November 2011 Volume 6 • Number 9

COMMUNICATING SCIENCE

IT'S TIME RESEARCHERS STEP UP & MAKE A CASE FOR THEMSELVES IN THE LARGER WORLD





Controlling Airflow in Class II Biosafety Cabinets



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Communicating Science

Science is now in the ring with controversial social issues and taking more punches. The public wants transparency. Funding is dicey. The media ecosystem is in flux. What scientists say, and how they say it, is more important than ever.

F. Key Kidder

Perspective On: An Academic Research Lab

Terry O'Connell is the University of Rochester's Director of Chemical Operations and is responsible for new instrument installation and building renovations to accommodate new instruments. During the 2009-2010 academic year, the Department of Chemistry acquired and installed over \$2 million worth of research instrumentation.

John K. Borchardt



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The purpose of the entire hiring process — reviewing candidates' application materials, talking to their references and engaging in interviews — is to hire high-impact individuals. They are the ones who will contribute quickly and significantly to the development of new products and processes and represent the future of the lab. John K. Borchardt

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Over the past year, trends in portable instrumentation have continued to progress, with devices getting smaller, faster, and more powerful as demand for portability remains high. However, there have been a few changes and some new developments in the industry overall. Rachel Muenz

32 **Controlling Airflow in Class II Biosafety Cabinets**

Significant strides have been made to maintain constant airflows in biosafety cabinets. Simple chopping circuits and differential pressure gauges have given way to sensor-based control systems. These, in turn, are now being supplanted by sensorless microprocessor-motor systems. Jim Hunter, Mark Meinders, and Brian Garrett

LAB DESIGN & FURNISHINGS

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Understanding basic acoustic space design criteria and strategies that building managers, users, planners, and designers can use to recognize and address the acoustic needs of laboratory spaces is deeply important for collaboration and efficiency in labs.

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Routinely checking or testing a chemical fume hood for adequate flow and velocity must be incorporated into your lab safety program. Post flow test results or performance checks directly on the hood and request a recheck if you suspect a problem.

Vince McLeod

BUSINESS MANAGEMENT

78 Help Wanted

Unlike other professions today, the demand for lab professionals exceeds supply. Awareness of the profession appears to be one of the reasons why people are not pursuing opportunities in this field. Lab professionals need to take an active leadership role to address the workforce shortage and ensure a favorable outcome. Kenneth Marques Thornton

Tell Us What You Like or Don't

We have recently added a "Post a Comment" tool at the bottom of feature articles on the web site, allowing you to share your thoughts on the topics covered. A reader and research manager from Montana State University-Bozeman recently emailed us saying: "I just read the article entitled, '10 Tips to Improve Your Pipetting Technique.' As a microbiologist, I routinely use pipettes. This article only relates to the use of pipettes in a chemical laboratory (or pipetting not using aseptic techniques). I would hope that most of your readers would understand the differences but your article should have stated this. While some of the techniques described are applicable in all settings (for example, looking at the tip before and after dispensing), a "newbie" to a microbiology lab might try some of the techniques described (such as removing droplets with a lint free cloth) with disastrous results."

Beginning this month, this kind of helpful and important feedback can be posted directly on articles.



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EDITOR'S NOTE



Speak Up

"Scientists and engineers tend to communicate poorly because their professions have not valued explanation and their career advancement doesn't depend on having lay-level explanatory skills, leaving scientists strategically maladroit when they engage external publics," says F. Key Kidder in this month's cover story. However, some believe public engagement is "a scientific duty that benefits the public good by promoting informed debate." In addition, there have been studies that show a correlation between visibility of research and research funding. "Communications that target legislators are a proven means of moving the federal funding levers supporting agencies such as NIH and NSF and can also improve funding atmospherics for other researchers," says Kidder. Turn to page 10 to learn more.

With budgets tight and pressure to be more productive greater than ever, lab managers cannot afford to make bad hiring decisions. Two articles this month focus on that fact and offer sound advice on how to make sure you staff your lab with the best and brightest. John Borchardt's "Hiring the Best" article (page 18) states: "[Lab managers] need to understand how to define job positions and how best to generate a job applicant pool and assess candidates. They need to understand how to make job offers." He then describes a process that allows managers to most efficiently identify and hire high-impact performers.

Alan Edwards, in his "Science Matters" column (page 24) says, "The days of the long-term strategic hire, when a company had the luxury of molding the perfect employee over time, are gone. The right experience—and a hiring manager's ability to spot it—is perhaps the most important component of the hiring process today to ensure an employee will hit the ground running." He recommends professional networking as one way to increase your odds of making the right hire. "You might have as few as 20 colleagues you can call on, but if they've got the right connections, the odds of them knowing someone who is the right fit for the job are in your favor."

This month we feature an update on field instrumentation — reporting on how this technology has evolved since we discussed it last year in the July/August issue. Turn to page 26 to find out how much smaller, lighter and accurate these devices have become.

For anyone building new or retrofitting an existing lab, this month's Lab Design & Furnishings article (page 38) discusses the often overlooked matter of sound and acoustics. Unlike our cover story on letting your research voice be heard, when it comes to lab design, it's better to keep those decibel levels down.

Included with our November issue is this year's 2011 Product Resource Guide, filled with an abundance of up-to-date laboratory technology information. We hope it will find a trusted place on your desk or benchtop and provide you with a go-to resource for making all your purchasing decisions.

Allhey

Enjoy.

Pamela Ahlberg Editor-in-Chief

Correction: On page 123 of the September issue, the captions for Figures 2 and 3 were inadvertently swapped. Figure 2 should have illustrated the data quality of Array Tape compared to microplates. Figure 3 should have shown the nearly 50% reduction in costs for consumables, reagents and labor with Array Tape.



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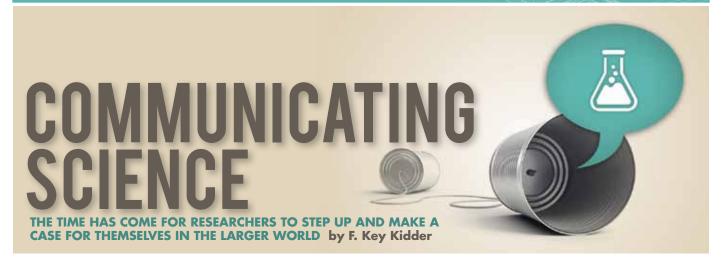
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The scientific community has historically taken a dim view of communications with nonscientific publics.

No thanks, said scientists. What an imposition! Why bother? What good could possibly come from interrupting research, sticking our necks out and dumbing it down for nonscientific dunderheads, only to see them mismanage our findings?

And when scientists did journey forth, their purpose was perfunctory, their communications couched in obtuse, technical jargon. They spoke of discrete probabilities and processes, a disconnect from the concerns of the man on the street. The intent of scientific communication was to inform, to transmit knowledge, lecture-like from on high—to feed the beast, as it were.

It's a new ball game now. A convergence of recent developments appears to be inexorably pushing the scientific commu-

nity toward a communication tipping point, a sea change that challenges scientists to step up and proactively engage their restive publics. The idea that social ills could be cured if people only had more knowledge—the decades-old deficit model that drove scientific outreach—has been discredited.

The entirety of the scientific enterprise is more exposed, at greater risk. Science is in the ring with controversial social issues and taking more punches. Important publics are agitating for transparency. Funding is dicey.

The media ecosystem is in flux. What scientists say, and how they say it, is more important than ever. But the scientific community, by and large, is communicatively challenged—variously untrained and unskilled, inept, timid, and preoccupied—and often disinclined to deal with it all.

Researchers and other scientists are increasingly tasked to

engage a variety of external publics.

When federal funding began in the 1950s, research was perceived as generally benign. Today, important scientific, medical and engineering issues such as stem cells, climate research, nanotechnology and genomics are contentious and politically charged. Dialogues and policy formation involving scientific data are susceptible to being compromised by competing special interests, misinformation and poor public scientific literacy.

The funding stream, besides leading to state and national

seats of political power, also takes researchers before other critical publics—donors, nonscientific administrators and potential collaborators.

"Researchers [need]
to master a more
conversational style of
scientific discourse,
in their own voice."

Do researchers make a good case for themselves in the real world?

Scientists and engineers "tend to communicate poorly" because "their professions have not valued explanation," said science communication consultant Dennis Meredith





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in *The Chronicle of Higher Education*. Their "career advancement doesn't depend on having lay-level explanatory skills," leaving scientists "strategically maladroit" when they engage external publics.

Meredith is among the new breed of communicators hacking out routes for scientists to follow. Matthew Nesbit and Dietram Scheufele recently helped show scientists the way toward framing—using metaphors and narratives to make communications more relevant to specific audiences—a major improvement over the dissemination of dry scientific data that had previously passed for outreach.

Framing sometimes came across as manipulating or

"selling" science. But at the very least, it encouraged science communicators to begin thinking about the wants and needs of external publics and was a major step toward the concept of engagement, the communication modality that builds trust.

Most commonly, bench scientists and others err in their communications by using overly technical language—"dense scientese," says Meredith—that loses lay audiences. When research leaves the lab, it must be repackaged and repurposed. "Your department chair might

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understand what's going on in your lab, but your institution's trustees, president, vice presidents and provost might not." Successfully engaging external publics requires researchers to master a more conversational style of scientific discourse, in their own voice.

Another frequent fault is failing to distill the essence of the message into a handful of talking points beforehand. Communicators should also study empirical data about target audience values—the cognitive filters in any public's decision-making process.

In a study of science communicators who self-identified as experts, authored by John Besley from the University of South Carolina's School of Journalism and Mass Communications, bench scientists were found to receive

little communication training.

Only one in five communication experts reported conducting communication training of bench scientists. When training did occur, the primary focus was most often on communication theories and models, followed by (in descending order) news values and norms, public speaking and presentations, engagement, being interviewed by the media, and writing for the media and other publics.

Compared to other science-related survey groups, the study reported that bench scientists are "the most likely to hold a deficit model perspective, the least likely to think the public have meaningful opinions, and the most

> likely to be out of touch with the public."

Lab managers who find public engagement challenging won't lack company; most scientists would seem ill prepared, since the majority are proceeding without benefit of adequate formal training and/or role models.

Recognizing the need for a more muscular communication system in its relations with key external audiences, the scientific community is creating pipelines to nurture talent, such as the American Association for the Advancement of Science's

Center for Public Engagement With Science and Technology and the American Chemical Society's Chemistry Ambassadors program. Educators are also filling the void; one leading effort empowering scientific communication is the Aldo Leopold Leadership Program at Stanford University. Geared toward academic environmental scientists, the two-week seminar program has trained more than 150 Fellows since 1998. Organizations are also stepping up to provide resources: the Union of Concerned Scientists produced a guide for talking to reporters.

Since many researchers are reluctant to venture beyond their laboratory comfort zone, advocates of greater public engagement are campaigning to persuade the

"Bench scientists are ...
the least likely to think the public have meaningful opinions, and the most likely to be out of touch with the public."



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profession it's a scientific duty that benefits the public good by promoting informed debate.

Other proponents maintain that outreach also serves the best self-interest of scientists, contrary to what some in the profession believe.

"There are studies that show a correlation between

visibility of research and research funding," says Carol Rogers, a University of Maryland journalism lecturer. Communications that target legislators are a proven means of moving the federal funding levers supporting agencies such as NIH and NSF and can also improve funding atmospherics for other researchers.

Furthermore, says Meredith, good communication skills can generate scientific citations, as evidenced by a *New England Journal of Medicine* study of citations earned by scientists whose outreach efforts attracted media coverage. Meredith says the scientific culture's utter aversion to publicity is neutralized by the heated interplay between science and society; he shakes off criticisms of researchers as publicity hounds as "vague grumblings" from those whose "research is not significant enough," provided the communications are judicious.

"The good news is that consumers have a healthy appetite for scientific information."

Taking one's research beyond the confines of a scientific journal once meant getting play in print media such as newspapers and periodicals. The contraction of that industry has reduced its outlets, so science, which was always a lesser topic, has been further marginalized. A 2008 Project for Excellence in Journalism report pegged the science news hole at two percent, while consumer-driven issues such as health and medicine warrant seven percent.

Despite this diminishment and the march of social media, it is traditional media, primarily print, that remains the gatekeeper for science news; the official print version becomes

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the basis for subsequent media use. Science always had an uneasy relationship with traditional media. Science is process driven and deals in uncertainties and probabilities. Media prefers all things novel and concrete and thrives on controversy, which can result in the systematic everywheld the of discenters. As reported relationships

overweighting of dissenters. As reporters relentlessly work issues for fresh angles, members of the scientific community are "sometimes treated as if they were just another special interest in the messy political food fight" wrote Christine Russell, president of the Council for the Advancement of Science Writing.

The good news is that consumers have a healthy appetite for scientific information. A 2010 NSF report showed that 40 percent of Americans get science information from TV, 28 percent from the Internet and 22 percent from print media. It's not an either-or proposition; audiences, says Pew Research, blend these sources.

New media technologies, the drivers of future public understanding of science, afford lab managers a host of communication opportunities by opening up digital platforms to better engage a range of external publics.

The future has already arrived for scientists who have taken to the blogosphere. Leader ScienceBlogs.com, "the largest online community dedicated to science," reports it has exceeded double-digit traffic growth every year since its 2006 launching, taking up the slack left by traditional media's shrinkage. The conversational nature of blogs helps researchers learn how publics perceive the convergence of science and society, an understanding that improves the quality of engagement and promotes trust.

Blogs, websites, webinars, social media, podcasts, wikis, videos, e-newsletters—they all work, say Scheufele and Meredith, who urge scientists to use the full range of communication tools at their disposal, in order to reach all audiences. Many scientists rely on a single communication mode. Others refrain because outreach appears too time-consuming; Meredith touts a communication "strategy of synergy," us-

ing the same document in multiple modalities.

Old and new media overlap; *Nature's* survey of 500 science journalists revealed that most have used a science blog for story ideas, an opportunity for lab managers' digital content to become mainstreamed. The magazine

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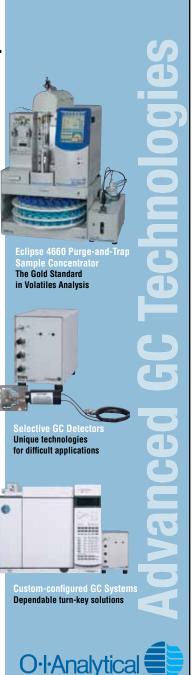


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P.O. Box 841 Woodbridge, NJ 07095 Phone 888-LABNET1 Fax 732-417-1750 email: labnet@labnetlink.com Visit our website: www.labnetlink.com editorially encouraged more "realistic writing about the experience of bench scientists," imploring them to "rise up and reach out" and "penetrate the news cycle."

In today's wide-open "publicize or perish" media environment, it's often advisable for lab managers to consult public information officers and media departments of scientific organizations and agencies. By going public directly, scientists preempt intermediaries who can distort their data and rivals who stand to gain from first-mover advantage; proactively going on record with their research provides lab managers' reputations with a measure of protection against subsequent misrepresentations and attacks.

The plethora of new communication technology platforms is mind-boggling: Meredith's website—ExplainingResearch.com—includes more than 50 Twitter sites and resources.

Social media is not without its traps. One common problem is jumping in with both feet, the "let's just do some social media" mistake. Another worry is the self-injurious "Facebook effect," supported by research into cognition and electronic communications showing how people are inclined to go over the top. Excessive and/or unprofessional personal musings can affect tenure and promotion. Many senior professors fail to see how social media improves research skills.

But scientific social media users maintain it produces better engagement. Even with their 140-character limit, the users say informal tweets are better than formal papers for providing publics with a true picture of a day in the life of a lab manager—the concept of "informational justice" that is essential if scientists are to achieve communicative engagement with external audiences.

F. Key Kidder left journalism to pursue a career in government relations, politics and PR, but he still likes to keep one hand in writing. He can be reached at k2@keykidder.com or by phone at 410-963-4426.



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HIRING TECHNIQUES FOR DETERMINING WHICH JOB CANDIDATE WILL BE YOUR HIGH-IMPACT PERFORMER by John K. Borchardt THE BEST

"If we don't get the people thing right, we lose; it is the most important thing in all of business," said Jack Welch, retired CEO of General Electric Company, who was named "Manager of the Century" in 1999 by Fortune Magazine. Getting the people thing right begins with hiring the best individuals, the high-impact players. The purpose of the entire hiring process—reviewing candidates' application materials, talking to their references and engaging in a series of interviews with them—is to hire high-impact individuals to work in your laboratory. Their knowledge, skills and work habits make them exceptionally productive. Of course, lab managers always want to hire new employees who have these attributes. They are the ones who will begin to contribute both quickly and significantly to the development of new products and processes and supply high-quality customer support. They represent the future of the laboratory.

Lab managers need to design their hiring process around determining which job candidates will be high-impact players if hired. They need to understand how to define job positions and how best to generate a job applicant pool and assess candidates. They need to understand how to make job offers. Newly appointed lab managers, in particular, often need mentoring and advice on how to do this.

What can lab managers do to help ensure that staff members they hire will rapidly become high-impact players?

Look for problem solvers

The best indicator of future performance is past performance. Look for job candidates who have been outstanding problem solvers in previous jobs or in their academic work. Look for evidence of this when reviewing résumés and discussing candidates with their references. Published

journal articles, patents and presentations at conferences can also suggest which candidates will be high-impact players. However, using journal articles, patents and presentations requires more than just counting how many a candidate produced. It also means considering the journal in which a technical paper is published. High-quality journals tend to publish higher-impact papers than less respected journals. Review the conclusions section of research papers. If job candidates hold U.S. patents, ask them why one of the major patent claims is important. They may be constrained from saying much because their current or former employer may regard development and commercialization plans as proprietary.

During interviews, ask candidates for examples of their problem-solving skills. Listen closely to their answers. When they provide these examples, ask additional questions to determine what impact their results had in terms of commercializing new



products or processes, or increasing a previous employer's business. Ask graduate students and post-docs what insights their findings are providing in terms of solving scientific problems.

Often, the hunt for new staff members who will have both a rapid and significant effect on productivity means hiring experienced people. Industrial experience can hone problem-solving skills while providing knowledge of how to get things done in an industrial work environment. So, while experienced staff members can cost more, they are often worth the extra money.

However, one has to consider the context in which experienced job candidates achieved their high-impact accomplishments. For example, a job candidate who worked for an established drug company with a highly structured environment may be less productive in the freewheeling laboratory environment of a start-up firm. Conversely, the opposite may also be true. It is usually difficult to determine the extent to which a candidate's work environment influenced his or her activity. However, it is often worth making the effort. Asking questions about what the candidate liked most and least about the previous employer's work environment helps you explore this issue.

Look for flexibility

In addition to looking for outstanding problem solvers, lab managers should look for candidates with other skills and accomplishments. For example, experienced researchers often have firsthand experience with the process of recognizing inventions and working with patent attorneys to obtain U.S. patents. Newly-hired, experienced researchers could serve as mentors working with younger coworkers, educating them about the patenting process from the researcher's perspective. Experienced new hires often begin making solid contributions faster than inexperienced new hires with little or no experience in industrial laboratory work environments.

Aim for an age mix when hiring new employees. One doesn't want to hire only experienced employees or only new graduates. Recent graduates often bring with them knowledge of and experience with new synthesis methods and instrumental analysis techniques. Combining these attributes with the skills and perspectives of experienced staff members can create a synergistic mix that increases productivity. Having seasoned coworkers as mentors can reduce the time younger new hires need to get up to speed.

Sometimes, but not always, younger job candidates have better or broader computer skills than older laboratory staff members. On the other hand, some of their soft skills—such as written communication, oral communication and time management—are often less developed and they can benefit from mentoring by older, more skilled colleagues. Thus, having an age mix can improve productivity through knowledge transfer among lab employees.

Communication skills

Oral and written communication skills are essential whether one works in new product (or process) development, analytical services or customer technical services. Communication skills are particularly important in the last category as lab staff members work with customers and potential customers to understand their firm's operating problems and concerns.

Effective listening skills are a critical part of oral communication skills. Polite but effective questioning can enable lab staff members to better understand the



problem their customer is experiencing and what, in their opinion, constitutes an effective solution.

Employment interviewing

The employment interview process has become a multistep procedure. Screening interviews include on-campus interviews, interviews at job fairs held at conferences such as PittCon and the ACS national meetings, telephone interviews, and online interviews. All these need to be designed to help the hiring manager make the decision on whether to invite the candidate for an on-site interview. On-site interviews are expensive but it isn't the travel expenses; it is the time of all the individuals engaged in the on-site interview process. So it is essential to invite only the best candidates necessary to make an informed hiring decision and choose a candidate who will perform well in the available position and is a good match for your lab's workplace culture.

