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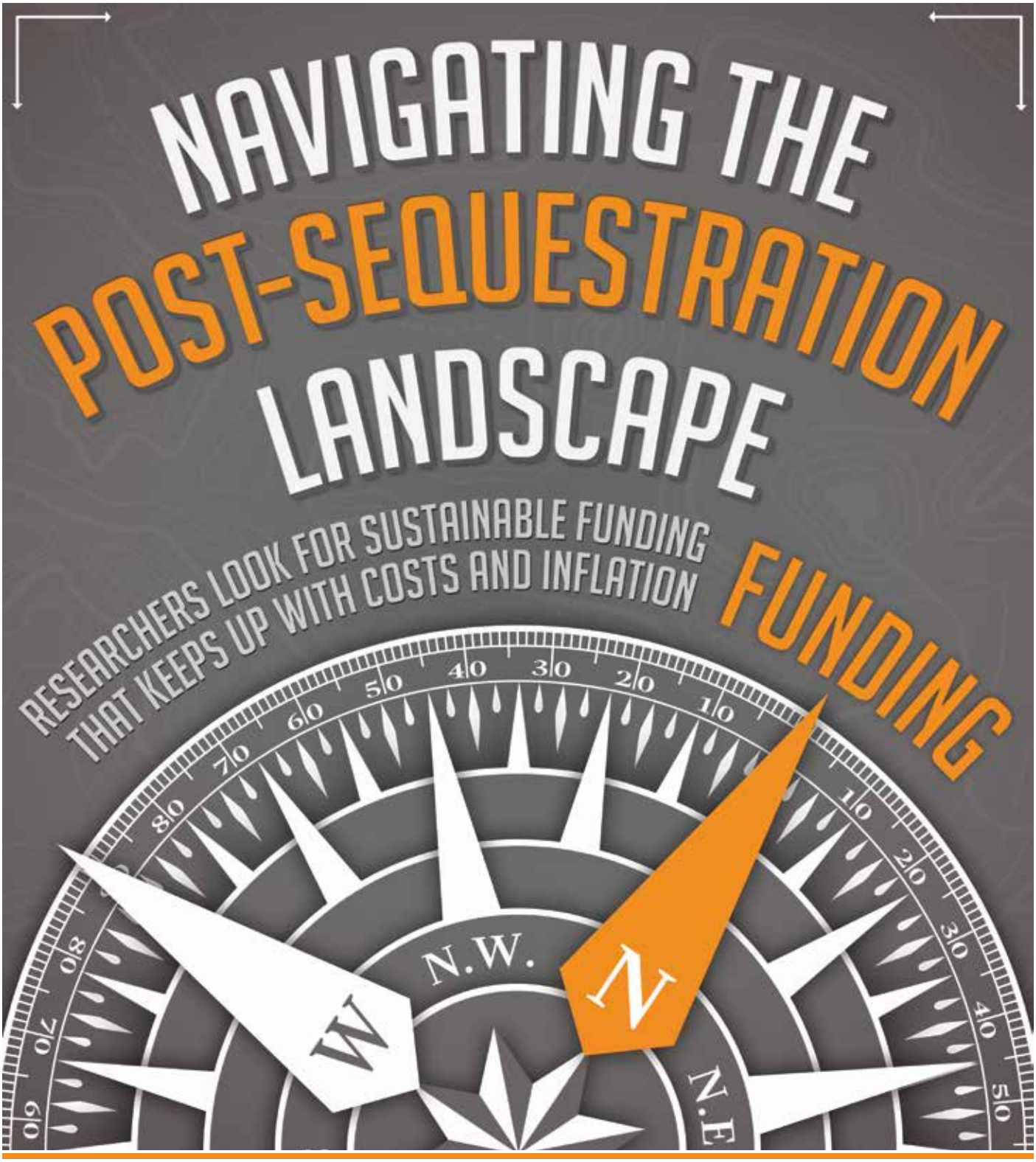

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Figuring out the future

Any researcher in the United States who is dependent on government funding knows firsthand the devastation that the sequestration wrought. Some have found ways, temporarily, to do more with less money, while others have had to pack up their research tents for good. This month's cover story looks at both of those scenarios and makes recommendations for moving forward. One of those recommendations is for those in the scientific trenches to get more involved in letting the general public know what they do and why it matters.

Andrew Rosenberg, director, Center for Science and Democracy, Union of Concerned Scientists, believes that scientists need to be involved in the public debate. "Scientists should be talking not only to other scientists but also to the wider community—saying this is what I do and why I do it," he says.

In the meantime, concern remains that because the results of funding aren't seen for 10 years or better, the post-sequestration situation will have a long tail.

"On average, every NIH grant supports seven jobs, and the economic return is $2 for every $1 the NIH invests in research. Today's technological advancements and treatments are the fruits of investments made 10 to 15 years ago," explains Benjamin Corb, director of public affairs of the American Society for Biochemistry and Molecular Biology, suggesting a grim picture for the next decade or two if the cuts persist.

While sequestration has negatively impacted morale in many research quarters, this year's Salary & Job Satisfaction survey does not reflect a sizeable decline in job satisfaction over the past year and the year before. Due mostly to the fact that *Lab Manager*'s readers represent every kind of laboratory in the country—from municipal water to the chemical & gas industry. That being said, the survey *did* reveal a slight decrease in the number of government scientists (7.6% decrease) and hospital researchers (18.8% decrease), perhaps owing to sequestration efforts.

But most notable in this year's survey was that the so-called Millennials represented only 11 percent of respondents, down from 20 percent reported for the previous year. This suggests that many labs continue to be populated with older high earners and, as organizations tighten their financial belts, it's the younger workers who are getting squeezed out. Which begs the question, who will be there to move into the spots baby boomers leave behind when they inevitably retire?

Appropriate and optimum laboratory staffing is the focus in this month's Leadership & Staffing article, "Your Workforce under the Microscope," in which author Mark Lanfear says, "The talent pool is not being replenished quickly enough to replace retiring life science professionals." To address that, he makes a case for strategic workforce planning, saying, "Aligning an organization's human capital program with its current and emerging business/financial goals has the effect of creating efficiencies, streamlining processes, and spurring innovation—all things that can help a business reach and exceed goals."

In addition to strategic workforce planning, running your lab like a business these days requires an understanding of general project management methods, or so believes Christian Mittelholzer, PhD, chief technology officer (CTO) at Redbiotec AG, a biotechnology company near Zürich, Switzerland and the subject of this month's Perspective On (page 58). He says that working on many different projects with widely different timeframes, "[requires] a structured approach to project management that ensures all deadlines are met and projects are completed on time—something we have become especially adept at." When it comes to his management style, Mittelholzer says, "I do my utmost to be hardworking, optimistic, honest, and structured while attempting to be fair and realistic about my strengths and weaknesses."

I don't think a lab manager can do much better than that!

Best,

Pamela Ahlberg
Editor-in-Chief

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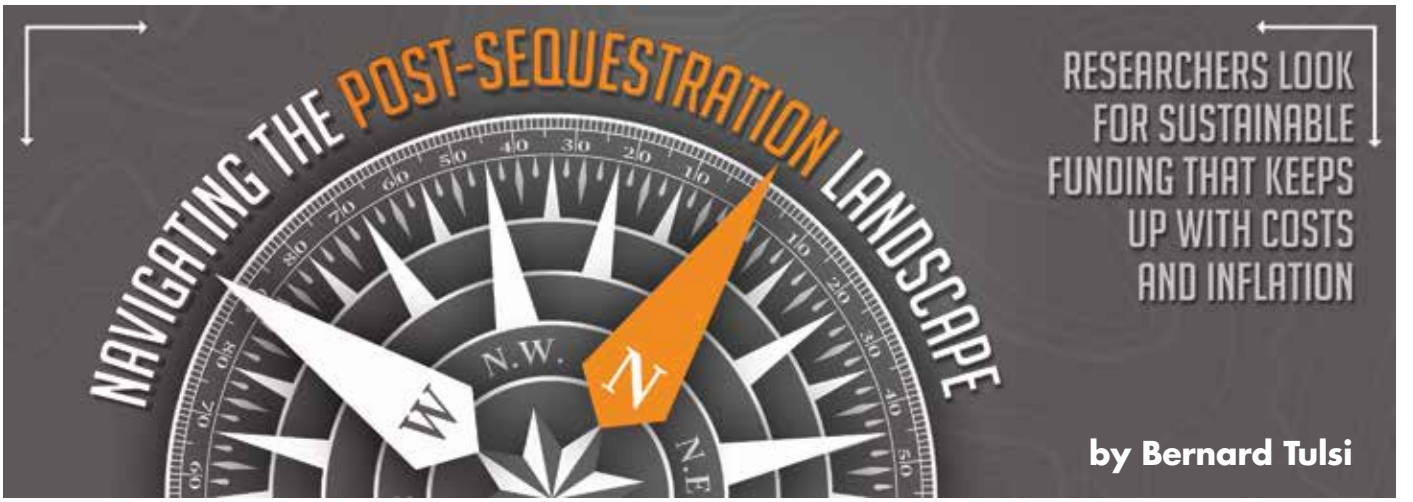

Job satisfaction and morale among researchers relying on government grants were body slammed by the sequestration—at least $1.3 trillion in across-the-board funding cuts were mandated by the 2011 Budget Control Act for 2013 through 2021.

Equally problematic has been the increased congressional scrutiny of grants, says Andrew Rosenberg, director, Center for Science and Democracy, Union of Concerned Scientists. He says that instead of scientists making determinations about promising lines of research, "members of Congress and their staff are reading the titles of research projects" and making decisions about their relevance.

