment for processing tissue samples, for example, is unlikely to need a presence near the bench, while a glassware wash station may be required in close proximity.

To neglect the workshopping-visioning phase is to miss opportunities to create a workspace that addresses the research team's precise requirements and methods. This is especially important in the design of facilities for unique research efforts. Consider the example of a transgenic (mutated) butterfly study facility at the Yale Department of Molecular, Cellular and Developmental Biology. Because the specimens could contaminate the surrounding ecosystem, design of the space must eliminate the possibility of escape. In this context, the reduction of researcher movement to a minimum is crucial. One working solution includes adjustable-height casework and shelving among the furnishings, to suit the specialized workflows and ergonomic needs of individual researchers.

Pharmaceutical laboratory at 300 George Street Technology Center, New Haven, CT.

➤ *Lab space with flexible bench/equipment arrangement at Yale School of Medicine, Sterling Hall C-Wing.*

Bench area for research at Yale Department of Molecular Biophysics and Biochemistry. ➤

Keeping it flexible

Adjustable and reconfigurable casework can be especially important in shared workspaces, where the workspace must be optimized for two or more researchers, perhaps performing differing tasks. Flexible configurations can provide an array of ergonomically optimal setups; these arrangements can make repetitive tasks the researcher is performing less stressful and, combined with natural daylighting and good indoor environmental quality (IEQ), can improve individual researcher performance in a way that positively impacts ROI.

In fact, the lab interior will be greatly enhanced by an increase in the overall flexibility of the facility. Tailoring the workspace to a precise set of requirements is worthwhile, but the design should account for the possibility of a new research paradigm, a new method or an adjustment to the project goal. This was essential for the new six-sigma productivity R&D labs developed for PepsiCo, for example.

Optimal laboratory flexibility is achieved through the implementation of an infrastructure that supports these changing needs. Recent innovations in casework systems and dry bench design are making such laboratories a reality, as are the shrinking footprints associated with lab equipment, including digital imaging technology, automation systems and the entire category of equipment associated with tissue culture study.

To support these systems as components of a flexible laboratory strategy, the infrastructure of the research space will have to provide easily reconfigured access to gases, water, ventilation, broadband and the like. Such

a strategy was implemented successfully at the Yale University Medical School, through the installation of plug-and-play pods in the ceiling. With rolling casework and easily relocated bench and equipment stations—conforming to the traditional 10-foot lab module, which continues to be the standard regardless of innovation—the lab can be configured for an entirely new project or goal without a construction crew. Furthermore, small adjustments can be made to best arrange an individual bench area, making on-the-fly workspace optimization a reality.

Don't reinvent the wheel

Applying these principles to the research workspace does not require reinventing the wheel. Most of the common sense guidelines found in various standards for lab layout, planning and design can still be applied. The only difference is that the existing guidelines should be considered a minimum standard, or as pieces to be fit into a new puzzle. For instance, Princeton University's lab safety manual includes the following guidelines:

- Work surfaces, including computer areas, should incorporate ergonomic features, such as adjustability, appropriate lighting and equipment layout.
- Benchwork areas should have knee space to allow room for chairs near fixed instruments and equipment, or for procedures requiring prolonged operation.
- Do not install more sinks or cupsinks than are necessary.

Naturally, such guidelines will dovetail with the goal of optimizing researcher performance through an advantageously organized workspace.

One of the big decisions for the facility design will be whether to incorporate lab equipment near bench areas or to isolate it in support zones or rooms. When equipment is segregated into its own space, the facility design allows for better control and a safer work environment with lower heat loads and fewer pollutants. Yet by bringing equipment closer to the bench, the designer can create a layout that offers increased efficiency and throughput, even as it constrains the use of write-up/bench space.

Vital to lab facility planning is an early assessment of researcher travel time and productivity enhancements, based on equipment location, against the safety hazards and infrastructure costs of bringing equipment closer to the bench. The planning meetings usually quickly reveal that some operations need to be close by while others, such as a procedure that runs tissue samples through an automated processing machine, don't need to be.

In every case, early planning is the key to ensuring that time-motion analysis and equipment-use parameters inform the most productive and safest lab layout.

Robert Skolozdra, *AIA, LEED AP, is a partner and LEED design specialist with Svigals + Partners, an integrated architecture and art provider specializing in research and educational facilities. The company is based in New Haven, CT. Robert can be reached at bskolozdra@svigals.com or by phone at 203-786-5110 ext 333.*

OPTIMIZING LABORATORY OPERATIONS

ASSET UTILIZATION MONITORING CAPTURES THE DATA NECESSARY TO IMPROVE INSTRUMENT UPTIME AND LAB PRODUCTIVITY

by Keith Martinko

To optimize lab operations, several questions must first be answered. How can you adjust service levels based on usage? How can you trigger preventive actions prior to failure? How effective are you at utilizing your assets? These questions can be easily answered by implementing an asset utilization monitoring solution. Such a solution provides laboratories with knowledge of how instruments are used throughout the laboratory, and can significantly help labs optimize operations, drive cost savings, and improve productivity. It also empowers lab managers to make smart operational decisions based on real instrument and equipment usage information.

Asset utilization monitoring delivers significant benefits, including the ability to eliminate unnecessary capital expenditures and reduce laboratory downtime. It helps laboratories reduce downtime and service costs through proactively adjusting the delivery of planned services (e.g., preventive maintenance, operational qualification), allowing laboratories to match actual instrument usage to optimize service levels. In addition, the data can be leveraged to balance workloads and reduce downtime risk through redeploying instruments and equipment from areas of low utilization to high utilization. Asset utilization data enables laboratories to optimize return on current investments and eliminate unnecessary future capital expenditures. Labs can make better strategic decisions by factoring current instrument utilization into capital purchase and disposition decisions.

"Asset utilization data enables laboratories to optimize return on current investments and eliminate unnecessary future capital expenditures."

Implementing an asset utilization monitoring solution in a laboratory consisting of instruments and equipment purchased from multiple manufacturers, comprising different scientific techniques, and controlled by different instrument software, can be extremely challenging. At a minimum, data such as sample run times and instrument reset times (time for the instrument to return to a starting point to run the next sample) must be captured across each instrument to give a true reflection of actual instrument usage. Data should be collected at least once per day, to ensure that utilization data is not skewed by explainable events that are missed (e.g., repairs, sample delays, power failure, researcher time off).

Laboratories have attempted to deploy both automated hardware and software solutions to meet these challenges, with varying degrees of success. Hardware solutions typically consist of a sensor (e.g., voltage, current) to capture a physical event on the instrument and log the time of the event and the time between events. These types of solutions can be difficult and expensive to implement and support, sometimes requiring physical modifications to the instrument itself. A more effective approach is to use a software solution to either monitor for creation of instrument data files or read instrument-generated logs and/or results files to capture sample acquisition times and instrument reset times. No matter what approach is chosen, it is important that it is easily scalable regardless of the manufacturer, technique, or instrument control software, and does not interfere with instrument functionality or research productivity. This

allows the laboratory to keep its existing technology and software infrastructure in place, protecting the lab's investment in instrumentation and operator training.

Automated collection of sample run and reset times is an important first step in generating useful utilization information for the laboratory. Additional process factors must also be considered to truly transform this data into valuable information and knowledge to drive decision making. For example, an accurate utilization calculation should take into effect the intended hours of operation for the instrument within the lab (e.g., 10 hours per day, 5 days a week versus 24/7) and adjust for periods of inactivity due to preventive maintenance and repairs that were performed during the monitoring period. Applying these types of corrections to the raw utilization data provides a more accurate account of instrument usage within the lab.

Having accurate utilization information does not provide enough knowledge on its own to drive actions that increase instrument uptime and lab productivity. In order to adjust preventive maintenance (PM) schedules based on instrument usage, for example, it is necessary to completely understand the number of hours of operation that are acceptable before performing a PM. Typically, this information can be obtained from the manufacturer or your existing service provider, and should be adjusted (either higher or lower) depending on the specific application and sample matrix used on the instrument. Over time, the combination of actual utilization information, instrument performance, and service history can be used to fine-tune this information for each specific instrument in the lab. Similarly, quantitative limits that define low utilization (e.g., less than 25 percent) and high utilization (e.g., greater than 70 percent) must be established for each instrument and/or lab area. Using these limits, a lab can easily identify areas of high utilization and potentially redeploy existing, or purchase new, instruments to balance the workload and reduce downtime risk. An expert multi-vendor service provider or consultant can often provide significant value to this process by standardizing reporting of asset utilization data and offering productivity recommendations based on the data.

Implementing a comprehensive asset utilization monitoring solution within a laboratory consisting of instruments from multiple manufacturers can be challenging, but recent advances in technology and service methodology now make it possible to implement a streamlined solution, and much easier for labs to take advantage of this valuable data. Development of a road map and an execution and support strategy can help ensure a successful rollout of the solution. Careful consideration to the method and frequency of utilization data capture, inclusion of process factors to create actionable utilization information, and application of this information against PM and utilization level limits can significantly improve instrument uptime and lab productivity. Knowledge is power.

Keith Martinko *is developer of Unity™ SmartCapture asset utilization monitoring and global product development manager for Unity Lab Services, Thermo Fisher Scientific.He can be reached at keith.martinko@thermofisher.com or by phone at 608-273-6819.*

Dr. Amanda Capes-Davis

ASK THE EXPERT

SETTING UP A CELL CULTURE LAB

by Tanuja Koppal, Ph.D.

Dr. Amanda Capes-Davis, an independent cell culture consultant and founding manager of CellBank Australia, talks to contributing editor Tanuja Koppal, Ph.D., about the imperative need to establish best practices in a cell culture laboratory. She talks about everything that can be done from the early stages in terms of utilization of lab space to establishment of procedures for minimizing contamination and also planning for emergencies and disaster recovery.

Q: What are some of the key elements that lab managers should consider when setting up a cell culture lab?

A: There are some things a lab manager simply cannot control, and one of them is the space they have for doing cell culture. But if possible, they should try to dedicate a space exclusively for cell culture. If you are working with cells and someone over your shoulder is working with bacteria, then you know that you are going to have problems down the line. The next thing that you should think about is the equipment for cell culture. When you are choosing equipment for a new lab, you have to remember that you are going to be living with those choices for years. So you want to have things that can be cleaned easily and you should know where to get them serviced or calibrated if there is a problem. You should look at the latest technology, especially when it comes to cleaning incubators, and make decisions based on what is the best you can buy within your budget. When you are buying consumables you want to focus on those that are cell culture grade. They may be more expensive, but essentially you are paying for the testing that the supplier has done for the relatively high-risk problems that can occur. I recommend using as many disposables as your budget allows, as it can reduce a lot of problems. Finally, when you obtain your cell lines, make sure that you obtain them from a supplier that also tests the cells, particularly for contamination. You need to know what types of tests have been done on the cells that are coming into your lab. A lot of the choices you make can have an impact on the problems you face later.

Q: What is the biggest source of contamination in a cell culture laboratory?

A: The most common source of contamination today is other cell lines. In past years, consumables were also a big problem, but suppliers these days do the necessary testing so that risk is rare. Contamination from other cell lines often occurs when people share a bottle of medium between cell lines. Some degree of contamination risk also comes from the operator or the donor. Based on the data that I have seen, mycoplasma and cross-contamination are the two most significant causes of contamination. Of course, contamination from bacteria and fungi is also common, but people are more likely to see those organisms under the microscope or they can see changes in the cell culture medium. Whereas changes caused by mycoplasma and cross-contamination are more subtle. If you have been working with the cell line you may see the change, but if you are new to the cell line, then it's easy to miss seeing the changes.

Q: What do you suggest in terms of keeping the cell culture area clean and contamination-free?

A: Testing for mycoplasma and cross-contamination is very important, and if you test for it regularly you are likely to pick up the problem early. A lot of people do a quick test for mycoplasma every month to make sure there is nothing detectable emerging that is problematic. At the minimum you want to test for mycoplasma and cross-contamination when you put down a stock in liquid nitrogen and you can keep coming back to the stock, say every three months. So you are always starting with something you have tested. Having good aseptic technique and separating the cell cultures so that you are not sharing medium or other consumables is important. Having some separation in time between handling different cell lines in the hood is also very important.

Dr. Amanda Capes-Davis has a background in medical research, with an emphasis on molecular biology and cell culture. She has an ongoing commitment to improving cell culture practice and increasing awareness of its problems, particularly relating to cell line contamination. Currently, Dr. Capes-Davis works as an independent technical writer and cell culture consultant. She was the founding manager of CellBank Australia, a facility growing and distributing cell lines to the research community in Australia and New Zealand. She chairs the International Cell Line Authentication Committee (ICLAC), a new initiative aiming to make misidentified cell lines more visible and promote authentication testing as an effective way to combat the problem. In collaboration with Dr. Ian Freshney, she has developed a database of known misidentified or contaminated cell lines. The database is available through ICLAC and culture-related websites worldwide. Dr. Capes-Davis received her Ph.D. degree working in cancer genetics at the University of Sydney in Australia.

For most labs, growing different cell lines in different incubators is not feasible and, hence, it's reasonable to share incubator space.

Q: What do you recommend in terms of disaster planning?

A: It is always good to assume that any new cultures coming into the lab could cause a problem. If you are starting out in a new lab, it's a good idea to set aside some space or an incubator to hold new cells before you have a chance to test them. You want to separate these cells from other cultures until the test results are back, particularly to avoid mycoplasma contamination that can spread across different cultures very easily. At a building level, all labs should think about having an emergency power supply to run fridges and freezers that contain irreplaceable samples. At the institute hosting our cell bank we have a generator that is tested regularly and can kick in if there is a power failure, and all our essential equipment is connected to that emergency supply. You also need to think about access to the building so that people can come in during an emergency to top off liquid nitrogen in the tanks that store the cells. Think about what needs to be done if elevators are not working and if you need to access the stairs. Finally think about a separate site where you can put some vials of cell lines that are irreplaceable to you. Either have a cell bank or storage facility store them for you or exchange samples with colleagues who are off-site, to cope with disaster recovery. It's one of those things that you can be tempted to put off until tomorrow, but it's best to think about it early in the process.

Q: What are some of the common issues that come up as you consult for various clients?

A: I am sometimes asked for help with problematic cell lines that need short tandem repeats (STR) profiling where it may be useful to seek multiple opinions. I am particularly interested in increasing awareness and educating people about cell culture. Generally people need more awareness of the problems that can come up with cell culture, and they find it particularly convincing when they see me present data on the problems that can come up. There are not enough programs to educate people about best practices. People often learn about cell culture based on what's being done in their own lab. That can be very good but it can also be that nobody ever learned how to do it using best practices. So they need a resource to go to and learn and bring best practices into their labs, so they know that they are doing cell culture as best as they possibly can.

Q: What can be done to educate and train lab personnel to ensure that best cell culture practices are being inculcated and followed?

A: First of all, each lab should have a cell culture expert who can teach new students and lab personnel. Every lab should have resources, such as a good textbook, that people can refer to for various problems that might crop up. Many undergraduate courses cover cell culture, but for most people it's a long time before they start using that knowledge in a lab. Training for graduate students and postdoctoral fellows is often missed. Some of the cell banks offer training courses, and this is also an opportunity for societies that have a big investment in cell culture. Online courses are good, but a challenge with cell culture is the need to be hands-on. Learning good aseptic technique is important for doing cell culture well, and it's an advantage to be able to watch someone actually working with cells to see what can be done differently. However, most of the ideas and the background of why and how things are done can be covered well with an online approach.