The behavioral interview has come to the fore in the

last several years. In this type of interview, candidates are asked questions about how they would handle—or have handled in the past—situations likely to occur in the workplace. These may be

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"Having an age mix can improve productivity through knowledge transfer among lab employees."

interpersonal conflicts, getting things done with limited resources, managing multiple priorities, etc. Of course, other types of questions dealing with the candidate's laboratory experience and accomplishments are asked as well, along with questions designed to determine if the candidate will be a good match for your workplace culture. A good match increases the chances a candidate will become a high-impact employee after being hired.

Some progressive managers review candidates with all the employees who will work with them. Before the onsite interview, the hiring manager divides up interviewing responsibilities to ensure that important questions will be asked at least once. At least some of the interviewers should familiarize themselves with the candidate's academic research experience or previous job experience so they can ask challenging questions, not questions answered in the candidate's résumé. The second staff meeting is immediately after the candidate's visit. Each person who met with the candidate provides his or her opinion of whether the candidate will make an excellent employee and the reasoning behind that opinion.

The employment interview seminar

Employment interview seminars, once primarily a feature of large-company on-site interviews, now are a common feature of mid-sized and often small company interviews as well. Besides offering an opportunity to evaluate a candidate's oral communication skills, employment interview seminars can enable members of the seminar audience to develop a sense of whether the individual will become a high-impact employee. Audience members can get a reading on how the individual formulates and defines problems and then works toward their solution. Questions from audience members can aid greatly in developing this understanding.

Making a good impression on candidates

High-impact job candidates are highly sought after. Even in today's job market, with many candidates chasing a relatively small number of positions, companies compete vigorously with each other to identify and hire

> high-impact job candidates. Lab managers must do more than offer competitive salaries and benefits to succeed in this competition. They need to develop and formulate a strong message that their company is a place where the candidate

would enjoy working and succeed in pursuing their professional goals. They must understand the pool of candidates they are trying to reach with their employment advertisements and have an effective process for managing the responses to those advertisements.

An effective on-site interviewing process is essential. The best way to develop one is to have a generic interview agenda that can be tailored to individual job candidates. Then, be sure all those interviewing the candidate understand the importance of being well prepared. These interviews should be their primary focus during the on-site interview day, with other job responsibilities temporarily secondary.

Interviewers should be coached on how to improve their effective listening skills. (One of the most useful training courses I ever took was on effective listening skills.) In particular, employees interviewing candidates should understand how important it is to study the candidate's résumé ahead of time and formulate insightful questions—not ones with answers easily found in the candidate's résumé or cover letter.

Managers should develop and implement a consistent candidate assessment method. This ensures that all candidates for a position are "measured" by the same standard. Before the on-site interview, managers should meet with staff members to discuss the parameters of the available laboratory position and the individual job candidates to be interviewed. All interviewers, including the lab manager, should focus on the specific competencies and personality traits likely to turn candidates into high-impact employees should they be hired.

All interviewers should meet as soon as possible after the on-site interview to discuss the candidate's qualifications, skills and the impressions the candidate made. Lab managers should run these discussions so they don't turn into an exercise in which staff members try to figure out the manager's opinions of candidates and parrot them back to the manager.

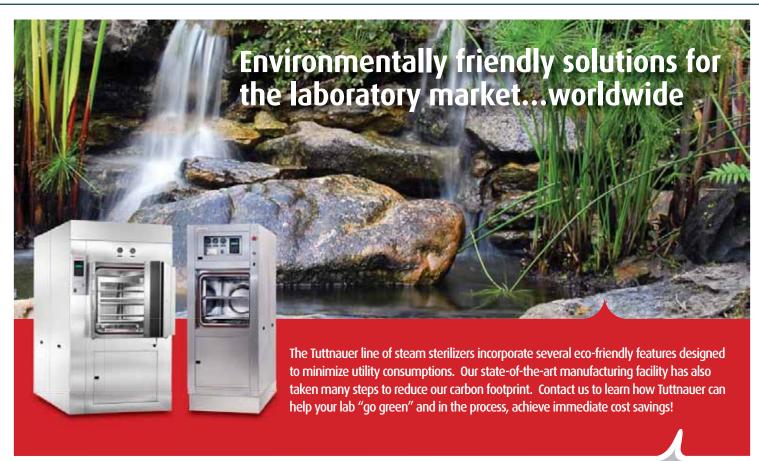
Finally, obtain feedback from the candidate. In par-

ticular, if the candidate declines your job offer, try to find out why. Also, ask them what they liked and disliked about the interview process.

Wrap-up

Identifying and interviewing job candidates is a time-consuming and expensive process. Therefore, it behooves lab managers to effectively identify high-impact individuals among job candidates. Doing this reduces the number of interviews that must be conducted, thereby reducing the laboratory's recruiting costs while hiring high-impact individuals.

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.





Lab Manager Academy



UNDER-MANAGEMENT DEFINED

IMPROVE RELATIONSHIPS BY ELIMINATING MICRO-INEQUITIES AND MIXED MESSAGES By Linda Talley



- 1. Clear performance requirements for the job
- 2. Clear and measurable goals with deadlines
- 3. Performance metrics or feed-back on a timely basis
- 4. Enough atta-boys or atta-girls

And they would be correct; however, there is also under-management when a manager's body language is "telling on" him or her. How does that happen? It's called micro-inequities and mixed messaging. Micro-inequities were first studied by Rowe in the early 1990s, while mixed messaging was studied by Burgoon in 1985. Rowe noted that micro-inequities are small discriminations or events that are often unrecognized by the perpetrator and often unintentional yet appear covert. Burgoon said that mixed messages occur when the person says one thing and their body says another. The good news is that once a lab professional becomes aware of these micro-inequities and mixed messages, and observes how they use them, they can then begin to self-regulate their behavior in order to improve long-term relationships with their staff and customers.

Here are some micro-inequities and mixed messages that you might experience in your lab:

A lab manager says she has an opendoor policy. When a staff member enters, she continues to work without looking up. Not taking the time to make eye contact is a message to the other person that they are invisible; they are not important. Without eye contact, the staff member won't feel visible and it won't take many of these encounters or micro-inequities before this person leaves the lab or disengages from his or her job.

When someone schedules a meeting with a staff member and then takes phone calls during the meeting, this sets a standard. Then when that staff member takes a call during a meeting and the manager berates him or her, a mixed message has been sent by that person and credibility and trust are diminished.

When a person stays seated behind his desk and puts the other person directly across the desk from him, they are in a confrontational position. Someone will win and someone will lose, and the other people involved probably do not feel comfortable.

When a lab manager leans back in his chair and crosses his arms as he

speaks with a staff member, a message of defensiveness is being sent. The lab manager might not recognize his body language, but the staff member will.

When a lab manager's hand is supporting her face with the index finger pointing up the cheek, the thumb cradling the chin and the middle finger cradling the lower lip, she is sending a message that says "I don't believe a word you are saying."

Under-management is about someone not being congruent when speaking with a staff person. In other words, what the manager is saying nonverbally does not match what she or he is saying verbally, or there are overt or covert discriminations. If you want to build mistrust and uncertainty in your lab, use micro-inequities, mixed messages and incongruence in your communication. If you want to build congruence, trust and credibility, eliminate these from your behavior.

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LABCAST

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Be sure to attend Linda Talley's Lab Manager Academy webinar, "Get the Interview Advantage! How to Use Body Language to Make the Right Hiring Decisions" on Wednesday, December 7th, or afterwards at www.labmanager.com/body to watch the archived video.



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SCIENCE MATTERS

LATEST TRENDS SHAPING THE SCIENTIFIC WORKFORCE By Alan Edwards



MAKING THE GOOD HIRE

In the new job landscape, I'm afraid we might be leaving hiring managers in the dust.

After all, as the job market continues to evolve, those looking for work need as much direction as possible—and career experts know this.

How do you write the perfect résumé? What interview questions will be asked? How should you answer? And just because you need a job, should you take the first one offered? Google any of these and you'll get good advice.

to fill a position quickly, should you hire the first qualified candidate who comes along?

Making the best hire is a difficult task, but making the wrong one is easy and can end up costing much more in time and resources down the line. That's why every hiring manager needs to understand how to make the process a success. This skill is critical in the sciences, where hiring decisions can be particularly complex.

That brings me back to this "new job

"The days of the long-term strategic hire, when a company had the luxury of molding the perfect employee over time, are gone."

Guidance on how to make the best hire, however, remains difficult to find, despite the stakes being just as high for the hiring manager in the employment process.

Tweak the questions above, and those high stakes become apparent: As a hiring manager, how do you read *between the lines* of the perfect résumé? What interview questions should you ask? How do you interpret the answers? And, just because you need

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landscape"—one in which people are increasingly being hired on a temporary or contingent basis, budgets continue to constrict, and practically every industry is expected to do more with less.

From an HR standpoint, it means the days of the long-term strategic hire, when a company had the luxury of molding the perfect employee over time, are gone. The right experience—and a hiring manager's abil-

ity to spot it—is perhaps the most important component of the hiring process today to ensure an employee will hit the ground running.

Managers with the biggest hiring challenges, however, often make the mistakes of allowing themselves to be lured in by rhetoric and miscalculating the importance of work history. Candidates typically tell you what you want to hear, but remember that raw experience will almost always bear out. Your job is to look beyond the résumé and know which candidate's experience best translates into on-the-job success. This includes knowing a candidate's track record for adapting to new situations and relating to colleagues too. These so-called soft skills contribute to a candidate's overall ability and can have an equally important impact on job performance.

The time element of making a hire can also challenge the process. Managers don't typically spend months looking for the right candidate anymore. If they need someone, they need him or her now, especially for special projects where contingent workers can provide so much value.

So instead of hiring the right person, hiring managers often settle because of a time crunch. And if the person hired turns out to be a bad fit, you

might not find out until weeks or months later. By then, you've invested time and money in the wrong employee, and starting the hiring process over will cost even more. Know that spending more time at the beginning of the process will almost always prevent problems later.

Now consider the powerful tool of networking—traditionally considered the holy grail of job seekers. But have you ever thought how powerful your network can be when you're looking for the perfect employee?

"Job seekers are assuming more responsibility than ever before in the employment process."

same goes for getting to know a reputable recruiter who understands the scientific industry and can be relied upon to send strong candidates your way.

Don't get left in the dust! Job seekers are assuming more

responsibility than ever before in the employment process, and you have to do your homework too if you want the best employees. Take the time to improve your own hiring processes, and watch the quality of your candidates grow.

If you're thinking you don't have time to constantly manage a professional network, remember the key to effective networking: quality trumps quantity. You might have as few as 20 colleagues you can call on, but if they've got the right connections, the odds of them knowing someone who is the right fit for the job are in your favor. The

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((THE POWER OF PORTABILITY

MOBILE INSTRUMENTS CONTINUE TO SHRINK, GET STRONGER AND FASTER by Rachel Muenz

Over the past year, the trends in portable instrumentation that we first explored in July 2010 have continued to progress, with devices getting smaller, faster, and more powerful as demand for portability remains high. However, there have been a few changes at the companies we interviewed last time and some new developments in the industry overall.

Also, as many parts of the world—unfortunately—continue to become more hostile, the defense industry is still one of the major drivers behind the growth of portable instruments because of its need for robust devices that can be taken into dangerous areas to measure for harmful materials. The need for personnel involved in this industry to quickly communicate their data has also had an effect on portable instruments, particularly spectrophotometers.

The definition of portability is still a gray area. Some vendors see truly portable instruments as being handheld, battery-operated devices, while others define them as larger but still compact devices that can be carried around like a suitcase.

And while portable instruments have many benefits, both in the lab and in the field (such as cost and convenience), they are still unable to run complex experiments and are best suited to single functions. Some vendors added that it's unlikely portable instruments will ever replace the lab, but they will continue to supplement the work done in laboratories, making things easier for everyone.

Changes in spectrophotometers

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Since July 2010, there haven't been massive changes in portable spectrometry. Some vendors have tweaked their existing products, while others have released new ones—all responding to customers' needs for quicker, smaller, more capable instruments.

Torion, for example, is in the process of releasing its next-generation portable GC/TMS after the Guardion-7—the Tridion-9, a luggable, 32-pound device.

"The last generation was basically an early-adopter instrument," said Torion president Doug Later. "We

have completely redesigned the instrument from the PC boards up through the GC and MS components to be more robust in a custom-designed case."

Later added that the system can be used in the field with its own portable helium source, or it can be hooked up to a helium source in the laboratory to provide quick results that users can act on almost immediately. Analyses on the device take only three minutes while there is a five-minute cycle time between injections, meaning labs can increase their productivity, he said. The Tridion-9 also provides access to more libraries than did the Guardion-7.

"We feel it's a lot more functional and a lot more user-friendly than the Guardion-7 was," Later said.

Although Later said Torion hopes to reach a broader range of customers with the Tridion-9, he expects 50 percent of the user base to be made up of the defense and security industries and about 15 to 20 percent to be in the environmental sector. However, one recent change he has seen is a growing market in food and beverage testing, along with the chemical and petrochemical industries. He expects portable GC/TMS to continue to follow the same trends as in the past few years—going smaller and faster but with the abilities of a lab instrument.



▲ Thermo Fisher Scientific has recently given its TruDefender Fti handheld smartphone-like capabilities, allowing users in the hazardous materials and defense industries to e-mail or text critical information to those who need to know it right away.







On the Raman and FTIR spectroscopy side, handheld instrument vendor Thermo Fisher Scientific has made some additions to their existing products.

Specifically, the company has given its TruDefender FTi handheld FTIR instrument wireless abilities similar to a smartphone, something that's very useful for the hazardous materials and military customers the instrument serves.

"They can make a measurement, and now, wirelessly, they can send that data out of the hazardous zone to anyone who needs to know it," said Chris Petty, Thermo's general manager for portable optical analyzers. "Whether it's the control vehicle that could be back half a mile away—they can send text messages, full data or emails right from the handheld."

Petty added handheld XRF, infrared, Raman and near-infrared instruments are still seeing huge growth due to the high demand—something he expects to continue. He also said handheld instruments will likely keep expanding into a wider range of applications. Up to this point, these technologies have mostly been limited to jewelry, pharmaceutical, military, and mining and exploration applications.

"Now we're starting to see people taking the systems

and starting to measure asbestos in the field—for example, if you want to remediate a building," Petty said.

With Thermo's Niton XRF analyzers, the company is currently focused on building upon the products it released in 2010, added Jon Shein, Thermo's senior



◆The Ocean Optics STS microspectrometer, for use with OEM devices, is their smallest yet due to its CMOS detector.

marketing and communications director for portable analytical instruments.

Two big changes have meant greater demand for handhelds, such as Thermo's Niton XL3t and XL2 XRF analyzers. Since China, which exports 96 percent of the world's rare earth metals, recently started putting tighter export controls on those metals, there's been an increased call for production in the U.S., Canada, Australia, and other parts of the world, Shein said. As a result, there's a greater demand for instruments like the XL3t for rare earth metal analysis.

The XL3t system uses a 50 kilovolt X-ray tube to excite a broad range of elements and determine whether rare earth elements are present and if they're enriched in "light" or "heavy" rare earth elements. In May of this year, Thermo added a "pseudo element" function to the handheld.

"Customers can input calculations directly on the analyzer," Shein said. "[And] it'll help display the mineralogy as opposed to just the elemental concentration that may be found in the host rock."

Thermo also added stronger data export abilities to the device in June 2011.

The recent rise in gold prices earlier this summer, on the other hand, created a jump in interest from the goldbuying market for the Niton XL2 analyzers, Shein added.

Also keeping up with the continued trend of smaller instruments, Ocean Optics released its STS microspec-





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NALGENE

trometer for original equipment manufacturer (OEM) use earlier this year. At roughly the size of a cigarette lighter, it's their smallest yet.

"One of the reasons we were able to make it so small is that it uses a CMOS detector, which is much smaller than CCD arrays [that] are typical in miniature spec-

"It's unlikely portable instruments will ever replace the lab, but they will continue to supplement the work done in laboratories, making things easier for everyone."

trometers," said Ocean Optics director of marketing Rob Morris, of the low-cost device.

Although CMOS isn't as sensitive as those CCD arrays, Morris said they've been able to do some clever things at the optical bench to mitigate that trade-off.

"There [are] some things you can do with how you collect the signal to offset some of those [downsides] as well," he said. "This is one of the better-performing CMOS devices I've seen." He added the mini device is geared toward high-volume industries because of its low cost and is best for high-light-level applications, such as laser characterization, LED control, and solid-state lighting analysis. It can also be used for absorbance measurements.

As for trends in mini-spectrometers, Morris said there are now more types of the devices than there were in the past and all of them are becoming more compact and portable, to some degree.

"It used to be the CCD-based spectrometers were the only thing you could see in the miniature format," Morris said. "Now you've got all kinds of spectroscopy technology."

However, Richard Larsen, Ph.D., spectroscopy product manager at JASCO, added he doesn't think portable instruments will ever be able to fully replace instruments specifically for the lab because they just don't have as many capabilities due to their small size.

"A lot of these smaller instruments, you can't put a lot of the advanced experiments on them—they just don't have the capability to provide that type of interface," Larsen said. "Even though there is a move to providing a smaller platform, if you want to get into research, you've got to move up to the larger instrument. You really have no choice."

He added there haven't been many changes at JASCO

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in the past year in the area of portable instruments, although they're currently working on adding more features to what they call their portable FTIR instrument, while making it more compact. However, with the changing definition of portability, Larsen said he almost hesitates to call JASCO's instrument portable, but added it has its advantages, even though it's not handheld.

"Ours is more designed to be used almost like an engine for doing spectroscopy. It's not as big as our standard instruments; it's a more compact-type model," he said. "We've got the ability to use this for a lot of different types of experiments and put a lot of different types of accessories on it."

Portable TOC analyzers revisited

GE Power & Water, whose CheckPoint TOC sensor we focused on last year, has released a new portable version of its Sievers 5310C total organic content (TOC) analyzer for the municipal market this year.

"One of the biggest features of our portable is the ability to run with an autosampler and the ability to run online with it," said GE municipal applications specialist Erin England. "You can do either/or."

►GE Power & Water released a new portable version of its Sievers 5310C TOC analyzer this year for municipal users.



She added portable TOC analyzers are following trends similar to spectrophotometers—going smaller and being faster and easier to use—and GE will likely continue that path into the future. However, one of the main reasons for making the 5310C portable was the trend of customers demanding more flexibility and versatility from their instruments.

"We have some of our municipalities [that] use it in the lab, but then a pilot project comes up and they want to run online for a little bit. But then they'll bring it back to the laboratory," England said. "Or they may want to

check different points in their treatment process or take it out to the distribution center."

One drawback is that, while the 27-pound instrument can be carried around easily enough, it does need to be plugged into a power source because it doesn't have its own battery. But England said the 5310C is just as capable as instruments designed specifically for lab use.

"It's the exact same technology," she said. "The only difference is it's packaged into a smaller case."

Modular tweaks

Like the other vendors, there haven't been huge changes at Forston Labs since we discussed its LabNavigator modular field analyzer last year, but the company has continued to build on the handheld.

"What we've done within that product is just refocus and repackage the probes and sensors for specific industries," said Forston VP of sales Jeannine Machone. "For example, we're looking at hydroponics and packaging together different sensors that have always been available but putting them into different kits based on what kind of need the hydroponic operations have."

One big change to the instrument, which now has a suite of 31 sensors, has been the addition of a GC sensor option, partly in response to increased need from the



◆ Forston Labs has continued to build on its LabNavigator handheld with the addition of a mini GC sensor option this year.

ethanol testing, winery and distillery markets.

"Last year, the LabNavigator system kind of became known to the world, and the unique thing about it is that it is so versatile in the types of sensors that it can run," said Steve Zelenak, Forston president. "To add a gas chromatograph is a pretty significant step forward—you're looking at a cost, including the handheld interface, of under \$5,000 in comparison to anything else out

there that can be tens of thousands of dollars."

He adds that portability and cost reduction haven't benefited just those out in the field.

"You can also think of the guys in an industrial process, such as the fuel blenders," Zelenak said. "Because portable instrumentation has dropped in cost and is easier to use, they could be taking measurements far more often in the plant, getting their answers in minutes."

Machone sees portable instruments giving more power to decision makers in the future.

"More and more of them will go out to where the decision is required—out into the hands of the person who needs to make the decision, not the chemists," she said.