"Had Congress identified a targeted solution, blunt, across-the-board cuts could have been avoided," says Prof. Joe Heppert, associate vice chancellor for research and graduate studies, University of Kansas. He says the sequestration undercut any opportunity to think broadly and creatively about solutions for maintaining scientific competitiveness.

Pointing to a likely cause of this blunt approach, Heppert says, "Most of our congressional delegation understand the role of science and technology and their vital place in future development." But, he adds, the challenge lies in working across the aisle in Congress to achieve consensus on research funding.

Nondefense discretionary funds, which support agencies such as the National Institutes of Health (NIH) and the National Science Foundation (NSF), are at their lowest as a percentage of gross domestic product (GDP) in 60 years—that is, since the Eisenhower administration—according to Benjamin Corb, director of public affairs of the American Society for Biochemistry and Molecular Biology (ASBMB).

Corb says that in grappling with the national debt and budget deficit, Congress chose to cut only spending, and except for across-the-board cuts in 2013, only in nondefense, discretionary areas. Even complete defunding of entities such as the Department of Education, the Food and Drug Administration (FDA), the NIH, and the NSF won't significantly change the debt and deficit equation, according to Corb. But the sequester-driven cuts had "a supreme impact on our ability to conduct science and [are] really hurting our research," he says.

ASBMB estimates the annual pre-sequester attrition rate at about 50 to 100 biomedical scientists—with an inflow of about 25 to 50 new entrants. In 2013, the first sequester year, about 1,000 scientists didn't receive NIH funding.

On average, every NIH grant supports seven jobs, and the economic return is $2 for every $1 the NIH invests in research. Today's technological advancements and treatments are the fruits of investments made 10 to 15 years ago, explains Corb, suggesting a grim picture for the next decade or two if the cuts persist.

Corb acknowledges the importance of improving efficiencies, stretching research dollars, and exploring other funding sources. "There are alternative areas of funding, but the government is the foundational investor in research. It is that way for a reason; industry does not invest in basic research."

Daniel Raben, professor of biological chemistry at Johns Hopkins University School of Medicine, says that private-sector funding in not a viable alternative. "They insist on the sure bet versus innovative research, and when it doesn't look like it will turn into something, they pull out." In any case, private institutions and foundations support only a small fraction of researchers and certainly couldn't support everyone, says Raben.

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He doesn't see any viable alternative to the government, and further adds that "government investment here is not a dumb idea because of returns such as improvements to health, new products, and the generation of new markets."

To be sure, the challenges predate the past few years. "For biomedical research, it has really been a decade of minimal growth in spending and investments." As a result, scientists have been trying to grow and do more with less money, Corb says, adding, "With the additional cuts, however, they can only do less with less."

Karl Matlin, professor, Department of Surgery, University of Chicago, who closed his lab recently, says that funding difficulties were a major consideration but is hesitant to link them directly to sequestration. "While that was the straw that almost broke the camel's back, funding had been difficult for several years. To put the emphasis on sequestration is to some extent missing the larger point—the real decline in funding for biomedical research in the US is having serious systemic effects."

> "Today's technological advancements and treatments are the fruits of investments made 10 to 15 years ago."

Because of the cutbacks, Raben placed some of his projects on hold and discontinued others that became too expensive. Still, he feels fortunate relative to researchers who closed labs or changed jobs because of diminishing funding. While his lab had to let one technician go, all graduate students were funded to completion. "It's been tough; everyone found jobs but [they were] not always what they wanted."

Raben says there is a definite brain drain now, noting the relocation of a scientist from his organization to England, while others moved to China and Singapore, among other countries, for better opportunities. "We have to recognize that if the funding problem remains the way it is now, the major advances in biomedical research will not happen in the US because we are not supporting them."

"Last summer, ASBMB surveyed scientists from 15 different professional societies and found that one in five was considering leaving the country for better funding opportunities and employment," says Corb. ASBMB has not followed up on this study yet, but Corb believes the basic finding still holds.

Rosenberg sees the brain drain a bit differently and says that might not be the most apt description. He acknowledges that researchers may be departing, but foreigners still want to come to the US to pursue training and research, although probably in lower numbers now.

"It might be a brain drain in the sense that many talented people are choosing not to pursue a research career," he says, citing funding challenges, greater scrutiny from universities, high university costs, and reduced support at the state level, among other hurdles.

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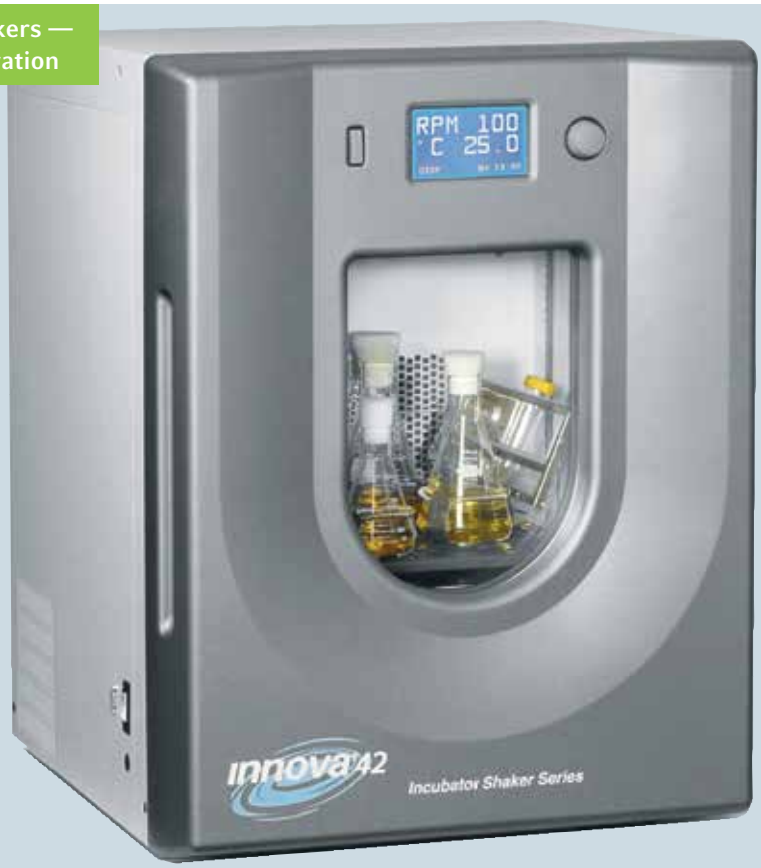

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The recent cuts have hurt morale among established researchers, says Raben. Heppert concurs. "I believe that satisfaction has been eroding among research faculty over the past 20 years—and the sequestration is definitely an additional blow to morale."

Noting that the percentage of grant renewals is dropping because of the cuts, Raben says, "Many new, younger faculty members will be devastated if they are unable to get a second grant, even if they manage to get a first."

Corb concurs. "Scientists would rather do science than fill out grant applications, which they have to do increasingly now because funds are scarce. Younger people are looking at the struggles their principal investigators have for funding and are walking away from that kind of future."

To illustrate the challenges with grant applications, Heppert says, "We are submitting a greater number of proposals—as is everyone else. Faculty is also increasing the total dollar value proposed in each grant. From monitoring the results this year, there was a decrease in the total number of projects funded and a decrease in the dollar amount for each proposal."

> "To be sure, the challenges predate the past few years."

On average, investigators today get their first grant at age 45 years, versus about age 30 years in the past. "If we hire investigators, we have to provide them with about $1 million because they are not able to get funding for several years," says Matlin.

By most accounts, researchers would like to see a sustainable model with provisions for increasing, not just maintaining, funding levels. "If the NIH budget stays flat, it is as good as going downhill," says Corb.

"This year there was a modicum of relief," Corb says, citing delays in stipulated funding cuts—the 5 percent NIH reduction in 2013 did not recur in 2014. Still, he says, "There hasn't been any growth—because of the cost of doing business and inflation, no cut and no growth still come out to a net loss."

Raben sees "boom and bust" support such as the Recovery Act, which he calls a "bolus of money that goes away after a few years," as untenable. "We have to get on a track where we have a sustainable increase that keeps up with costs and inflation—if it stays flat, it is an overall negative slope."

Matlin explains that a major portion of academic research grants pays salaries and other personnel costs. Cuts and lost funding, therefore, mean not only project discontinuations but also lost jobs and institutions having to support faculty at an unprecedented rate. No institution has sufficient resources to pay all the investigators it employs, according to Matlin.

"In this institution, for example, for every $100,000 an investigator gets, the institution gets $53,000 as overhead. Over the years, institutions have leveraged this money to build the scientific research enterprise—with growth predicated on the number of grants. If the enterprise growth stops, the system begins to collapse. We are seeing that here and among our peers."

Rosenberg says that rather than base science funding on annual appropriations, a trust fund approach could be implemented. "We can agree at the outset on the nation's budget allocation for science, innovation, and exploration and gain some independence," he says.

Matlin says he has seen ups and downs in funding over the years, but now "we see no end in the current decline." He too believes that the US will lose its lead in the biomedical field if this trend persists. "You will have concentrations of high-level research in a few institutions, but in general there will be a significant decline—and nothing is happening to change the tide on this."

"One of the really troubling aspects of this is that a lot of the people in Congress don't understand that the health of the scientific endeavor depends on funding from the NIH. They think that funding comes from universities and outside sources, and it doesn't," says Raben.

Corb says the future is hard to figure out now. "We have sequestration relief for the next fiscal year as part of the Ryan-Murray budget agreement from last year. So there seems to be little interest now in discussing sequestration and the impact of the cuts from Capitol Hill. "We can change this—if we make our case loud enough and hold our elected officials accountable for their decisions."