THE RIGHT CHOICE FOR

UV-VIS SPECTROPHOTOMETERS

by Rachel Muenz

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One of the oldest and most common forms of absorption-based analysis, ultraviolet-visible (UV-Vis) spectrophotometry continues to evolve. The market for UV-Vis spectrophotometers, based on information from Strategic Directions International (Los Angeles, CA), is growing by roughly $400 million each year (a six percent annual growth rate). Experts predict that increased mobility, reliability, ease of use, speed, and overall miniaturization will be the major trends in these instruments and they will continue to get cheaper. Pressure to shorten analysis times, increasing demand for small volume UV, and shrinking lab space are other factors that are affecting UV-Vis spectrophotometers and will likely continue to affect innovation in this technology into the near future, vendors say. One UV-Vis expert notes that USB stick-type mobile spectrophotometers are going to open new application areas for food testing, forensic analysis, off-site research, and diagnostics.

APPLICATIONS

- HPLC detectors
- Pharmaceuticals
- Genomics & proteomics
- Cell biology & biochemistry
- Day-to-day laboratory activities
- Diagnostics
- Off-site testing

CO_2 INCUBATORS

NEW ENVIRONMENTAL PRECISION GIVES RESEARCHERS MORE CONTROL

by Mike May, Ph.D.

To culture cells reproducibly, scientists seek a consistently controlled environment. "At the end of the day, a customer just wants to grow cells," says Uwe Ross, president at BINDER (Bohemia, NY).

The evolution of incubators started with the control of heat. Then, scientists wanted humidity control. The desire to control an incubator's pH spawned CO_2 incubators. "Now, we're in the middle of looking at a growing number of applications that need O_2 control," says Ross. "If you run an experiment on organ tissue and expose it to ambient oxygen levels of about 20–21 percent or reduce the levels to around five percent, you get different results." Tomorrow's incubators could control even more parameters, but each one adds to the cost.

"At the end of the day, a customer just wants to grow cells."

A customer's checklist for an incubator also includes contamination concerns, says Leah Harris, chief marketing officer at Caron Products (Marietta, OH). "Being able to have an incubator that offers the best contamination controls and elimination options is always a concern."

Judging the jacket

In the past, the best CO_2 incubators used a water jacket to control the temperature. "The water jacket was invented because a CO_2 incubator needs highly accurate uniformity," says Ross. "Now, we have air-jacket units that are as good or better." In fact, Ross points out some disadvantages of a water jacket. "You can't heat the water over 100 degrees Celsius," he says, "and a water-jacket incubator is hard to move because it's so heavy."

An air-jacket incubator provides the same temperature accuracy, according to Ross, and it can be sterilized up to 180 degrees Celsius. He adds, "An air-jacket unit is also easier to service if you have a problem."

Some incubators even use a gel jacket. "An incubator with this type of jacket has the benefits of both air and water jackets," says Harris. For example, Caron's GelJacket, Harris says, "incorporates proprietary gel active insulation, which surrounds the incubator on all sides. It is lightweight, requires no maintenance, can withstand high temperatures for decontamination cycles, and has no risk of leaking."

Technology at work

The lifetime of a CO_2 incubator depends largely on how it gets used and maintained. Ross says that an incubator should last 5 to 10 years, and most likely closer to the 10. Keeping it working right for a decade, though, takes maintenance. "You don't just purchase a CO_2 incubator, set it up, and never touch it again," he says. "You wouldn't do that to your car, and you shouldn't do it to your incubator." So an incubator should be serviced to maintain accuracy and efficiency.

"The number of contaminated CO_2 incubators out there is really staggering."

At the Wilmot Cancer Center at the University of Rochester in New York, Randall M. Rossi, director of the Translational Research Core Facility, uses CO_2 incubators to culture animal and human cell lines. When asked what he'd like to see changed in today's technology, he says, "I'd love to have the cost drop." He adds, "The reliability of the CO_2 and O_2 sensors, if an incubator has them, are quite important right now. Most of the incubators that are CO_2 and O_2 are too large to maintain accurate O_2 levels." Systems that do a good job of maintaining both gas levels, says Rossi, are "very expensive and not practical for general lab use."

Other experts also find some of the dual-gas units challenging. From the Stem Cell and Flow Cytometry Core at the University

of California, Santa Cruz, facilities manager Bari Holm Nazario reports, "We just opened a new building and we have been battling with a dual-gas unit." She even notes they are in discussions with the manufacturer to "rewrite some firmware." She also says that "one unit has had three post-installation visits for the engineers to stabilize things."

Adding volume

Volume also matters. "We're getting more requests and calls for high-volume cell culture," says Harris. "More people are doing cell-culture applications with shakers, stirrers, and roller bottles." Often, these devices only fit in large incubators.

Adding devices inside incubators creates other needs. For one thing, the incubator might need more shelves. In addition, the shelves must be strong enough. "The incubator must also isolate vibration so the shakers don't move around," Harris explains.

Adding instruments inside a CO_2 incubator can also increase the need for refrigeration. "Shakers let off some heat, so you need cooling to reach the set point desired for the cells in culture," says Harris. "When a customer wants to do these higher-end applications that put off heat, we always quote refrigerated models, because only those units will give the precise set points that the scientist needs."

As units get bigger, users consider energy consumption more than ever. "Some units are over-designed," says Harris, "but you can get units that even plug into a 115-volt outlet, and that can save money."

Corralling contamination

"Contamination is a bigger and bigger issue," says Ross. "The number of contaminated CO_2 incubators out there is really staggering." So in selecting an incubator, consider its anti-contamination features.

Sterilizing an incubator depends on the type of heating. With a water-jacket incubator, inside components get removed and autoclaved, and the remaining inside surfaces get washed down with alcohol. "With air jackets," says Ross, "you just hit a button that heats up the unit to 180 degrees Celsius, and everything in there is killed."

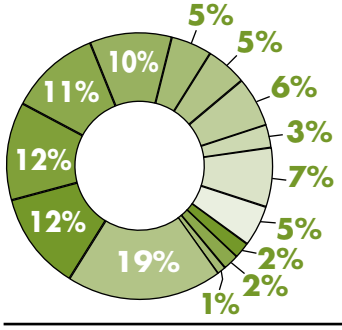
"Sterilization could become even more critical as CO_2 incubators move into more applications."

Sterilization could become even more critical as CO_2 incubators move into more applications. For example, Ross says, "The manufacturing trend is just starting." Rather than just using CO_2 incubators in research labs, they also appear increasingly in manufacturing environments. "More and more, companies grow cartilage for knees or grow skin after a burn," says Ross.

In any situation, though, sterile culturing conditions will stay on the incubator checklist.

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

THE TYPES OF CO_2 INCUBATORS BEING USED IN OUR READERS' LABS:



WATER JACKETED	19%	THERMISTOR-CONTROLLED CO_2	6%
AIR JACKETED	12%	O_2 CONTROL	3%
STACKED UNITS	12%	BENCHTOP	7%
HEPA FILTERED	11%	AUTO-DECONTAMINATING	5%
PASSIVELY HUMIDIFIED	10%	COPPER-LINED	2%
ACTIVELY HUMIDIFIED	5%	DATA LOGGING	2%
INFRARED-CONTROLLED CO_2	5%	OTHER	1%

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BATHS AND CHILLERS

PRODUCT AND TECHNOLOGY ROUNDUP: HOLD THE DECIBELS

by Angelo DePalma, Ph.D.

Instrument noise, particularly from cooling devices, can take its toll on laboratory workers. "Chillers can be quite noisy," observes Bob Bausone of PolyScience (Niles, IL). Noise interferes with conversations but can also induce stress, leading to irritability, anxiety, and poor performance. Lab workers are particularly susceptible, as decibels in busy labs can add up quickly from refrigerators, freezers, aspirators, fume hoods, and chillers.

WhisperCool™ Environmental Control System technology, developed by PolyScience and incorporated in several of their refrigerated circulating baths, controls noise by optimizing fan speed and compressor operation based on the actual overall cooling demand. "As demand decreases, so does fan speed and the demand on the compressor," Bausone says. Under conventional temperature control, fan and compressor run alternately (and mostly) at full speed mode, then turn off and on again.

"Most cooling applications do not demand all-out operation," Bausone explains. "If you're controlling the temperature of a laser, the chiller needs to operate full-tilt only when the laser is active. When the laser shuts down, the cooling system can slow down too." WhisperCool also reduces energy consumption and stress on the compressor, prolonging its life and minimizing the need for servicing.

Weight and complexity

According to Vero Tabares, director of business development at TriTech (Edgewater, MD), the most often-heard complaints about chillers are about their complexity and weight.

> **"The most often-heard complaints about chillers are about their complexity and weight."**

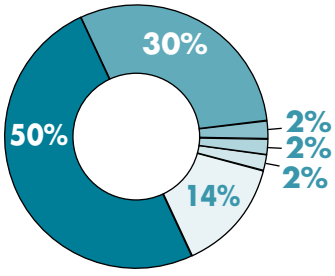
While noting the commendable size reductions in many lab instrument categories, he believes miniaturization comes at a cost, particularly for chillers and baths. "People are becoming more comfortable with technology like tablets and smartphones, but when it comes to the lab, they want to focus on the experiment and not on setting up instrument conditions." Many manufacturers, he adds, promote features that make a difference for just a small percentage of users. "This is true not only for chillers and baths, but for lab equipment in general."

Given the persistent issue of bench space or lack thereof, it is not surprising that customers would grumble about the size and weight of chillers. With chillers frequently moved around within a lab, or from laboratory to laboratory, Tabares notes that "most lab workers are not weight lifters, constantly moving 24-pound objects from here to there." His advice to manufacturers: "Make them smaller *and* lighter-weight."

Size and weight reductions eventually run up against the laws of nature, however. "Smaller machines do not necessarily weigh less. In many cases, it's impossible to reduce weight due to the limitations on the components. You can't defy physics or gravity," Tabares says. Nor does he expect OEMs to replace solid steel cabinet materials with space-age carbon fiber or titanium. "But the use of aluminum alloys will make these products lighter. After all, they are not subject to vibrations from an internal motor like shakers or spinners."

Tabares believes that customers can save substantially by acquiring refurbished chillers and baths instead of new units, and at a very attractive risk-benefit ratio. "Chillers and baths use basic components that are not prone to breaking down. Many are still in operation after a decade or longer with no serious issues. It's not the same as with a

TEMPERATURE RANGES RESPONDENTS TO OUR LATEST SURVEY OPERATE THEIR WATER BATHS OR CHILLERS AT.



LESS THAN -100 C	2%
-50 C TO -100 C	2%
0 C TO -50 C	14%
0 C TO +50 C	50%
+50 C TO +100 C	30%
MORE THAN +100 C	2%

water-jacketed incubator or carbon dioxide-injected incubator, which require very precise controls. Chillers and baths are much less temperamental."

Compact, powerful chillers

Rotary evaporators, incubators, reaction vessels, and analytical instrumentation require heat removal and rely on precise temperature control. "Without the right temperature control solution the process may be ineffective or the machinery may even be damaged," says Kelly Gibbons, marketing coordinator at PolyScience (Niles, IL).

Gibbons recognizes both the bulkiness and complexity issues. To address physical heft she notes that chillers "with a lot of cooling power" are the most desirable. And she agrees with Bausone that, since these products are generally viewed as accessories, users do not want to spend a lot of time with setup, operation, and maintenance. "Manufacturers must consider ease of use, plus environmental friendliness and cost when designing chillers."

PolyScience has met these challenges with a line of affordable, low-temperature, and compact but powerful chillers—the LS-Series, LM-Series, and the MM-Series—that provide up to 1290 watts of cooling at 20°C with ±0.1°C stability and a variety of other features. The LS-Series products can cool multiple rotary evaporators and are available with either a centrifugal or turbine pump.

When moderate rather than robust heat removal—with more precise temperature control—is required, refrigerated circulating water baths are the ideal product choice, says Gibbons. "When considering this type of cooling device purchasers should consider temperature range, temperature stability, pump capabilities, footprint, working access, and any features that make the circulating water baths easy to use and maintain."

Desirable features include multistep temperature ramping, icon-driven touch screen operation, built-in electronic keypads, and networking potential to document temperature settings.

Heating and cooling

Heating units have been undergoing changes as well. Earlier this year, Grant Instruments (Cambridge, UK) unveiled a new line of heating circulators, Grant Optima™, which provides temperature stability of down to ±0.01°C and excellent uniformity (±0.1 to ±0.05°C). Grant designed Optima for use with the company's five new stainless steel baths, three plastic baths, and models in its refrigerated bath and circulator product lines.

According to Emma Hewson, product manager at Grant, her company "worked closely with customers during the design, prototyping, and development stage of the Optima" products to account for workflows in modern labs involving heating and cooling. As a result, Grant has improved design and usability features, and built in more programmability "so the user can set up a simple or highly complex procedure and leave the equipment to do its job while they do theirs."

Optima incorporates several advanced features, such as a full color screen with icon-driven menus, USB interface for PC programming (through Grant's Labwise™ software), and an integral pump for external fluid circulation.

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NON-GASSED INCUBATORS

ADVANCED CONTROLS KEEP THE TEMPERATURE ACCURATE THROUGHOUT THE BOX

Mike May, Ph.D.

To grow a culture of bacteria, researchers typically use an incubator. The so-called non-gassed or microbiological incubators come in many styles, and usually provide temperature options of 5 to 70 degrees Celsius, although most researchers grow bacteria at 37 degrees Celsius. Yeast, on the other hand, usually grows better at 30 degrees Celsius. Differences like these drive the need for accurate temperature control in a microbiological incubator. Moreover, the specifics of an experiment and even user preferences impact this product market. Like a chef selecting an oven, researchers know what they want from an incubator.

Kristof O'Connor, director of marketing and business development at Boekel Scientific (Feasterville, PA), describes a non-CO_2 incubator as "a durable good in the lab environment." He adds, "It's similar to a microwave oven or a toaster in a kitchen in that almost everybody has one. It's not a want to have, but a need to have." In a *Lab Manager Magazine* product survey on incubators in 2011, for example, only 14 percent of the respondents were not using an incubator. Moreover, 44 percent of the incubators being used were microbiological ones, versus 53 percent being CO_2 incubators.

Overall, says O'Connor, "The majority of these incubators hold samples in plates, Erlenmeyer flasks, or other vessels." He adds that some researchers also agitate some samples during incubation. It all depends on what grows cultures best.

Control and contamination

The method of heating in a microbiological incubator comes from gravity or convection. The basics of the technology tend to be fairly standard: A thermocouple in the chamber measures the temperature, and that device keeps the temperature in the chamber within some tolerance range by turning on the heating element when the temperature falls below the tolerance and turning it off when the temperature climbs above the tolerance. "The tolerance is getting smaller," says O'Connor.