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

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SENSORLESS MICROPROCESSOR-MOTOR SYSTEMS MAINTAIN ACCURATE AIRFLOW EVEN AS HEPA FILTERS LOAD

by Jim Hunter, Mark Meinders, and Brian Garrett

Sensor-based feedback loops

In the late 1970s and early 1980s, the increased availability and reduced cost of electronic air velocity sensors made sensor-based feedback loops a viable solution for biosafety cabinet manufacturers. The first of these cabinets used an airflow sensor, specifically a thermal (hotwire) anemometer, to continuously measure the downflow velocity in a single spot in the work area. The velocity was reported to the biosafety cabinet's speed controller via a feedback loop. As downflow velocity dropped due to filter loading, the speed controller increased the blower speed to return the velocity to its nominal setpoint.

The biggest advantages of this technology are real-time airflow monitoring and the display of airflow in the biosafety cabinet. However, there are shortcomings to this design. The thermal anemometer consists of a small wire through which an electrical current is passed.

The air passing over the wire cools it proportionately to the air's velocity and the resulting temperature differential is converted to a voltage. The voltage is sent to the controller, which must interpret the voltage as an air velocity. Each sensor element responds differently to changing

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↑ The Purifier® Logic® Biosafety Cabinet is one example of a biological safety cabinet that uses sensorless airflow control.

velocities. Therefore, either the controller must be calibrated with its unique sensor, or a calibrated sensor with an integral compensation circuit delivering a standardized output must be used. Replacement can be expensive and requires a trained certifier and recertification of the unit after repairs are completed.

The most significant drawback to this technology is in the sensor's lack of accuracy. Typical thermal anemometer sensors used in biosafety cabinets have an accuracy of +/-10 percent, which allows for a considerable amount of fluctuation. Finally, the sensor itself requires annual recalibration to compensate for changing airflow patterns in the cabinet as well as sensor "drift" as it ages.

When the design was first introduced, a thermal anemometer to maintain biosafety cabinet performance was a vast improvement over the manually adjusted speed controls that were originally used. However,

its inherent drawbacks have led manufacturers to seek more robust and reliable methods to automatically compensate for changing airflows as the HEPA filters load.

"The most significant drawback to [sensor-based feedback loop] technology is in the sensor's lack of accuracy."

Sensorless girflow control

In 2007, Labconco solved the intrinsic problems associated with using sensors to monitor and automatically adjust motor speed to compensate for filter loading. One goal in the development of the Purifier® Logic® Biosafety Cabinet was to incorporate better, more efficient motor technology. To that end, a direct current (DC) electronically commutated motor (ECM) was installed in place of the conventional alternating current (AC) permanent split capacitor (PSC) motor.

The ECM offers numerous advantages over earlier PSC technology. Its inherent efficiency offers an energy savings of 50 percent or more, while its rugged design provides an operational lifespan approximately three times longer than that of the PSC motor. The cooler operation of the ECM minimizes the increase in air temperature in the working environment of the biosafety cabinet, promoting user comfort. Microprocessor sensing and control of motor speed and torque allow for the programming of the motor to deliver constant air volume to the biosafety cabinet even as HEPA filter loading changes.

Constant Airflow Profile (CAP) technology

The process of "teaching" the ECM to

deliver constant airflow volume, the Constant Airflow Profile (CAP), was developed by Labconco. In order to program the ECM to maintain a nominal airflow, engineers recorded the speed and torque requirements of each size cabinet at a variety of different airflows and HEPA filter differential pressures. The speed, torque and airflow data was processed using software provided by Regal Beloit to generate a unique performance profile for the ECM (Figure 1).



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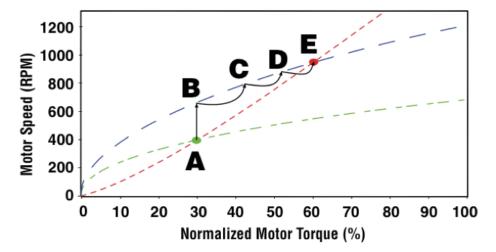
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♣ Figure 1. This graph illustrates how the ECM motor maintains constant airflow. The CAP (red) line indicates the motor torque and speed required to maintain a constant volume of 800 cubic feet per minute (CFM). This line is programmed into the motor as a series of constants generated during the characterization process. The green dashed line represents the starting filter pressure in the biosafety cabinet. As the HEPA filters load, the new pressure will be represented as the blue dashed line. The biosafety cabinet is operating stably at point "A," until the filters load. The blower then speeds up to point "B," a result of increased pressure and reduced airflow. This increase in speed (referred to by some as "self-compensation") happens with any type of motor (see the "Self-Compensating Blowers" sidebar for further discussion). Unlike the PSC motor, which would remain at point "B," the ECM checks its speed and torque. Because point B is not on the CAP line, the ECM increases its speed and torque to points "C," "D," and finally "E" until its speed and torque fall back onto the red line.

"With CAP technology, there are no sensors to recalibrate or replace."

With this process, CAP technology has solved the previously encountered problems with airflow monitoring. As discussed above, thermal anemometers require routine calibration. With CAP technology, there are no sensors to recalibrate or replace. Therefore, maintenance and equipment replacement costs for these airflow monitoring devices have been eliminated. In addition, this robust design is not susceptible to temperature and humidity fluctuations that can plague thermal anemometer-based systems. Perhaps the most beneficial advantage to this design is its inherent accuracy. Testing performed at Labconco Corporation has demonstrated that airflow is maintained with only a 1 to 2 percent change as the HEPA filter loads. Figure 2 shows a representative data sample from this study.

Conclusion

Significant strides have been made in the last 40 years to maintain constant airflows in biosafety cabinets. Simple chopping circuits and differential pressure gauges have given way to sensor-based control systems. These, in turn, are now being supplanted by sensorless microprocessor-motor systems, which are capable of maintaining accurate airflow volume even as the cabinet's HEPA filters load. One sensorless system uses CAP technology, which offers the advantages of tenfold accuracy and reliability, and the elimination of periodic recalibration of airflow sensors to ensure proper airflow.

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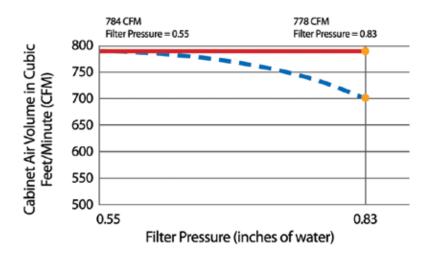
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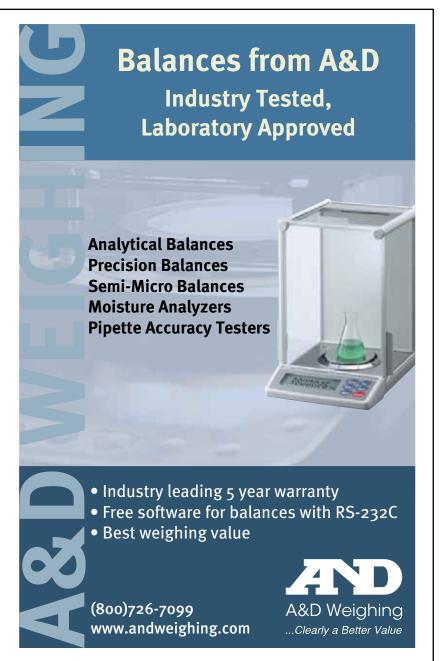
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◆Figure 2. This graph illustrates actual test results from NSF International on a Purifier Logic Type A2 Biosafety Cabinet powered by an ECM with CAP technology and a biological safety cabinet powered by a PSC motor. In the Motor/Blower Performance Test as defined in NSF/ANSI Standard Number 49, a new biological safety cabinet's total volume of air displaced by the blower is measured. The cabinet's front grille is then restricted to simulate an additional 50% load on the HEPA filters. The total volume of air is measured again and compared to the initial value. In the graph shown, the Purifier Logic Biosafety Cabinet with the CAP technology saw its volume decrease from 784 to 778 CFM, a loss of 0.7% (represented by the red line). The biosafety cabinet with the PSC motor saw a loss of approximately 60 CFM, or 8% (represented by the blue dashed line). These results demonstrate that the Purifier Logic Biosafety Cabinet maintains airflow at more than ten times the accuracy of the PSC-powered biosafety cabinet.

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LABORATORY ACOUSTICS

HOW A CONSENSUS APPROACH TO PLANNING AND DESIGN CAN ENSURE DESIRED ACOUSTICAL PERFORMANCE by Gary McNay

Understanding basic acoustic space design criteria and strategies that building managers, users, planners, and designers can use to recognize and address the acoustic needs of laboratory spaces is deeply important for collaboration and efficiency in labs. This article suggests methods for minimizing the negative impact of HVAC systems and laboratory equipment often used in lab spaces.

The expectations for the acoustical performance of teaching and research labs have changed since many of the design standards were created. Older standards were based on assumptions about lab use and noise that may no longer be appropriate.

"Collaboration is one of the keys to research advances, and noise should not prevent easy communication in a lab."

When planning for new or renovated lab space, it is important to clearly state the expected functions of the space and the required acoustical properties; this allows the HVAC design professionals to accommodate the acoustic needs.

The following four considerations are critical in laboratory noise control:

- 1. Understand the communication needs of the space.
- 2. Reference the appropriate acoustic metrics for the design and intended use.
- 3. Contain equipment and utility noise.
- Integrate energy efficiency and acoustics in the HVAC design.

Each of these is discussed below.

Understand the communication needs of the space

Labs have a wide range of functional needs; however, human communication needs tend to be consistent across lab types. For example, teaching labs often function as both a full-service lab and a classroom. Since in-lab lectures and discussions are the norm, a teaching lab may need to exhibit acoustic properties similar to those found in a classroom to support all learning models. Instructional labs must also support individual work, teamwork, and a variety of presentation and discussion methods, including AV systems with or without amplified sound.





Research teams need spaces where people can easily communicate detailed information that may affect their safety and the accuracy of the research data. Scientists and lab technicians on a single team commonly speak a variety of native languages, with English as a second language. They must be able to communicate in the lab environment without confusion or fatigue. Collaboration is one of the keys to research advances, and noise should not prevent easy communication in a lab. If scientists have to move to another space to have an effective conversation, the opportunities for conversations that move the science forward are reduced.

In research labs, the current level of collaboration,



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team communication, and cell phone conversation requires a reevaluation of the acoustic requirements. In a typical biology, chemistry, physical science, or interdisciplinary lab, teamwork is common and often requires a setting more like an open office, in which normal conversation is an important part of the daily function.





Reference the appropriate acoustic metrics for the design and intended use

The most common measures of background noise are dBA (decibel A-weighting)—a measure of sound that de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear—and NC (noise criteria)—an index of sound pressure levels based on equal loudness curves. The dBA measurement is approximately equivalent to an NC rating of +5, so, for example, a dBA measurement of 35 would roughly correspond to an NC rating of 30. The NC ratings are used herein. This article does not seek to establish the exact NC ratings required for lab spaces; rather, it suggests that readers consider lab acoustical design criteria based on a more current understanding of the verbal communication and collaboration that occurs in most labs.

"Using the term 'laboratory' in a planning document may be unwise if the space is actually a 'dry' computational lab."

For more information, the ASHRAE Handbook provides design criteria for minimizing background noise in a variety of spaces, and the ANSI/ASA S12.60-2010/Part 1 Acoustical Performance Criteria, Design Requirements, and Guidelines includes more specific criteria for learning spaces (see Additional Resources below).

During the programming phase for a new or renovated facility, the acous-

tic design criteria are established with reference to the dBA or NC standards noted above to provide a space that works well for its intended use. Mechanical engineers, architects, and acoustical consultants then work together to provide systems that meet the established criteria.







The established acoustic design criterion for a class-room is typically NC 25 to 35, and the criterion for a laboratory is NC 45 to 55, yet the functions are not very different. Ultimately, the acoustic needs for a teaching lab may be no different than those for a classroom.

It is important that the word "laboratory" not be used as a blanket term when programming acoustical metrics in a given space. When "laboratory" is used in a programming document, it is commonly misconstrued and interpreted as a space that includes fume hoods and/or processes that are noisy and assume a default lab NC of 55. The traditional standard of NC 55 was based on the assumption that one could not justify the cost of reducing the noise level further due to the high air-change rates and/or hood use—not on a good understanding of the communication needs in a lab. A space designed for NC 55 is near the threshold at which fatigue and stress are the natural results of trying to speak or hear normal speech over the background noise.

Using the term "laboratory" in a planning document







may be unwise if the space is actually a "dry" computational lab, such as that used for bioinformatics or computing research. A typical research lab, wet or dry, could be considered acoustically similar to an open office with an NC rating of 40 or less. A computing-based lab that requires constant collaboration and teamwork throughout the day may be more appropriately treated as a conference room, which has an acoustic NC rating of 25 to 35.

Thus, more clearly defining the acoustical function of the space in addition to the NC criteria during a lab's design phase is recommended to avoid misunderstandings that could impact the lab's acoustical properties.

Contain equipment and utility noise

Sources of noise that must be managed include the supply air system, supply valves, and general and fume hood exhaust ducts. Equipment such as vacuum pumps, chillers,

> and other noisy process equipment should be housed either in a lab cabinet lined with acoustical material or in another room away from the open work environment.

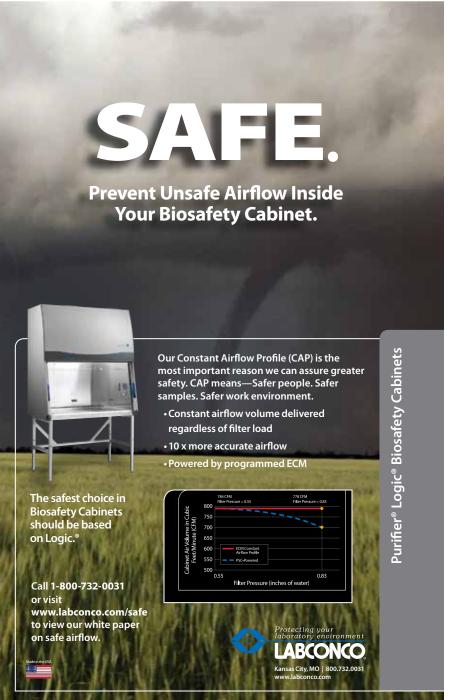




Noise-producing refrigerators, freezers, incubators, centrifuges, and environmental chambers should be kept in equipment rooms or alcoves when possible. Computer server racks and their associated cooling systems should also be in enclosed spaces.

High-bay labs, robotics labs, and various types of engineering labs are often designed without ceilings to afford greater overhead clearance and flexibility to accommodate unique structure-mounted apparatuses. In spaces without acoustical ceilings, more attention must be given to additional sound reduction. Placing supply terminal units in acoustical containers or outside the lab above a corridor ceiling helps. Supply air valves for hoods will need additional sound attenuators in a ceilingfree room.

Duct noise due to excessive supply air velocity is another culprit. Maintaining a design airflow rate of 300 to 500 feet per minute (fpm) at a terminal unit is good practice to minimize



unnecessary noise due to air velocity. Individual terminal units for private offices and multiple smaller terminal units in larger spaces will help keep the airflow velocity

within the appropriate range for an acoustically comfortable work environment. When possible, low-flow/high-performance hoods with lower-containment airflow velocities of 60 to 80 fpm can help reduce noise

"Sources of noise that must be managed include the supply air system, supply valves, and general and fume hood exhaust ducts."

Supply and exhaust ductwork for labs cannot include internal acoustical lining. However, insulated, nonmetallic flexible duct often can reduce noise at the final run to

> a ceiling diffuser or can be used for the first few feet of a small general exhaust duct.

Axial-type exhaust fans characteristically generate the least low-frequency noise of any of the fan types, given good aerodynamic flow conditions.

when the sash is open. Radiused and/or tapered exhaust transitions and multiple exhaust outlets for hoods more than six feet wide will also help reduce noise generated by the hoods.

Air handlers can be an additional source of unwanted noise. Fan array technology that includes multiple smaller fans inside the air handler unit instead of a single, large fan helps reduce low-frequency noise and provides greater flexibility to serve changing/dynamic loads.

Integrate energy efficiency and acoustics in the HVAC design

Chilled beams and Venturi wedges are becoming more prevalent in labs with equipment-driven cooling loads and lower air-change rates. When radiant ceilings or chilled beams are used in an open office environment, they temper noise levels in the space with much less







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Shimadzu Scientific Instruments 7102 Riverwood Dr., Columbia, MD 21046 airflow than a typical variable air volume (VAV) system. Because of the higher chilled water temperature and elimination of the reheat typical for a VAV system, the chilled beam system is much more energy efficient. It is not unusual for a radiant ceiling or chilled beam system to have a background noise level of NC 20. Some believe this is a problem insofar as it limits speech privacy. Others suggest it contributes to a sense of community and collaboration.

The trend toward lower air-change rates in labs helps to reduce energy use and improve overall acoustical quality in lab spaces. Systems that monitor lab air quality and deliver fresh air on an as-needed basis also help to reduce air noise and energy use.

Perhaps one day it will be common to consider the acoustical properties of a lab as part of the typical building commissioning process. Until then, designers, planners, and building managers need to bear in mind the four considerations discussed herein when planning laboratories of all types. A consensus approach to reducing lab noise will lead to greater assurance that the desired acoustical performance will be achieved.

Additional Resources

Note: There are very few publications on laboratory acoustics. Most of the references below are for learning spaces, but the concepts described in the documents are transferable across space types to some degree.

- · ASHRAE Handbook, HVAC Applications Volume, American Society of Heating, Refrigerating and Air-Conditioning Engineers, ASHRAE 2011, Chapter 48, Table 1 http://www.ashrae.org/publications/page/158
- ANSI/ASA S12.60-2010 Part 1 Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools, Part 1 Permanent Schools. http://asastore.aip.org/shop.do?pID=594
- Acoustical Barriers to Learning/Classroom Acoustics II, Acoustical Society of America, 2002 http://www.centerforgreenschools.org/docs/acoustical-barriers-to-learning.pdf
- Acoustic Comfort, Whole Building Design Guide, National Institute of Building Sciences www.nibs.org/
- Classroom Acoustics, Acoustical Society of America, 2000 http://acousticalsociety.org/about_acoustics/acoustics_of_classrooms

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INTHEHOOD

WHAT YOU SHOULD CONSIDER WHEN SELECTING A CHEMICAL FUME HOOD by Vince McLeod

One focus of laboratory management is equipment, and a basic fixture in any laboratory is the chemical fume hood. We recently had an issue with a chemical hood that we think is a common occurrence, and we feel it is a good time to discuss chemical fume hood design and installation. Consider the following scenario:

A new building was constructed for research and included several chemical hoods. The hoods and ducts were selected based on feedback from principal investigators. However, after securing a new research grant, a PI shifted the focus of one of the labs toward concentrated hydrochloric acid digestion. It didn't take long before green slime began dripping down the back panel and forming a puddle in the back of the lab's hood. Shortly afterward, the hood stopped working altogether, and the call went into Environmental Health and Safety to investigate.

Obviously, we had a duct material compatibility issue. The acid fumes from the complete digestion work were eroding the stainless steel duct. Only fiberglass reinforced plastic (FRP) duct materials should be used for acid digestions. Unfortunately, the fix for this situation was expensive and required a completely new exhaust system for the hood. To help labs avoid this and other pitfalls related to chemical fume hoods, we are providing information on design and installation for chemical hoods.

General laboratory ventilation considerations

Before we get to the specifics for chemical fume hoods, there are a few basic ventilation rules that should be incorporated into all research labs where potentially toxic or hazardous chemicals are used. First, provide proper general ventilation. All labs should have mechanical supply and

exhaust. The supply should use 100 percent outside air and be exhausted to the outside.^{1,2} In other words, neither the fume hood nor lab exhaust should be returned or recirculated. The general supply is not for protection from exposures but provides a continual supply of fresh outside air to prevent the buildup of fumes, vapors and particulates.

Second, keep chemical laboratories under negative pressure in relation to the adjacent non-laboratory rooms, offices and corridors.² If there is a spill or release, the contaminates will keep from spreading into surrounding rooms and offices and, instead, will be exhausted outside. Generally, the airflow should be from low-hazard areas to high-hazard areas. Proper pressurization is maintained by balancing the ventilation system.

A good rule of thumb is to provide make-up air equal to 90 percent of exhaust volume. However, pay attention to design of make-up air systems. They should be introduced so that air patterns and negative pressurization are maintained. Locate make-up supplies at the end of the lab

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PROVIDE AN APPROPRIATE SUPPLY OF FIRST AID EQUIP-MENT AND INSTRUCTION ON ITS PROPER USE

By James. A. Kaufman

There are some emergencies that can't wait five minutes for EMTs to arrive. Severe bleeding is one of these. A person can bleed to death in three to five minutes depending on the severity. Employees need to be available to deal effectively with this and other serious emergencies.