Rosenberg believes that scientists need to be involved in the public debate. "Scientists should be talking not only to other scientists but also to the wider community—saying this is what I do and why I do it," he says. Noting the attacks on and resulting demoralization of government scientists and researchers in fields such as climate and the environmental sciences, Rosenberg says, "The use of science as a political football will hurt us all, and the general public needs to be aware of this and start saying it too."

> "No institution has sufficient resources to pay all the investigators it employs."

"Over the next four or five years, scientists need to be better communicators about what we do and our role in the formation of the modern economy and in providing opportunities for future generations," says Heppert.

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

THE EIGHTH ANNUAL SALARY & EMPLOYEE SATISFACTION SURVEY

LIVE LONG AND PROSPER: BABY BOOMERS CONTINUE TO DOMINATE THE LABORATORY LANDSCAPE

by Trevor Henderson

As we wind up this year's Salary & Employee Satisfaction Survey, it seems that little has changed for many of our 1,199 survey respondents. For the most part, year-over-year changes remain minor; however, when we revisit the results of earlier surveys it appears that the demographics of the scientific workplace may be changing and, more important, may be on the cusp of a complete reworking as baby boomers exit the workforce.

Demographics

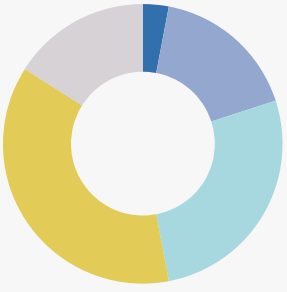
As in previous years, the majority of respondents—75%—work in academic, industrial, or clinical research labs [Table 1]. Not surprisingly, we witnessed a slight decrease in the number of government scientists (7.6% decrease) and hospital researchers (18.8% decrease), perhaps owing to recent sequestration efforts. The upside appears to be that these losses have been balanced by a simultaneous increase in contract research and consultancy positions as well as increases in the highly regulated fields of environmental monitoring and food science, as well as the energy sector.

TABLE 1: Research Organization

Clinical / Hospital / Medical Lab	27%
Industrial Research Lab	24%
Academic Research Lab	24%
Government Research Lab	12%
Private Research Lab	4%
Contract Lab	4%
Consultant	1%
Other	4%

FIGURE 1: A Snapshot of Survey Respondents

AGE



20 – 29	3%
30 – 39	17%
40 – 49	27%
50 – 59	37%
60+	16%

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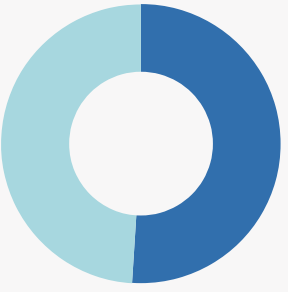
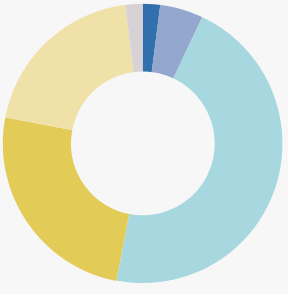


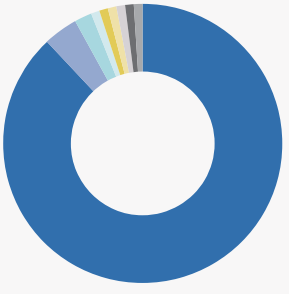
Female	51%
Male	49%

LEVEL OF EDUCATION



Some College	2%
Associate's Degree	5%
Bachelor's Degree	48%
Master's Degree	25%
Doctoral Degree	20%
Other	2%

GEOGRAPHICAL LOCATION



United States	87%
Canada	4%
Western Europe	2%
Middle East	1%
Central/Eastern Europe	1%
Africa	1%
Pacific *(Australia, Philippines, etc.)*	1%
Central/South America	1%
Asia *(Japan, China, Korea, India, etc.)*	1%

Laboratory management professionals continue to represent the majority of survey respondents, with 70% of respondents working in a management position and the balance working as researchers/technologists or in academia [Table 2]. Research fields were well balanced across many disciplines, with the majority of respondents working in applied and analytical chemistry, life science, or clinical research. The balance of survey respondents reported involvement in environmental research, agriculture, drug discovery, or physical science [Table 3].

TABLE 2: Job Function

Lab Management	70%
Research Scientist	14%
Technologist / Research Assistant	8%
Academics	4%
Engineers	1%
Other	5%

TABLE 3: Field of Research

Life Sciences	34%
Chemistry	29%
Clinical	10%
Environmental	8%
Agriculture	3%
Drug Discovery	3%
Neuroscience	2%
Forensics	2%
Physical Sciences	1%
Other	8%

Who's the boss?

Management responsibilities appear to be increasing among lab professionals, as evidenced by a decline in the number of respondents reporting that they have no supervisory/management responsibility (18% versus 22%), and there was an increase in the number of managers responsible for management of both laboratory professional and non-laboratory professional employees. Further, lab managers appear to be managing more staff than ever. In previous surveys, the largest cohort of lab managers (26%) supervised one or two employees; this year that number decreased to 23%, with the largest group of managers (24%) now responsible for 10 to 24 employees, an increase of 4% from last year. Increased responsibility for lab managers, including the management of nontechnical staff, appears to be a trend moving forward.

Longevity and loyalty

When it comes to tenure, this year's survey revealed interesting results. There is a noticeable reduction in the numbers of new researchers, with only 2% of respondents working in the sciences for less than two years. This figure is down 3% from last year and overall represents a 66% decrease in the acquisition of new laboratory workers since 2010. Conversely, 52% of respondents report over 20 years of experience, compared to 48% last year and an overall increase of 27% since 2010.

Concerning loyalty and job retention, the 2014 survey results suggest that hiring may be on hold for many labs. Employees working less than two years with their current employer sharply decreased by 6% over last year (10% versus 16%). This figure is again down from 21% in 2010, perhaps indicating a trend toward decreased hiring and less mobility among lab workers currently employed. Long-term employees continue to show an increase, with a similar 6% increase in employees with over 20 years of service compared to last year (26% versus 20%), a whopping 10% more than the reported 2010 numbers (16%). This again suggests that more tenured employees may be displacing new workers in many labs.

Interestingly, again this year we see a trend toward smaller labs and smaller organizations where respondents work. Last year, 49% said they worked for organizations with over 1,000 employees; this year that number decreased to 44%, in spite of the fact that we see a 2% increase (27% versus 25%) in the number of people working for organizations with over 5,000 employees. Minor growth was seen in both small and midsize organizations. These numbers are not surprising, as the industry continues to see the acquisition and merger of many companies as well as downsizing and consolidation of many labs.

Live long and prosper

When considering the salaries of our survey respondents, an interesting trend is revealed. There has been a marked reduction in the number of employees earning less than $35,000 annually. In fact, we see a 33% decrease in this earning group for last year alone and an over 50% reduction since 2010. We can only speculate on the cause of this reduction; however, it seems apparent that these workers are not simply moving into higher pay categories, as the percentage of workers making

between $35,000 and $75,000 has remained virtually unchanged for the past five years. It is far more likely that budget constraints on many labs have eliminated or automated these jobs or moved them offshore.

While the percentage of the highest earners remains unchanged (approximately 13% earning over $110,000), we see the greatest change among those earners making between $75,000 and $110,000 annually. The percentage of individuals in this category rose 4% last year and has risen over 8% since 2010 [Table 4]. These shifts in wages are not unexpected as we see the baby boomers (those born between 1946 and 1964) mature in the workforce.

TABLE 4: Annual Salary

	2014	2013	5YR TREND
Less than $25,000	4%	6%	48% ↓
$25,000 - $34,999	4%	6%	29% ↓
$35,000 - $44,999	6%	10%	19% ↓
$45,000 - $54,999	13%	12%	2% ↓
$55,000 - $64,999	14%	14%	2% ↑
$65,000 - $74,999	13%	12%	5% ↑
$75,000 - $84,999	12%	11%	16% ↑
$85,000 - $94,999	10%	9%	36% ↑
$95,000 - $109,999	11%	9%	18% ↑
$110,000 - $124,999	6%	5%	13% ↑
$125,000 - $149,999	4%	4%	20% ↑
More than $150,000	3%	2%	28% ↑

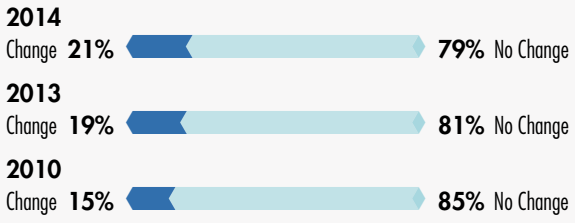
When considering the influence of the baby boomer generation on salary costs, it seems that they remain the primary earners and perhaps are not exiting the workforce as early as many experts and analysts had predicted. According to our survey results, a full 53% of researchers are of the baby boom generation, as compared to 44% last year and 36% in 2010. The newest cohort of workers, the so-called Millennials, represented only 11% of survey respondents, down from 20% reported for the previous year.

It appears that many labs continue to be populated with older high earners, perhaps in more secure and tenured positions. Further, it appears that as organizations tighten their financial belts, it's the youngest workers who are getting squeezed out. Fortunately, this is likely a short-term solution for many labs, as most baby boomers will inevitably be retiring in the near future, freeing up more opportunities for young scientists.

Benefits

Again this year we see an increase in the percentage of laboratory workers experiencing significant changes in their benefit packages, with 21% of respondents reporting changes in benefit plans compared to 19% last year and only 15% in 2010 [Figure 2]. When asked to describe these changes, the comments were typically negative, complaining of reduced health benefits, higher premiums, increased co-payments, decrease in or elimination of 401(k) matching, reduced tuition reimbursement, etc.