> **"Like a chef selecting an oven, researchers know what they want from an incubator."**

In purchasing a device to keep samples at some temperature, "consider the specification that you need, not what the product is called," says Uwe Ross, president at BINDER (Bohemia, NY). For example, he points out that "some incubators go up to 100 degrees, which means that some low-temperature oven applications that need high accuracy can be run in an incubator." So when choosing between an oven and an incubator, consider all of the possible uses.

For any use, researchers worry about contamination in growing biological samples. First, researchers want to prevent contamination. Second, they want the easiest options for sterilizing an incubator between uses. Some microbiological incubators include decontamination technology, such as a one-touch button—almost like a self-cleaning oven—that heats the chamber to a higher level, such as 140 degrees Celsius in some models.

Device details

In selecting a microbiological incubator, researchers choose between a few more features than just gravity of convection heating. Some incubators come with solid doors and others include a window. In addition, some of the devices use analog controls and others use digital ones. In general, convection units cost more than gravity-based ones. Likewise, the cost also tends to increase with the size of the incubator as well as the temperature range.

"Certain applications are driving people to get incubators that

are more and more precise," says O'Connor. "So they want a stable temperature that is uniform." Uniformity means the consistency of the temperature across the entire incubator chamber. "This is called chamber mapping," O'Connor says, "and some researchers want increased levels of this to get finer control." That way, any plates or vessels inside the incubator experience the same environment.

Beyond heating, an incubator might also need to cool. "If you want to run an incubator at 25 degrees Celsius, which can be less than room temperature in the summer, you need a refrigerated incubator," says Ross. Of the respondents in the incubator survey, 19 percent were using cooling devices with their incubators.

"Certain applications are driving people to get incubators that are more and more precise."

Incubator users often look for very specific features. For example, David B. Fankhauser, Ph.D., professor of biology and chemistry at University of Cincinnati Clermont College in Ohio, looks for several features in a microbiology incubator. He looks for a double door with glass on the inside. He also wants an "easy-to-use latch that is secure when closed." Inside, the shelves should be "easily moved or removed," Fankhauser says. Plus, he wants an incubator that is "large enough to easily accommodate a tray of at least five stacks by five stacks of plates." In terms of operation, Fankhauser wants an incubator that includes "closeable vents, which are open when drying plates, but closed when you do *not* want the plates to dry." Last, he also likes a microbiological incubator to provide a digital readout to the nearest 0.1 degree Celsius.

In many cases, cost makes up the key feature in the microbiological incubator market, says O'Connor, "because of its commodity nature." Likewise, adding features to these incubators typically adds to the price.

Expanding applications

Increasingly, incubators get used in food and water testing, says Ross. "We will see that testing for contamination and shelf life will become more important," he says.

As incubators get used for more quality assurance and control, the required sample volume might trigger the need for automation. "You see some companies that come up with, let's say, robots attached to chambers, like an oven or incubator, and specific applications where that is beneficial, but that's in its infancy," says Ross. "There's no automated incubator that a lab can buy and adjust to their needs."

Although it might seem easy enough to keep a culture at just the right temperature, today's research requires even more features from microbiology incubators. In fact, specific users find some features more important than others. Overall, though, a device that grows culture consistently and without contamination matters the most.

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

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

PIPETTES

NEW DESIGNS REDUCE FATIGUE AND INCREASE THROUGHPUT

by Mike May, Ph.D.

Few labs these days could survive without pipettes. Many assays require pipetting, and the increasing size of multiwell plates demands more steps than ever. Likewise, many experiments and processes—both in academia and in industry—must be validated, especially when regulatory oversight could be involved. Consequently, scientists demand increasing capabilities from pipettes.

According to market research conducted by Hamilton Company (Reno, NV), says product manager Devon Bateman, scientists seek four improvements in new pipettes. The first is process control, which Bateman describes as "something that would aid in reproducible results and increased accountability." Bateman adds, "Manual pipettes are all based on how the lab technician manually adjusts that pipette, and they can make an error." The second desired improvement is increased lab efficiency. "As labs get more money conscious, they must increase throughput to decrease the cost per sample," says Bateman.

> **"Manual pipettes are all based on how the lab technician manually adjusts that pipette, and they can make an error."**

That often depends on pipettes that are easier and faster to use. The third involves fatigue. "Carpal tunnel syndrome is very expensive for labs," Bateman says. "Scientists want a lighter-weight hand device to maximize all-day performance." The last topic involves increased accuracy. "This is especially important in forensics environments," Bateman says, "because they are bound by law to prove that their results are true."

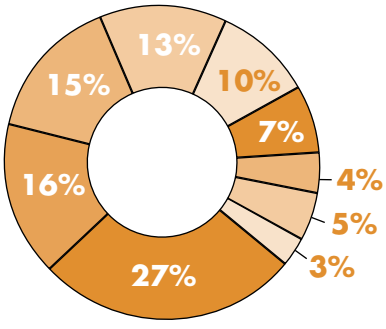
The most accurate pipetting requires automation. "To provide full validation and have traceability that measurements are accurate," says Bateman, "you need automation robots that really fine tune the process. With hand pipettes it's getting better, but you can't really control the process start to finish."

Going electronic

"The main move today is toward using electronic pipettes, and there are a few reasons for that," says Melinda Sheehan, Ph.D., product manager, liquid handling at Eppendorf North America (Hauppauge, NY). "One is ergonomics, and another, by far, is reproducibility."

With an electronic pipette, everyone can use it consistently. "It doesn't matter how hard a user pushes down on a button," says Sheehan. "You can just pass an electronic pipette to a colleague, who will get the exact same results." She notes that electronic pipettes cost more than manual ones, but she thinks the advantages outstrip the cost. "With a manual pipette, you might have to do more replicates and even redo complete experiments if pipetting errors arise," she says. "An electronic pipette pretty

THE SOURCES OF ERRORS OUR RESPONDENTS ENCOUNTER WITH THEIR PIPETTES INCLUDE:



HUMAN ERRORS	27%
VISCOSITY REDUCES ACCURACY	16%
LIQUIDS STICK TO TIP	15%
IMMERSED TIPS CARRY OVER LIQUID	13%
SURFACE TENSION REDUCES ACCURACY	10%
PIPETTES TAKE UP MORE LIQUID	7%
LIQUIDS EVAPORATE	4%
OTHER	5%
LIQUID TEMPERATURE	3%

much stays clear of the errors that affect precision."

Also, Sheehan notes, electronic pipettes provide some programming options. "You can set the volume and the speed," she says. "Some liquids need to be aspirated or dispensed at a certain speed." As an example, she says that glycerol needs to be aspirated and dispensed very slowly. "Everyone can set the same speed for a specific liquid across the lab to ensure consistency," she says.

Some electronic pipettes do even more. For example, some can mix, aspirating and dispensing the same solution a few times. Some electronic pipettes can also aspirate a large volume and then dispense it in smaller volumes to multiple wells. "For ten wells, it takes 20 movements—ten aspirations and ten dispensings—with most pipettes," says Sheehan. "If one includes a multi-dispense mode, you can do the same thing in 11 moves—one aspiration and ten dispensings."

Increasing the throughput

As screening applications move to more labs—even smaller academic ones—more users require higher-throughput options for pipetting. "In the past ten to 20 years, screening applications have multiplied," says Michael Beier, liquid handling product manager at INTEGRA Biosciences (Zizers, Switzerland). "Before it was limited to specialized labs, but now these screening assays are available to the whole scientific community."

To work with the higher-end multiwell plates, screening facilities often use liquid-handling robots, which can be expensive to purchase and complicated to program. Now researchers purchase manual and electronic benchtop pipetting systems.

For 96-channel pipetting, says Beier, "bench-top models have evolved and you have a couple of choices." He adds, "Electronic ones offer more flexibility over manual ones." Some applications require as little as one microliter per channel to aspirate and dispense. "So the demand for accuracy and precision is just as important as it is with a robot." Plus, the benchtop models are easy to set up and program. "You can turn it on and change volume as in a normal electronic pipette, and then you can start working," says Beier.

"An electronic pipette pretty much stays clear of the errors that affect precision."

This trend in increasing throughput will continue. Some benchtop pipettes already provide 384 channels. Beyond that, though, robots will still rule.

Find the right features

The accuracy and life of a pipette depends on the starting product and how it gets maintained. "If you keep products serviced and keep them out of disrepair, you don't need to replace them and they're easier to use," says Sheehan. Also, she believes that the manufacturer can help with serviceability. "The easier that the manufacturer makes a pipette to repair, clean, and maintain, the more likely the customer will do it." Therefore, she advises users in the market for a new pipette to "know if it will be easy to maintain."

Different pipettes also offer different features that might matter more to some users than others. When asked what she'd like to see on more pipettes, Cary Ann Gallini, research assistant II at the Harvard School of Public Health (Boston, MA), says, "A locking mechanism to prevent drift when pipetting multiple samples with precision is key!" She adds, "I would also like to see more ergonomic pipettes on the market. VistaLab Technologies [Brewster, NY] makes a nice design, but I believe, because there is a lack of competition when it comes to pipettes with non-traditional designs, their price remains pretty high. It would certainly be hard to convince my principal investigator to purchase a whole new set."

In the end, the right pipette depends on the application and the user.

***Mike May** is a freelance writer and editor living in Austin, TX. You can reach him at mike@techtyper.com.*

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

GCXGC

SYSTEMS FOR COMPREHENSIVE 2D CHROMATOGRAPHY

by Angelo DePalma, Ph.D.

Comprehensive two-dimensional GC (GCxGC) is a powerful gas chromatographic technique that uses two columns to achieve separations of complex mixtures that would not be possible with a single column. Because of its complexity, GCxGC requirements for system, column, detector, and data handling differ from those of conventional, one-dimensional GC systems.

GCxGC employs an injector as does one-dimensional GC. But instead of one column, GCxGC employs two columns with orthogonal or complementary resolving capability. The second column is generally much shorter than the first. During a GCxGC run, the effluent of the first column is concentrated and introduced, in defined cycles, onto the second column through a process known as modulation.

Columns may be located in the same oven or in two different ovens for temperature programming versatility. In practice, the ovens usually are ramped in sync, with the shorter second column approximately five degrees higher than the first column to ensure vaporization of cuts from the first dimension.

A Restek (Bellefonte, PA) method for determining polyaromatic hydrocarbons (PAHs) in seafood employs a typical setup based on differing affinities to aromatic structures. Column one uses a 30-meter Rxi®-17Sil MS (50% phenyl, 50% dimethylsiloxane) stationary phase, while the second column is just 1.2 meters long and carries an Rxi®-1ms (100% dimethylsiloxane) stationary phase. The high phenyl content of column one provides more of a "like dissolves like" affinity for aromatics than column two, and is slightly more polarizable as well.

GCxGC differs fundamentally from conventional multi-dimensional GC. In the latter, only selected peaks or portions of peaks ("heart cuts") are introduced into the second column. In GCxGC, the entire eluent stream undergoes two-dimensional analysis. This generates significantly more data than either one-dimensional or multi-dimensional GC. Instead of generating familiar 2D peaks (retention time vs. response), a GCxGC plot adds a third dimension, the retention times on column two.

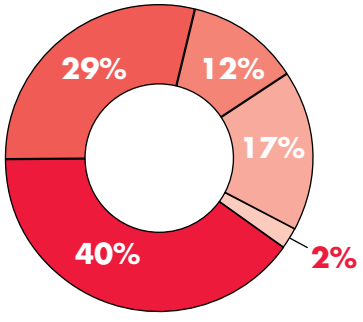
"GCxGC is more comprehensive than other 2D methods, because everything that comes off the first dimension goes into second dimension," explains Michelle Misselwitz, a Restek innovations chemist. GCxGC has become a go-to method for analyzing complex mixtures like crude oil or metabolomics samples. "GCxGC pulls analytes apart in a way that's impossible with one dimension."

For example, a mixture of aliphatic and aromatic compounds requires fractionation before single-column analysis, where GCxGC resolves the analytes through a single run.

Modulation: The heart of GCxGC

By bridging the two columns, the modulator is arguably the most

THE TYPES OF GC COLUMNS OUR READERS USE IN THEIR LABS INCLUDE THE FOLLOWING:



ONE SINGLE POROSITY COLUMN	40%
ONE MIXED BED/LINEAR/ MULTIPORE COLUMN	29%
TWO OR MORE MIXED BED/ LINEAR/MULTIPORE COLUMNS	12%
TWO OR MORE SINGLE POROSITY COLUMNS	17%
MIXED BED/LINEAR/MULTIPORE COLUMN WITH OLIGOMER COLUMN	2%

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critical component of a GCxGC system. The modulator "traps" effluent from the upstream column, and releases it in timed pulses to column two. The time between pulses, generally from two to six seconds, is known as the modulation time. Because the modulation time is much shorter than the elution time for a mixture, the modulator cuts each peak from the first column several times. A fast detector such as TOF-MS is required to resolve peak slices this narrow.

Literature from Restek lists thirteen different commercial or semi-commercial modulator designs; many academic "home brewed" modulator designs exist as well. The two main designs are mechanical and thermal. Mechanical modulators employ valves and holdup volumes within a modulation capillary to concentrate peaks and shunt them off to column two. Thermal modulators, which are much more prevalent today, operate by rapidly cooling the effluent from column one with liquid nitrogen or carbon dioxide. After concentrating the cut, the modulator vaporizes it and injects it into column two.

The model in use at Restek is the Leco (St. Joseph, MI) quad-jet dual-stage modulator. This device employs two cryogenic jets to freeze the cut and two thermal jets to re-vaporize it onto the second dimension.

Importance of software

The first thing readers who are unfamiliar with GCxGC printouts notice is that the typical peak height vs. time plot has been replaced by plots of first-dimension retention time vs. second-dimension retention time. Graphically, results are "contour" plots consisting of irregularly shaped roundish-oval areas or even streaks. Ideally, elution elements that overlap in the first dimension are fully resolved as two or more regions in the second dimension.

Because GCxGC is comprehensive and does not rely on heart cuts, each sampling of the first dimension and introduction onto the second dimension creates a new chromatogram. This factor alone generates hundreds or thousands of times as much data as a typical run in a single dimension. Software must also be capable of correlating the dimensional data to generate the contour plot.

Most GCxGC systems come pre-packaged with software capable of handling high data load, contour plot generation, and the usual detector output. Leco, for example, ships its Pegasus® 4D GCxGC-TOFMS system, with a time-of-flight mass detector, with the company's ChromaTOF software.

A new—and free—program, MetAlignID, developed by Dr. Arjen Lommen at the Institute for Food Safety (Wageningen, Netherlands) exploits the computational power of multiprocessor desktop computers to speed up GCxGC analysis and extend its concentration dynamic detection range to 10 ppb. Detection range is essential for analyzing samples containing analytes of widely varying concentrations.

"MetAlignID works on up to 128 cores, and speed improvements are approximately linear with respect to the number of cores," comments Dr. Lommen, "but data quality is not."

MetAlignID has only been tested on Leco GCxGC systems, but the package should work with other brands. The program is available for download at www.metalign.nl.

Why give such valuable software away? "We are a research institute," Lommen explains. Our main focus is acquiring and funding new projects. If GC researchers like our work, we are happy to collaborate with them."