OSHA specifies in 29 CFR 1910 that first aid kits need to be specified by the consulting physician. Employees should be trained in the appropriate use of the materials provided. First aid and CPR courses can be offered. You can't expect people to respond properly to emergencies unless they have an opportunity to practice.

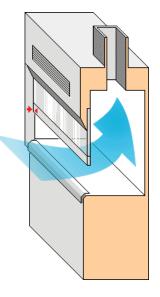
Proper first aid in the case of a spill of chemicals on a person is to use the safety shower in less than ten seconds and to remove all contaminated clothing immediately. This is no time for modesty (although shower curtains or fire blanket screens are appreciated).

You never get good at anything unless you practice. Make up a card that says: "You have just splashed concentrated nitric or sulfuric on yourself." Drop the card on one of your employees or students two or three times a year to start the safety shower/fire blanket drill. If you generate one or two less data points that day, it's ok. You've just said to everyone (by your actions) that working safely in the lab is more important than making widgets!

Speaking of first aid, what's the first thing you do if your clothing is on fire? That's right ... stop ... drop ... and roll.

What's the second thing? Ah ha! Not as easy. The correct answer is lots of cold water in the shower to take the heat away to stop the "cooking" process.

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



opposite from the fume hood. Try to plan HVAC systems and hood exhausts so they complement rather than fight each other in regards to flow patterns.

A third recommendation is to provide at least six general ventilation air changes per hour for your chemical laboratory.¹ This means the total volume of air in the lab is replaced six times every

hour. In general, room air velocities should not exceed 50 feet per minute or 20 percent of the average face velocity around fume hoods. This minimizes interference with proper capture and hood operation.

Ventilation system ducting should also be scrutinized. Ducts should not contain any internal insulation. Use external insulation if needed. Using the right air velocity will preclude the need for acoustical insulation (see below).

Do not use air speeds too high for the duct size, and keep velocities at optimum levels. Air velocities should be high enough to prevent any condensation of liquid or condensable solids on the duct walls. The ACGIH recommends velocities from 1,000 to 2,000 feet per minute.³ All horizontal duct runs must slope at least one inch per ten feet downward to a suitable drain in the direction of airflow.

All ventilation should be ducted, and corridors and ceiling spaces should not be used for plenums. Fume hood exhaust ducts must be constructed entirely of noncombustible material. Any gaskets must be resistant to chemical degradation and fire.

Design location principles for fume hoods

Layout of the laboratory and location of the chemical fume hood is very important for optimum performance and minimal interference. Fume hoods must not be located near doorways or exits. Ten feet from any door or exit is recommended by the National Fire Protection Association. The reason is obvious. Should a fire or chemical release occur, the exit would be blocked.

Also, to the extent possible, locate fume hoods away from high-traffic areas, air supply diffusers, doors and windows. Any area that produces air currents or potential turbulence could affect the ability of the hood to capture and exhaust contaminates as designed.

Do not locate chemical fume hoods opposite worksta-

tions, desks, microscope benches or other areas where personnel spend significant time. As above, the reason should be obvious, as any incident in the hood could involve or injure anyone seated in front of the hood.

Ensure that there is an emergency eyewash and safety shower within ten seconds of every fume hood. This is a requirement wherever a worker could be exposed to corrosive, toxic or severely irritating substances.

One final recommendation is to make sure cabinets and equipment do not block or interfere with the fume hood opening or the laboratory's supply or exhaust vents. Very often we inspect labs and find things stored on top of cabinets or in front of hoods or vents, completely disrupting the air flow.

Maintaining fume hood performance

When we think about chemical fume hood performance, the first thing that comes to mind is face velocity. Granted this is important, but hitting a specific number should probably not be the primary focus. Although the OSHA Lab Standard (the OSHA standard for Occupational Exposure to Hazardous Chemicals in Laboratories, 29CFR1910.1450) does not specify procedures for safe hood operation, exhaust volumes or face velocities, it does contain this statement, albeit in

the non-mandatory Appendix A: "Airflow into and within the hood should not be excessively turbulent; hood face velocity should be adequate (typically 60-100 lfm)".

The generally accepted consensus is for face velocity to be around 100 feet per minute on average. We feel it is more important to provide an airflow indicator and routine performance certification or testing. The flow indicator should be located so it is easily viewed from the front of the hood. It could be a magnehelic gauge that shows inches of water and is marked for a corresponding 100 fpm, a digital FPM readout, both with audio and/or visual alarms, or a simple strip of yarn or Kimwipe®. The key is a visual indication that the hood is exhausting.

The next most critical part to maintaining hood performance is a regular check or testing of fume hood flows. Routinely checking the hood for adequate flow and velocity must be incorporated into your lab safety program. We recommend you post flow test results or performance checks directly on the hood and request a recheck if you suspect a problem.

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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.



GENTLE MIXING, AERATION FOR BIOLOGICAL SAMPLES by Angelo DePalma, Ph.D.

"Shaken, not stirred" was James Bond's preferred mixing method for martinis. Similarly, biological shakers aerate and mix cells with their media by the action of a moving platform. Shaking is often preferred with cell cultures because overhead or magnetic stirrers can induce shear damage in cells and are impractical with multiple culture vessels.

Shakers may be deployed inside or outside incubators, depending on the requirements of the specific cell or organism. They are common equipment in pharmaceutical, biotechnology, and vaccine development, as well as in biological safety and environmental labs.

Shakers lend their name to another category of cell culture product, the *shaker flask*, a cell culture vessel specially designed for use with shakers. Until the advent of large-scale cell culture, many vaccine manufacturing processes occurred in shaker flasks.

The two main shaker designs are orbital and reciprocating. In the former, the platform rotates around a perpendicular axis, creating a vortex; in the latter, vessels are moved back and forth within the platform's plane. Of these two basic models, orbitals predominate.

A third type of shaker employs a rock-

50

ing mechanism. GE Healthcare (Piscataway, NJ) sells several benchtop units that handle sealed, disposable plastic bags laid on their sides, with volumes ranging from 50 to 500 mL. These products are scaled-down versions of the company's much larger (up to 1,000 liters) bioprocess bags, which also employ rocking to mix and aerate cells.

"Biological shakers have experienced several technical upgrades over the last three years."

Despite their maturity as a product category, biological shakers have experienced several technical upgrades over the last three years. User interfaces have improved, as have data acquisition and other advanced features. Thermo Fisher Scientific has introduced stackable shakers to improve capacity in space-strapped labs and Boekel Scientific sells a shaker with multiple speed ranges, while Grant Instruments markets linear shaking baths for highly sensitive microbiology work.

Saturated with options

"Orbital designs provide maximum mixing or aeration based on the orbital velocity," explains Scott Egyed, director of sales and marketing at Boekel Scientific (Feasterville, PA). Boekel manufactures shakers ranging in size from tabletop to high-capacity floor models.

Unlike some instrument types, for which components may be "mixed and matched" to provide custom configurations, shakers are typically sold off-the-shelf with little customization. "The market is saturated with options," Mr. Egyed says, that include size, footprint, capacity, clamping or hold-down methods, and other features.

Customization may occur when working with unusually shaped vessels or specialized cell cultures. Boekel has also received requests for integrating small orbital shakers with carbon dioxide incubators. This setup is suitable for biological samples that thrive in anaerobic environments and require temperature control as well.

Microtiter plates require some special care when subjected to auto-

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mated shaking. "You need a system with a good hold-down mechanism," explains Mr. Egyed. Some systems use clamps or spring-loading to keep plates from slipping on the platform. The other consideration is a means of sealing plates without encouraging condensation or leaching of foreign materials into the wells.

Product manager Kristoff O'Connor at Heidolph USA (Elk Grove, IL) notes that microtiter plate shakers have become more common during the last few years. Shakers enable "reformatting" plates from lower to higher densities. During this operation, a 96-well plate is charged with cells and shaken. After the cell populations expand, they are transferred robotically to a 384- or 1536-well format. From there, cells may be subjected to assays or imaging, according to the experimental protocol.

Despite the wealth of feature possibilities, Eberbach Corp. (Ann Arbor, MI) does "quite a bit of custom manufacturing" of its shaker products, according to company president Ralph "Trip" Boehnke III. "A fair number of our customers want something they cannot find in a catalog."

Eberbach's flexible manufacturing approach enables it to quote a custom unit at a price that is "very competitive" with other vendors' standard models, Mr. Boehnke adds. "Customization is our niche."

The key to Eberbach's success may lie in their strong presence in non-lifescience markets. The company sells shakers to the petroleum and biofuels industries, where desirable features include explosion-proofing and motorized controls. Biofuels plants that culture bacteria for pilot production sometimes require a shaker with a capacity of 300 pounds. "Not many off-the-shelf shakers can handle that," Mr. Boehnke says.

"Shakers are typically sold off-the-shelf with little customization."

Eberbach has recently introduced a model with a wired remote controller for operation inside cold rooms or fume hoods; the company is contemplating a wireless remote.

What to look for

The feature-richness of biological shakers is a blessing but should also raise red flags for potential buyers. Heidolph's Kristoff O'Connor says the first consideration should be capacity, specifically how much weight the shaker can handle compared with the weight of flasks plus contents currently run. Purchasers should also consider the possibility of future expansion. "Because shakers are a workhorse product, buyers should strongly consider the length of the warranty."

The third set of criteria are "reproducibility" features such as digital display,

timers, and alarms. Finally, consider the environment in which the shaker will be used—benchtop, fume hood, incubator, or cold room—and how it will be cleaned. "Purchasing a shaker that does not meet the standards of its intended operating environment will shorten its usable life and possibly void its warranty," Mr. O'Connor says.

"Users want a controllable shaker that will provide the same or better results from one run to the next," observes Eberbach's Ralph Boehnke. "Our customers don't ask for too many exotic features. The main thing they're interested in is robustness, a shaker that will run continuously without problems." Nevertheless, customer service "must be top-notch" since units do occasionally break down.

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

CONTROL SOFTWARE AND DATA REPOSITORIES IMPROVE INSTRUMENT UTILIZATION

by Angelo DePalma, Ph.D.

Chromatography data systems (CDSs) are software packages that perform two basic functions: They control the mechanical and electronic functions of analytical HPLC, GC, and capillary electrophoresis systems, and they perform data acquisition and processing.

Simple instrument control software traditionally supplied by the instrument vendor operates in "workstation" mode, where all data is stored and massaged on a local computer. In some instances, one computer can run several instruments.

This has been the default configuration for CDSs until fairly recently, notes Mark Harnois, director of informatics product management at the ability to become more efficient by increasing instrument utilization and tracking usage status, says Christoph Nickel at Agilent's Waldbronn, Germany, site.

CDS packages store analytic information such as chromatograms, peak analysis, areas under curves, calibration and calibration curves, user/usage information, and run times, while performing advanced statistics, providing audit trails, and generating reports. All data systems must be compatible with the various detection method(s) and combinations that may include UV, visible, refractive index, electrochemical, flame ionization, photodiode array, and mass spectrometry.

any analysis, from fully documented and validated runs for QC or batch release to quick runs for early-stage development work.

The operative term here is "usability," and its key components, says Mr. Nickel, are an intuitive interface and built-in workflows. "The software should make complex tasks easy." Agilent CDSs, for example, incorporate "intelligent reporting"—a graphical, dragand-drop system for creating reports.

The connectivity option

Many modern CDSs both operate in workstation mode and interact with

corporate networks at the laboratory, site, or enterprise level. Waters' Empower 3 software, for example, operates as a fully stand-alone package, but its strength is its performance on an enterprise-wide computing platform.

Networking CDSs has the usual benefits: Data is available across the network, providing access to collaborators across the hall or around the

"The business justification for CDSs is the ability to become more efficient by increasing instrument utilization and tracking usage status."

Waters (Milford, MA). "Most chromatography data systems today are deployed in workstation mode."

The business justification for CDSs is

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CDSs also store chromatographic methods, and some provide functions that speed method development. Users can define the complexity level for

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world; data remains in one controlled location (plus a backup), so it's easier to control; and methods are easier to transfer when every potential user works on the same IT platform.

CDSs with higher networking capability can communicate with other instruments and computers, supervisory software, laboratory information systems, and electronic notebooks.

"Companies may decide to enter networking through a small group, then across a department or facility," says Mr. Harnois. But eventually, the need for a unified data platform becomes obvious.

Where older data systems employed a flat file database system, networked CDSs employ more advanced relational databases, which are much more suited to advanced IT platforms. Relational databases are superb at storing chromatographic data, generating reports, and allowing sharing over networks. The cost for achieving this flexibility is reflected not only in purchase price, but in software complexity.

Larger laboratories, particularly in regulated environments, tend to select networking options, whereas small operations with two or three instruments still rely on what April DeAtley, product planning manager for liquid chromatography at Perkin Elmer (Shelton, CT), calls "a single point of access."

To network or not to network?

According to Ms. DeAtley, companies deciding on chromatography control and data software need to consider the number of instruments involved, workflow complexity, data control, and permissioning. Who gets to view and manipulate the data? Who will control certain reports? Do results af-

fect QA/QC or regulatory processes?

She notes that large nutraceutical manufacturers were recently required to comply with FDA manufacturing and purity regulations; eventually even smaller labs will follow suit. "So even with just four or five instruments, if you need to document every analysis fully, it may be worth considering going the client-server route."

Many small labs are completely satisfied with CDSs that operate exclusively in workstation mode. But the drawbacks, even for some labs where networking might be overkill, are apparent. Each workstation requires its own security, archiving, and updating, and users need to be retrained if they switch from one vendor's instrumentation to another's.

"Having different data systems for every instrument, or even for every GC or LC, would be a nightmare," says Mr. Harnois.

Moreover, data harmonization would become a huge issue if the company did decide to move everything to even a modest-sized network, or if it doubled or tripled its instrument base.

Workstation-only software packages may save money up-front, but substantial reconfiguration likely will be needed if the lab decides to connect all its instruments through a client-server network. "You can't just plug instruments into the new system. It will probably require a completely different software package," Ms. DeAtley tells Lab Manager Magazine.

One step chromatographers are apparently unwilling to take at this juncture is to transfer all their data to the "cloud"—an off-site storage location. Although web-only or electronic notebooks have begun to catch

on and appear to be successful, cloud computing has not yet emerged for CDSs. "It's definitely something to consider," says Ms. DeAtley, "but its drawback is security."

Complete interoperability? Not yet

An industry-wide trend toward consolidation has left fewer, larger companies serving the software needs of chromatographers. At the same time, the need to harmonize instrument software to enterprise platforms has strengthened. These two factors have led to emerging standards that allow the connection of major manufacturers' instruments with other vendors' software packages. "It's absolutely necessary for each data system supplier to provide at least a generic interface with documentation," says Mr. Nickel. The systems are not quite plug-and-play—yet—but that is what large vendors are shooting for. "This is a long-term objective for Agilent, not just for instrument control but for data formats as well."

Options exist even for smaller instrument vendors. For those lacking the development bandwidth for such projects, Waters will refer them to third-party software specialists.

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STREAMLINING WORKFLOWS WHILE IMPROVING ACCESSIBILITY

by Angelo DePalma, Ph.D.

From the perspective of Shimadzu Scientific Instruments (Columbia, MD), gas chromatography sales closely follow the ups and downs of specific economic sectors related to energy and the environment. According to GC product manager Mark Taylor, the uptick in sales to government and government-funded research during 2010—likely due to stimulus money trickling down—has abated. A fair portion of that demand came from biofuels R&D.

Through early 2011, sales to the petrochemical industry picked up, which Taylor attributes to the rise in energy prices. "With fuel so expensive, it became economically viable to tap into energy sources that are more costly to reach or clean up," Mr. Taylor tells *Lab Manager Magazine*.

Although demand from this sector has slowed somewhat, interest in GC from the environmental sector remains vibrant. Greenhouse gas analysis driven by government regulations and pure academic research is on the rise. For the most part, instruments sold into this sector are turnkey, black-box systems, Mr. Taylor says. "They're all fully 'applicated," as are most GC systems sold today.

Up in smoke

Now that medical marijuana is legal in about a dozen states, testing for marijuana potency is an up-and-coming application. Scott Bergeron, applications manager at Buck Scientific (Norwalk, CT), wryly observes that "for reasons you'd expect we see a lot of non-chromatographers undertaking that particular analysis." Dispensaries

"Interest in GC from the environmental sector remains vibrant."

are interested in the relative quantities of THC and other cannabinoid constituents in pot because their relative abundances affect the drug's potency for relief of pain, nausea, or stress.

Buck Scientific custom-builds every GC system it sells. Mr. Bergeron describes his firm's products as "user-friendly but not high-throughput," and the instruments are not available directly from Buck with mass detectors.

One can construct a good argument for custom-building: Customers only pay for what they need, so prices are often lower than for off-the-shelf systems. "It's an à la carte sort of deal," Bergeron tells *Lab Manager Magazine*. "Customers can specify detectors and whether they require split or splitless injection, purge-trap capability, or autosamplers. Some of our purchasers have added mass detectors, but we do not service or support them."

Custom-building works well because many GC purchasers are unsure of the features they really need. Buck stocks several column oven types and system case sizes. But based on the application, any number of injectors or detectors (or combinations of detectors) might be appropriate. For example, labs analyzing fatty acid methyl esters require a split-splitless injector and a capillary column, whereas academic

require a split-splitless injector and a capillary column, whereas academic labs should select a conventional injector, Mr. Bergeron advises, "so students have a harder time messing them up."

Two interesting and fairly recent trends in GC systems are "fast GC" and the use of hydrogen as the carrier gas.

Hydrogen is much less expensive than helium. It also has superior optimal linear velocity and produces a very low effective plate height, meaning more theoretical plates are available for a given column length. Because of

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its lower density relative to helium, hydrogen works extremely well with very narrow-bore columns. In one test run, Supelco, a subsidiary of Sigma-Aldrich (St. Louis, MO), has published data on separations with hydrogen on a 0.1 mm ID column that were impossible with a helium mobile phase due to the high backpressures.

Fast GC provides benefits of lower instrument and human resource costs, higher revenues for high-throughput testing or service labs, and more rapid method development. Perhaps best of all, these benefits accrue with no additional capital investment. Ultra-high-performance liquid chromatography, by comparison, requires purchasing an instrument capable of generating and withstanding high backpressures.

Fast GC is achieved by shortening column length, ramping up temperatures faster, and raising the carrier gas flow rate. The negative effects on resolution are countered by narrowing the column's internal diameter, reducing the film thickness, and (a second trend) switching from helium to hydrogen carrier.

Not everyone is enamored with fast GC. According to Shimadzu's Mark Taylor, methods involving rapid temperature-ramping in resistively heated columns are "not mainstream."

He notes that traditional fast GC is a high-pressure, high-gas-flow technique conducted in very narrow columns with high split ratios.

Very narrow-bore columns have very low volumes, and therefore low sample capacity. Trace compound analysis may be limited due to the quantity of sample that may be injected. The other challenge is the difficulty in transferring methods from conventional GC/column formats to fast GC. Busy analytical labs must weigh the benefits of shorter analysis times vs. revalidation of methods already working perfectly with conventional GC.

Technological limits

Agilent Technologies (Santa Clara, CA) GC product manager Dave Johnson observes that top GC vendors have all introduced technologies for enhancing and simplifying workflows while improving productivity.

Historically, advanced features were deployed for early-adopter expert users. But the vast majority of GC users today lack the experience, and cannot devote the time, for hacking complex instrumentation. "To make these technologies more accessible to a broader user base, major vendors are offering factory-built, preconfig-

ured 'analyzers and solutions," Mr. Johnson says, and this accessibility extends to sample preparation.

Sample and standards preparation is time-consuming for any instrumental analysis, particularly for GC. Some industries, such as biofuels, require users to formulate calibration standards through complex processes that take hours.

Agilent has recently published an application note (find it at http://bit.ly/n3Mdue) describing a technique, enabled by an automated liquid handling system, for derivatizing glycerol, monoglycerides, and diglycerides, and subsequently adding an internal standard to biodiesel samples. According to Mr. Johnson, this technique has evolved from a "fairly basic" liquid-handling exercise to a fully automated technique based on an Agilent liquid handler.

"Customers are increasingly asking for help on the front end as well as with the instrument, methods, and detectors," Mr. Johnson adds.

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STRUCTURAL IDENTITY FOR LC, GC SYSTEMS

by Angelo DePalma, Ph.D.

Early in the evolution of chromatography-mass spectrometry, one could consider the two components as separate boxes requiring a good deal of engineering to link them together.