FIGURE 2: Respondents Reporting Change in Benefit Package



While benefit packages may have been slashed in many cases, interestingly there appears to be an increase in the number of employees eligible to participate in bonus programs, with a 5% increase (39% versus 34%) among eligible individuals in 2014 compared to the previous year. Further, the average amount of bonus payments increased, with 38% of respondents receiving bonuses over $5,000 compared to 32% in 2013. This strategy of pay for performance appears to be a growing trend in the research industry, where compensation is at least partially tied to personal, group, and/or financial objectives.

"The 2014 survey results suggest that hiring may be on hold for many labs."

Education matters

As research becomes increasingly technical, it is not surprising that the number of laboratory professionals with advanced degrees is also increasing [Table 5]. The largest change was among laboratory professionals with doctoral-level degrees; a full 20% of respondents carry the title of doctor, up from 14% last year and 9% in 2010. A decrease was observed among lab workers with associate-level degrees or no degree, with only 7% of

employees reporting in this category, down from 9% and 17% in 2013 and 2010, respectively. While there has been very little change in the percentage of lab workers with bachelor's- and master's-level degrees, clearly the demand for highly skilled workers remains persistent.

TABLE 5: Education

	2014	2013	5YR TREND
Some college	2%	4%	77% ↓
Associate Degree	5%	5%	37% ↓
Bachelor's Degree	46%	47%	4% ↓
Master's Degree	25%	27%	19% ↑
Doctoral Degree	20%	14%	122% ↑
Other	2%	3%	20% ↓

Job satisfaction

The majority of lab professionals surveyed appear satisfied with their current positions, with 78% of respondents stating that they will be working in the same capacity next year, a value up 4% from last year. Given that, slightly fewer people (15% versus 17%) reported that they expected a promotion in the upcoming year as compared to last year. Very few employees expect to be leaving their employers in the coming year, again supporting the evidence that most lab workers are currently satisfied with their present employment.

Professional development

A full 92% of respondents indicate that their current experience and skills are sufficient for their job, a value up 2% from last year's survey. Interestingly, far fewer respondents indicated that they were interested in seeking additional training or education, with only 13% of respondents considering returning to school, down from 19% in 2013.

When questioned about their organizations' training, respondents indicated that across the board, training opportunities were slightly worse than in previous years. Results indicated 1% to 3% decreases in satisfaction in the areas of initial and ongoing training, job support and enhancement, and education to better balance work and personal time.

In summary

While year-to-year differences appear minor in most areas, it seems apparent that the aging demographic of the laboratory community is placing pressure on laboratories to become more innovative with their approaches to business. Changes in benefit packages and bonus structures seem to be part of many labs' plans, as is a reduction in new and less-skilled employees, perhaps in favor of automation or moving jobs offshore. However, we are on the brink of change for much of the laboratory industry as the bulk of the mature workforce looks forward to retirement and exciting new positions are created for emerging scientists. As always, we will be watching closely.

If you participated in this year's Salary & Employee Satisfaction Survey, thank you. We look forward to returning to this important topic a year from now and will be counting on your participation once more.

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DISPOSAL DONE RIGHT

WHILE RULES GOVERNING LAB WASTE DISPOSAL VARY, COMMON SENSE BEST PRACTICES SHOULD PREVAIL

by Stewart Gillham

Disposing of unwanted or outdated lab chemicals has always been somewhat of a troublesome, expensive, and sometimes outright dangerous process. Ironically, the introduction in the UK of legislation designed to make this practice simpler has not, in our experience, always had the desired effect.

One of the main factors in this is the change in responsibility for the chemicals' safe disposal. Traditionally, the spotlight had always been on the waste disposal company to ensure that safety standards were met and that correct disposal procedures were followed. In more recent years, however, there has been a great shift in focus and responsibility to the person or lab that produced the waste; this is where things begin to get tricky in lab waste disposal.

> "Due to the extra responsibilities involved in disposal paperwork and labeling, some labs were avoiding collections altogether."

To get a handle on just why, we need to realize that although these laboratory chemicals are usually stored and used in only small quantities, they are still classified pretty much the world over as hazardous waste.

Disposal in the US is governed by the Environmental Protection Agency (EPA) and in the UK by The Environment Agency (EA). Both agencies are tasked with protecting the environment and can enforce large fines and, in extreme cases, a custodial sentence for the incorrect disposal of hazardous waste.

Due to the extra responsibilities involved in disposal paperwork and labeling, some labs were avoiding collections altogether, in some cases leaving waste to build up for years in deteriorating packaging and overflowing storage cabinets.

While this might have seemed a minor issue—after all, we're not talking about large quantities here—it's actually where most of the issues that we've helped resolve were created.

The first problem we have is the containers the chemicals are stored in. Many of the most commonly used laboratory chemicals are highly corrosive, and over time these can perish seals and lids, meaning vapors and the liquids themselves can potentially escape into the environment.

Second, over time the labels on these types of materials can become illegible or disappear altogether due to dampness or splash back from the chemicals' usage eroding them away. One of the main issues with this is that when it comes time for the chemicals' eventual disposal, it can become a nightmare for the disposal company trying to identify them, which can lead to costly analytical fees.

Finally, as the waste builds up and storage suddenly becomes an issue, incompatible liquids are commonly found stored next to each other. Throughout our years in waste disposal, we have found this is definitely one of the common reasons, if not the most common, for accidental damage to both the environment and human health. Leaking oxidizers have been found next to unsealed flammables, explosives next to combustibles—and it certainly doesn't take a lab technician to work out that this really isn't a good idea!

This growing problem was well managed for schools, colleges, and universities in the US with the introduction of the Academics Laboratories Rules, whereby it was legislated that labs must have unwanted or outdated lab chemicals collected every six months. Also, students and professors alike now have to follow a carefully designed lab management plan that has been specifically devised to identify and ensure best practices.

Although this was really enforceable only for educational labs, some of the rules and procedures would be a great idea for all facilities using and disposing of

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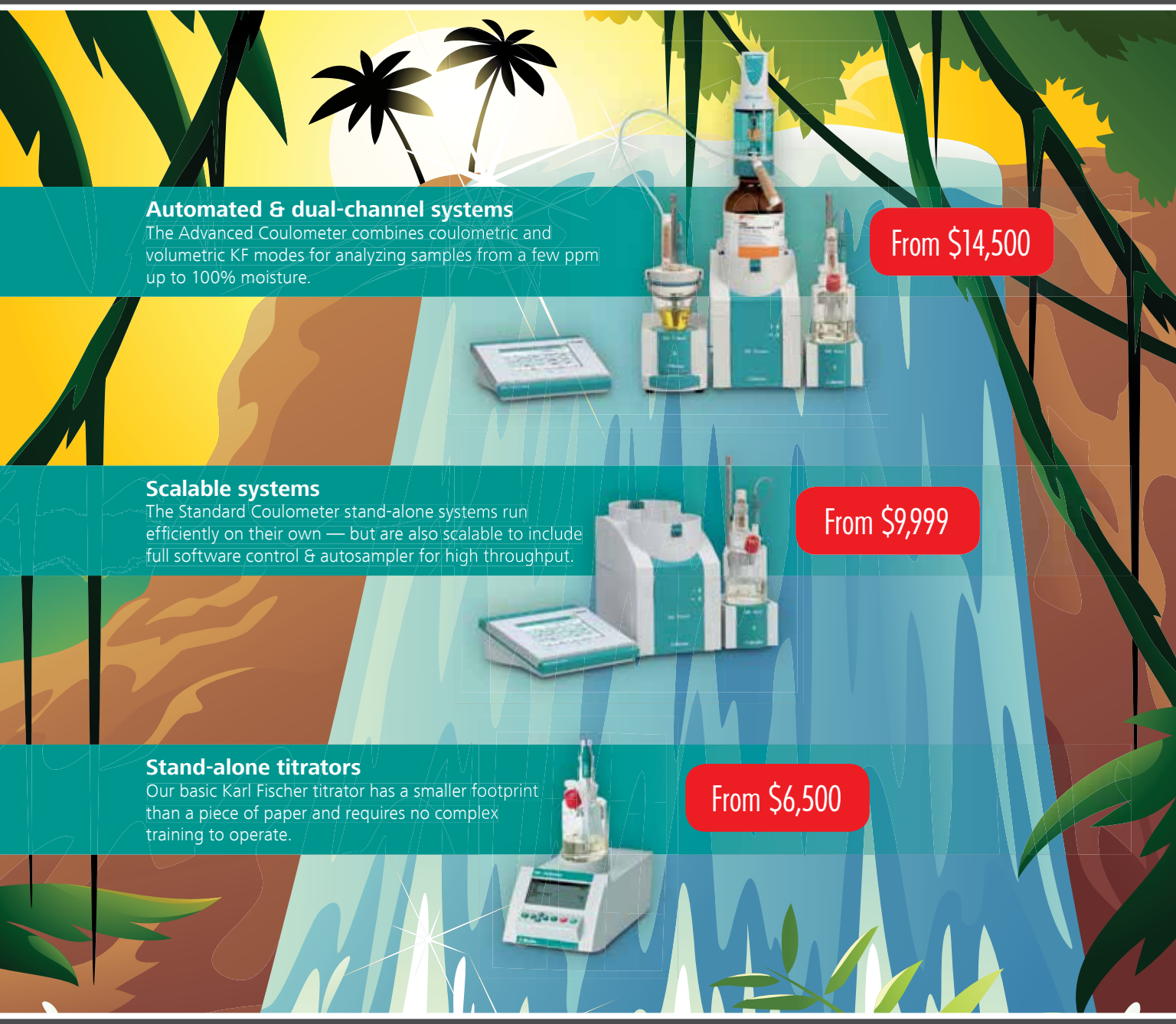

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hazardous chemical waste. We've cherry-picked some of the best of them (and some ideas of our own) to help those keen to sharpen up the health and safety procedures in their own labs.