GCxGC is a powerful technique, but in its current implementations it is by no means suited for a novice chromatographer. "GCxGC has saved me at times, when sample cleanup didn't work well, by pulling the matrix away from my targets," Restek's Misselwitz admits. "But it entails a learning curve."

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

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

ARE YOU IN THE MARKET FOR AN... ELECTROPHORESIS SYSTEM?

Electrophoresis relies on a basic process — particles moving in an electric field. Known for more than 200 years, this phenomenon still drives fundamental techniques in many labs and its long history plays a role in the widespread use of the technology. Current interest lies in making the technology, faster, more accurate and more sensitive.

Top 9 Questions You Should Ask When Buying Electrophoresis Equipment and Gels:

1. How many gels per experiment can you run at once in a single electrophoresis cell?
2. Can you run hand cast and precast gels with the same electrophoresis equipment?
3. Can you blot in the same tank as you run the gels?
4. How fast can you run a set of gels with optimal performance?
5. How fast can you visualize your proteins in the gel?
6. Do you need any special buffers or sample buffer to run your gel?
7. Does a precast gel give you the same separation as a hand cast gel?
8. How fast can you transfer proteins from your gel to a membrane?
9. How efficiently can you transfer your high MW proteins from your gel to a membrane?

Electrophoresis components being used in our readers' labs:

Electrophoresis gel apparatus	94%
Reagents: gel staining chemicals, premade gels, gel chemicals, buffers, etc.	93%
General lab equipment: pH meter, pipettors, scale, stir plates, etc.	87%
Power supply	85%
Digital camera/gel documentation systems	72%
White light/UV light box	58%
Cooling apparatus	18%
Other	4%

Respondents are using or planning to use the following gel types:

Acrylamide	43%
Agarose	40%
IEF	5%
Cellulose acetate	5%
Other	8%

Top ten factors/features considered by our readers when buying an electrophoresis system:

Ease of use	100%
Availability of supplies and accessories	99%
Durability of product	99%
Low operating costs	98%
Fast time to results	97%
Low maintenance/easy to clean	97%
Integrated software lets you control the instrument	97%
Footprint/size	95%
Safety and health features	94%
Price	94%

The main application for electrophoresis use in our readers' facilities:

Protein Gel Electrophoresis	33%
Western Blotting	24%
Nucleic Acid Gel Electrophoresis & Blotting	14%
DNA & Genome Sequence Analysis	9%
Capillary Electrophoresis Sequencing & Fragment Analysis	8%
Genotyping & Genomic Profiling	4%
Protein Sample Preparation & Protein Purification	4%
Other	5%

The main issues with electrophoresis products being experienced by users:

Time to results (not quick enough)	39%
Inconsistency in gels	31%
Shelf life is too short for gels	24%
Dangers in handling toxic chemicals to make gels	19%
Buffers heating up too much	15%
Not enough control options in the electrophoresis system	11%
Other	7%

COMPLETED SURVEYS: 250

For more information on electrophoresis systems, including useful articles and a list of manufacturers, visit www.labwrench.com/electrophoresis

ARE YOU IN THE MARKET FOR A... REFRIGERATOR OR FREEZER?

Freezers and refrigerators are an integral part of any laboratory that requires temperature controlled storage. Maintaining samples at an optimal storage temperature is vital for many labs and makes choosing the right freezer or refrigerator a crucial task. Users need to demand accuracy, consistency, capabilities & reliability.

Top 5 Questions You Should Ask When Buying a Lab Refrigerator or Freezer:

1. How is the product manufactured? Ask about the quality of the materials used and the product life expectation based on manufacturing testing.
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 4 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?

Type(s) of service used by respondents for repair/ service of their refrigerators/freezers:

In-house service department	41%
Third-party time/material	30%
Third-party contract	21%
Instrument manufacturer time/material	12%
Instrument manufacturer service contract	12%
Multi-vendor service provider	8%
Don't know	6%
Our department	3%
Other	2%

Temperature ranges required by respondents currently using or planning to purchase fridges or freezers:

0° to -20°C	38%
-20° to -30°C	17%
-30° to -45°C	5%
-45° to -85°C	27%
Other	13%

Top ten features/benefits our readers look for when purchasing refrigerators or freezers:

Price	100%
Reliability of product	100%
Durability of product	99%
Warranties	97%
Energy efficiency	96%
Quiet operation	96%
Sensitivity and accuracy of temperature controls	95%
Reputation of vendor	94%
Service and support	90%
Audible and visual Hi/Lo alarm for each controller	86%

Types of refrigerators or freezers survey respondents are currently using:

Upright general purpose lab freezers	63%
Upright ultra-low temperature freezers	36%
Low temperature upright lab freezers	33%
Under-counter general purpose lab freezers	25%
Low temperature chest lab freezers	16%
Flammable materials storage	15%
Blood bank and plasma	14%
Chest ultra-low temperature freezers	14%
Explosion-proof	12%
Other	10%

COMPLETED SURVEYS: 221

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

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

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

Top 5 Questions You Should Ask When Buying a TOC Analyzer:

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

Types of TOC analyzers being used by survey respondents:

Benchtop	54%
Online	50%
Portable	7%

Percentage of labs that have difficulties in ensuring efficient oxidation of the organic carbon:

No	93%
Yes	7%

Percentage of labs where compliance with Title 21 CFR Part 11 is important for TOC analysis:

No	82%
Yes	18%

Top ten features/benefits survey respondents look for in TOC analyzers:

Ease of use	99%
Accuracy and performance of results	98%
Continuous analysis and rapid display updates	98%
Ease of installation	98%
Low maintenance costs	98%
Service and support provided by vendor	98%
Small footprint/size	98%
Speed of analysis	98%
Warranty	98%
No gases or reagents to handle	97%
Real-time continuous monitoring, no time-consuming batch measurements	95%

Instrument technologies being used in readers' labs for online TOC analyzers:

High Temperature Catalytic/Combustion Oxidation (HTCO)	44%
Heated Persulfate Ultraviolet (UV) Oxidation	35%
Supercritical Water Oxidation (SCWO)	6%
Patented Two-Stage Advanced Oxidation (TSAO) Process using Hydroxyl Radicals	4%
Other	11%

Methods used by respondents to detect resultant CO_2:

Non-Dispersive Infrared (NDIR)	71%
Direct Conductometric (Non-Selective Conductometric)	17%
Membrane Conductometric Detection (Selective Conductometric)	9%
Other	3%

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

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

A laboratory information management system (LIMS) consists of software that serves as the interface to a laboratory's data, instruments, analyses and reports. A LIMS can help develop a workflow for a new experiment, control the steps of the process as it runs, or integrate a collection of laboratory platforms.

Top 5 Questions You Should Ask When Buying a LIMS:

1. Why does your organization need a LIMS? You and your staff should come up with a cost-benefit list to help you decide if a LIMS is worth investing in.
2. What are your current user requirements and how do you expect those to change five to ten years down the road? Make a list. If you expect your needs to change, a flexible LIMS is likely a good choice. Requirements can include labeling, sample registration, etc.
3. Do you need a consultant to help you decide whether a LIMS is a good fit for you or not? Examine the pros and cons and make sure you properly research potential consultants.
4. How does the company's LIMS differ from other products out there? Make sure you do your homework and phone each company you're interested in. If they can't answer your questions, they probably aren't a good fit for you.
5. Ask for fact sheets, features lists and case studies from the company. This literature is a starting point for picking the best LIMS for you. A product demonstration is essential.

The type of LIMS installation configurations our respondents have:

Client/server	49%
Stand alone	30%
Web based	29%
Thin client/server	8%
Other	2%

Readers respond to whether their companies have internal information technology (IT) departments that support laboratory systems:

Yes	51%
Yes, but very limited	31%
Other	17%

Primary reasons why our readers are purchasing LIMS:

Upgrading existing LIMS	24%
Sample management	13%
Quality Assurance/Quality Control	12%
Workflow automation	11%
Regulatory management	9%
Addition to existing systems, increase capacity	7%
Setting up a new lab	5%
User reporting	5%
Other	14%

Top ten factors/features considered by our readers when purchasing a LIMS:

Ease of use	98%
Service and support	98%
Customization	97%
Up time	97%
Versatility	96%
Price	96%
Ease of installation	96%
Security	95%
Multi-platform	94%
Scalability	93%

Respondents' biggest challenges with LIMS implementation:

Product supports the lab's workflows and processes	31%
Configuring and integrating with other systems in the lab	19%
Staff adoption and training	18%
Data migration into the new system	17%
Demonstrating ROI	5%
Adding new features and functions to the application	4%
No challenges	4%
Other	2%

Number of instruments integrated into our readers' LIMS:

1-10	57%
11-25	18%
26-50	14%
51-100	6%
100+	5%

COMPLETED SURVEYS: 317

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

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ARE YOU IN THE MARKET FOR AN... ULTRA-LOW FREEZER?

Low-temperature (or ultra low) laboratory freezers will achieve temperatures of -40°C to -85°C — much lower than their kitchen-based counterparts. When selecting a freezer for your lab, it is important to know what specific storage requirements you'll need, such as the temperature range or space available.

Top 6 Questions You Should Ask When Buying a Low-Temp Freezer:

1. How long does it take to get to -80°C after set-up / install (cool down time)?
2. If there is a power failure, how long will it take to get to -60°C (holdover time)?
3. How often do the compressors have to run (compressor run time)?
4. What is the max and min temp variation from set-point across the chamber (temperature variation)?
5. What is the capacity, how many racks and 2" / 3" boxes can it store (sample storage)?
6. What are the optimal voltage/wiring conditions for running the ULT? If your building is older, will low voltage or voltage fluctuations affect the performance of the freezer?

Type(s) of service used by respondents for the repair/service of their ultra-low freezers:

In-house service department	38%
Third-party contract	27%
Instrument manufacturer time/material	21%
Third-party time/material	19%
Instrument manufacturer service contract	13%
Our department	7%
Multi-vendor service provider	7%
Don't know	5%
Other	2%

The number of ultra-low freezers in respondents' labs:

1	34%
2-4	40%
5-7	9%
8-10	3%
10 or more	14%

Top ten features/factors our readers look for when buying an ultra-low freezer:

Price	99%
Sensitivity and accuracy of temperature controls	99%
Warranties	99%
Faster temperature recovery after door openings	98%
Rapid access to samples	98%
Service and support	96%
Audible and visual Hi/Lo alarm for each controller	94%
Reputation of vendor	93%
High energy efficiency operations	92%
Maximum storage capacity in small footprint	92%

Types of ultra-low freezers respondents are currently using:

Upright ultra-low temperature freezers	78%
Chest ultra-low temperature freezers	28%
Other	1%

Temperature range of the ultra-low freezers currently in use by survey respondents:

-45° to -85°C	92%
Over -85°C	17%
Other	3%

The location(s) of the ultra-low freezers in our readers' facilities:

In the lab	42%
In the hallway	13%
In a separate room with other freezers	37%
Other	8%

COMPLETED SURVEYS: 241

For more information on ultra-low freezers, including useful articles and a list of manufacturers, visit www.labmanager.com/ULTfreezers

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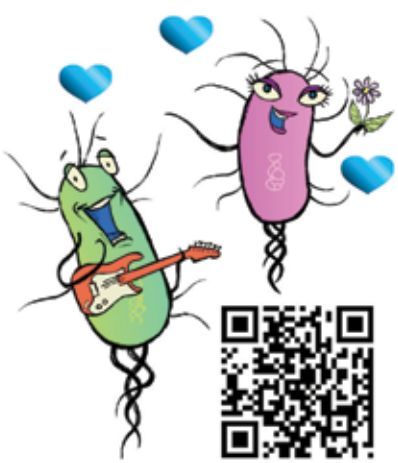

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TROUBLESHOOTING, SCHEDULING, COMMUNICATING, AND CONSULTING ARE JUST PART OF LAB MANAGER LISA WRIGHT'S MANY RESPONSIBILITIES

BY SARA GOUDARZI

Lisa Wright is in the business of improving people's health. Through her several roles at the facilities of Indiana University School of Medicine, Wright, along with her colleagues, tests for genetic and metabolic disorders, supporting physicians, nurses, nurse practitioners, and genetic counselors in finding the right care for their patients.

"The results from our testing assist clinicians in determining diagnosis and prognosis and also assist with the treatment of many disorders," says Wright, who is the quality control and regulatory specialist for the Division of Diagnostic Genomics, the laboratory manager at the Clinical Cytogenetics Laboratory, and the supervisor of the Cancer Cytogenetics Laboratory—all within the Department of Medical and Molecular Genetics at the School of Medicine.

The clinical laboratories in the Division of Diagnostic Genomics are the Clinical Cytogenetics, Clinical Molecular Genetics Diagnostic, and Pediatric Biochemical Genetics laboratories.

Together, the laboratories provide clinical services to the patients of Indianapolis and the surrounding area. In addition, the labs at Indiana University School of Medicine are also committed to educating students, residents, and fellows in the fields of cytogenetics, molecular genetics, and associated testing.

Laboratory structure

The division's three labs—Clinical Cytogenetics, Clinical Molecular Genetics Diagnostic, and Pediatric Biochemical Genetics—take up around 7,000 square feet on three floors in two buildings.

"Space is at a premium in an academic institution located in the middle of a large city," Wright says. "We are looking to expand our laboratory to new space in the next few years, but we make what space we have available now work."

The Clinical Cytogenetics Lab has 23 employees. These include 17 technologists, two administrative staff members, two postdoctoral fellows, one assistant director, and one director/medical director. The lab runs approximately 7,500 tests each year.

Three technologists, one administrative staff member (shared with the Pediatric Biochemical Genetics Lab) two assistant directors, one director, and a medical director make up the staff of the Clinical Molecular Genetics Diagnostic Lab. This eight-person team processes around 1,400 tests annually.

With two technologists, one administrative staff member (shared with the Clinical Molecular Genetics Diagnostic Lab) and one director who also serves as medical director, the Pediatric Biochemical Genetics Lab has the least staff of the three labs yet manages to run about 1,100 tests each year.

The director of the Division of Diagnostic Genomics clinical labs, Gail H. Vance, MD, who is also the direc-

Fairbanks Hall, headquarters of the Indiana University School of Medicine. Photo credit: Kevin Drumm

tor of the Cytogenetics Laboratory, oversees all three labs. Wright reports directly to Vance. She also reports to the other directors regarding compliance and quality assurance as she represents all the laboratories at the IU Health, IU Agreement Laboratories Quality Assurance meetings.

"The cytogenetics staff supervisors—and their staff members in their absence—report to me," Wright says. "The biochemical genetics lab staff report to me and the medical director of the lab."

The cytogenetics lab staff at the Indiana University School of Medicine's Department of Medical and Molecular Genetics in Indianapolis. Photo credit: A. Morse

The lab staff are mainly educated and trained in biology, biochemistry, and chemistry, some with an emphasis in genetics. Wright herself has a Bachelor of Science degree in biology from Indiana University in Bloomington and a Master of Science in medical genetics from Indiana University-Purdue University Indianapolis.

Because it is an academic lab setting, Wright and her staff often utilize work-study students as lab assistants both in the lab and office areas. This gives the labs additional help when needed but also provides an opportunity for graduate students, medical residents and fellows, postdoctoral fellows, medical students, and genetic counseling students to gain valuable hands-on experience.