Today, providing the integration and interoperability demanded by GC-MS or LC-MS users is virtually impossible without designing both instruments with the other in mind—and in most cases together. "Customers today view GC-MS or LC-MS as a single solution," says Dr. Steve Smith, senior director for mass spectrometry products at Waters (Milford, MA).

Integration is the main reason for the virtual disappearance of the specialist GC or MS supplier that produces chromatographs for someone else's mass detector, and vice versa. The level of component and software interoperability demanded by end users practically invalidates this business model.

Although chromatographs and mass detectors physically occupy different boxes, their common boundary is blurring from the perspectives of hardware design and software control. "Today's instrumentation features system-level diagnostics, so you don't have to worry if one component is smart enough to tell you what's wrong. And this makes workflows more efficient," Dr. Smith adds.

Terry Sheehan, GC-MS marketing manager at Agilent, compares the purchasing experience to buying a car: "People want to pay for it and drive away."

"Customers today view GC-MS or LC-MS as a single solution."

This is all great news for users. As the education and expertise levels of chromatographers wanes, their employers increasingly look for turnkey systems. That means developers must spend more time thinking of the user experience and workflows. What information is being brought into the analysis at the front end, and where will the data go after it's acquired? How will the system software handle two types of output while controlling two different instruments? "It's very tough to visualize complex workflows these days if you're only making one of the boxes," Dr. Smith says.

More options for LC

LC has considerably more options than GC in terms of mass detection. "Mass detectors for LC show a much wider diversity in capability than GC detectors in terms of raw sensitivity and mass resolution," Dr. Smith observes.

The basic options for GC include single quadrupoles, ion traps, and tandem quadrupoles. LC employs these MS modalities as well, but for each option there is significant stratification. For example, Waters offers three tandem quad detectors for GC, each with different performance characteristics. LC enjoys other options as well, for example, time-of-flight (TOF) and quadrupole TOF (QTOF) detectors, which are rarely found on GC instruments.

Lab Manager Magazine has recently completed a user survey for MS detectors used with chromatography systems. Among the GC-MS respondents, 22% primarily used a single-quadrupole MS, 16% used electron ionization (suitable for gases), and 8% used a quadrupole ion trap. Among LC respondents, quadrupole and ion trap were the most prevalent (17% and 10%, respectively), but TOF also weighed in at 10%.

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If you can touch it, you can break it

Both GC and MS have been around for a long time. "GC-MS is improving, but we're not talking about quantum leaps in sensitivity or detection limits any more," says Agilent's Terry Sheehan. "We've realized that for many applications, products from all the major vendors can satisfactorily do the job. The question is how well can they do it, how reliably, and what is the cost of ownership?"

Agilent's California and Delaware GC-MS development teams have been paying increasing attention to these issues, as well as how to increase productivity by enhancing workflow and reducing "cost per test."

Buyers—and salespeople as well—

too often reflect on the list or sales price of an instrument, which Mr. Sheehan describes as "myopic." Purchasers, he says, should consider the larger picture

that includes reliability and operating costs. "If you expand your viewpoint regarding an instrument purchase to include cost of ownership for ten years, the list price takes on a different position in the argument."

He points first to Agilent's ten-year "Value Promise" on GC-MS and LC-MS instruments, which guarantees that the systems will remain in working order for ten years. If not, the company will credit the residual value

against the price of a new instrument.

Design features promote value as well. MS detectors have become more compact and robust, but they are still complex, expensive instruments. "My philosophy is if you can touch it, you can break it," Mr. Sheehan jokes. "Every time you have to open up an MS, you risk messing something up."

For example, conventional GC maintenance requires that users periodically bake high-boiling, non-eluting materials off the column at a high temperature. When an MS detector is at the back end, all that junk winds up in the MS source. "You can't simply disconnect because you can't break the vacuum, and unlike an LC-MS, you can't just turn a valve." The answer is backflush, which reduces downtime and maintenance of the MS detector

for reducing the effective price of an instrument. A workflow study conducted by the U.S. Dept. of Agriculture compared the entire workflows, including sample prep, for GC-MS (single quad) vs. GC-MS/MS (triple quad) analysis of trace residues. The tandem MS instrument costs twice as much as the single-quadrupole detector, so on the basis of sales price

But the triple-quad detector significantly reduced the time and cost of sample preparation. Researchers concluded that very busy laboratories could recoup the difference in cost in less than a year by purchasing the more expensive instrument.

many organizations would not even

consider the upgrade.

Mr. Sheehan explains that "many laboratories have two budgets—one for

capital equipment and one for supplies. As long as you keep them separate, you'll never realize that you could select triple quad and thereby begin saving money on sample

prep almost immediately."

"As the education and expertise levels of chromatographers wanes, their employers increasingly look for turnkey systems."

by routing non-eluting materials away from the MS. Agilent has created a backflush software tool that facilitates setting up and executing regular backflush "without the need to be a GC guru," says Mr. Sheehan.

Price vs. operating costs

Lowering cost of ownership through higher throughput is another strategy Angelo DePalma holds a Ph.D. in organic chemistry and has worked in the pharmaceutical industry. You can reach him at angelo@adepalma.com.

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STRIVING TOWARD GREATER FUNCTIONALITY

by Angelo DePalma, Ph.D.

Mature product lines such as pH meters are fundamentally limited in underlying technology, so they evolve through adding features and functionality.

High-end pH meters often come with USB or Bluetooth communications and networking capability. Beckman Coulter (Brea, CA) has sold "Bluetoothed" meters for two years. Along with the company's SmartLogger software, users can capture pH data in real time, "and it doesn't need to be hardwired," says support engineer Tom Dawkins.

Companies are moving away from handwritten records, particularly with numeric data, for several reasons. Human error in copying multi-digit readouts is the most obvious. Increasingly,

"The interesting thing about the pH marketplace is we have very sophisticated users and those who are just looking for a number."

firms prefer to maintain data in repositories from which it may be shared, referred to from outside the lab, and presented to auditors. Software can track readings, usage, user identity, calibration history, etc. Some pH software packages, including SmartLogger, comply with the U.S. Food and Drug Administration's 21 CFR Part 11 regulation on electronic records and signatures.

"The interesting thing about the pH marketplace is we have very sophisticated users and those who are just looking for a number," says Mr. Dawkins. The first group is composed of researchers who perform kinetics experiments and advanced titrations, while the latter are found on production lines. "Having to serve both ends of the market with similar products makes designing new meters quite challenging."

Beckman's pH meters can separately measure pH, dissolved oxygen, conductivity, and (through ionselective electrodes) various ionic species.

Mr. Dawkins recognizes the "clamor" for multifunction meters that measure two or more parameters simultaneously, "but this adds complexity to the

measurement, the probe, the meter, and the data."

Overcoming wear and tear

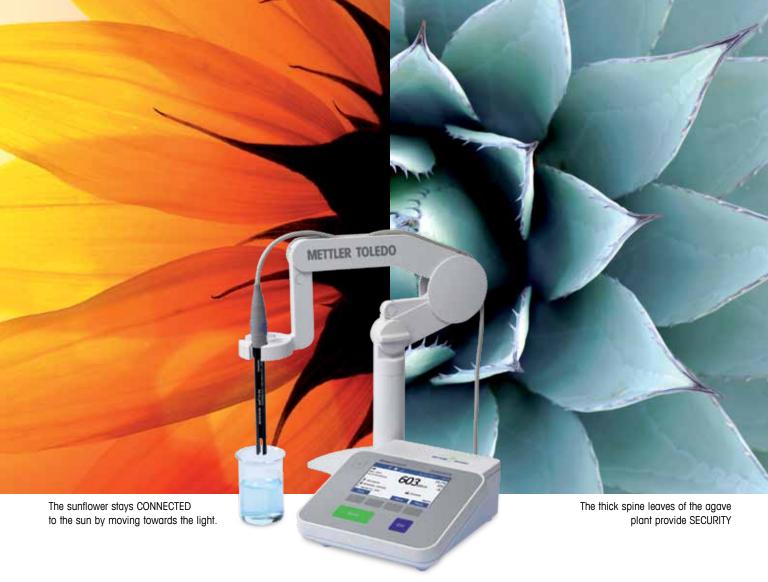
Electrode life is one of the most controversial issues in the total cost picture for pH meters. Probes are subjected to chemical, mechanical, and temperature-related damage. "How long an electrode lasts depends on so many factors, including who is using it," Mr. Dawkins says. "If you don't take care of the electrode during and between measurements, it will go bad a lot faster than if you follow the manufacturer's directions."

In some instances, the answer may be ruggedized electrodes, which respond more slowly than conventional designs but are more resilient to everyday use and abuse.

Another possibility is the use of maintenance-free pH electrodes suitable for pH measurements or titration. Metrohm's (Riverview, FL) model uses a potassium chloride gel instead of conventional liquid electrolyte and is suitable for both pH measurement and titration.

"Users don't have to worry about fill solutions or closing the electrolyte

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vent at the end of the day," explains George Porter III, titration product manager. The gel self-indicates, by turning from opaque to clear or translucent, when its useful life is depleted. Users must then replace the electrode, but Mr. Porter offers assurance that "they are priced to be easily replaceable."

Stretching the boundaries

Hanna Instruments (Woonsocket, RI) has become something of a specialist for pH measurements in the food industry. Company president David Minsk explains that standard pH electrodes are only reliable when used in dilute aqueous solutions, but most foods are complex, viscous mixtures. Hanna has developed a probe sporting a "conic" tip that allows it to penetrate thick sauces, even cheese. Another model employs a blade that clears the way for the probe to enter solid meat products. Several of these designs use electrodes made of viscolene, a nontoxic material that does not leach into samples. "Unless you take samples, a standard electrode could theoretically leak silver chloride into your batch of ketchup," says Mr. Minsk.

Food laboratories share a regulatory requirement with pharmaceutical R&D: data traceability and consistency under GLP (Good Laboratory Practices). Hanna's GLP-certified pH meters allow up to three-point calibration with five standard or three custom buffers, a calibration reminder,

and storage/retrieval of calibration history and performance.

"Top pH meters all have GLP features," Mr. Minsk says. "If you're a food or pharmaceutical lab, you want to be able to show an auditor verifiable proof that your meter has been calibrated to specifications."

Metrohm's George Porter also notes that demand for high-end pH meters has picked up, particularly from pharmaceutical firms.

Multifunction meters

Metrohm and Hanna Instruments have both noted increased demand for multiple functionality in pH meters: conductivity, alkalinity, and ion selectivity in addition to pH. Hanna Instruments has even bundled a pH meter with global positioning functionality, for automatically recording pH measurements as a function of location, say, on a large lake.

Titrations are frequently pH-based, so pH meters often serve in that capacity as well. "Having more functionality in a single form factor adds value," says Mr. Minsk.

Users are particularly fond of meters with ion-selective electrodes. Newer models, Mr. Porter explains, respond rapidly—and comparably to individual stand-alone electrodes. In Metrohm's calcium-specific electrode, the reference function is built in so the electrode is compact and connects via a single wire. "If you're using it in combination with other probes, it

doesn't take up a lot of space in the measurement vessel." Metrohm targets this ruggedized electrode to environmental markets.

Metrohm also manufactures a solidstate electrode containing no liquid junctures, so drying out is never an issue. The "brain" is a sensor chip printed onto the electrode itself. Useful life is "well over 1,000 measurements," Mr. Porter says. Operators simply swap out the chip, which is significantly cheaper than replacing the entire electrode. "Because they're only replacing the chip, customers will be much less prone to push the usable life of the probe and much more likely to replace it when it's time."

"pH meters as instruments have come a long way since their invention in the 1930s," notes Beckman Coulter's Tom Dawkins. "Today's meters sport digital displays, data recording, and advanced user interfaces. But while electrodes and housings have become sophisticated, it's basically the same device on the inside as 80 years ago."

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In today's economic environment, cost reduction is a driving force in the lab, but research organizations should not forget the critical role lab equipment repair and preventive maintenance plays in generating high-quality results that get their products to market faster. Unfortunately, a fair number of labs underestimate the value of preventive maintenance. In addition to savings, preventive maintenance programs provide greater productivity and operational efficiencies, reduce downtime caused by equipment failure, safeguard the lab's Good Laboratory Practices (GLP) and extend the life of an instrument.

A typical research organization works with over 100 different laboratory equipment providers and has key contracts in place for the most critical instruments, including high performance liquid chromatography (HPLC), gas chromatography (GC), ion chromatography (IC), mass spectroscopy (MS), centrifuges, plate readers, and robotic liquid-handling systems. The different repair and maintenance services available to labs vary according to the company's business priorities, the support of researchers and supporting business units, and the amount of internal resources allocated to lab equipment support.

Labs have several choices when it comes to maintaining equipment: In-house facility maintenance people, asset management companies, third-party service agencies, and original equipment manufacturer (OEM). Each option comes with its values and benefits but also with its obstacles and costs.

Scientists often favor OEM's contracts or a time-and-materials approach because they maintain the long-standing personal relationships that played a major role in their decision to procure a specific product in the first place. Managing multiple contracts can be expensive and most labs that enter into an OEM contract usually focus on price with their OEMs rather than on performance, risk, and service-level efficiency opportunities that could benefit their business. In addition, each equipment provider has unique preventive maintenance and qualification protocols, response times, and service reports, thereby creating significant ongoing administrative challenges.

Labs can move away from contracts altogether and work with an OEM on a time-and-materials call-out basis, in which contracts are placed for scheduled preventive maintenance only. In this option, risk is passed to the lab.

A declining number of research organizations have their own laboratory equipment maintenance teams, whose activities range from contract management to financial reporting, or company-employed in-house engineering staff that perform maintenance in laboratories or workshops. It is becoming more challenging and costly to ensure in-house teams are sufficiently trained and that parts are available; as a result, labs that have in-house facility maintenance people are moving away from this model.

Knowledge of lab equipment failure rates, downtime, and cost of ownership all would help research organizations make better risk assessments, but labs rarely find the resources to collate and manage such asset knowledge effectively. Hence, asset management maintenance models are growing. Asset management companies cover everything in the lab. Labs are generally free to include or exclude different types of equipment, which will affect the price of their contract. Typically, the company will employ onsite technicians, providing the lab with the benefit of having in-house facility maintenance techs but will frequently use third-party contractors or manufacturers for more difficult lines of equipment. Terms of the contract and price varies and is based on the lab's usage of the policy. The skill gap is a greater concern with newer, more complex equipment, where it is difficult for the asset management companies to keep abreast of the latest technology when they do not have access to the OEM training resources. For this reason, most laboratory managers take a very cautious approach to selecting this option.

What respondents expect will happen to their maintenance models in the next three years:

	INCREASE	DECREASE	STAY THE SAME	DON'T KNOW
Instrument manufacturer service contract	25%	7 %	59 %	9 %
Instrument manufacturer time/material	21%	8%	56%	14%
Third-party contract	18%	8%	48%	26%
Third-party time/material	18%	8%	45%	28%
In-house service department	19%	6%	59 %	16%
Self-service/individual departments	24%	6 %	53%	1 7 %
Multi-vendor service provider	13%	5%	48%	34%

Over 60 percent of the respondents' labs have a tracking system in place to keep track of lab equipment location, service history reliability, and other pertinent information about the instruments in their lab.

Yes, our department developed a tracking system which keeps track of maintenance and service issues for our instruments.	40%
No, we have no system in place and we are not planning to implement a system.	19%
Yes, a tracking system was developed by another department within our organization which keeps track of maintenance and service issues for instruments in the laboratory.	11%
No, we have no system in place but are starting the process to implement a system	11%
Yes, we have a commercial product that tracks the location, service, preventive maintenance, compliance, laboratory efficiency, etc.	7 %
Yes, we have hired a multi-vendor service provider that tracks the location, service, preventive maintenance, compliance, laboratory efficiency, and much more.	2%
Don't know	5%
Other	5%

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Respondents utilize the following services for the instruments in their lab:

Instrument repair when needed	75 %
Routine instrument service scheduled according to time/date of service	68%
As needed depending upon the condition of the instrument	62%
Non-warranted instrument services	39 %
Planned/scheduled according to the SOP	26%
Planned/scheduled according to usage/ number of analyses	12%
Other	2%

Sixty-eight percent of the respondents believe that management of lab instruments' uptime and service is adequate, while 23 percent (one out of five) believe that their lab's management needs to pay more attention to service.

Management of instrument uptime and service is adequate	68%
Management of instrument uptime and service needs more attention	23%
Management of instrument uptime and service is more than what we need	7 %
Don't know	2%
Other (please specify):	1%

Top ten features/factors in selecting a maintenance model and service offerings/capabilities of instrument service providers.

Availability of replacement parts	100%
Knowledgeable service agents	97 %
Service costs	97%
Timely repairs	97 %
Service contracts	93%
Telephone/Internet support	92 %
System's ease of service capabilities	87 %
Initial warranty	85%
Calibration services	80%
Regular software upgrades	80%



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With the widespread adoption of liquid and gas chromatography instruments throughout laboratories, chromatography data systems (CDS) have followed suit, becoming one of the most popular software products in use within a lab. From single workstations to enterprise installations delivering multi-channel, multi-user client/server applications, CDS solutions provide the flexibility to fully integrate with laboratory information management systems (LIMS) and other enterprise-level data management systems, as well as the most relied upon laboratory instrumentation.

Improvements in CDS solutions have for the most part tracked advances in hardware. Today, all instruments ship with software packages that control instrumentation, acquire data, prepare reports, manipulate spectra and chromatograms, store methods, perform calibrations, and interface with lab- or organization-wide computer systems.

As new developments in instrumentation continue, CDS solutions are becoming more versatile and less instrument-centric. Several software-only firms are establishing relationships with instrument vendors to develop drivers and controls for their instruments that operate within their software. As a result, as labs acquire LC and GC instruments from different vendors, more software systems are capable of controlling third-party instruments and improved communication between instruments and related software.

Many other emerging changes in the laboratory marketplace are having a major influence on CDS development from managing workflow for optimum performance and enable faster and more informed decision-making across the organization.

Respondents identified the following reasons for implementing a CDS solution in their lab. Twentythree percent selected "all of the above."

•	
Improve communication between instruments and related software	21%
Create an infrastructure for capturing, accessing and sharing experimental information	14%
Centralize data repositories	13%
Accelerate the documentation and reporting of experimentation	8%
Streamline regulatory compliance	7 %
Create remote access of data from any location	7 %
Enable scientists to collaborate effectively on multi-stage projects	4%
Workflow coordination across geographic and business boundaries	3%
All of the above	23%

Fifty-five percent of the respondents' labs have up to ten users and 88 percent have up to ten locations with access to CDS.

	Users	Locations
1 – 10	55%	88%
11 – 25	23%	8%
26 - 50	12%	5%
50+	10%	0%

Chromatography data systems can be deployed in standalone, thin client, or enterprise client/server computing environments. Over 80 percent of the respondents have deployed either a stand-alone or client/server solution.

Stand-alone	47%
Client/server	37%
Web-based	9 %
Thin client/server	5%
Other	1%

Supporting the most important factors in making a buying decision, respondents identify "migration of existing data" and "staff training" as the biggest challenges in purchasing a CDS solution. As vendors continue to address these challenges, the selection of the right system will get easier.

What is your biggest challenge in this CDS purchase?

Migration of existing data into the new system	22%
Staff adoption and training	22%
Determining the right system for our lab	21%
Investing in software that will become obsolete	10%
Demonstrating ROI to senior management	10%
Integration with other software programs in the lab	4%
Gaining user buy-in	3%
Other	7 %

CDS solutions continue to adapt to the evolving demographic of laboratory personnel, from specialist to generalist. Based on a recent survey on job satisfaction, lab professionals have told Lab Manager Magazine there is a shift from users who were chromatographers and analytical chemists to a new group composed of process managers, quality managers, statisticians, biologists, and so on. This may explain why the three most important features/factors that influence the buying decision are "service and support"; "ease of use" and "versatility." While achieving this level of user-friendliness, CDS vendors must cope with the ever increasing intricacy of the analysis, particularly those supporting regulated industries or law enforcement and involve the use of multiple columns and detectors, which generate outputs in multiple dimensions.

Respondents identify emerging influences in their buying decision that may suggest what effect they will play on future CDS development.

Top ten features / factors in the buying decision:

iop ien ieurores / ruciors in ine boying u	ccision.
Service and Support	98%
Ease of use	96%
Versatility	96%
Price	92 %
Seamless communication between different instruments and software	88%
Incorporate high speed chromatography systems calculations	87%
Complete scalability from one to multi- instruments and remote access for all labs	83%
Customization	81%
Remote access of data from any location	69%
Web-based access	51%



Please visit http://www.labmanager.com/?articles.view/articleNo/4862/ to view a webinar on choosing the right chromatography data system for your lab.