Container labeling and management

Labels should contain the following information:

- The words "Unwanted Material"
- A bar code to track the container
- Accumulation start date
- General information about the laboratory generating the unwanted material (person generating the material, department, building, room number, phone number)

If possible, use the original manufacturer label. This label is located on the original container. However, it is important to clarify that it can be used as an alternate label only if it is in good and legible condition.

Good condition means that it is clearly readable, not torn or missing information. The laboratory worker must add the words "Unwanted Material" to the container, plus the accumulation start date. This is not an approved option if any chemical materials other than the ones stated on the original label are stored in the container.

"Leaking oxidizers have been found next to unsealed flammables, explosives next to combustibles."

Two types of containers should be used in the laboratory to hold unwanted materials: working and nonworking containers.

The working containers (maximum size one gallon) should be smaller and used at benches or work stations to collect unwanted material from experiments or procedures.

Nonworking containers (maximum size five gallons) are larger and should be sealed, unless they are being used to decant the unwanted material.

For the safe and suitable handling of all unwanted materials, it is essential to select the appropriate containers. The following provides guidelines for the appropriate selection of containers to be used for the handling of unwanted materials at laboratories:

- The most appropriate container for the different types of unwanted materials should be used.
- Separate containers should be used for nonhazardous unwanted materials, biomedical, and radioactive waste mixtures, among others.
- Separate containers should be used for liquids, solids, and gases.
- Containers should be compatible with the properties of the materials to be contained (e.g., acids must not be stored in metallic containers).
- Plastic and glass containers should be used for unwanted materials handling. They can either be new or reused containers of chemical substances used in the laboratories. Containers must be clean and free of polluting agents and must have their original caps.
- Plastic containers should be made of polyethylene (HDPE or LDPE), polypropylene, polystyrene (PET), polymers of vinyl, or TEFLON (e.g., polyetrafluorethylene (PTFE) and fluorinated ethylene propylene (FEP)).

- Glass containers of chemical substances can be reused (e.g., soda lime) or glasswork made especially for laboratory use by known brands, such as Pyrex, Kimax, Corning, and Kimble.

Training for laboratory workers

It's highly recommended that all lab workers be familiar with the laboratory management plan and be capable of working to it. Workers can be students, professors, employees, and anyone who has access to and use of the laboratory chemicals.

Removal of unwanted material

Unwanted materials will be removed from the laboratory using a rolling six-month approach—that is, each container will be removed within six months of its accumulation start date.

Only a fully licensed waste management company may be called in to collect and dispose of the chemical waste. A copy of the company's waste disposal license should be kept for your records.

It is also important to ensure that collection is carried out in keeping with the latest legislative paperwork. This can be checked by contacting your relevant environmental agency, and copies of the paperwork should be kept for as long as possible as proof that the waste was disposed of properly.

It is not recommended that a laboratory accumulate more than 55 gallons of unwanted material before arranging a hazardous waste collection.

Some of the above are in fact compulsory for educational labs choosing to have their hazardous waste disposal regulated by the Academics Laboratories Rules, while others are suggestions.

As previously mentioned, the regulations and rules governing lab waste disposal do vary from country to country, but the underlying theme would have to be that wherever possible, whether a lab is industrial, government-run, or academic, common sense best practices really are the best policy.

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THE RIGHT READER

MICROPLATE READER REQUIREMENTS FOR CELL-BASED ASSAYS NEED TO BE CONSIDERED CAREFULLY

by Michael Fejtl

Automated cell culture preparation

With an ever-increasing number of multimode microplate readers on the market, it is more important than ever to choose the right solution for your laboratory and workflow. Having a reader that is poorly suited to your assays can be a real headache for researchers, causing the loss of valuable data and bottlenecks in your workflow, which can ultimately lower the productivity of the laboratory. In contrast, the careful selection of the right microplate reader can be a real boon for your cell-based applications, allowing faster, easier processing of samples and potentially enabling previously unachievable or impractical experiments to be performed.

> "An instrument with the optics located below the microplate is vital for cell-based applications."

What are you measuring?

The first decision to be made is the measurement modes you are likely to require. Fluorescence intensity measurement capabilities are vital for the majority of cell-based measurements, but an increasing number of assays now rely on luminescence-based or time-resolved techniques. While the ability to easily switch between measurement modes may not be important for a high-throughput facility using a reader for a single application, this flexibility is a key requirement for research centers. If your budget does not currently stretch to a system that gives you the level of flexibility you desire, a modular instrument may be the best solution, allowing you to purchase a system suitable for your current workload with the option to upgrade to additional measurement modes as necessary.

Similarly, instruments with filter-based optics are well suited to high-throughput applications requiring a single measurement type to be performed repeatedly, but monochromator-based systems generally offer greater versatility by negating the need to purchase numerous filter sets to meet changing assay requirements. In either case, an instrument with the optics located below the microplate is vital for cell-based applications, as the volume and optical properties of the medium can significantly impact measurements from above the microplate, leading to poor reproducibility and a loss of data. This is particularly important for 3-D cell cultures, which have a greater depth of field. Instruments routinely used for cell-based assays ideally should have an adjustable Z focus, enabling the user to optimize the measurement height within the well for each assay to maximize sensitivity. Some systems also now offer fully automated Z focusing, further accelerating cell-based assays by determining the optimal Z position based on measurement of a reference well or multiple wells.

The size of the excitation apertures is also an important consideration for cell-based measurements, as the reporter molecule of interest is unlikely to be uniformly distributed across the entire well. Ideally, the light source should illuminate the entire culture at once, speeding up measurements and improving

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reproducibility by avoiding the need for multiple "spot" measurements at different points within each well. Autofluorescence from the growth medium is another significant issue for many cell-based assay systems, making some form of background signal correction vital to avoid small changes in cellular response being masked by noise from a high background signal. This autofluorescence, combined with the high cell densities encountered in some cell-based systems, can also lead to large changes in signal intensity across a measurement series, making it important to choose an instrument with a large dynamic range to avoid loss of sensitivity or data at one or both ends of the assay sequence.

"Size of the excitation apertures is also an important consideration for cell-based measurements."

What assay conditions do you need?

The optimal culture conditions will vary significantly with the cell line, assay type, and experimental duration, but rigorous environmental control is vital for any cell-based application. Almost all microplate readers now offer some form of temperature regulation, but as even small variations can lead to experimental bias or erroneous results, it is important to choose a reader with good thermostatic control. The measurement chamber of some readers can suffer large fluctuations over time as the system responds too slowly to increases or falls in ambient temperature. The location of the heating element can also affect assay performance, with uneven heating leading to temperature gradients across the plate, compromising both cell growth and enzymatic activity. As the experimental durations increase, this effect can seriously impact results and is potentially further compounded by differing evaporation rates between wells, leading to the formation of concentration gradients across the plate.

For many cell-based assays, effective control of gas pressure is also an important consideration. Maintaining *in vivo*-like partial pressures of CO_2 and O_2 can be vital for cellular survival and proliferation, particularly of eukaryotic cells, as many culture systems depend on precise regulation of atmospheric CO_2 levels to control the pH of bicarbonate buffer systems. In addition, the hypoxic conditions found *in vivo* can significantly influence cellular regulation and responses. Most currently available microplate readers do not offer the ability to control CO_2 and O_2 partial pressures within the measurement chamber, and so culture plates must be regularly transferred between an incubator and the reader for measurement.

Although this is possible with some robotic systems, the added expense and complication are beyond the scope of most laboratory setups, leading to overnight gaps in data. In addition, the "shock" experienced by cells as they are regularly exposed to atmospheric conditions for measurement can bias results and hide subtle trends. Ideally, the reader should offer precise regulation of both CO_2 and O_2 within the measurement chamber, allowing continuous measurement without affecting results.

How does it fit into your workflow?

A reader that is poorly matched to your cell-based assay workflow can cause significant bottlenecks in processing and analysis, leading to a backlog of plates for measurement and potentially impacting time-critical experiments. For higher-throughput applications, choosing an automation-friendly instrument that can be integrated with your laboratory's liquid-handling systems, downstream analytical devices, and LIMS can streamline analysis and data transfer while virtually eliminating the risk of transcription errors.

"Optimal culture conditions will vary significantly with the cell line, assay type, and experimental duration."

Cell-based assays offer significant advantages for many applications, providing greater biological insight than straightforward biochemical assays. Implementation of cell-based assays requires careful consideration of your reader requirements so that you select the system with the hardware and software that best fit your cell culture system and assay needs. Ideally, the readers should offer walkaway automation of assays, providing rigorous environmental control and allowing long-term, continuous measurement of cellular activity within the measurement chamber.

***Michael Fejtl**, marketing manager for detection, Tecan Austria, can be reached at info@tecan.com or by phone at +43 62 46 89 330.*

YOUR WORKFORCE UNDER THE MICROSCOPE

ACCESSING THE RIGHT TALENT AT THE RIGHT TIME TO BEST SUPPORT YOUR BUSINESS STRATEGIES

by Mark A. Lanfear, BS, MS

There is a simple goal at the heart of practically every life science company—to improve the health of the public at large, often through medical intervention such as drugs or life-saving devices and procedures. Achieving this goal takes rigorous work. In the preclinical phase, ideas and theories must undergo microscopic examination—literally and figuratively—to be understood, put to the test, and ultimately developed into something sound. Will problems be found along the way? Of course. But such examination almost always allows an organization to see problems early and eliminate them before the process evolves too far.