Duties

Wright's overarching roles include assisting with troubleshooting for all sections of the division labs in order to maintain and improve quality of services provided to their clients.

As manager of the Clinical Cytogenetics Laboratory, Wright is responsible for scheduling holiday and Saturday duties. She also works with laboratory supervisors from the various sections of the lab to schedule daily activities.

"I consult with the director or assistant director regarding unusual situations in the laboratories," Wright says. "I also

➤*A technologist completes analysis in the FISH room. Photo credit: L. Wright*

communicate with current and future clients regarding laboratory processes to ensure quality preparation, accuracy of results, and competitive turnaround time."

As supervisor of the Cancer Cytogenetics Laboratory, Wright reviews the accuracy and quality of results of tasks completed before submission of the final report to the assistant director or laboratory director. She also assists in communicating the preliminary and final results to physicians and other appropriate personnel to assist in diagnosis, prognosis, or treatment of leukemia or cancer.

Being the quality control and regulatory specialist for the clinical laboratories in the division, Wright designs, implements, and maintains an effective and unified quality management system for all three sections of the laboratory.

"I oversee quality assurance meetings for each of the laboratories," Wright says. "I also participate on the quality assurance committee of the IU School of Medicine Laboratories."

As part of this process, she prepares reports and makes recommendations for areas of improvement, and revises policies and procedures related to quality assurance, regulatory compliance, and safety.

"I participate in oversight of daily operations of all sections of the Division of Diagnostic Genomics laboratories to maintain good laboratory practices that meet the guidelines of all appropriate regulatory agencies," Wright says.

Inventory, maintenance, scheduling, and hiring

Ensuring that all materials in the lab—such as reagents, instruments, and disposables—are up to date is not an easy task, especially for three labs. At IU School of Medicine laboratories, each section of each lab is responsible for maintaining its own inventory. When a lab needs supplies, the staff informs the clinical administrative laboratory coordinator (CALC) responsible for ordering for all three labs.

"Inventory is tracked in an Access database created by the CALC," Wright says. "The university uses a unified ordering process that is electronic for almost all items used in the laboratories. Expenditures and costs are also tracked by the CALC."

The CALC is also responsible for setting up maintenance contracts and coordinating the maintenance schedule of instruments such as automated slide stainers, thermal cyclers or PCR machines, and gas chromatography-mass spectrometry machines.

"Another Access database is used to track this process," Wright explains. "The university uses a maintenance vendor for most contracted preventive maintenance services to take advantage of bulk use of vendors."

With so much going on, Wright and her staff find that to run effective laboratories they need to ensure that they have a scheduling system that is beneficial for the employees and for the labs.

"For example, the Clinical Cytogenetics Lab is open six days a week from 7:00 a.m. until 5:30 p.m.," Wright says. "We also have staff members on call on all major holidays. I like to say that people don't get sick on a schedule. To provide the best service, we have staff members who arrive early and others who arrive later, and we need to be able to communicate effectively to keep the flow of work moving."

Scheduling also works smoothly if proper communication is in place within the lab.

"We also need to communicate effectively with our clientele to ensure that accurate results are given in a timely manner," Wright says.

Communication, however, works only when staff members with appropriate backgrounds and training are in place. For this reason, the management team takes great care in picking a strong team.

When Wright or any of the lab managers notice a need to add or replace a staff member, they need to go through the university's established process.

"Jobs are posted to the university website and applicants apply through the site," Wright explains. "Batches of

resumes and applications are sent for review and then interviews are scheduled."

Once the lab managers find a good fit, they notify the university Human Resources department, which will review the recommendation and make an offer to the candidate.

"I think it is important to realize that working in an academic lab, we can't always compete with commercial labs as far as salaries and some benefits," Wright says of the hiring process. "There are some benefits that we have that are more difficult to find in commercial labs, including frequent opportunities for continuing education. We also have the benefit of a tuition discount from the university."

Additionally, the supervising staff works hard to provide incentives to their employees. These include holding fun events during Medical Laboratory Professionals Week each spring, providing several breakfasts and lunches throughout the year, and holding an annual holiday party in December.

MAIN INSTRUMENTS:

- Microscopes
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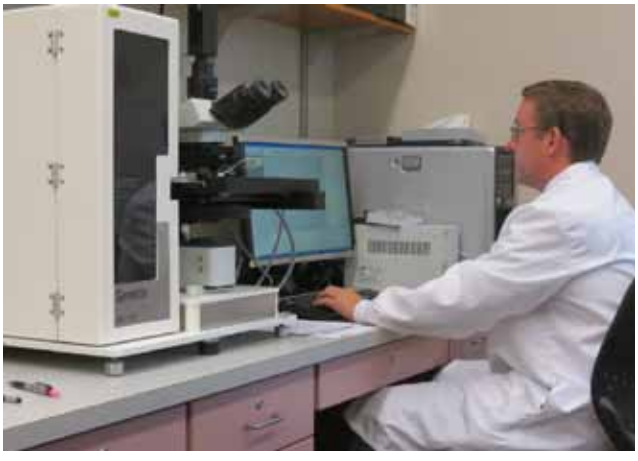
- Automated slide stainer
- PCR machines
- Gas chromatography-mass spectrometry devices
- ABI Prism 310 Genetic Analyzer
- ABI 3130 Genetic Analyzer

Challenges

As academic facilities, the labs at the Division of Diagnostic Genomics are smaller than commercial labs performing similar tasks. For this reason, Wright and her colleagues find it challenging to stay competitive with commercial laboratories that can cut costs due to high-volume work. Also because of the labs' size, the managers face some difficulty marketing their labs at IU and rely mostly on word of mouth from their clients who are satisfied with the quality of the work produced.



A technologist sets up a run on the Leica Microsystems GSL automated slide scanner. Photo credit: L. Wright

"One of our main sources of pride in the laboratory is that we produce reliable, quality results in a timely fashion," Wright says. "We are very accessible to our clients and have had some clients indicate that they have been contacted by larger laboratories but are staying with our lab due to our quality results and accessibility."

It's these challenges, combined with a competent staff and knowledge of the central goal of the labs that keep Wright in the lab business.

"When I first started working in the lab, I thought it was going to be a temporary position and I would move on to other things," she says. "I didn't realize how much I would enjoy the work and the challenges that come along with the job. In the ensuing 26 years, I have found that I really enjoy my work and working [with] the other staff members in the labs as well as our clients."

Additionally, Wright knows that what she and her staff do has significant beneficial impact in the community.

"I know we are providing a service to our clients that is vital to providing excellent care and treatment," Wright adds. "We care about our patients and provide a valuable service, and that makes it easy to come to work every day."

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

TOO HOT TO HANDLE

A 3-STEP PROGRAM FOR WORKING WITH AUTOCLAVES

by Vince McLeod

Like the coffee pot used for brewing your favorite morning beverage, an autoclave is such a common and familiar piece of lab equipment that it is easy to overlook the associated hazards. If we do not think about what might go wrong, sooner or later we will get burned (couldn't resist the bad pun). So the Safety Guys thought it would be a fine time to discuss one of our hot topics (OK, OK, no more). Seriously, by following our simple three-step program of training, testing/monitoring/maintenance, and record keeping, you can avoid mishaps and potential significant damage or injury.

Recognizing the hazards

Just consider autoclaves large, specialized pressure cookers. Autoclaves use heat and pressure with water to create superheated steam. Accordingly, they can pose significant hazards to untrained or lackadaisical employees.

Autoclaves are usually needed for two basic purposes, either to steam-sterilize media, instruments, or lab equipment such as glassware and specialized implements or to inactivate biological waste materials.[1] The main hazards are physical ones presented by high temperatures, steam, and pressure. Effective sterilization requires steam temperatures in excess of 250°F (121°C). Typical autoclave pressurization is at least 20 pounds per square inch (psi). Depending on the use, additional biological hazards such as infectious materials or physical hazards from sharps may be of concern. By utilizing the practical information and guidance given here (as well as from many other sources online), researchers are ensured safe operation of autoclaves in the laboratory.

Training, the first step

Even though loading and running an autoclave may seem as simple as using your dishwasher at home, some forethought is required to operate the autoclave safely and efficiently. Begin by becoming thoroughly familiar with the owner/operator's manual for your particular machine. Controls vary between brands, and each has its own unique loading characteristics, load-sizing requirements, cycle settings, and cycle types.[2] The amount and type of each material requiring sterilization or inactivation/decontamination will determine

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LEARNING HOW TO BE SAFE IS AN INTEGRAL AND IMPORTANT PART OF YOUR WORK

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 it becomes part of the process. At Dow, 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.

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 workday) to set-up and test experiments, to look up the hazards of chemicals, to find out what protective equipment and protective facilities are needed. This *is* the job.

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

the cycle needed. It is highly recommended that the manufacturer's operation manual be copied (perhaps even water-proofed/laminated) and a copy be kept in the room with the autoclave.

Instill a policy whereby all users are trained prior to operating any autoclave. Principal investigators or laboratory supervisors should bear the responsibility of ensuring this is done. Document all training, and maintain copies of the records in the lab.

At a minimum, training should cover:

- Location, function, and use of controls
- Proper loading and unloading (including packaging, sizing, and testing protocols)
- Required personal protective equipment (heat-resistant gloves, lab coats, eye protection, and closed-toed shoes)
- Incident and maintenance reporting; record keeping
- Emergency procedures

Step Two - monitoring and testing autoclave effectiveness

In order to make sure our autoclave is functioning properly and sterilization/inactivation is effective, we need to monitor the operation of the autoclave and routinely test sterilization cycles. In fact, in Florida this is mandated by a Florida Administrative Code for handling biomedical wastes, FAC 64E-1.[1] Under this law autoclaves must be tested before being placed into service and periodically afterward. For autoclaves used to inactivate human pathogens, blood, tissues, clinical samples, etc., testing is required every 40 hours of use. Autoclaves used to sterilize other materials must be tested every six months. This is a reasonable testing schedule for most research laboratories. Other institutions recommend testing at least once per month with biological indicators.[2]

Testing an autoclave's sterilization effectiveness requires the use of biological indicators. These are available in commercially prepared test kits containing bacterial spores—usually *Bacillus stearothermophilus* (e.g., Prospore2™). Most spore vial test kits require incubation of the autoclaved test vial along with a nonautoclaved control vial. Incubation will allow surviving spores to grow. It is recommended that test loads (if used) approximate the weight and density of actual waste or materials normally autoclaved. For best results, test vials should be placed at the bottom, top, front, rear, and center of the autoclave chamber, by placing vials in those positions of the test load or making a number of smaller test packs with vials in the center and placing the packs appropriately in the chamber. In this way, the correct parameters for sterilization (time, temperature, and pressure) can be determined.

Third and final step - record keeping

A good autoclave safety program must include documentation. Principal investigators and supervisors are responsible for ensuring proper records are kept up to date. Autoclave users should be responsible for recording autoclave run information.

We have already mentioned keeping training records. In addition, we recommend keeping records of all on-site maintenance performed. Only contractors approved by the manufacturer should perform maintenance. Keep contact information posted conveniently.

Each load processed in the autoclave should be logged. Record the date, time, and operator's name and contact

information (e.g., lab, room number, and phone number). Indicate whether the load is biohazardous material or not, and record the temperature, pressure, and time length for the cycle. If the autoclave data can be printed out or is recorded on a cycle wheel, save the printout or disk.

Finally, include in the log sheet information for all efficiency tests performed and the results of each test.

Summing up

Additional information and technical assistance is available from manufacturers as well as the NIOSH, OSHA, and many academic websites. The key to working with autoclaves is first to recognize the hazards, followed by training, testing, and record keeping. In the areas where autoclaves are used, it is most important to ensure proper and sufficient facility supply and exhaust ventilation as well as use of appropriate personal protective equipment. By using a little forethought and planning, you can avoid being placed in the hot seat.

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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 22 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 2,200-plus research laboratories.*

Delivering the Paperless Lab Environment – a Game Changer

By Trish Meek
Thermo Fisher Scientific

Trish Meek, Director of Product Strategy for Life Sciences in the Informatics business at Thermo Fisher Scientific, spoke with Lab Manager about how the paperless laboratory concept could prove to be a game changer for pharmaceutical and other life sciences industries, and reports on the impact of achieving a truly paperless lab, which can significantly reduce human error, increase efficiency and facilitate integration, and ultimately foster more robust collaboration both inside and outside the organization.

What are the disadvantages of the traditional, paper-based laboratory environment?

Meek: We could start by asking "what are the benefits" of using paper, which are obvious – paper is for the most part easy to use, it's often convenient, frequently portable and much of the time legally defensible. And paper requires no "user training" so for the most part, new users can be trained on a process and quickly accomplish the task. Those are the positive aspects of paper. BUT, as you'd expect, the downside to paper is greater than the upside. Using paper-based methods for sensitive and complicated laboratory workflow creates a number of security, expense and productivity challenges. First of all, paper reports or workflow documents introduce significant security risks into what should be a completely secure process.

Paper processes also always introduce a human factor, and any human activity is inherently prone to errors to some degree. Organizations have to keep strict controls around their paper processes because they must control document access, version control, and cataloging the information to ensure that it can be located when required. Paper-based processes are costly, both in terms of the physical purchase of paper and in terms of the human capital that is expended to manually handle the process – human capital that is probably highly skilled and trained for scientific research and laboratory processes, not managing paper reporting. So there's a productivity factor in the cost equation to using paper.

Finally, in the current economic climate where every minute of research and scientific progress must be measured by a success factor, paper processes represent the antithesis of collaborative efforts. Today's pharmaceutical company works in collaboration with academia, Contract Research Organizations (CROs), and partner biotechnology companies. Their data is spread across these organizations. Paper isn't "searchable" and in this era of distributed research and development and outsourced testing, paper-based processes represent barriers to collaboration and a time drain on sharing valuable scientific information.

JUST HOW COSTLY ARE YOUR CURRENT OPERATIONS?

Here's an example of how a company could reap the benefits of reducing time spent on manual documentation efforts.

How does the paperless laboratory concept overcome these issues?

Meek: More and more laboratories are realizing that the investment they've made in setting up the state-of-the-art laboratory is not being fully optimized and they're looking for ways to optimize that investment. The typical lab has expensive instrumentation and other laboratory equipment, all of which are

generating data of some kind. Each of these instruments, if siloed, requires that a human has some interaction with that data to collate it with data from other instruments and compile reports.
A fully integrated laboratory will connect instrumentation to a central data system, such as a Laboratory Information Management System (LIMS) so that data storage and reporting is automated. You can imagine how this situation becomes more complicated when there are multiple laboratories across different geographies working together across an organization. Also in many cases lab data is required by management at some point to satisfy decision making that is reliant on key business metrics which some of the lab data may provide. In a manufacturing environment, this will require that the lab is fully connected with other existing enterprise systems, such as ERP, MES, PIMS, etc.

So what's occurring now with the paperless lab concept is that many companies are looking for ways to optimize the ROI for their lab investments. The key to this is integration of the lab itself, as well as connectivity of the lab with the rest of the organization.

In what ways does going paperless make a laboratory more efficient?