COMPLETED SURVEYS: 244



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Tuesday, February 7, 2012

Presentation: Biochips and Translational Medicine

Robert Ballard, Ph.D.

Professor, University of Rhode Island (URI) Graduate School of Oceanography; Founder and President, Institute for Exploration (IFE) at Mystic Aquarium, Mystic, Connecticut

Wednesday, February 8, 2012

Presentation: Deep Sea Science and Exploration











Gas chromatography (GC) was at one time commonly called "GLC," where the "L" stands for liquid. Inside GC columns are particles of a ceramic or inert material coated with an extremely viscous liquid stationary phase that interacts with the analyte. By contrast, HPLC stationary phases are bonded to the base material. GC is a common technique used in analytical chemistry for separating and analyzing compounds that can be vaporized without decomposition. GC is typically used for separating the different components of a mixture, improving the purity of a particular substance, or identifying a particular compound. GC makes it possible to separate the volatile components of a very small sample and to determine the amount of each component present. The essentials required for the method are an injection port through which samples are loaded, a "column" on which the components are separated, a regulated flow of a carrier gas which carries the sample through the instrument, a detector, and a data processor. In gas chromatography, the temperature of the injection port, column, and detector are controlled by thermostatted heaters.

In gas chromatography, the mobile phase is a carrier gas, usually an inert gas such as helium or an unreactive gas such as nitrogen. The gaseous compounds being analyzed interact with the walls of the column, which is coated with different stationary phases. This causes each compound to elute at a different time, known as the retention time of the compound. The comparison of retention times is what gives GC its analytical usefulness. The most widely used gas selected by the respondents is helium and cylinders (standard – 46 percent and portable - 19 percent) are the number source for delivery.

Different types of gases respondents use:

z / pos or gasos respenses	
Helium	23%
Hydrogen	19%
Nitrogen	17%
Air, industrial	9 %
Zero air gas (<1 ppm hydrocarbons)	9 %
Argon	7 %
Oxygen	5%
Other	9 %

Many GC systems are available as basic units that can accommodate different detectors and different sample injectors. This allows users to customize the GC system according to their own particular needs, providing full flexibility. If you are in the market for a new GC system, vendors recommend that you should first choose a base system, then a detector type and, finally, a method of sample introduction. The base system is the fundamental part of the modular GC unit, accommodating the GC column and basic hardware. GC detectors have been evolving rapidly to provide greater sensitivity. Flame ionization detectors (FIDs) have been the most widely used, as they detect any molecule containing carbon. Numerous other detector types have been introduced over the years, but the most interesting is the mass detector, which is essentially a miniaturized mass spectrometer. Mass detectors provide unequivocal identification of peaks emerging from the chromatograph based on the molecules' molecular weights and fragmentation patterns. Other detectors are sensitive only to specific types of substances, or work well only in narrower ranges of concentrations

, ,	
Flame ionization (FID)	31%
Mass spectrometer	25 %
Thermal conductivity (TCD)	15%
Electron capture (ECD)	11%
Nitrogen-phosphorus	5%
Flame photometric (FPD)	5%
Photo-ionization (PID)	5%
Hall electrolytic conductivity	2%
Other	2%

Although many of the chromatographic instrumental techniques have matured and automation is commonplace, sample preparation is still considered to be slow, labor-intensive, and even a bottleneck in laboratory processes. Some high-throughput laboratories take advantage of the latest autosampling technology to process hundreds and sometimes thousands of samples a day.

Related gas chromatograph components respondents are using in their lab:

Autosampler	24%
Data system	24%
Regulators, valves, fittings	22%
Headspace sampler	11%
Purge & trap	10%
Gas generator	8%

For the service and repair of their GC instrument, 45 percent of the respondents use instrument manufacturers either as a service contract or time and material.

Instrument manufacturer service contract	23%
Instrument manufacturer time/material	22%
Our department	20%
In-house service department	12%
Third-party contract	10%
Third-party time/material	8%
Multi-vendor service provider	4%
Other	1%

Around the mid-1980s, column chromatography began to give way to capillary column GC, in which the liquid phase is coated onto the inner walls of a thin capillary tube that can be anywhere from 15 to 100 meters long, and wound into a coil. Capillary column chromatography represented a significant advance in the field and greatly improved the ability of columns to separate the multiple components found in complex drug and arson samples. However, a few applications still require packed columns.

The most common problems respondents encounter with their GC columns are "short column life" and "interactions with sample or solvent." Problems respondents encounter with GC columns:

Short column lifetime	23%
Interactions with sample or solvent	22 %
Low reproducibility after changing columns/batches	18%
Low repeatability	11%
Lack of support from vendor	11%
Poor documentation	7 %
Pressure increase	6 %
Other	3%

Top ten features / factors that are important to respondents in the decision-making process for a new GC system:

in the decision making process for a new oc system.			
Accuracy	96%		
Availability of supplies and accessories	83%		
Ease of maintenance	85%		
Easy transfer of methods	84%		
Price	85%		
Quality of data	92 %		
Resolution	85%		
Ruggedness and reliability	87 %		
Sensitivity	89%		
Service and support	90%		



For more information on gas chromatography systems, visit www.labmanager.com/GC

COMPLETED SURVEYS: 223

VERHEAD STIRRERS

Depending on scale and viscosity by Rachel Muenz

CAFRAMO HIGH TORQUE BDC SERIES



≺Caframo high torque overhead bench-top stirrers are designed and engineered to meet the continuous demands of high volume, high viscosity mixing. A unique two-speed transmission provides incredible power. Caframo's brushless DC motors and rugged metal housings are durable, dependable, and maintenance-free. Products are made in Canada, always in stock, and shipped worldwide.

- Three models offer speed ranges from 12-6000 rpm
- Mix viscosities up to 90,000 cps (max torque 565 N-cm)
- Digital display of speed (rpm) or torque (N-cm)
- Through shaft, chuck guard, and overload protection
- Built to industrial equipment safety standards (IEC1010)

ratories, mixing is an important part of many tasks. Deciding which type of stirrer, magnetic or overhead, is best for you depends on the viscosity and scale of the substance you're stirring. Overhead stirrers - the best fit for high-viscosity applications - are made up of a stirring fixture or panel, a controller, drive shaft, and a drive mechanism or motor. There are a variety of overhead stirrer configurations as well as analog and digital options. To choose the right overhead stirrer and accessories for your lab, it's always a good idea to get help from your vendor.

ommon in both industrial and academic labo-

EBERBACH MODEL 7225 CON-TORQUE STIRRER



▼Eberbach's Model 7225 Con-Torque Stirrer is suitable for continuous duty stirring of highly viscous materials. A 1/9 hp motor and gear drive produces 196 oz-in of continuous torque which drives the hollow spindle through a speed range of 0 to 700 rpm.

- Tool-less manual chuck
- Hollow spindle for easy shaft adjustment
- Numerous accessories such as stirring shafts, propellers, blades, clamps, and supports available for Eberbach stirrers, including the Model 7225

APPLICATIONS

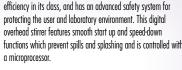
- · Tissue grinding to create low and high dose medications
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- Media prep
- Food and beverage production

IEIO TECH MSP DIGITAL SERIES



▼The MSP Series is designed for optimum usability, strongest efficiency in its class, and has an advanced safety system for protecting the user and laboratory environment. This digital overhead stirrer features smooth start up and speed-down functions which prevent spills and splashing and is controlled with

- PID feedback control system controls and maintains constant motor speed under conditions of changing viscosity
- Powerful torque means easy use with high viscosity samples
- Convenient emergency stop



Compact and slim head design





▼Providing an alternative to the Atlas Scorpion Overhead Stirrer, this adaptor enables additional user flexibility through the incorporation of third-party instrumentation. As a new addition to the Atlas range, the high torque stirrer adaptor enables effective mixing, homogenizing and re-circulating of high viscosity substances with torque feedback.

- Stirrer can reach speeds up to 1000 rpm when combined with adaptor
- Can reach a maximum peak overload torque of 40 Newton centimeters (Ncm) or a continuous torque of 20 Ncm with feedback
- Controlled via the front panel of the stirrer or by the Atlas Software and
- Consists of support rods, a factory-fitted quick adaptor and a support post





Mixing solutions is one of the most common laboratory tasks.

Magnetic stirrers are a popular type of laboratory stirrer that use a rotating magnetic field to cause a stirrer bar to rotate within the solution. These stirrers are often combined with a hotplate and are ideal for small volumes of non-viscous liquids and for situations in which a reaction must take place in a closed vessel or system. The overhead stirrer, however, is more suitable for larger volumes and more viscous solutions, but can be less convenient and more time-consuming to set up.

Lab shakers are available in two different mixing actions; orbital and reciprocal and are primarily used for culturing organisms in shake flasks or test tubes. and can also be used for mixing liquids. Shakers range from small to mid-size bench top models, larger-capacity console (floor standing) models, or spacesaving stackable models. Heavier loads may also require a heavy-duty drive mechanism such as a triple-eccentric drive vs. a lighter-duty single-eccentric drive. Samples in a lab shaker can be agitated via a linear motion or by an orbital motion to create a vortex in the solution. The principal application of shakers is for growing yeast, bacteria, or mammalian cells in specialized containers known as shaker bottles.

Different types of lab shakers and stirrers respondents are using or planning to purchase for their lab:

	Currently Using	Planning to Purchase
Rocking shaker	93%	7 %
Magnetic stirrers (scale)	95%	5%
Vortex shaker	92 %	8%
Hotplate stirrers	90%	10%
Vibrating shaker	88%	12%
Overhead stirrers (economic)	89 %	11%
Orbital shaker	88%	12%
Magnetic stirrers (digital)	87 %	13%
Biological shaker	87 %	13%
Overhead stirrers (analogy)	87 %	13%
Incubator shaker	87 %	13%
Overhead stirrer (digital)	87 %	13%
Reciprocal shaker	86%	14%
Magnetic stirrers (multi positions)	82 %	18%
Nutating shaker	82%	18%

Components respondents are using or planning to purchase with their lab shaker and stirrers:

	Currently Using
Microtube adaptor	22%
Stirring paddles	26%
Plate adaptor	1 9 %
Stirring propellers	32%
Flask attachments	18%
Holding clamps	36%

There are many different factors to consider when making a lab shaker or stirrer purchase: is the equipment going to be used to grow cultures or to mix chemicals and liquids? Is temperature control needed and, if so, do you need incubation only or refrigeration as well? Do you need digital controls to ensure precise and reproducible results, or will analog controls do?

The technology in lab shakers and stirrers continues to advance at a fast rate. The future for lab shakers and stirrers is likely to involve the development of instruments that offer alternative mixing actions for more thorough and efficient mixing, possibly mimicking further the action of the human wrist. Other innovations are likely to include instruments capable of mixing more samples simultaneously and greater integration with other lab processes, allowing for more automation in the laboratory and less human intervention. A number of automated methods for mixing have been devised, all of which remove this burden from the operator by offering a sustained and controlled stirring action for indefinite periods of time.

Choosing a shaker comes down to such features as heating/cooling capability, capacity, shaking speed, orbital vs. reciprocating motion, ease of use, programmability, heating capability, and footprint. With research budgets tight and lab space even tighter, groups or departments are increasingly sharing shakers. Fourteen percent of respondents choose models that they are able to stack and keep them in a shared equipment room.

Customers also value ease of use — the ability to utilize shakers fully, out of the box, with labware of any shape and size. The choice of overhead or magnetic stirring to achieve uniform mixing is relatively straightforward, based on scale and viscosity of the medium being stirred. Overhead stirrers are used when sample viscosity and/or size are issues, or when there exists a concern for significant changes in viscosity.

La	ıb Stirrer		Lab Shaker
Durability of product	92 %	Durability/rugged design	92%
Low maintenance — easy to use and clean	85%	Simple operation — easy to program and monito	r 89 %
Simple operation — easy to program and monitor	81%	Low maintenance/easy to clean	87%
Compact design	75 %	Shaking speed	86%
Safety features	70 %	Compact design	71 %
Minimal vibration	67 %	Low noise — quiet	66%
Price	63%	Electronic speed controls	65%
Warranty	57 %	Warranty	63%
Temperature controls	54 %	Heating/cooling capability	59 %
Energy efficient/low operating cost	49 %	Orbital vs. reciprocating motion	51%
Service and support	48%	Wide range of accessories	48%
Wide range of accessories	42 %	Programmable controls	47%
Stackable up to three units	18%	Nutating shaker	82%



For more information on Shakers and Stirrers, visit www.labmanager.com/shakers-stirrers

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ASK THE EXPERT

DESIGNING AN ECO-FRIENDLY LABORATORY

by Tanuja Koppal, Ph.D.

Matthew Gudorf, campus energy manager with the Facilities Management group at University of California, Irvine, (UCI) talks to Tanuja Koppal, Ph.D., contributing editor at Lab Manager Magazine, about the Smart Labs program developed at UCI, which aims to reduce overall energy consumption by 50 percent. Smart Labs has been implemented across various research and teaching buildings at UCI, as both retrofits and new construction, and it has resulted in significant energy and emissions savings.

Can you give us some details about the Smart Lab program developed and implemented at UCI?

We have taken all the different pilot projects that we've done over the years and rolled them into one retrofit program called Smart Labs. Smart Labs is centralized demand control ventilation (CDCV), exhaust stack velocity reduction, energy efficient lighting, active and passive daylighting, and all other retrofits found in our Smart Lab Energy Retrofit Guide. We looked at each system individually, sequenced the retrofits for the best possible energy savings and payback, and then put them into one program, and that's Smart Labs.

Can you tell us about your team and how it goes about planning, designing, and implementing projects across campus?

A: The university has what we call the Energy Team, which is made up of the

campus engineer, the campus energy manager (that's me), some project managers who run the construction projects, the director of project services, and the associate vice chancellor. We meet weekly to look at where we are, where we need to get to, what projects are under way, what projects are in planning, the budgetary issues, and such. Once a project gets an initial scope and budget, it gets assigned to a project manager, who takes the lead and starts the initial talks. If the retrofit involves one of our major lab buildings, the project manager outlines the impact that we think the building is going to sustain while we're doing the construction and gets initial feedback from the lab and facilities manager. While we are doing the design work with our engineers or with the architectural firms, we're already aware of how the researchers in the labs feel and what kind of interruptions they can sustain with minimal impact to their research.

Why is there this sudden need to attain energy efficiency, and how has technology impacted what you can accomplish to achieve those efficiencies?

A • Obviously the cost of energy has gone up and is now becoming more and more significant. When you look at the future and try to make the lab more eco-friendly and economical to operate, you start to look at each individual system. We take a look at the lab efficiency cycle, do some monitoring to

figure out how the energy is used, and identify two or three opportunities to implement some changes. It can be something very simple, such as raising the blinds to bring in more daylight or using perforated window treatments or applying a daylight control to the lighting. Then we do some more monitoring to see how the outcome compares to past results and whether there is something else we can do to make it better. Technology has certainly improved, bringing down the costs of controls and sensors and making them more capable. A system like the CDCV did not exist 10 or 15 years ago. Similarly the building and environmental codes have changed too. In the past, the solution to pollution was dilution. Instead of doing point source controls and making sure that the labs are safe, they just diluted their way out of it. So now we are going back and making the savings adjustments and the retrofits.

What's the most challenging aspect of your job?

The most challenging aspect of my job is this: After you do these retrofits and have all this equipment installed, you have a huge flow of data coming in. The amount of data is overwhelming. Taking that data, breaking it down, and coming up with action items—whether it's a retrofit project or a behavioral change or something that is just designed or operated that way—can be very daunting. The challenge is really trying to

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Matthew Gudorf is the campus energy manager at University of California, Irvine, and a LEED Accredited Professional with 12 years of infrastructure project management experience. A graduate of The Ohio State University with a degree in electrical engineering and an emphasis on high-voltage systems, he has worked for Dayton Power and Light in transmission and distribution; with American Electric Power as a member of the ultra-high-voltage sub-station design team; and with the Southern California Pipeline, managing wet utility projects throughout Southern California. He has focused his efforts at UCI on energy efficiency upgrades, utility and infrastructure retrofits, and project development.

pick out those key actionable pieces and then effecting the change on them.

ls heat the biggest concern from an energy perspective?

Whenever you have all this equipment in laboratories that produces heat, it's going to drive your cooling demand. If your cooling demand is high, you're going to have more air changes per hour. So you have to deal with the heat-generating equipment in your laboratory, and that can be anything from an ultra-low-temperature freezer to an autoclave to the general lighting load in the room. Just as we talk about point source control of dangerous chemicals, we want to have point source control of heat generation in the laboratory to reduce those air change rates that allow you to save energy.

Are you looking into any alternative green sources of energy?

A• We have on campus 895 Kw of solar power installed and another 136 Kw under construction. With a combustion turbine that's 13.5 megawatts and a steam turbine that's 6 megawatts, we have 19.5 megawatts of self-generation capability at UCI, which is natural-gas powered. We haven't currently

gone down that path because it's just cost prohibitive. But of course, that will be another green opportunity for us sometime in the future, as more biogas becomes available and the price comes down or the price of burning natural gas goes up.

• Are there any obvious gaps in technology or know-how that make you feel limited in what you can do?

A . Every system has its next generation, **A.** and we're always waiting on technology to kind of catch up. When you look at the lighting side, obviously light-emitting diode (LED) is where we're going to go. But it hasn't gotten to the point where it makes economic sense to do it. So there's going to be a breakthrough. It's going to come, but it's not there yet. Lab equipment, I think, falls pretty far behind. There are so many different pieces of lab equipment, and a lot of it is legacy equipment, probably from the '60s, '70s, and '80s, without the technological improvement to make it energy-efficient. We've gone in and taken a really hard look, and we've done as many retrofits as we can to make our buildings efficient. The next step is trying to get that plug load down, trying to reduce that equipment load within the building. So obviously we're looking for technology improvements there.

What are you most excited about in this field?

• I guess I'm most excited about the **A.** way that UCI has come up with this lab retrofit program. It's the fact that we're really driven to conduct pilot projects on campus, and then, once the proof-of-concept is out there, that we can balance safety with energy savings and then go out and start retrofitting our labs campus-wide. Then we get the opportunity to go out and try to show people we're willing to take the risk, we're willing to be that pilot project, we're willing to try the new technology. We get to share our results. So that's what's really interesting — trying to push those new technologies out to the consumer market and trying to get more acceptance. If you want to make an environmental change, you can't just do it on one campus, in one building, in one location. You have to be able to go out there and spread the word and get people to buy into the concept and take it forward.





nstrumentation laboratories in the University of Rochester (UR) Department of Chemistry play a key role in both academic research and education. Besides instruments belonging to each professor's research group, the department also maintains a large group of instruments devoted to the research needs of faculty members and researchers as well as for educating students taking various chemistry department courses.

the Department of Earth and Environmental Sciences as well as the Department of Chemistry. The instrumentation specialists in charge of the individual laboratories schedule usage time on the instruments and train students and postdoctoral researchers in their operation. They also maintain the instruments in top operating condition. All are long-time university employees.

"The X-ray crystallography laboratory analyzes an average of one new research sample daily."

The Instrumentation Laboratory is housed in the University's massive Hutchison Hall, home to the Department of Biology and

Terry O'Connell is the Director of Chemical Operations. With 29 years of experience with the Chemistry Department, O'Connell

▲ Bill Brennessel, X-Ray crystallographer and scientist.

is responsible for new instrument installation and building renovations to accommodate new instruments. During the 2009-2010 academic year, the Department of Chemistry acquired and installed over \$2 million worth of research instrumentation. This includes a Bruker EMS-Plus electron paramagnetic resonance (EPR) spectrometer, a Thermo Scientific LTQ Velos ion trap liquid chromatograph/mass spectrometer, a Bruker Fourier transform mass spectrometer (FTMS), a PerkinElmer 2400 Series II HNS/O elemental analyzer and a Bruker Autoflex III MALDI-TOF mass spectrometer.

O'Connell works closely with Senior Lab Engineer Pete Serrino

PERSPECTIVE ON: AN ACADEMIC RESEARCH LAB



and Research Scientist Ray Teng. Teng has worked at UR since 1987 in the Department of Physics and Astronomy, the Nuclear Structure Research Laboratory, and the Department of Earth Science and Environmental Sciences. In 1987 he joined the Department of Chemistry as Research/Facility Coordinator.