In order to achieve a company's ultimate goal, the talent that the company employs must work just as well as any new treatment or other project. After all, one's scientific workforce is the critical link between idea and outcome and those individuals are the ones with the skills to achieve that organization's next great discovery.

Understanding and effectively managing a scientific workforce is similar to the research and development process in that companies need to put their workforce practices under the microscope as well. Only then can they discover and understand what it is about their mix of talent that most supports their business strategies. This "microscopic" analysis will also put organizations in a position of insight and knowledge when it comes to selecting the most qualified and cost-effective mix of workforce engagements.

Unfortunately, most life science companies are not experts at "operating the microscope." And often they do not fully understand the kinds of problems or bugs that can rear their heads under that microscopic lens when they start to look at their workforce at a more granular level. However, with a plan and continued practice, life science companies can become just as adept at using the workforce microscope as they are at using other analytical methods in the lab.

Let's start with the adjustment knobs when using a microscope to view a specimen. There are coarse adjustment knobs that give a macro view, and fine adjustment knobs that provide a more granular view. When examining your workforce, there are four critical adjustment knobs you will need to use. Their impact on your business will be variable, and, as with research, will sometimes reveal results slowly.

Knob one—business goals such as profit, bottom-line stock price, delivery of product to market and operational goals—are driven by knob two—business strategy. The business strategy and how to get there—increased market share, decreased product lines, investment in R&D, decreased costs, off-shore resources, and a change in workforce balance—are under the direct influence of knob three—HR practices. Those practices include time to fill, cost of filling roles, retention of talent, partnering with the business units, and talent acquisition. These challenges are only addressed through the fine tuning of knob four—HR strategy, which encompasses the ability to attract and retain talent, raise an employment brand, and true supply chain management.

Of course all of these knobs, when adjusted correctly, can have a dramatic impact on a company's workforce as a whole. Once the business goals are formed, turning the business strategy knob becomes one of the most important steps. Before any workforce planning can begin, an organization must have a clear understanding of the long-term company strategy in order to determine the kind of talent needed to achieve corporate objectives. Each company's long-term plan

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or business initiatives are unique to them, but a few key elements tend to stand out under the microscope both at a macro and granular level. At the beginning of their fiscal year, these plans usually take the shape of corporate revenue goals announced by the company's leadership. Things such as percentage of revenue growth, increases in production, and increases in sales are tangible and can easily be seen and understood. More granular aspects of business strategy, which require fine tuning of the knob, tend to be market trends, new markets to explore, where efficiencies can be found in the current state, or where immediate growth or R&D opportunities exist.

These aspects of business strategy, once seen and understood from both a broad and granular viewpoint, will start to give a company clearer insight into the labor pool, allowing an organization to better understand how it can attract, retain, and engage talent. A majority of workforce engagements, however, are still time- and materials-based, rather than outcome-based—ultimately, these engagements are never looked at holistically enough to effectively drive overall business goals. The result is inefficient use of the workforce, which can significantly affect operations and business goals. To gain a more meaningful understanding of how the workforce affects business, there must be a paradigm shift in how the firm views talent. When HR practices and strategies are considered first in the process, the acquisition of human capital becomes one of the business goals. Specifically, how your workforce is engaged becomes a primary goal, while the physical goods or services a company provides are considered the activities. In this model, hiring the right talent becomes the first step in all business strategy discussions.

Fine-tune adjustments will be required to make this paradigm shift permanent. This is where organizations systematically align the priorities of the organization with those of its workforce in order to make sure all facets of product and service delivery are met. This is done by segmenting roles, scanning those roles, and analyzing the current state of the workforce. These three steps require analytics that identify the current and future state of an organization's departments, quantity and types of positions, and technology. This valuable data will help organizations form a framework for linking talent acquisition directly to business strategy. Done right, this will allow companies to secure and optimize talent and services through vendor channels both internally and externally.

By learning to operate the workforce microscope and all its inherent knobs correctly, life science organizations can better move through the dynamic clinical trial environment, where both revenue and talent supply are tight. Companies today are forced to accomplish more with less, but having a smooth workforce plan is key to adhering to a drug launch schedule—and indeed, business strategy as a whole—that is crucial to the viability of an organization.

Consequently, this new analysis of your workforce may reveal some surprising truths. Namely, that being able to properly access the right talent at the right time can actually *increase* time-to-market for scientific products, yielding an increase in profitability and revenue dollars. Why? Because aligning an organization's human capital program with its current and emerging business/financial goals has the effect of creating efficiencies, streamlining processes, and spurring innovation—all things that can help a business reach and exceed goals. By giving HR a greater stake at the strategic workforce planning table, companies will also see how HR can contribute to business performance in addition to its traditional HR functions. Rather than human resources teams focusing only on administrative efficiency, companies will come to see human resources as a partner to every business unit, providing strategy to overall management and contributing to improved business outcomes.

Remember those bugs—those problems—mentioned earlier? Now that you're looking at your workforce more carefully, these problems will become more obvious. Some of these problems are outside risk factors beyond a company's control when it comes to implementing a successful workforce plan.

They are the political, environmental, social, and technological (PEST) factors, which can manifest themselves in the form of increased costs and complex regulations that affect all businesses and interfere with expected outcomes.

Globalization. Mobility. Talent management. These three concerns consistently make the top of the "PEST" list for most CEOs and CHROs. All three areas are underpinned by one core activity: workforce planning. As one continues to see these PESTs under the microscope, one can further examine the factors that propel companies to greater success or the factors that cause them to stumble.

For example, line leaders don't need to wait for the whole company to adopt a workforce planning focus to benefit from the creation of one that drives their own business goals. As with finance and marketing, workforce planning is increasingly a skill needed by every business leader, and understanding how it affects your particular business unit will give you an additional tool to make decisions with. A leader can address vital skills needed for success in his or her own specialized workforce. They can do a gap analysis. They can rectify an imbalance in skills to help combat turnover. All of these things help tweak individual goals of reaching new outcomes in business development through workforce planning.

While this novel approach to understanding your workforce may seem overwhelming, the need for such in-depth examination and analysis has never been more important. Studies suggest that as much as 80 percent of most organizations' assets are intangible and based on their human capital. Human resources heads are being asked for detailed and strategic workforce plans by the C-Suite. Those professionals or service companies that can provide them will thrive and see greater partnership and opportunities. Those that can't will likely drift into increasingly marginalized roles.

Furthermore, the talent shortage, as well as the demand for talent, is high on a global scale. Yet currently, college students who pursue scientific degrees are not choosing the most in-demand courses of study. The talent pool is not being replenished quickly enough to replace retiring life science professionals.

In addition, future talent needs are changing so quickly that companies are having a hard time adapting fast enough to meet those demands. What kind of talent, exactly, will be needed in five years? This rapid pace of job development will require organizations to move more quickly in the training process in order to capture the ideal talent for their current workforce needs. The life science industry may need to get involved in helping develop highly specialized training programs designed to produce a new workforce that can meet the demands of specialized scientific fields.

Similar to using the right lens to examine a specimen, using the right lens to examine your talent strategy will no doubt lead to some breakthrough discoveries when it comes to your workforce. You will start to understand that human resources and talent acquisition, along with talent development, collectively contribute to business performance.

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

ACHIEVING A COLLABORATIVE CONSENSUS

By Kristin Arnold

As a manager, you have three options when something needs to be done in your lab:

1. You can do it yourself.
2. You can delegate it to a specific person.
3. You can involve a group of people (two or more) to accomplish the task.

This last option requires collaboration—perfect for when the task is complex and requires expertise from a variety of disciplines. Simply put, one person doesn't have all the information or answers.

However, just because you put people together doesn't mean they are going to collaborate well and achieve the desired results. In my experience facilitating myriad meetings, there are seven steps leaders must take to ensure the group explores the possibilities, has meaningful discussions, makes the best decision, and is committed to seeing that decision implemented quickly:

1. Set the Tone. As the leader, your role is to be the catalyst for collaboration to take place. As that catalyst, you set the tone for group work to occur. Your people are looking to you to model the behaviors you seek, so pay close attention to what you say as well as what you do.

2. Clarify the Objective. Whenever you bring your people together (either face-to-face or virtually), clarify the overarching goal (if it is one in a series of meetings) as well as the objective(s) and deliverable(s) of that specific meeting.

3. Generate the List of Possibilities. Once you have teed up the topic, problem, or issue, you invite discussion around the topic. Typically, this starts with some form of "listing" the ideas or "brainstorming" new ideas.

4. Organize Your List. Once you finish your brainstorming session, you can organize the ideas in one of three different ways:

- *Synthesize.* You can summarize what has been said by synthesizing all the ideas into a handful of headlines or highlights.
- *Sort.* You can have the group sort the ideas into a few manageable categories or in a specific flow, for example, chronological, process, along a continuum, and so forth.
- *Prioritize.* You can have the group narrow down the pool of ideas into a smaller, prioritized list.

Or, you may do a combination of these techniques. For example, first you sort, and then prioritize the categories.

5. Decide Which Ideas to Pursue. Perhaps an obvious option leaps out of the pack and the group comes to a quick decision. Most of the time, however, they are faced with a choice among many options. If the group is interested and has the time, it can combine, create, and synergize the items into a better idea. The group builds a consensus—striving to reach a decision that best reflects the thinking of all of the participants.

6. Take Action. Accountability is even more important in a collaborative session because the group itself owns the result. If there is no action the session is a waste of everyone's time, so make sure there are some defined action items along with a deadline and the name of at least one person responsible to make it happen.