Meek: Efficiencies in the lab come from streamlining workflow and automating processes. When the lab is fully integrated, that is that the instruments and other information systems are integrated with the LIMS, then all data collection and analysis is automated, freeing up the lab's scientists to focus on science and more value-added revenue-generating activities. The reduction in time spent performing manual paper-drive tasks can produce an enormous improvement in productivity and also cost savings. For example, a modest reduction, say 20% in man-hours spent on paper-based efforts can produce hundreds of thousands of dollars in annual savings. It's worth thinking about how much more revenue could be generated by those man-hours if they were spent on novel research instead of paper-based data collation and reporting processes or if a problem with production was discovered and the organization was able to react even one hour earlier in the process. This is the value many companies are seeing when they fully integrate their labs and connect the labs with the rest of the organization.

How does a laboratory begin to take steps towards implementing the paperless concept?

Meek: We're advisors to our customers and the first thing we look at is the landscape of the lab. How is the lab set up, what instruments are in place or are planned for the future, what is the workflow required? It's important to ask these seemingly basic questions because often the existing workflow isn't the one that the lab actually wants–but it's the one that's in place. So part of implementing a paperless lab is to find a consulting ally that can honestly assess the situation in the lab and lay out a plan that will be flexible enough to grow with the lab and the business into the near future. Once this assessment is complete and an optimum workflow has been identified, the work can begin to make recommendations for integrating all those disparate instruments and connecting the lab's output with key business metrics for management to use.

What tools are available to help companies achieve paperless status and ensure a smooth transition?

Meek: The paperless lab concept has been talked about off and on for a number of years and each time it resurfaces the technologies that support this movement are a little bit closer to fully achieving the goal. This time around we're closer still and a number of new technologies are now available that can fully integrate even the most heterogeneous of labs. This is an important distinction to make because most labs will have a fairly broad spectrum of vendors installed, something which in the past has been the perceived and sometimes practical obstacle for fully integrating the lab. The problem, up until now, has been the cost to integrate different software systems and equipment from each of these independent instrument vendors. But newer technologies based on open standards have led to big opportunities for life sciences labs today. At Thermo Fisher, we've spent time developing Integration Manager and Data Manager, which transform data from any instrument and deliver it to any source. While importing the final result is crucial, this solution takes it further by enabling scientists to see their real analytical data, chromatograms, mass spectra, and results from other instrumentation regardless of the instrument supplier. This type of automated data acquisition and point-to-point data distribution across the enterprise is what is enabling today's paperless lab.

Are a significant number of pharmaceutical companies beginning to move in the paperless direction?

Meek: We have had a tremendous response to CONNECTS. It is important to understand that life sciences industries are telling us that they want to get to a paperless lab. With CONNECTS, we are in a strong position to help our customers tackle this problem. We ensure that they understand that this is a process which starts with an evaluation of their existing organizations processes and how they are using their current software and hardware. We look at what works today and where paper-based, manual processes create bottlenecks that integration could address.

We are working with several customers at the moment to implement paperless lab projects. This is a customer-driven initiative, and our customers have just reached the point where they see the value in going completely paperless.

Trish Meek is the Director of Product Strategy for Life Sciences in the Informatics business at Thermo Fisher Scientific. Ms. Meek may be reached at trish.meek@thermofisher.com.

For More Information about CONNECTS for the Paperless Lab, visit www.thermoscientific.com/paperlesslab, or email us at marketing.informatics@thermofisher.com.

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SUPERSPEED FOR SHARED LABS

NEW CENTRIFUGE SERIES REPRESENTS A LEAP FORWARD IN DESIGN

At the end of October, Thermo Fisher Scientific announced its new Sorvall LYNX superspeed centrifuge series which aims to maximize everyday centrifuge use in shared laboratory settings.

The company says the series represents a major design innovation and is at least one, if not two, generations ahead of the centrifuges used by academic and institutional laboratories globally.

"Our new Sorvall LYNX superspeed centrifuges dramatically simplify high-speed centrifuges while increasing user safety and peace of mind," said Maurizio Merli, global product director of centrifugation at Thermo. "We accomplish this with breakthrough technology advancements, such as the Auto-Lock rotor exchange, Auto-ID instant rotor identification and carbon fiber rotors."

Auto-Lock allows users to exchange rotors in less than three seconds and ensures that the rotor is automatically and securely locked and won't loosen during a run, while Auto-ID recognizes a rotor when secured in the chamber, improving safety, saving time, and protecting the integrity of samples, the company explained.

The new centrifuge series features a 100,000 x g top speed performance and supports high-throughput sample processing from 50 mL conical tubes and microplates to 1 L bottles, up to a six-liter capacity.

Run set-up is made easier with the series' touchscreen interface that includes a bright, durable display, while on-board video tutorials and access controls, such as user login with password protection, provide advanced training and programming options.

"Today's researchers require centrifuge performance that is simplified, to accommodate the reality that labs have multiple users with different experience levels and a variety of processing requirements," Merli added about why these features are important.

For more information visit: www.thermoscientific.com/lynx

General Purpose Benchtop Power Supply

BT-GP Series

- Now offered at 1kV, 2kV, 4kV, and 6kV of output power at 30W
- New, lower voltage range on the BT-GP Series fills in the gap in the product lines by offering bench-top devices at 30W in lower voltages
- Suited for OEM biasing applications such as air purification, process fluid cleansing, hi pot testing, and for laboratory research

UltraVolt www.ultravolt.com

Flow Reactor Systems

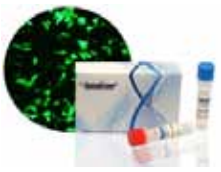
FlowSyn™

- Designed to handle everything from homogeneous single reactions to complex, multi-reagent reactions
- A range of optional gas addition, microwave, low temperature and binary pump (4-channel) modules further enhance the operational versatility
- Available with a wide range of reactors (2 - 60ml) in a choice of inert materials
- Can undertake high throughput applications

Uniqsis www.uniqsis.com

Transfection Reagent

GeneIn™



- Allows hard-to-transfect primary cells and stem cells to be transfected with improved efficiency and lower toxicity
- Offer a unique rapid optimization protocol that enables researchers to maximize the transfection efficiency in their cells
- Validated on multiple cell lines
- Designed for transfecting primary cells and stem cells and is highly effective on commonly used cells

GlobalStem www.globalstem.com

Oil-Free Vacuum System

WelchNet Titan

- A microprocessor controlled system of high capacity PTFE diaphragm vacuum pumps for multi-user laboratory installations
- Pumps work individually or in tandem as the laboratory vacuum demand requires, holding vacuum level even if an individual pump needs maintenance
- Chemical-resistant, energy efficient system includes intelligent vacuum control and green technology and is low maintenance

Welch-Ilmvac www.welchvacuum.com

Hormones Application Kit

- Designed to simplify the detection and analysis of hormone contaminants in ground water and drinking water samples using liquid chromatography/ tandem mass spectrometry
- Reduces time-consuming and costly method development
- Contains a Thermo Scientific Accucore HPLC column, solid phase extraction disks, MS-Certified vials, a detailed application protocol and Thermo Scientific TraceFinder software method files

Thermo Fisher Scientific www.thermoscientific.com

CHEMICALS, KITS & REAGENTS

Reagent Kits

SPRIselect

- Utilizes SPRI (Solid Phase Reversible Immobilization)-based chemistry to speed and simplify genomic DNA size selection for next generation sequencing fragment library preparation
- Allows size distribution to be adjusted between 150 and 800 base pairs
- Available in 5, 60 and 450 mL volumes, enable rapid and consistent size selection, and come with guidelines to assist users in customizing protocols

Beckman Coulter www.beckmancoulter.com

24(S)-Hydroxycholesterol ELISA Kit

- Offers an alternative to mass spectroscopy for measuring this key marker of cerebral cholesterol metabolism and neurodegeneration
- Allows for quantitative detection of 0.78 ng/ml of 24-OHC in various sample types including: tissue culture media, cerebral spinal fluid and tissue homogenate samples
- Enables the analysis of up to 36 samples in duplicate in just two hours

Enzo Life Sciences www.enzolifesciences.com

LAB AUTOMATION

Laboratory Automation Workstation

Biomek 4000

- Features intelligent liquid handling that adapts as processes require
- Incorporates easy-to-use, icon-driven software and an enhanced work surface with interchangeable tools
- New single and multichannel 1000 µL pipetting tools offer higher throughput for assays using volumes greater than 200 µL and up to 1000 µL
- Includes simple method building

Beckman Coulter www.beckmancoulter.com

Well Plate Loader System

HLW20

- Adaptable to most modern inverted microscopes
- Provides three independently controlled and encoded axes for rotational, vertical and horizontal movement
- Two stainless steel racks provided with each loader accommodate covered and uncovered well plates up to 19mm in height
- Can be programmed to respond when racks are changed in the middle of a run

Prior Scientific www.prior.com

Automated Nucleic Acid Extraction WorkStation

- Offers consistent, high-speed purifications by combining several Thermo Fisher tools into one turnkey solution
- Designed to provide cost- and time-effective nucleic acid extraction
- Allows users to process samples from virtually any source, while ensuring accuracy and sample integrity
- Can be easily programmed to ensure the simultaneous running of multiple processes

Thermo Fisher Scientific www.thermoscientific.com

PRODUCT SPOTLIGHT

CAN YOU HANDLE THIS?

LIQUID HANDLING SYSTEM COULD MEAN BIG IMPROVEMENTS TO WORKFLOW

A new liquid handling system announced early last month by Agilent Technologies aims to improve every stage of the research process in user's labs through a number of unique technological advances.

Yvonne Linney, vice president and general manager of automation solutions at Agilent says the Encore Multispan liquid handling system was the result of customer feedback.

"In partnership with our customers, we worked to understand the many bottlenecks and limitations associated with sample-prep automation and created a unique solution," Linney said. "It combines advanced liquid handling and robotics to enable true sample-to-analysis automation."

Two of the system's innovations include a dual, multispan pipetting system that provides two individual banks of multiple pipettes where each moves independently in multiple axes and a software package featuring a 3-D simulator that allows researchers to set up, visualize, and optimize their protocols remotely and offline prior to running experiments on the system. A built-in robotic arm that provides a span of up to 21 inches off-deck with patented one-touch easy teaching that enables end-to-end workflow integrations is the third major innovation the system will include.

"Agilent's distinct expertise in both workflow automation and liquid handling has allowed us to integrate innovative technologies into a single platform, and empower scientists to take their research to the next level in terms of flexibility, throughput and ultimately lab productivity," Linney said. "With the introduction of the Encore Multispan System, Agilent is offering scientists the ability to reach beyond routine liquid handling and experience the highest levels of efficiency and productivity in their laboratories."

For more information visit: www.agilent.com/lifesciences/encore

Compact Chilling/Heating Stage

EchoTherm™ RIC20

- Settable from -20.0°C TO 110.0°C
- Designed for remote controlled applications on robotic systems
- Any number of units can be set to any single temperature via a single computer serial port
- Unit(s) will continue to run the temperature instructed, even without a hardwire connection, until told otherwise

Torrey Pines Scientific www.torreypinesscientific.com

LIFE SCIENCE

Extraction Products

TruTip®

- Designed for rapidly purifying human genomic deoxyribonucleic acid (gDNA) on the Hamilton Microlab® STAR line of robotic liquid handling workstations
- Extract superior quality gDNA simultaneously from eight to 96 samples in just 57 minutes
- System does not require a magnetic head, vacuum manifold, centrifuge, or other space-consuming or expensive capital equipment

Akonni Biosystems www.akonni.com

DH5G Electrocompent E. Coli Cells

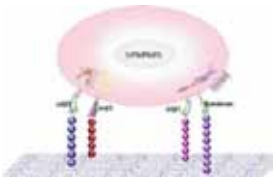
CloneCatcher™ Gold

- Exhibits extremely high electroporation efficiencies that approach the theoretical maximum of 3.4 x 1011 cfu/μg pUC19 DNA
- Meets the needs of scientists that are seeking to find rare clones or are building complex or metagenomic libraries
- When the amount of input DNA is limited, enhances users' likelihood of success

AMSBIO www.amsbio.com

Extracellular Matrix (ECM) Mimetic Library

- Designed for engineering surfaces to direct receptor binding specificity, signalling and growing cells in 3D
- Contains nearly 300 biomimetics of fibronectin, vitronectin, laminin and collagen
- Provides a powerful tool for identifying the cellular adhesion profile of user's cell line or tumor against the widest commercially available collection of cell surface receptor binding peptide motifs



AMSBIO www.amsbio.com

Dedicated Absorbance Reader

Apollo 11

- Features continuously optimized optics as well as a modern LED light source with a basically endless lifetime
- Up to six filters can be used with the instrument enabling the performance of all important applications
- Provides a large dynamic range of 3.7 OD
- Gives users excellent accuracy and precision

Berthold www.berthold.com

Cell Sorting System

S3 Cell Sorter

- Automated, easy-to-use benchtop cell sorter now provided and supported exclusively under the Bio-Rad brand as the S3 Cell Sorter (formerly Propel Labs' Avalon™)
- Establishes a new benchmark in terms of price, performance, and ease-of-use
- New ProDrop™ technology automates setup and calibration in less than 30 minutes
- Includes intuitive, lab friendly ProAnalyzer™ software package

Bio-Rad www.bio-rad.com

Automated Cell Counter

TC20

- Features an improved lens and cell counting algorithm that makes it compatible with a broader range of cell sizes and types
- Provides reliable counts of live mammalian cells in 30 seconds
- A good fit for stem cell research, toxicology studies, and flow cytometry
- Has the ability to analyze cells across multiple focal planes

Bio-Rad www.bio-rad.com

Imaging System

Lightsheet Z.1 LSFM

- Provides biologists with a new method of imaging dynamic processes in living organisms
- The extremely low phototoxicity and the integrated incubation enable gentle imaging of specimens over hours to days
- Delivers more information on large objects, in particular, than established methods of fluorescence microscopy
- Achieves maximum image quality at minimal illumination intensity

Carl Zeiss Microscopy www.zeiss.com/micro

Adherent Cell Electroporation System

Cellaxess® ACE

- Developed to meet the growing need for in-situ transfection of hard-to-transfect adherent cell types
- Enables transfection and delivery of non-genetic material in any adherent cell type at any developmental stage
- Enables in-situ primary and iPSC-derived cell types directly in 96- and 384-well microplates and cell culture dishes at any cellular developmental stage

Cellectricon www.cellectricon.com

Sample Preparation System

PBI Shredder SG3

- A good fit for the extraction of DNA, RNA, protein, mitochondria, and small molecules
- Creates a closed system in which to safely prepare samples
- Portable for easy and efficient field collection
- Operates by using pressure, which forces the sample against the lysis plate in the tubes for low-shear cell disruption

Cole-Parmer www.coleparmer.com

System for Low-Volume Cell-Based Assays

DropArray™

- Gives scientists the freedom to run cellular assays as their research demands, and not based on the availability of cells or cost of reagents
- Allows scientists to use a fraction of the cells, media and reagents they have traditionally used
- Enables users to acquire rich, high content data