X-ray crystallography and elemental analysis

Bill Brennessel is in charge of the management and operations of the X-ray crystallography and combustion elemental analysis facilities. These instruments are used in the determination of the chemical structure of solid samples. X-ray crystallography enables researchers to determine the structure of a single crystal of a sample, delineating the identity and spatial arrangement of the atoms in a crystal.

Typically only a few crystals are required to find an acceptable crystal specimen. More crystals are better and larger crystals are preferred. Brennessel accepts crystals either dry or still wet in the mother liquor used to perform the sample crystallization.

Absolute stereochemical configuration can be determined for compounds containing at least one heavy atom (silicon or heavier). Relative stereochemistry can be determined for light atom structures. Absolute stereochemical configuration can then be assigned from a known stereochemical center.

Air-sensitive samples are prepared under a nitrogen atmosphere. Experiments are run on a Bruker-AXS SMART Platform diffractometer equipped with an APEX II CCD detector. An X-ray tube (50 kilovolts and 30 milliamperes) delivers molybdenum radiation to the crystal sample. The standard test temperature of 100° K is maintained using a Kryoflex low-temperature device. Operating temperature range is 90°K to 300°K. Samples are examined using a polarizing microscope.

Data manipulation and structural solution and refinement are performed with the SHELXTL package from Bruker-AXS.

Typically, data collection requires 8 to 24 hours and is controlled by Bruker-AXS's APEX2 software

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package. The X-ray crystallography laboratory analyzes an average of one new research sample daily.

The submitter receives a full report in PDF format by e-mail plus a crystallographic information file (CIF). The CIF is suitable for journal submission while the PDF file contains experimental data, ORTEP diagrams, bond lengths and angles.

UR research groups pay a fee of \$200 per sample. Researchers from other universities pay \$250 per sample. The industrial researchers' fee is \$500.

Graduate students learn the theory and operation of the X-ray crystallography instrument as part of a graduate-level chemistry course, Chemistry 416. Students who take this course are considered officially trained users of the instrument and can study their own research samples.

In addition, as part of the undergraduate Chemistry 234 Advanced Laboratory Techniques course, Brennessel provides students with hands-on training on the instrument. This laboratory course provides experience with analytical methods including infrared and ultraviolet-visible nuclear magnetic spectroscopy, resonance spectroscopy, magnetic susceptibility, X-ray crystallography, differential scanning calorimetry, and methods of handling air-sensitive compounds under inert atmospheres.

▼ Inorganic chemistry graduate student Thomas Dugan preparing a sample for EPR spectrometer.



Combustion elemental analysis involves burning a solid sample to produce carbon dioxide, hydrogen and nitrogen. Measuring the amounts of these gases produced enables researchers to determine the absolute percentages of carbon, hydrogen and nitrogen in the sample.

Center for Enabling New Technologies Through Catalysis

The Center for Enabling New Technologies Through Catalysis (CENTC) is a National Science Foundation Phase II Center for Chemical Innovation. **CENTC** brings together researchers from 12 universities across North America and a U.S. national laboratory with the primary purpose of assisting research on development of more cost-effective and environmentally friendly methods to manufacture chemicals and fuels from a variety of feedstocks. The major focus is on catalysis. Effective catalysts can reduce the amount of energy needed to perform chemical conversions. Catalysts can also enable the use of less-expensive and nontoxic starting materials while generating less waste per pound of product formed.

CENTC has established an elemental analysis facility at UR. The facility consists of three main units, a PerkinElmer 2400 Series II analyzer for micro-scale elemental analyses and a PerkinElmer Model AD-6 Autobalance. Air-sensitive materials are prepared in a dedicated VAC Atmosphere glovebox loaded with Ar (argon) gas. Solid and liquid samples are crimp-sealed in special tin capsules and aluminum capsules, respectively.

To improve accuracy, precision and consistency of the analyses, Brennessel is the only person authorized to operate the UR equipment. Helium (99.998%) is used as the carrier gas for the analyses. Accuracy is 0.3% and precision is 0.2% per element.

A calibration standard of known composition is used to determine the correct signal:microgram ratio for each element. It is run as an actual sample before and after all other sample runs. To maintain the calibration, the calibration standard is also run at regular intervals during a long series of samples.

Industrial laboratories can become affiliates of the CENTC program. This provides them with early access to CENTC research results. Possibilities include sponsored research by the industrial affiliates or technology licensing. Among the 14 industrial affiliates nationwide are three oil companies, ExxonMobil, Chevron and BP; chemical firms Dow, BASF, Eastman and Strem Chemicals; Procter & Gamble; and Pfizer.

UR's CENTC facility will also perform analyses for research groups from other universities and from companies. These organizations must apply and be accepted to have their analyses performed. While the fee for UR research groups and research groups from other CENTC facilities is \$25 per sample, it is \$30 for external academic researchers. Industrial research groups must pay a \$50 fee.

Other instrumentation

Other Department of Chemistry instrumentation includes five nuclear magnetic resonance (NMR) spectrometers: a Varian 500 megahertz (MHZ) spectrometer, a Bruker 500 MHZ spectrometer, two Bruker 400 MHZ spectrometers and a Bruker 300 MHZ spectrometer.

The department's mass spectrometers include the Bruker FTMS, Bruker MALDI-TOF and Thermo LTQ Velos ion trap LC-MS mentioned above, plus three Shimadzu instruments: an LC-MS 2010 with APCI and electrospray ionization, a GC-MS with dual columns, and a GC-MS with direct injection probe.



▲ Inorganic chemistry graduate student Meghan Rodriguez operating a liquid chromatograph/mass spectrometer (LC-MS).

The department also has laser systems for absorption, fluorescence, and Raman spectroscopic analysis; nonlinear four-wave mixing; electrooptic sampling; time-resolved electron diffraction; photoelectron spectroscopy; temperature-jump studies; photoacoustic calorimetry. To initiate photochemical reactions, the department has two kHz regeneratively amplified femtosecond titanium:sapphire lasers. One is equipped with an optical parametric amplifier for generation of continuously tunable UV, visible and infrared femtosecond pulses. The department also has transient absorption systems based on a picosecond Nd:YAG laser and a nanosecond excimerpumped dye laser. There is also a

picosecond time-correlated single photon counting fluorescence system based on an Nd:YLF-pumped cavity-dumped dye laser. Besides a laser Raman facility, there is also an Nd:YAG/dye laser system. There are also associated optical instruments: monochromators and spectrographs; fast multichannel plate photodetectors; and state-of-theart, highly-sensitive array detectors (CCDs and photodiode arrays).



↑ Organic chemistry graduate student Ria Swanekamp preparing to operate a Bruker Autoflex III MALDI-TOF mass spectrometer.

Other instruments include an infrared spectrometer with probes for remote monitoring and recording of spectra over time. This last probe is useful for monitoring changes in the composition of reaction mixtures over time. To aid in polymer characterization, the department also has thermogravimetric

analysis and differential scanning calorimetry instruments.

There is a Digital Instruments Nanoscope IIa atomic force microscope, an ellipsometer, a single molecule time-resolved fluorescence confocal microscope and a Roper Scientific spectrofluorometer with infrared and visible light capabilities. There are also four Shimadzu FT-IR spectrometers and many UV-Vis spectrometers. Finally, the department has an H-cube hydrogenator and a phosphorimager.

In addition to all the instruments mentioned in this article, many of the department's research groups possess their own instruments dedicated to their own research needs.

The instrument capabilities of the UR Department of Chemistry are essential in performing the research of its members and achieving its educational mission. These capabilities are responsible in no small part for the department being ranked in the Top 50 U.S. chemistry departments in the U.S. News & World Report Annual Survey of Graduate Schools.

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@botmail.com.

All photographs are courtesy of the University of Rochester and were taken by Karen Chiang, a graduate student and aspiring professional photographer.



Laboratory Testing



EVOLUTION OF BY JOHN BUIE **ULTRA-HIGH-THROUGHPU SCREENING**

Ultra-high-throughput screening (uHTS) is an automated methodology for conducting hundreds of thousands of biological or chemical screening tests per day using liquid handling devices, sensitive detectors, robotics, data processing, and control software. The results of these experiments provide starting points for drug design and for understanding the interaction or role of a particular biochemical process in biology.

The cut-off between high-throughput screening (HTS) and uHTS is somewhat arbitrary. The advent of automated plate-handling and reading instrumentation, and the replacement of radiolabeling assays with luminescence- and fluorescence-based screens, created the opportunity for the several-hundredfold improvement in throughput represented by uHTS. As instrumentation prices have fallen, uHTS is now accessible to small research companies and academic groups.

Recently, in vitro testing has become a viable alternative to in vivo testing for assessing hepatoxicity, a technique that is appealing to manufacturers. The development of quantitative high-throughput screening (qHTS) allows a wide range of toxins to be tested, making it an economical and efficient option for manufacturers.

Here is a summary of some of the main milestones in the history of uHTS from its origins in the late 1980s.

Until the 1980s, the number of compounds that could be screened by a single facility in a week was between 10 and 100.

By 1992, technology had advanced enough that thousands of compounds could now be screened by a single facility in a week. By this time, Pfizer was using HTS to produce approximately 40 percent of its 'hits' in its Discovery portfolio.

The 1994 International Forum on Advances in Screening Technologies and Data Management saw the first mention of the term 'Ultra-High-Throughput Screening' in a presentation by Harry Stylli entitled, 'An Integrated Approach to High-Throughput Screening'.

1980 1985

> In 1986, Pfizer was involved in natural products screening by substituting fermentation broths with dimethyl sulfoxide solutions of synthetic compounds, using 96-well plates and reduced assay volumes of 50-100µl. A nominal 30mM source compound concentration provided high µM assay concentrations. Starting at 800 compounds each week, the process reached a steady state of 7200 compounds per week by 1989.

be screened a week, but 384-well plates were still extremely rare.

1990

By 1994, tens of thousands of compounds could By 1996, uHTS was considered a realistic goal, and 384-well plates were being used in proof-of-principle applications. Around this time, thousands of compounds could be screened a day.

1995

In 1996, Evotek, in collaboration with Novartis and SmithKlineBeecham, developed a high-throughput screening system, EVOscreen®, which was eventually launched in 2000.

FUTURE OF ULTRA-HIGH-THROUGHPUT SCRFFNING

Ultra-high-throughput screening is a new field which is evolving at an astonishing rate. The advances made over the past 20 years have revolutionized drug screening and development, and this pace of change is only likely to increase over the coming years.

In the future, uHTS is likely to move to even higher density formats, with no limit on the number of wells that can theoretically be analyzed simultaneously. Chip-based screening systems are likely to become increasingly important, as well as micro-channel flow systems, and plateless systems.



▲ The Evotek EVOscreen

76 Lab Manager November 2011 www.labmanager.com levels of efficiency when RTS Life Science began selling the Symphony ultra-high-throughput screening system developed in conjunction with Novartis to European customers. The Symphony system was conceived as a multi-lane robot system combining local compound storage, reformatting, assay plate creation and screening and was designed for use in laboratories needing to screen in



▲ The FLIPR Tetra

In 2005, high-throughput screening reached new excess of 1,000,000 compounds per day.



▲ The 1536-Head LumiLux Cellular Screenina Platform

In **2007**, PerkinElmer responded to the increasing importance of flash luminescence in primary and secondary screening of drug targets by releasing the first dedicated flash luminescence uHTS instrument, the 1536-Head LumiLux Cellular Screening Platform. This instrument enabled 1536 simultaneous "inject and read" flash luminescence assays, allowing laboratories to produce over 100,000 data points per day.

In 2008, Sanofi-aventis launched the dScreen Consortium, a research initiative conducted with RainDance Technologies and Louis Pasteur University, Strasbourg, France, to develop the next generation of high-throughput screening for drug discovery applications.

In 2010, BIOCIUS Life Sciences and Agilent Technologies developed the RF360 High Resolution System for the high-throughput screening of in vitro ADME assays. This system combined time-of-flight mass spectrometry with the high sample processing speed of RapidFire technology for efficient in vitro ADME analysis by eliminating a notorious bottleneck in drug discovery.

Also in 2010, PharmaDiagnostics launched the So-PRano assay kit for in-house assay development enabling users to develop assays for a range of applications, including fragment screening, focused high throughput screening, antibody discovery, and hit confirmation.

In 2011, Beckman Coulter, Inc. released the AU5800 Automated Chemistry System designed to improve processing time compared with existing systems and meet the demands of high- and ultrahigh- volume clinical laboratories. This system was capable of up to 2,000 photometric chemistry tests per hour for the single module, and up to 8,000 photometric tests per hour with a four-unit configuration.

2000 2005 2010

Annual annual

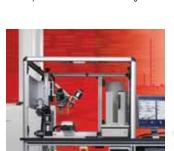
In 2000, Aurora Biosciences completed development of an ultra-high throughput screening system for Merck. This platform combined compound management, plate replication, assay preparation, hit identification, selection and re-tests of the hits, fluorescence detection, and data analysis into one fully-integrated and automated system that enabled the performance of miniaturized assays with a ten-fold increase in efficiency over conventional highthroughput screening methods.

throughput averages by up to five to ten times.

well plates were being used in proof-of-principle testing.

In 2001, Molecular Devices launched the FLIPR High-throughput Screening System. This was followed in 2004 by the FLIPR Tetra Ultra High-throughput Screening System for identifying early leads against GPCR and ion channel receptors. Because the company recognized that assay needs vary during the different stages of the drug discovery screening process, the FLIPR Tetra System was designed to be user-configurable and available with either a fluorescence or luminescence camera.

In 2006, Molecular Devices made high-throughput screening available to a greater number of laboratories when it launched a benchtop high-speed confocal imaging system that streamlined high-throughput imaging and hit selection in a fully-integrated environment. This system was intended to offer higher performance high-throughput screening at a lower price than existing instruments and was specifically intended to compete with similar products offered by GE Healthcare and Evotec Technologies.



▲ The RF360 High Resolution System

In 2009, BioTrove announced the launch of the RapidFire 300 system for high-throughput screening of in vitro ADME assays, enabling researchers to perform a wide range of assays with 24-hour, unattended operation. The RapidFire system streamlined drug discovery workflow, significantly decreasing the processing time compared to conventional MS-based technologies and helping to eliminate bottlenecks in drug discovery while providing accurate results for data-driven decision making.

Also in 2011, High Throughput Genomics launched the M3 series of multiplex mini-microarrays based on the qNPA ArrayPlate that improved the precision of data generated from samples by increasing automation. This technology allowed hundreds to thousands of samples to be analyzed per day.



▲ The AU5800 Automated Chemistry System



78

HOW A FOCUSED CAMPAIGN SEEKS TO ADDRESS AND REVERSE THE GROWING SHORTAGE OF LAB PROFESSIONALS by Kenneth Margues Thornton

A curious high school student conducts several chemistry experiments during a field trip and discovers an affinity for the sciences. Is this a fluke or could this student be on to something that may lead to a meaningful career and, more importantly, may aid in the healing process of an ailing profession? Encounters like the one just described are critical, as the number of students pursuing the medical laboratory profession continues to decline. For every seven lab professionals who are exiting the profession due to retirement, there are only two being replaced.1 If this trend continues, we will not be able to adequately staff laboratories across the country.

"Automated technology... cannot replace the expertise of a highly skilled lab professional."

Hospital management is investing in automation to help fill some of the full-time equivalent (FTE) shortages; however, it still may not be enough. Automated technology does improve productivity and reduce human error in many labs, but it cannot replace the expertise of a highly skilled

lab professional. With unemployment rates near double-digit levels across most of the nation², one would think that such a critical role in the healthcare profession would be in high demand.

Unlike other professions today, the demand for lab professionals actually exceeds supply with more than 40,000 current vacancies in the U.S.3 Keeping these staggering statistics in mind, awareness of the profession appears to be one of the reasons why people, especially our youth, are not pursuing opportunities in this field. But for those interested in science, research, healthcare or even engineering, it certainly appears to be an obvious occupational match. And if more of the younger generation enters the field, it will provide the medical laboratory profession with a much-needed boost and help address the growing shortage of this aging profession.

Studies indicate that 70 percent of all medical decisions are based on laboratory data and information that medical laboratory professionals provide.⁴ Without this information, physicians cannot make accurate diagnoses or determine appropriate treatment for their patients. As a result, lab professionals must begin to increase the visibility of their contributions and be recognized by the broader healthcare community as viable members of the

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diagnostic teams and assist in the efforts to preserve this critical profession.

The laboratory workforce shortage is a recurring topic within the in vitro diagnostics industry and one that needs to be addressed as soon as possible. Frequently published statistics from many of the laboratory professional organizations reveal the serious nature of the shortage. As the aging workforce begins to retire in large numbers, educational medical technology programs cannot keep pace. The Bureau of Labor Statistics predicts a need for 14,000 new laboratory professionals annually. However, educational programs produce fewer than 5,000 new lab professionals each year.5 This phenomenon has existed for many years with no relief in sight. With the exception of a few states where med tech programs are flourishing, these facilities are shutting their doors due to insufficient funding and the drastic decrease in enrollment.

To address this issue, the Labs are VitalTM (LRV) program was developed by Abbott in 2006. The mission of LRV is to positively impact the laboratory profession and ultimately patient care by (1) elevating the profile of the lab and its professionals (2) extending the lab's influence and impact within the healthcare community and (3) addressing key issues facing the profession. This program has approximately 15,000 supporters worldwide, which include the partnerships with many professional organizations that support the lab industry such as ASCP, ASCLS, AACC, CLMA,

AABB and APHL, to name a few. This year at the AACC/ASCLS and CLMA national conferences, LRV showcased its Student Outreach Program (SOP) to continue to fuel the campaign and bring awareness to the profession.

"Students are exposed to various aspects of the lab as different experiments and simulations are conducted with their active participation."

The SOP targets high school sophomores and juniors who are interested in science-related fields. Utilizing the #1 social network medium among adolescents, LRV has more than 3,000 friends on FacebookTM, and the numbers continue to grow. The supporters of LRV work with local healthcare facilities and med tech programs to coordinate venues where students and lab professionals can interact. As a result of this exchange, students are exposed to various aspects of the lab as different experiments and simulations are conducted with their active participation. During the session, visiting lab professionals also share their reallife experiences with the students, including the rewards and chal-



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Tel 860-767-5341 Cust. Serv. 888-882-6730 lenges of their profession. It is our hope that the outcome of the time spent together will resonate with the students and result in a heightened interest in lab science as a possible career option. This program should expand the choices for students upon graduation and to encourage them to pursue enrollment in a med tech program and begin the process of filling many empty seats of surviving programs across the country.

Changing the course of this unfortunate workforce shortage trend in laboratory science will demand the efforts of many people, but none more than lab professionals. The LRV campaign has contributed to that effort since its inception and has played an active role in preparing lab professionals through our National Advocacy Program. This program was designed to be a true complement to the SOP. It is comprised of laboratory professionals (educators and scientists) who have exhibited a sincere passion for lab science and have made the decision to partner with the LRV program. These individuals speak on behalf of the profession to help address the challenges they are experiencing and help facilitate the program. The advocacy program certifies its participants via online training, which affords them continuing educational credits upon completion. Speaker training and materials are also provided to advocates to equip them with the tools that are necessary to be effective in spreading the word.

It will undoubtedly take considerable time and effort to address the workforce shortage but it can be done, and lab professionals must take an active leadership role to ensure a favorable outcome. They must communicate their value to healthcare administrators in healthcare delivery and patient safety, to regulators and legislators on their role in the practice of lab science and patient care and to educators of their role in research and community and professional services. They must become better advocates for the profession and their role in healthcare as part of the diagnostic team.

"Enlisting the support of the community can also contribute to the desired outcome of promoting labs and professionals."

Enlisting the support of the community can also contribute to the desired outcome of promoting labs and professionals and delivering the appropriate level of awareness about the occupational challenges that industry alone cannot accomplish. We must take a similar approach to the response to the shortage in the nursing profession and amplify the necessary awareness of this issue beyond the healthcare industry. This tactical approach will profoundly resonate with the

general public benefitting from this work, as no human being is exempt from the services that are performed by a lab professional.

Let's support our lab professionals and make a concerted public effort to apply some dedicated resources and effort to this campaign, because as we save this shrinking profession, we also preserve life—an inverse relationship that we must change in order to improve patient care.

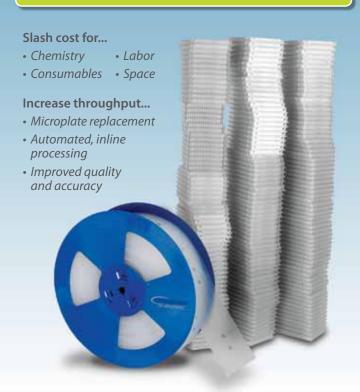
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Kenneth Marques Thornton is director of brand marketing for the Diagnostics Division of Abbott. He has spent almost 20 years at Abbott. A primary area of focus for Ken is the successful execution of the Labs Are VitalTM initiative launched by Abbott.