7. Recognize and Celebrate Success. While there isn't an "I" in team, there is a "me," and people like to be recognized for their individual contributions to the whole. Some people like to be recognized publically and others would prefer you to express your appreciation one-on-one. Regardless, take the time to recognize each individual and their contributions the way they want to be recognized.

Keep these seven steps in mind as you bring your team together to achieve astonishing results!

***Kristin J. Arnold**, MBA, CMC, CPF, CSP is the president and founder of Quality Process Consultants, Inc., with offices in Scottsdale, Arizona and Cape Traverse, Prince Edward Island, Canada. Visit www.KristinArnold.com or call (480) 502-2100.*

LABCAST Be sure to attend Kristin Arnold's Lab Manager Academy webinar, "How to Achieve a Collaborative Consensus," on Wednesday, October 1, or afterward at www.labmanager.com/consensus to watch the archived video.

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HOW TO HIRE THE BEST TALENT FOR YOUR LAB

By Mark A. Lanfear

If you pay attention to this column every month, chances are you work in an established lab and manage a good group of employees (hopefully!) who keep the work running smoothly and on time.

But what if all those employees quit tomorrow? And what if you had to start up your own lab from scratch? What would be the biggest challenge in getting back to that sweet spot where everything is running smoothly again?

Whatever challenges arise at the workplace at any given moment, there's one that will forever stand out: it's the people, plain and simple. If you don't have good people working around you, chances are you won't have good results. This is true of a company that's been around for a hundred years—or one that's just starting out.

It's a continual challenge, too. Just because you have a good workforce now doesn't mean you won't have turnover in the near or far future. You must always have your finger on the pulse when it comes to what kind of people are walking into and out of your workplace.

You must always know how to conquer the challenge of getting and keeping the best talent for your lab.

As simple as this sounds, it can also be dizzyingly complex because of how our world of work has changed. There are a million ways to go about finding the right people, from the improbable use of something as fleeting as Twitter to the engagement of a workforce partner with the expertise to source talent through multiple channels.

Similarly, candidates themselves have become super savvy in their quest for the perfect job at the perfect company. Organizations—especially those in the science industry where specialized talent is at a premium—can't afford to rest on their laurels in their quest to woo potential employees.

> "If you don't have good people working around you, chances are you won't have good results."

Your job as a manager is indeed to ultimately get and keep those employees who will effectively contribute to your lab's bottom line. It's a serious proposition, and whether or not you are successful at it, the challenge will remain.

If (and when) this challenge comes directly to you, you probably won't have a grand plan in your pocket for overhauling your workforce. That's not something you can do on a whim anyway. But if you need just one qualified candidate, for example, starting on a small scale with the following strategies will get your momentum going.

First, make sure your homework is in order. Keep a professional network of people, maintain an updated presence online, and make smart use of social media and digital tools. It may be tempting to bury yourself in the minutia of your lab's current big project, but as a manager, you must also invest in things that will help maintain your lab's presence with the scientific talent pool.

When the time comes, mine your network in the scientific community (this is where maintaining a professional network obviously comes in very handy). Your network can clue you in on people who are actively looking and potentially a good fit. Other managers can also alert you to passive candidates who might be open to change. This one seemingly simple step can often be a gold mine of potential talent—you may even find the right person relatively quickly if you're lucky.

Don't be afraid, though, to engage outside help, like a workforce partner who specializes in scientific talent, and who likely has a much larger network of candidates. This is essential if you honestly don't have the time to do a search yourself—and when you believe your only option may be to cast a wide net into the unknown. A workforce partner can also help analyze your current situation, helping to form a long-range plan for taking care of employment gaps that are not yet seen.

Speaking of the "unknown," an often-overlooked aspect to acquiring good talent today is the old-fashioned vetting process. Especially if you operate a small lab, you will likely be working intimately with your staff. Soft skills, like being able to get along with colleagues, are just as important as the hard technical skills you no doubt want in an employee. Make sure you personally contact past employers to get a sense of who a candidate is, how he or she works with others, and what their track record is when it comes to employment. Despite our world of social media where everyone is a "known entity" online, speaking to real people is still absolutely essential in the process of hiring someone.

Hiring the best people for your lab is no doubt a daunting task, as it is for every business, big or small. No one process or set of rules will be the answer for every employer. Be open to the modern search manifested in online media, but don't underestimate the power of classic techniques like using a personal network. Learn from your mistakes what does and doesn't work—and stick to your own tried-and-true methods for your lab's individual needs.

> "Your network can clue you in on people who are actively looking and potentially a good fit."

The more you polish your skills for sourcing the best talent, the more you might find that you won't have to use those skills very often.

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

MAKING DATA MEANINGFUL

HOW TO INCREASE THE VALUE OF INTEGRATED INFORMATION ANALYTICS

By Mike May, PhD

A search of Google Trends for "big data" in news headlines reveals almost no interest until 2011, and then the numbers soar. Moreover, a search for "big data" on Google in general returns more than 300 million hits. Consequently, it's no surprise that Igor Jurisica—who holds the Tier I Canada Research Chair in Integrative Cancer Informatics and is a professor of biomedical physics and computer science at the University of Toronto in Canada—says, "Recently, some of the most common buzz in informatics focuses on big data." Despite today's enormous amount of data, says Jurisica, there is a shortage of knowledge.

There's also a shortage of infrastructure. "A lot of people jumped on the big-data bandwagon prematurely," says John F. Conway, global director, R&D strategy and solutions at LabAnswer in Sugar Land, Texas. "Their underlying informatics environments weren't ready for it." That continues to be the case. "Lots of companies are having difficulty assessing the data they need to make informed decisions [or garner knowledge from it]." Conway says. Consequently, these companies get less from informatics than they could.

Historically, computer systems focused on structured data, such as numbers in a table in a database, but unstructured data, such as text, created a challenge for analysis. "We have a reasonable handle on structured data," Jurisica says, "but the need is quickly growing to integrate unstructured and structured data." For instance, biomedicine must combine structured information, such as test results or even the sequence of a patient's genome, with unstructured data, such as written medical records. To make use of this data in big ways, researchers must analyze millions of records. "That takes enormous computing power to sift through the data and then turn that efficiently into meaningful information and present that to the user in effective way," Jurisica explains.

Although the data makes informatics complex, other elements make it even more intractable. For example, informatic systems must deal with various kinds of computer architecture—from smartphones and tablets to supercomputers and the cloud. On top of that, informatics users range from biologists and engineers to patients and physicians. "So a system needs to be flexible in terms of what to present to whom and in what form to increase the value of integrated information analytics," says Jurisica.

A technology transition

Although chemistry informatics companies keep providing scientists with more and more options for data analysis, how those results are being delivered and reviewed is evolving rapidly. As Ryan Sasaki, director of global strategy at Advanced Chemistry Development (ACD/Labs) in Toronto, Canada, explains, "The biggest trend is the continuing evolution of thin-client technologies." With a thin client, a low-powered device depends on a high-powered one. For example, a laptop can be connected to a supercomputer to deliver sophisticated analysis without the user needing to own all the hardware.

A thin-client approach also reveals some of the history of informatics. "It's very interesting to follow lab informatics over the last 20 years or so," says Sasaki. "In the early days, companies had their own IT developers who made their own systems." The overhead required to develop and maintain those systems, though, triggered a transition. "A 180-degree change caused customers to look to providers for an end-to-end solution, like an ELN or LIMS—electronic lab notebook or laboratory information management system—where one size fits alls," Sasaki says. That approach still created challenges, because different customers like to do things in their own way.

"So now we are seeing more of a hybrid approach," Sasaki says, "where companies are looking to build internal web technology and have vendors provide applications that plug into that." As an example, he mentions the ACD/Spectrus Platform, which can be used to collect and analyze a wide range of chemical and analytical data. Although Sasaki calls this a robust platform that

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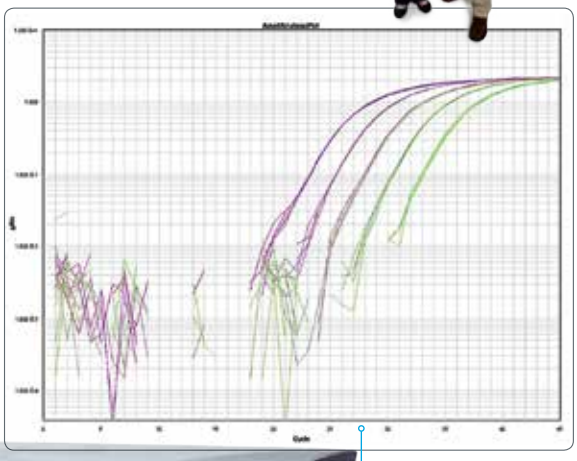

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can stand on its own, market requirements demand that it be a platform that can easily plug and play with other systems in an organization. Furthermore, the transitions in informatics demand that nonexperts can use it.

Pushing productivity

Although modern informatics allows researchers to accomplish more with less in-house hardware or software, users expect more from the results. "If you look at the history of the space," says Gene Tetreault, senior director of enterprise laboratory management at Boston area-based BIOVIA, "there wasn't a lot of push on productivity for informatics in the pharmaceutical industry, but the tightening of financial belts is driving the need for informatic solutions to become more productive."

In the pharmaceutical industry in particular, that increase in productivity must also meet expanding regulatory requirements. So informatic systems must constantly adapt to new compliance issues. "The regulations are increasing by orders of magnitude, so you need electronic systems to keep up," says Tetreault.