Curiox Biosystems www.curiox.com

Sample Concentrator

miVac

- Efficiently removes water and other higher boiling solvents
- Reduces the temperature of the solvents being concentrated, keeping samples cool and safe
- In conjunction with the highly efficient SpeedTrap, the miVac sample concentrator is able to safely recover almost all removed solvents
- Features an LCD display with digital controls, enabling programming of time and temperature

Genevac www.genevac.com

Sample Preparation System

Microlute™ SPE

- Provides a faster, trouble-free alternative to cartridges for high throughput sample clean-up
- Handles samples as small as 150ul
- Includes filter plate, collection plate, waste tray and manifold
- Offers all the advantages of automated and high throughput SPE sample preparation in a convenient microplate format
- Capable of rapidly processing 96 samples in one go repeatedly and precisely

Porvair Sciences www.porvair-sciences.com

Imaging System

MYECL Imager

- Delivers one-touch image capture and analysis of protein and nucleic acid gels and Western blots
- Incorporates advanced charge-coupled device (CCD) camera technology with more than two times the sensitivity of X-ray film and 10 times the dynamic range
- Stores images on an internal drive in a nonproprietary data format for easy sharing

Thermo Fisher Scientific www.thermoscientific.com

CO_2 Microscope Cage Incubator

Okolab Bold Line

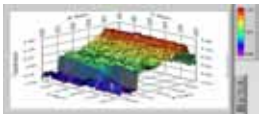
- Enables prolonged observations on biological specimens and allows space for other equipment
- Features easy 'turn-to-open' assembly and full accessibility to microscope
- Models for any inverted and upright microscope are available
- A wide choice of chambers and interchangeable plate adapters allow the use of any cell culture support
- Compatible with manual and digital CO_2 / O_2 gas controllers

Warner Instruments www.warnerinstruments.com

LIMS & SOFTWARE

Microspectrometer Control and Spectral Analysis Software

MINERVA



- New Windows™ 8 compatibility provides a more fluid response, with the operating system's newly enhanced stability and advanced memory management
- Features enhanced usability through Windows™ 8's quick resizing of windows, easier to see icons and speedy access to often used documents and spectra
- Windows™ 8 is designed to more efficiently use resources allowing for better operation of micro-spectrophotometers

CRAIC www.microspectra.com

Desktop Molecular Design and 3D SAR Tool

torchV10

- Uses molecular fields to show the binding patterns of the user's compounds
- Protein's eye view gives clear insights into the causes of biological activity
- Allows chemists to see how to optimize the shape and electrostatic properties of their series, and rapidly identify the best next molecule to synthesize

Cresset www.cresset-group.com

Analyst Software for Luminex® Assays

MILLIPLEX® Analyst 5.1

- Enables more rapid and efficient management, tracking, and analysis of multiplex assays
- Provides excellent quality of fit, autofit, and potency calculation
- Relational database functionality enables analysis of multiple files from different experiments
- Available as one-, five- and ten-seat licenses, enabling complete flexibility for small, medium, and large laboratories

EMD Millipore www.millipore.com

Device Driver Software

OmniDriver Version 2.20

- Platform-neutral Java based OmniDriver provides a simple interface for programming of USB spectrometers, accessories and devices in optical sensing systems
- Available with an optional set of spectral processing math algorithms
- New features have improved the platform's high-speed data acquisition, spectral processing, data analysis, data visualization and data transfer options

Ocean Optics www.oceanoptics.com

SEM Sharpness Measurement Tool

PCI

- Based on ISO standards, this new feature of Quartz PCI software works with a single image or a group of images
- SEM images can be measured regularly to monitor the performance of a SEM and a detailed report can be generated in just a few clicks

Quartz Imaging Corporation www.quartzimaging.com

Detector-Agnostic Software for LC and GC

TraceFinder Version 2.1

- Now supports Thermo Scientific non-mass spectrometry detectors
- Detector-agnostic package is designed for the quantitative and qualitative review of data for routine analyses
- Eliminates the need for multiple software packages when moving between most gas and liquid chromatographic techniques
- Offers a simple workflow-driven method setup and automated data acquisition, data processing and reporting capabilities

Thermo Fisher Scientific www.thermoscientific.com

SUPPLIES & CONSUMABLES

96-Well Plates for PCR and qPCR

Hard-Shell®

- Hard-Shell low-profile semi-skirted PCR plate is compatible with multiple instruments including the Applied Biosystems 7500 Fast and ViiA 7 real-time PCR systems
- Hard-Shell 96-well 480 PCR plate is designed and optimized specifically for the Roche LightCycler 480 System
- Patented Hard-Shell technology prevents plate warping that often occurs during thermal cycling

Bio-Rad www.bio-rad.com

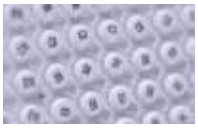
Sample Vials

Versa Vial™

- Combine a wide mouth with a tapered neck, simplifying the task of routinely preparing samples for autosamplers
- Vase-like neck design features a 9mm opening
- Design makes it easier to add samples to the vials using a pipette, and safer to empty the vials
- Accommodates variations in robotic arm settings

J.G. Finneran www.jgfinneran.com

Alphanumeric Coded Sample Storage Tubes



- Sizes available include 0.5ml, 0.75ml, 1.1ml, and 1.4ml
- Feature a flat polypropylene bottom on which the alphanumeric code is encrypted with a laser
- Codes cannot fade or peel off even when subjected to repeated handling, exposure to different solvents or multiple freeze-thaw cycles
- Combine affordability with secure sample traceability

Micronic www.micronic.com

A Bulk Solvent Delivery System

Problem: Solvents are used in virtually every laboratory to perform routine research procedures as well as product quality control and medical and diagnostic tests. Laboratory staff are responsible for the documentation, staging, storage and transport of solvents, which compromises valuable time spent on research. Lab personnel are also tasked with the handling and disposal of large quantities of solvents, many of which are toxic. Although solvents vary in degrees of toxicity, almost all can be hazardous to the skin, eyes, and in some cases the nervous and reproductive systems. Increased exposure to dangerous solvents presents a safety risk to those lab members handling them.

Traditionally, solvents are delivered in small, disposable containers that are not recycled and end up in landfills or disposal facilities. When disposed of incorrectly, these solvents also pose a significant risk to the environment.

Conventional solvent delivery, storage, and disposal is inefficient, harmful to the environment, and a potential safety risk to members of every lab.

Solution: One alternative to traditional delivery is the EMD ReCycler™ service, which delivers bulk quantities of solvent and solutions in reusable containers. Container size and delivery schedule are designed based on estimated solvent usage. Usage data determines future customized delivery schedules to ensure necessary solvents are always on hand. With this particular service, EMD Millipore delivers the containers; lab personnel simply inform the company when they are running low on solvent and new, full containers are delivered. Once the solvent is used, empty containers are removed, cleaned and refilled. The entire process is supported by a dedicated customer service team to ensure a seamless operation. Systems like this significantly reduce the waste typically associated with solvent usage and disposal, making labs more environmentally-friendly. In addition, the service reduces researchers' exposure to solvents associated with the use of small, disposable containers, increasing the safety of the lab and those who work in it.

Most solvents, solvent blends, and grades that come in traditional bottles are available via the EMD ReCycler™ system. The service offers three container systems to address a range of customer needs. Basic container systems are suitable for most applications, while ASME-certified container systems are suited especially for those applications requiring higher pressure or long-distance transport. Specialty container systems provide a unique packaging system designed for chemically challenging products such as mobile phase blends and DNA/RNA synthesis reagents. EMD ReCycler™ containers are available in sizes from 18.9L (5 gallon) to 1,250L for the many diverse scientific applications from laboratory to small-scale manufacturing. These bulk solvent delivery systems meet the new NFPA 45 (2004) criteria and offer more flexibility in solvent storage.

Bulk solvent delivery systems make for more efficient, safer labs, where researchers spend less time disposing waste and handling chemicals, leaving more time to devote to important research.

For more information go to: http://www.emdmillipore.com/chemicals/emd-recycler/c_OcWb.s1OkrQAAAEjsVplzX_0?back=true.

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Temperature Control in Chillers & Baths

Problem: Temperature control is a critical aspect of many applications spanning numerous laboratories across the biotech, pharmaceutical and industrial sectors. Chillers and bath circulators are commonly employed to maintain the optimal temperature. The success of your hard work hinges on your temperature control solution. With numerous options currently available, covering different sizes, capacities and modes of action, identifying the best model for your specific application, while still maintaining a cost-effective protocol, can be challenging.

For example, many experimental set-ups only require external temperature control and it is a common misconception that larger bath circulators are more efficient, absorbing more heat and providing greater stability. Instead, larger bath circulators take up more space within the lab, and are generally more costly to run. Furthermore, they will take longer to reach the desired temperature, making them a less energy- and time-efficient option, especially for time sensitive applications.

A large bath reservoir does not necessarily provide increased cooling capacity or better temperature stability. Conversely, cooling capacity is actually based on the set-point temperature and compressor size, while stability is affected by both the consistency of the heat load produced by the application, and the precision with which the heating/cooling is controlled by the bath circulator.

The stability specification of the bath is ultimately determined by how well the heater and flow of the refrigerant are controlled. Essentially, to achieve the best temperature stability, heat must be removed at the same rate that it is added. In this bath circulator, Figure 1 illustrates how all of the factors important to maintaining temperature stability are located towards the rear of the bath. These elements include heating, cooling, pumping, temperature measurement and control.

Solution: The most appropriate choice for this type of use would be a bath circulator with the smallest possible reservoir that still meets the set-point temperature and cooling capacity requirements. This will lower the load when moving between set-points, improving the time taken to reach the desired temperature. As such, users will be provided with a more efficient and cost-effective method of temperature control.

The optimal temperature control solution for external applications requiring up to 500 W of heat removal would be a "bathless" circulator, such as the Thermo Scientific Polar Laboratory Chiller. These systems combine fast time to temperature with a lower cost and a smaller footprint than traditional bath circulators.

For more information, visit: www.thermoscientific.com/tctechlibrary

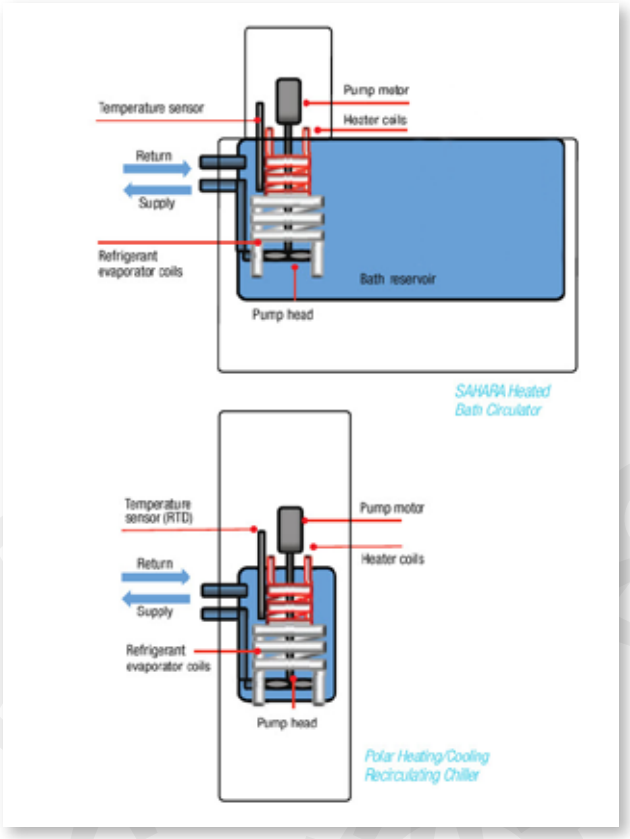

Figure 1➤
All of the factors important to maintaining temperature stability (heating, cooling, pumping, temperature measurement and control) are located towards the rear of the bath.

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JUST HOW IMPORTANT IS CALIBRATION?

WHEN AND WHY YOU SHOULD CALIBRATE YOUR BALANCE

The answer is simple: if you use your balance at all, regular calibration is critical. The question frequently comes up when a balance is initially purchased. A new balance operator's manual almost always recommends calibration before use.

There are many reasons a balance needs to be calibrated. The simple process of shipping can cause small changes to the mechanics of the balance. These small changes can mean big differences in your measuring results. Variations in barometric pressure can also affect the results you get from a precision or analytical balance. If your locale has a different gravitational force than the location of the factory producing the balance, calibration is necessary.

ADAM®
26 Commerce Drive
Danbury CT 06810 USA
Phone: 203-790-4774
www.adamequipment.com

LOCATION, LOCATION, LOCATION

Gravity is not the same everywhere on Earth, as our planet is not a perfect orb. Every place in the world is positioned differently to "magnetic north." This results in slight gravitational differences, depending on a particular location's altitude compared to sea level. If the balance is moved to a place where the gravitational pull is greater or less, it will display a different value, as the force will vary.

If you stand at either of the Earth's poles, you are slightly closer to the center of the Earth than if you stand on the equator. As you move closer to the center of the Earth, the force due to gravity will be slightly greater. As you move away from the center it will be less. Therefore, if you climb a mountain, you move farther from the Earth's center and the effect of the gravitational force is less. This is important because balances measure the force of gravity pulling the mass toward the center of the Earth.

Different balances will react differently to a change in location. A less-sensitive balance, one that is readable to 1.0g for example, may not be able to measure a change in gravity when it is moved from one location to another. More sensitive balances, such as those found in laboratories, will more readily display the difference in gravitational forces. On the most sensitive laboratory balances, it is possible that a very small difference in location can cause large changes to the balance's calibration.

For example, an analytical laboratory balance capable of weighing 100g, readable to 0.0001g, can detect very miniscule changes in gravity. If the balance is calibrated with a 100g mass and then moved upstairs three floors, the change in gravity will cause the balance to measure the 100g mass as 99.9970g, or 0.0030g less because it is farther away from the center of the Earth. If the balance moves north by 1,000 meters (1km), it will measure the same 100g mass as 100.0007g, an increase of 0.0007g, because it has moved closer to the North Pole. If it moves south by 1,000 meters, it would be measured 0.0007g less. If it moves east or west it would stay the same, as it is the same distance to the center of the Earth.

TYPES OF CALIBRATION

Some balances are equipped with internal motorized calibration, and while this feature might add to the purchase price versus a balance with external calibration, it's a convenient feature to have in a precision or analytical balance. Since internal calibration is extremely easy, it may mean the balance will be calibrated on a timely basis. Most balances with internal calibration also offer external calibration. External calibration is a fairly simple process, but requires more effort on the balance owner or user.

During external calibration, a previously determined weight is always used to set the balance's parameters, guaranteeing its results. For example, when a one-kilogram mass is used as the standard and is placed on a balance, its force will always read as 1000g. Any other weight that is placed on the balance will be measured against this standard.

Some balance owners may have calibration weights that are slightly different from those used to initially calibrate the balance at the factory. Using different standards (weights) to calibrate a balance can result in different readings.

Depending on the use of the balance, the calibration may need to be traceable for ISO purposes or to meet other requirements. In this instance, a certified weight should be used to calibrate the balance. In the United States, the National Institute of Standards and Technology is the industry group that certifies weights for calibration. A traceable calibration can be done through a balance service company that specializes in calibration certification, or it can be done by the balance owner providing they buy a certified weight to be used in the calibration process.