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PRODUCT SPOTLIGHT

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Caron has added a new benchtop CO2/O2 incubator (model 6404) to its Oasis line, designed specifically for hypoxic applications. The new incubator creates ultrastable conditions for cell culture and also precisely suppresses and controls oxygen concentration down to one percent.



"Many of our customers require hypoxic conditions

for their studies and can now take advantage of the technological advances and conveniences offered by the new Oasis incubator," said Joyce Abicht, Caron customer service manager.

The Oasis series features a 6 cu. ft. capacity in a new compact, lightweight benchtop or stackable format. This affordable unit is available in either 115V, 60Hz or 230V 50/60 Hz models.

Oxygen levels are controlled in hypoxic culture incubators by introducing nitrogen into the chamber. However, injecting nitrogen will drive humidity levels down and further create sluggish humidity recovery after door openings; but, Caron's advanced design provides exceptional recovery times.

The Oasis™ maintains high relative humidity and precisely controls temperature and CO2. Some standard features include: an Infrared (IR) Sensor; tri-zone heating design; rapid, overnight decontamination cycle with a drying phase that eliminates messy cabinet wipe-down; polished stainless steel interior with coved corners; an intuitive, easy-to-operate, intelligent control panel; and ISOCIDE antimicrobial powder-coated exterior paint.

Users also have many options for additional accessories.

"One popular option is the inner door kit and shelving; it allows the customer to compartmentalize the interior into four sections, allowing for tighter control of environmental conditions," said Leah Harris, Caron's director of marketing communications. "Users that frequently need access to cultures inside especially benefit from this feature."

For more information, visit http://caronproducts.com/94/prodcat/CO/prod/6400#details.

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LAB AUTOMATION

PRODUCT SPOTLIGHT

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BioTek has responded to researchers' need for more aspiration options for tall labware with the recent release of its ELx405™ Select deep well washer.

The system is a robot-compatible, full plate washer for automated aspirate and dispense steps in 96- and 384-well plates up to 50 mm high and can also accommodate standard 15 mm microplates.

"Before the ELx405™ Select Deep Well Washer, choices for

aspiration were handheld or homemade solutions or an expensive, slow and complicated pipetting system that was more than they likely needed," said Jason Greene, product manager at BioTek

He added the washer is also useful for BioTek's robotic partners who need a device to empty plates before they're thrown out at the end of a run on their robotic system decks. Doing so keeps waste down at the system's side.

Greene said setup for the system is also very easy and no different than setting up a washer for standard ANSI/SBS-height plates.

"We include pre-programmed default wash parameters to automate the process; however, all software selections are open and customizable by users for further optimization through an adjustment utility software tool," he said.

Typical applications that can now be automated include: plasmid DNA purification, serum/plasma sample preparation, hematopoietic progenitor cell enumeration, and cell proliferation assays.

Additionally, optional Ultrasonic Advantage™ integrated ultrasonic cleaners provide manifold selfmaintenance, and optional automatic 1-to-4 wash buffer switching further enhances efficiency.

The ELx405 also features BioTek's patented Dual-Action™ manifold for independent and precise aspirate/dispense control, and variable flow rates and angled dispensing for optimized cell

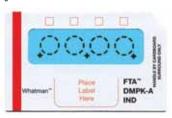
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Permits numerous parameters to be quickly switched both during and after processing

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HOW IT WORKS



Reducing the Environmental Impact of Pure Water in the Lab

Problem: Laboratories everywhere rely on water purification systems to produce the pure water they need for their daily procedures and experiments. Such systems, including those from EMD Millipore, use a combination of several purification technologies in order to remove contaminants present in tap water. Some of these technologies are integrated within the systems, while other technologies and media are available as consumable cartridges. These cartridges have a limited capacity and typically must be changed once or twice a year. Until now, nothing had been done to reduce the environmental impact associated with disposal of the company's purification cartridges.

More and more, reducing the environmental impact during the use and end-of-life phases of a product fits with the sustainability programs adopted by companies and academic centers. The approach is also of increasing interest to users of lab equipment themselves: scientists are sensitive to waste avoidance in their laboratories and are genuinely inclined to adopt sustainable solutions such as the ech2o™ Collection & Recycling Program.

Solution: The ech2o Collection & Recycling Program was created to reduce the environmental impact of EMD Millipore lab water purification cartridges for the company's U.S. customers.

The program combines the complementary strengths of two customercentered and environmentally responsible companies: EMD Millipore and Heritage Environmental Services, the largest privately held U.S. full service environmental company.

By recycling their used purification cartridges instead of throwing them in the trash, EMD Millipore's U.S. customers will be taking another step toward sustainability. The ech2o Collection & Recycling Program will have a positive effect on the environment by reducing packaging and solid waste by



40 percent. Environmental impact will also be reduced by 10 to 12 percent for overall cartridge life cycles.

Full Life Cycle Assessments (LCAs) were performed for the cartridges by a third party LCA specialist using a multi-indicator approach, as recommended in the ISO® 14040 series and the PAS (Publicly Available Specification) 2050. Indicators used for this study are: global warming potential, non-renewable resources, air acidification, eutrophication, non-renewable energy, and product and packaging solid waste.

The entire process the program involves is also traceable and certified. Traceability starts with a user's identification on our website, increases with the barcode affixed to the cartridge during transport, and continues right

up to the auditable Heritage Environmental Services waste management site where recycling occurs.

Users who wish to participate in the ech2o program benefit from a streamlined, web-based process. Customers register on the website and request a cartridge mailback kit that contains everything needed to return a used purification cartridge for recycling. The program has been adapted to fit the needs of both small-to-mediumvolume users (who will send back one or two cartridges at a time) as well as large-volume users, who will prefer to return cartridges in a bulk shipment.

Summary:

Over the past few years, increasing emphasis on product stewardship has gone hand in hand with a rising number of customer requests for environmentally sound ways to manage the products used in labs. Launched in September 2011, the ech2o program provides one more way for scientists to work toward making their lab environments more sustainable.

For more information, visit www.millipore.com/ech2o

HOW IT WORKS



An Integrated Platform-Based Approach to Proteomics Research

Problem: The ever-increasing sophistication of today's laboratory technologies means that scientific researchers must be constantly finding new ways to improve the quality, efficiency, and pace of their research to ensure success. Mass spectrometry-based proteomics research generates such a vast amount of data that making sense of this research now requires server-based computing power far beyond what ordinary desktop PCs can offer. The large amounts of data collected also means that data can be lost and errors can be made. Additionally, many scientists agree that there is valuable data obscured in large datasets, with limited means of accessing it. Consequently, a specialist IT solution is required to manage this data efficiently and accurately. Using the correct technical expertise can ensure that researchers end up with reliable and precise findings, a necessity when managing data looking at diseases such as cancer and stem cell research.

Solution: Studying proteomics holds various challenges, one being the large, dynamic quantity of proteins that are identified during research. The ever-increasing data generated through mass spectrometry means that it is no longer feasible to have technicians manually sort information only using a PC. Instead, proteomics analysis requires a server-based solution and integrated hardware and software workflow to identify peptides and proteins and their post-translational modifications, and to quantify the samples.

To solve this problem, Sage N Research

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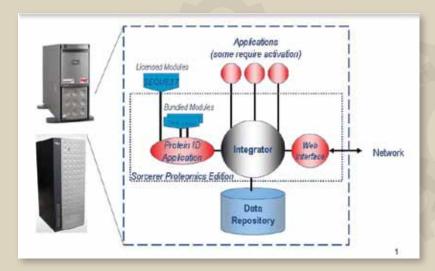
has launched an integrated platform that combines hardware and software to minimize data turnaround time and improve productivity. The platform will allow laboratory technicians to spend more time doing important research and less time operating and customizing equipment. The platform was developed from a detailed, thorough investigation into mass spectrometrybased proteomics research.

The importance of mass spectrometry-based proteomics in cancer research means that it is critical that data is not lost or undependable in any way. The integrated platform enables researchers to characterize and identify proteins in complex disease states, while being customizable to offer the best solutions for proteomics research into diseases like cancer and stem cell research. The server-class integrated IT solutions are able to address 80 percent of computing applications, with the remaining customization being achieved through scripting, making the process considerably faster.

In order for research teams to experience the most efficient and uncomplicated mass spectrometry data searches, a platform-based approach should be adapted. This encourages researchers to concentrate on the science side, with the proteomics IT experts handling the specialized backroom servers and integrated storage systems, ensuring that staff are utilized to their full potential. An increasing number of laboratories are discovering that they need to implement more sophisticated technologies into their processes, therefore it is expected that this will become the industry norm in proteomics research.

Specialized solutions that integrate hardware and software have already been developed by high-end proteomics product companies and offer a proteomics workflow that ensures safe storage and retrieval of proteomics data, effective back-up and recovery, and smoother data analysis. These breakthrough products allow laboratories to work with safer, more reliable data, a necessity in labs dealing with disease research.

For more information, please visit www.sagenresearch.com or e-mail info@SageNResearch.com



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Abstract Submission Deadlines:

December 15, 2011 for Oral Consideration January 20, 2012 for Poster Consideration

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HOW IT WORKS O



High-Power Ultrasonication

Problem: Emulsions are a common working material in laboratories and industry. An emulsion consists of two or more immiscible liquids, e.g. oil and water. To produce an emulsion, one liquid – the disperse phase – has to be dispersed in the other – the continuous phase. Due to the hydrogen bonds of aqueous systems and the Vander-Waals forces of fat molecules, liquids can be hydrophil + lipophob (=easily miscable with water) or lipophil + hydrophob (= easily miscible with oil). That means that an emulsion is an unstable mixture and does not form spontaneously. To produce a stable emulsion, the droplets have to be dispersed very finely and evenly to overcome the bonding forces. Conventional stirring equipment, colloid mills and homogenizers, do not allow the preparation of emulsions with uniformly dispersed droplets as there is no direct control of the droplet size.

Solution: High power ultrasound is known to be a reliable tool for dispersing and emulsifying smaller volumes. Ultrasonic batch processing has been used in laboratories for a long time to produce emulsions. The emulsification effect is caused by ultrasonically generated cavitation. The sound waves propagated in the liquid media result in alternating high-pressure (compression) and low-pressure (rarefaction) cycles, with rates depending on the frequency. During the low-pressure cycle, high-intensity ultrasonic waves create small vacuum bubbles or voids in the liquid. When the bubbles attain a volume at which they can no longer absorb energy, they collapse violently during a high-pressure cycle. This phenomenon is known as cavitation. During the implosion, very high temperatures (approx. 5,000K) and pressures (approx. 2,000atm) are reached locally. The implosion of the cavitation bubble also results in liquid jets of up to 280m/s velocity.

Highly intensive ultrasound thereby supplies the power to disperse the dispersed phase in small droplets in the continuous phase. Depending on the basic materials, emulsions generated by ultrasound can be self-stable or can tend to separate. In order to stabilize the newly formed droplets of the disperse phase against coalescence,



▲ Hielscher's ultrasonic processors, such as the UIP1000hd (in the picture with glass flow cell), are reliable devices for the production of stable emulsions. The UIP1000hd is a versatile ultrasonic processor for emulsifying in the lab as well as in R&D and the industrial production line.

emulsifiers (surface active substances, surfactants) and stabilizers are added to the emulsion. As coalescence of the droplets after disruption influences the final droplet size distribution, efficiently stabilizing emulsifiers are used to maintain the final droplet size distribution at a level that is equal to

the distribution immediately after the droplet disruption in the ultrasonic dispersing zone. Stabilizers actually lead to improved droplet disruption at constant energy density. Studies in the oil-in-water (water phase) and water-in-oil (oil phase) emulsions have shown the correlation between the energy density and droplet size (e.g. Sauter diameter). There is a clear tendency for smaller droplet size at increasing energy density. At appropriate energy density levels, ultrasound can easily achieve mean droplet sizes below 1 micron (microemulsion) or can even create nano-sized emulsions with droplet size below 100nm.

For further information, please visit: www.hielscher.com/emulsion

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HOW IT WORKS O



Titration Instrumentation for QC **Analysis in Beverage Products**

Problem: In an age of ever-increasing consumer requirements and the enforcement of strict regulations such as the Food Law and Foodstuffs and Commodities Act (US Food and Drug Administration, §64 LFBG), it is vital that beverage manufacturers demonstrate the quality and safety of their final product. Poor food quality or dangerous levels of specific ingredients (such as citric acid in beverages) can have disastrous results, from an impact on consumers' health to the exorbitant costs of recalls.

Citric acid is the acidulant of choice in the beverage industry and is used extensively in carbonated beverages for flavor enhancement and as a natural preservative. However, its use can cause serious health risks if consumed excessively and, as a result, its content in beverages has to be monitored. This means that adherence to health and safety legislation is critical.

The compliance of manufactured beverages with health and safety guidelines has to be monitored throughout the entire production cycle in order to eliminate possible safety hazards and ensure that ingredients are kept within specified ranges. Critical control points (CCPs) for manufacturers include "on-line", "at-line" and "off-line" analytics. "On-line" processes include monitoring and improving production parameters on the production line, with time and throughput being the most important factors. "At-line" monitoring is used to determine the parameters of the finished product, against specified requirements, with quick tests and simple screenings such as pH measurements. Finally, "off-line" analytics include in-depth analyses performed in quality control laboratories by trained employees to ensure a product conforms to particular specifications.

In the mass production of beverages, experts have to meticulously check, at routine intervals throughout the entire production process, that the concentrations of various soft drink ingredients are within the prescribed limits. This level of monitoring requires a versatile, accurate and fast method of analysis.

Solution: Titration is a common laboratory method of quantitative chemical analysis used to determine the unknown concentration of a known reactant, such as citric acid in beverage products. It works by providing an accurate measure of how much of a chemical substance is dissolved in a given volume of solution and can therefore provide manufacturers with the precise quantity of reactant in a sample. The completion of the reaction is demonstrated by a pH meter and electrode or a change in color caused by an indicator.

Titration uses instrumentation with which volumes of solutions can be measured to an accuracy greater than 0.1%. With reactions taking between two and four minutes, this versatile method can be successfully employed to conduct fast, accurate,

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clear, and repeatable analyses in various industries, including the beverage industry. Furthermore, recent technological developments have expanded the technique's capabilities and provided users with a new range of possibilities that enhance speed and accuracy.

Quality control analysis in the beverage industry is often a demanding process requiring high throughput, flexibility, and accurate instrumentation. As a result of the latest technological innovations, the monitoring of certain ingredients including citric acid can be easily optimized to ensure quality and safety of the final product. Designed for advanced titration and dosing applications, the SI Analytics TitroLine series from ITT Analytics is well-suited for a range of quality



▲ The TitroLine 6000 from SI Analytics, part of ITT Analytics

control applications throughout the entire beverage production cycle, enabling users to demonstrate a product's adherence to prescribed limits. The new TitroLine® 6000 is a "stand alone" system while the TitroLine® 7000 automatic titrator can function as both a "stand alone" and a PC-controlled system. It features an easyto-use PC-based interface, eliminating the need for extensive training and providing trouble-free analyses at all CCPs in the process. High throughput is also ensured as a result of the instruments' automatic recognition of both the dispensing module and reagent data, optimizing productivity for the manufacturer. In addition, the easy-to-read display tracks titration curve and data for fast and reliable analyses at all stages. The TITRONIC® 500 piston burette allows users to perform dosing operations quickly while conducting manual titrations with ease, ensuring accurate measurement. The TITRONIC® 500 can also be used with the TitroLine® 7000 for pre-dose operations.

To learn more about ITT Analytics products visit www.ittanalytics.com

HOW IT WORKS O



A Portable Gas Chromatograph **Mass Spectrometer**

Problem: Routine monitoring of soil and groundwater are used to detect contamination from toxic chemicals. This contamination may be due to industrial runoff or wastewater effluent. Monitoring provides protection of local tributaries and surrounding property. How can sample areas be screened prior to sending samples to a laboratory for analysis, and how can sampling and analysis times be shortened when it is necessary to make urgent and critical decisions involving contaminated sites?

Solution: For industrial environmental monitoring programs, the ability to quickly analyze samples taken from nearby ground and water sources is key to environmental protection. The ability to analyze samples at the source without the need for fixed laboratory analysis can save time and money, and in the case of a spill can lead to improved response times for clean up. A sampling and analysis methodology with results produced in under three minutes without the need for sample storage at 4°C and transport back to a fixed base laboratory represents a significant time and cost savings.

The CUSTODION® Solid Phase Microextraction (SPME) syringe, together with the TRIDIONTM gas chromatograph-toroidal ion trap mass spectrometer (GC-TMS) can be used for rapid on-site sample extraction and analysis providing needed information used in the decision-making process. Following on-site sample analysis, informed decisions can be made regarding which samples should be sent to a laboratory for confirmatory analysis. In addition, on-site sample collection and extraction using SPME minimizes target analyte losses compared to traditional techniques that risk analyte loss during storage and transport.

The CUSTODION SPME sampling syringe consists of a 1cm fiber coated with a liquid polymer film, solid sorbent, or a combination. The SPME

fiber is housed in a durable needle syringe that can be operated with a single hand. This makes operation easy even while wearing personal protective equipment. Much like a retractable ball point pen, the push button trigger

above ambient to 300°C. The detector is a miniature toroidal ion trap mass spectrometer (TMS) with a nominal unit mass resolution over a mass range of 50 to 500 Daltons. The mass and temperature range of the instrument make it suitable for detection and identification of a wide range of chemicals. The system is totally self-contained, weighs 32 pounds, is both battery and line power operable, and has an onboard helium GC carrier gas cartridge. A VOC target compound library based



▲ The TRIDION™ Gas Chromatograph-Toroidal Ion Trap Mass Spectrometer (GC-TMS)

on top of the CUSTODION syringe allows the SPME fiber to be extended and retracted into and out of a protective needle. The SPME fiber traps target analytes from air, headspace (solids or liquids), or direct sampling of liquids and dissolved solid samples.

The TRIDION GC-TMS features a low thermal mass (LTM) capillary gas chromatograph with high-speed temperature programming (>120°C/min) and a temperature range of 10 degrees on retention time and key mass ions is pre-loaded into the GC-TMS target compound library and used to positively identify compounds while in the field. The sample analysis and identification method is rapid, requiring <3 min for sample analysis and compound identification.

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PARTING POINTS

Takeaways from this month's issue:



COMMUNICATING SCIENCE

Science is now in the ring with controversial social issues and taking more punches. The public wants transparency. Funding is dicey. The media ecosystem is in flux. What scientists say, and how they say it, is more important than ever. Some tips for better communication include:

- Use metaphors and narratives to make communications more relevant to specific audiences
- Speak in a more conversational style
- · Study empirical data about target audience values

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HIRING THE BEST

The purpose of the entire hiring process – reviewing candidates' application materials, talking to their references and engaging in interviews – is to hire high-impact individuals. They represent the future of the lab. Here's what to look for in potential hires:

- · Problem solving abilities
- Flexibility
- Strong oral and written communication skills
- · Ability to work well with others

THE POWER OF PORTABILITY

Over the past year, trends in portable instrumentation have continued to progress, with devices getting smaller, faster, and more powerful as demand for portability remains high. However, there have been a few changes and some new developments in the industry overall:

- · More rugged instruments
- Increased wireless communication abilities
- The defense industry continues to be a major driver of portability
- Portable instruments are expected to continue supplementing work done in labs



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51 (1987)

LABORATORY ACOUSTICS

Understanding basic acoustic space design criteria and strategies that building managers, users, planners, and designers can use to recognize and address the acoustic needs of laboratory spaces is deeply important for collaboration and efficiency in labs. Those include:

- The communication needs of the space
- The appropriate acoustic metrics for the design and intended use
- · Containment options for equipment and utility noise
- · Integrated energy efficiency and acoustics in the HVAC design



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DESIGNING AN ECO-FRIENDLY LAB

Matthew Gudorf, campus energy manager with the Facilities Management group at University of California, Irvine, discusses the Smart Labs program developed at UCI, which aims to reduce overall energy consumption by 50 percent. It involves:

- Centralized demand control ventilation (CDCV)
- Exhaust stack velocity reduction
- Energy efficient lighting
- · Active and passive daylighting, and a number of other retrofits

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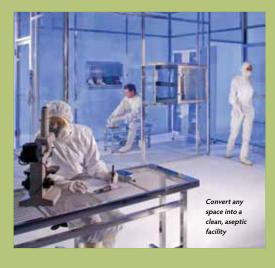
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