For the best results, all balances should be calibrated regularly with use, if the local ambient temperature changes more than the specification allows, if the balance is moved, and if the balance will be used for making high-precision measurements.

ABOUT ADAM EQUIPMENT

Adam Equipment manufactures and distributes a full selection of precision balances and scales for the lab, education, industrial, food, health/fitness, animal/veterinary and jewelry markets. The company is headquartered in England and has offices in the United States, South Africa, Australia and China. Founded in 1972, Adam is proudly celebrating its 40th anniversary in 2012. Since its inception, Adam has provided its customers with the winning combination of speed, performance and value. For more information about the company and its products, contact: sales@adamequipment.com.

DETERMINING ANTIOXIDANT POTENTIAL

USING AN OXYGEN RADICAL ABSORBANCE CAPACITY (ORAC) ASSAY

The oxygen radical absorbance capacity (ORAC) assay is an analytical method to determine the antioxidant potential of nutraceutical, pharmaceutical and food ingredients. The ORAC assay relies on the fluorescent probe to monitor antioxidant activity, which can be read in 96-well microplates using a fluorescence-capable reader.

Authors: Pete Brescia and Paul Held

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www.BioTek.com

INTRODUCTION:

Oxidative damage to living organisms is associated with several disease states and aging[1]. Sources of reactive oxygen species (ROS) are both endogenous and exogenous, and can lead to toxic compound formation within organisms. A proper balance must be maintained between oxidants and antioxidants to ensure that the ubiquitous ROS species are not deleterious to the organism. Disrupting these mechanisms can result in an imbalance and ensuing damage to critical components required to maintain cells. Thus, there is interest in accurately determining the antioxidant capabilities of foods, cosmetics, dietary supplements and pharmaceutical agents.

While several methods exist to measure total antioxidant capacity, ORAC is a low cost method suitable for microplate-based high-throughput automation[2,3]. The assay relies on free radical damage to a fluorescent probe resulting in a loss of fluorescent intensity[4]. Inhibition of oxidative damage to the fluorescent probe is correlated with a compound's antioxidant capacity acting as a free radical scavenger. Kinetic reactions containing antioxidants and blanks are run in parallel with integration of the resultant curve to calculate the area under the curve (AUC). Antioxidant protection is then quantified by the difference between the AUC of the blank reaction and reactions containing antioxidant.

EXPERIMENTAL CONDITIONS:

The ORAC assay was performed as described by Huang et al.[2] with modifications described by Held[5]. Reactions were initiated by adding 25 µL of AAPH solution using the Synergy™ H4 Hybrid Multi-mode Microplate Reader injectors (BioTek Instruments, Inc., Winooski, VT) in a 200 µL final reaction volume. The fluorescence was monitored kinetically with data taken every minute for two hours.

RESULTS:

Several compounds with known antioxidant properties were assayed by the ORAC method (Figure 1). To determine each compound's antioxidant capacity, the net AUC for each sample was calculated and Trolox® equivalents calculated using the ratio of the compound's slope of the linear regression analysis to the Trolox® standard's slope[6].

CONCLUSIONS:

High throughput antioxidant determination requires a low-cost assay with high precision and accuracy that is amenable to microplates. Here we show that the ORAC assay provided antioxidant determination of several known antioxidants and subsequent conversion to the commonly accepted Trolox® equivalents for quantitative analysis. The assay used common reagents, a standard 96-well microplate and a fluorescence-capable microplate reader. The ORAC assay provided excellent precision across all microplate wells tested and performed the assay in approximately 60 minutes. Results correlated well with those presented in the literature[2].

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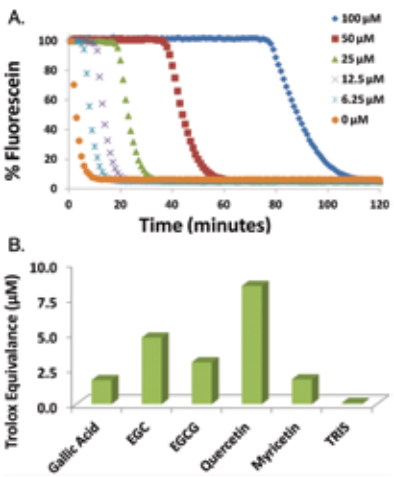
EDITOR NOTES

Figure 1. Trolox® kinetic curves and resultant Trolox® equivalents. (A) ORAC assay kinetic curves of Trolox® antioxidant concentrations ranging from 0-100 µM. (B) Calculated Trolox® equivalents were then used for sample antioxidant comparative analysis.



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The PLC 2020 offers direct user control options for modifying gradients, advancing fraction collection or diverting to waste without affecting the rest of the purification run. This allows users to interrupt the normal method operation and prime the system from the run screen. Likewise, users have the ability to modify conditions – including tasks and mobile phase – mid-run so that samples can be quickly collected while they are being purified.

The PLC 2020 offers flow rates from 2 to 100 mL/min and pressure up to 4600 PSI with interchangeable pump heads allowing users the flexibility to choose the pump system that best fits their application. In addition, the manual sample injection process (with electronic software-controlled positions for Load and Inject with graphical indicator) provides an electronic actuation resulting in higher reproducibility, saving time and money.

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The i.C³ user interface is icon driven, featuring a 7" full-color touchscreen that is door mounted at eye-level on all upright models. Undercounter models feature an angled screen for easy viewing. Multiple information logs with temperature and event data can be downloaded and saved.

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i.Act™ On-screen Event Acknowledgement allows users to immediately record corrective action at the time of the event. Information is date stamped to validate each entry and cannot be changed, providing a secure record of every corrective action. Data records can also be downloaded.

Optional i.D™ Integrated Electronic Access Control offers secure access to the unit via on-screen PIN entry. Access data is captured by person, method, and time of entry. The Access Control keypad can be used as an alternative Home screen allowing users to customize each unit.

In addition to the i.C³ user interface, i.Series models now feature increased capacity, energy saving LED spot lighting, rechargeable battery backup, and optional leveling feet.

Contact Helmer Scientific at www.helmerinc.com or sales@helmerinc.com for more information on i.Series products.

EFFECTIVE CLEANING OF PIPETTES

Chemical, water or other analysis requiring exact measurement and dispensing of liquid reagents relies on the use of pipettes. Some pipettes are disposable, however, reusable glass pipettes are preferred because they are typically of higher quality and are calibrated more exactly. The main disadvantage of using glass pipettes is the difficulty of cleaning them between users.

Some pipette cleaners are simple plastic jugs that fill and siphon water several times. Cleaning is accomplished by means of soaking and flushing. After this process, pipettes are typically placed in an oven for drying. This process can take hours and requires handling of wet pipettes. As a result, the tips are easily broken, rendering the pipettes useless. Another cleaning method is to use a laboratory glassware washer. Miele lab glassware washers equipped with pipette injector baskets and specified cleaning agents are ideally suited for the task and provide repeatable and analytically clean results.

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DIRECT INJECTION BASKETS:

When cleaning pipettes, Miele injection baskets provide remarkably clean results for hard-to-reach interiors. Each pipette is placed tip down in a protective plastic holder, where water and detergent are injected, providing thorough cleaning. A heated DI rinse follows to ensure complete removal of trace residues. If HEPA-filtered drying is used, forced hot air will circulate through the pipettes, providing complete drying.

A variety of injector baskets are offered, including the E 404 full injector basket which is designed to hold up to 36 pipettes in a three row configuration. Row 1 can accommodate ten 100 ml pipettes (up to 550 mm in length), row 2 can hold fourteen 25 ml pipettes and row 3 can accommodate fourteen 10 ml pipettes. The E 405 basket offers the same capacity along with a drying connection for use in Miele washers with HEPA-filtered forced air drying.

The E 406 pipette basket is ideal for higher throughput. This basket holds 116 pipettes up to 45 mm in length. If the washer has HEPA-filtered forced air drying, the E 408 (which holds up to 96 pipettes) should be used.

TEMPERATURE:

In general hotter water provides better cleaning and rinsing. For this reason, Miele's washers can heat water and DI water up to 93 C. Additionally wash and DI water temperatures are independently adjustable for maximum flexibility.

MECHANICAL ACTION:

It is often assumed that high pressure must be used to provide good cleaning results. The problem is, higher pressure also means greater chance of breaking delicate glassware. Miele's high turnover rate (circulation) of water at a low discharge pressure provides the best results without risk of glassware breakage.

How often the water and detergent contact the surface to be cleaned is actually more important than spray pressure. Miele lab washers circulate 106 or 156 gallons of water per minute compared with 25 gpm for typical household dishwashers and 60 gpm for typical lab washers. Miele's high circulation rate ensures analytically clean results, reduces the wash time required, aids in energy efficiency and allows for lower detergent usage.

Additionally, the Miele lower spray arm features special spray nozzles which angle and feather the jet spray for maximum coverage and impingement. Most other washer manufacturers simply provide drill holes in the spray arm which do not direct the water in this way.

TIME:

Increasing the time of a wash cycle will improve the cleaning results. Yet most labs cannot afford to spend time waiting for a washer to complete long cycles. In addition to high circulation rates providing faster cleaning, Miele systems utilize only 2.5 gallons of water per cycle which is heated by 6000 watts of power at 220 V. This means less time is wasted waiting for water to be heated up to temperature.

DETERGENT:

Selecting the proper detergent is an important step in achieving critically clean glassware. Miele offers an extensive line of powder and liquid detergents, and acid neutralizers for removal of virtually any residue from glassware. Miele provides detergent and neutralizer recommendations with every washer.

CONCLUSION

All Miele laboratory glassware washers can be utilized for effective cleaning of pipettes if equipped with the appropriate direct injection baskets.

For further information contact Miele at:
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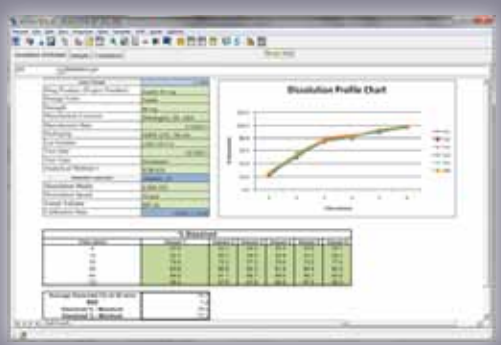

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PRE-OWNED EQUIPMENT MARKETPLACE

PARTING POINTS

Takeaways from this month's issue:

5 KEYS TO EFFECTIVE COMMUNICATION

Effectively communicating with staff members, customers, and suppliers is a critical skill for laboratory managers. In particular, staff members have to feel that the manager is providing valid information, is not withholding information, and is available to listen. Four of the five keys to communication include:

- Honesty is the best policy
- Speak directly to people
- Practice active listening skills
- Adopt a participatory management style

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INVESTING TO SAVE

Is your laboratory looking for ways to save money? Try spending (investing) some! Labs can invest their way to a better bottom line by:

- Reviewing their current technologies/practices to uncover inefficiencies
- Making sure they calculate the ROI of any possible upgrades
- Upgrading older technologies or procedures to something more efficient
- Hiring/retaining experienced staff to mentor younger/less experienced employees

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MODELING & SIMULATING SCIENCE

The modeling and simulating field is on fire. It's one thing to make a model that you can see, but imagine making a model from numbers. Key trends in this field include:

- Some of today's most exciting modeling occurs in chemistry and biology
- Simulating combustion remains a high priority
- Modeling and simulations require a team of experts nowadays
- Computing is playing a huge role in answering scientific questions

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IT'S ALL IN THE PLANNING

The same goal for making the best use of research space is shared by all: arrangement and layout should promote successful scientific research and the well-being of the researchers. Important parts of planning your research space include:

- A pre-planning-phase workshop that includes lab occupants
- Adjustable and reconfigurable casework can be especially important
- Existing guidelines for lab layout should be considered a minimum standard
- An early assessment of researcher travel time and productivity enhancements

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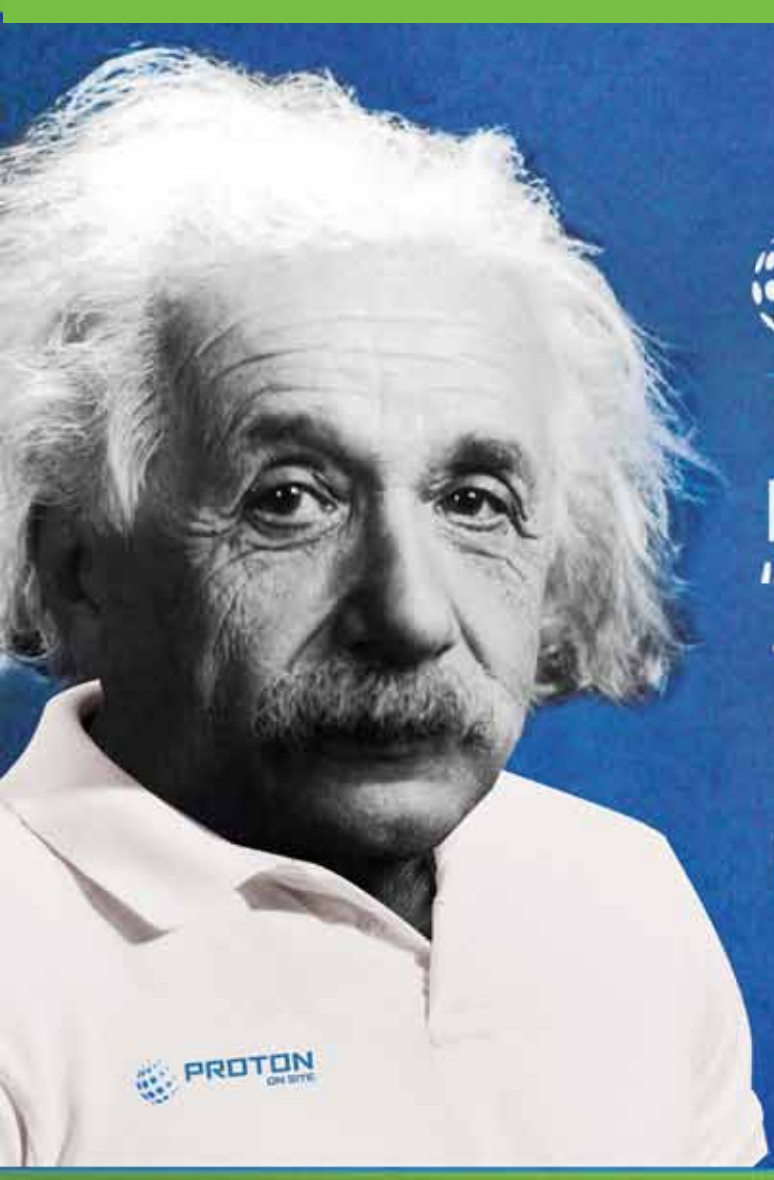
TOO HOT TO HANDLE

An autoclave is such a common and familiar piece of lab equipment that it is easy to overlook the associated hazards. Following these steps can help you and your staff avoid mishaps and potential damage or injuries:

- Become thoroughly familiar with the owner/operator's manual for your particular machine
- Instill a policy whereby all users are trained prior to operating any autoclave
- Monitor and test autoclave effectiveness
- Ensure proper records are kept up to date and users record autoclave run information



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