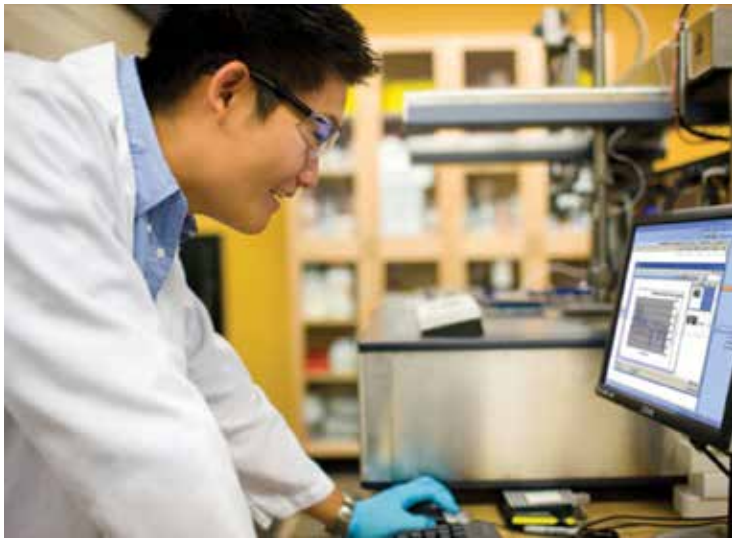
While achieving these goals, informatic users also want more mobility. Tetreault says, "The desire is increasing dramatically to be able to access data in or outside the lab on a phone or tablet."

Lab informatics will also incorporate augmented displays—things such as Google Glass and beyond—to enhance productivity. "Imagine standing in front of a lab refrigerator and seeing the samples inside without opening the door," Tetreault says. "This kind of technology could also record what you are doing at the lab bench."

Going global

A large company's productivity also depends on fluid interactions between different business systems, units, and locations. As a result, Mark Harnois, director of product management for the informatics business unit at Waters in Milford, Massachusetts, says, "In the last few years, we've seen many customers evaluating all the technology they have in their labs and developing strategies to harmonize, globalize, and standardize the technology." To harmonize and standardize, companies want different systems and sites to, basically, reduce their software footprint and benefit from the reduced training, support, and software validation. As Harnois says, "You want to make sure there's seamless integration between solutions you have." Globalizing means being able to do that around the world.

Despite this emphasis on wide-scale consistency,



▲ *Informatics helps scientists keep track of and analyze enormous amounts of data through a variety of portals, from computers to smartphones. (Image courtesy of BIOVIA.)*

Harnois points out the need for flexibility in an informatics system. He says, "Your technology must be able to adapt to your environment."

As an example, Harnois says, "We offer solutions that allow users to connect different software packages, like a chromatography system and a LIMS system, to multivendor business systems applications." He adds, "Our products are also designed to be deployed in enterprise-wide area networks that can be global."

Tackling problems in teams

In the life sciences, proteins create one especially tricky challenge: figuring out function from form. How a protein works depends on its components, which are amino acids, and the three-dimensional shape that they take, which arises from folding. This knowledge could reveal, for instance, how a molecule drives a disease as well as how a treatment might manage it.

Jurisica and a team of colleagues turned this molecular biology problem into an informatics one. Working with researchers at the Hauptman Woodward Medical Research Center in Buffalo, New York, they used robots to screen 13,000 proteins using 1,536 different crystallization conditions and then took six images of each over time. That created about 120 million images. Then, the scientists used algorithms for morphological image analysis and machine learning to characterize and classify the data on IBM's World Community Grid, which is created from a network of almost 3 million high-end workstations around the

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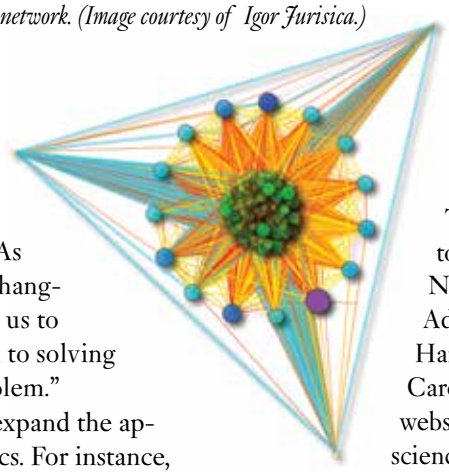
world. "We created a much better image classification algorithm using this grid that now rivals human expert performance," Jurisica says. Even on this high-performance grid, it took 5.5 years to analyze all the data, but it would have taken182 years on the hardware that the team had. As Jurisica says, "This was a game-changing collaboration, which enabled us to completely change our approach to solving this protein crystallography problem."

An informatics approach to molecular biology generated this diagram of a physical protein interaction network. (Image courtesy of Igor Jurisica.)



Other groups also team up to expand the applications of advanced informatics. For instance, Matthew Hahn, professor in the department of biology and the School of Informatics and Computing at Indiana University in Bloomington, says, "With a virtual machine, you can use a computer on your desktop, and it can do your analysis for you." He adds, "You don't need to do things with command lines, because you get a desktop of tools."

For example, the US National Science Foundation (NSF) developed iPlant to provide scientists with tools to finds ways to feed the world's expanding population. This project supplies researchers with access to databases and software, all delivered by the NSF plus the University of Arizona, Texas Advanced Computing Center, Cold Spring Harbor Laboratory, and the University of North Carolina at Wilmington. According to the iPlant website, "By enabling biologists to do data-driven science by providing them with powerful computational infrastructure for handling huge datasets and complex analyses, iPlant fills a niche created by the computing epoch and a rapidly evolving world."

Hahn and his colleagues at Indiana University

◀ *Powerful informatic approaches, such as the Waters NuGenesis Lab Management System, let scientists connect a variety of research platforms with business ones. (Image courtesy of Waters.)*

provide a similar NSF-funded service called the National Center for Genome Analysis Support. "It lets anyone with NSF funding get help with sequencing analysis," Hahn says. "You don't need to install your own software, and we will even tell you which button to press."

▲ *The Italy-based European Institute of Oncology uses the Thermo Scientific LIMS for Biobanks to process thousands of biospecimens. (Image courtesy of Thermo Fisher Scientific.)*

Looking ahead

Before launching into a big-data driven system of analytics, scientists must get the informatics under control. For example, Conway points out that many companies still need to implement the ability to search an entire enterprise system, and that includes metadata, such as the details behind an experiment. "If the metadata are not there, a search is worthless," Conway explains. "People need to think about ways to ask more from their data and put things in place now."

Putting the data in the right place determines its value. For example, the European Institute of Oncology (IEO)—a Milan, Italy-based organization committed to making an active contribution to fighting cancer, particularly tumors of the breast, lung, prostate, and bowel—turned to a solution from Thermo Fisher Scientific in Waltham, Massachusetts. IEO implemented the Thermo Scientific LIMS for Biobanks to more efficiently manage its biospecimen data. For instance, IEO is using this system to process more than 4,000 biospecimens annually, including liquids, solids, and nucleic acids. Previously, IEO's data management solution did not allow integration across multiple platforms, so information remained in silos or needed to be combined manually. Now sample data are integrated across multiple systems.

Education also comes into play when planning for tomorrow. What does a science student need to learn in order to develop an informatics arsenal? Hahn says, "Basic statistics and probability are really important." He adds, "You need some basic UNIX command-line skills, and Python and Perl are good for moving around text files, like DNA strings."

To make the most of informatics, science needs advanced hardware and software tools, plus personnel to run them. Only then can big data turn into big improvements.

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

Geoffrey Bartholomeusz, PhD

ASK THE EXPERT

CELL CULTURE REAGENTS AND APPLICATIONS: FOCUS ON 3D CULTURES

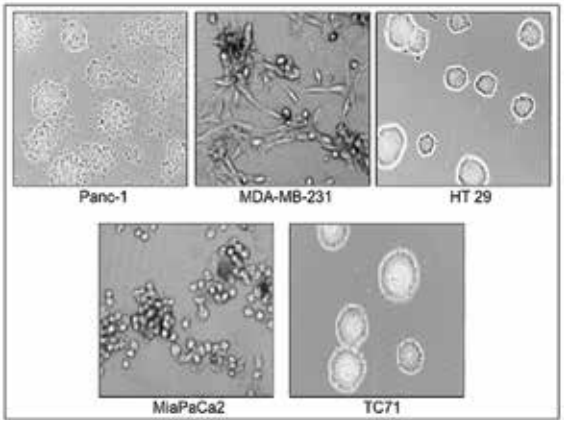
by Tanuja Koppal, PhD

Geoffrey Bartholomeusz, PhD, associate professor in the Department of Experimental Therapeutics and director of the siRNA Core Facility at the University of Texas MD Anderson Cancer Center, talks to contributing editor Tanuja Koppal, PhD, about why there is a growing interest in replacing some 2D cell culture applications with 3D cell cultures. He talks about where and why he uses 3D-based cell cultures in his lab and what lab managers should take into consideration before making the investment in this innovative technology.

Q: Why the sudden surge in interest for using 3D cell cultures?

A: Many scientists, like Dr. Mina Bissell, Dr. Joan Brugge, and others, have been advocating the move to 3D cell cultures for a long time now, but developing 3D cultures is complicated. Selecting the right methodology to generate the appropriate 3D *in vitro* cell culture systems, and having the technology to correctly interpret the data obtained using these culture systems, is more complicated. In the early days, these complexities were somewhat of a deterrent. However, after big pharma spent billions of dollars on 2D monolayer cell culture models that showed promise in preclinical drug development but didn't translate to the clinic, it became very apparent that, at least for cancer research, we were using the wrong models.

When grown on non-adherent surfaces, cancer cells have an inherent tendency to migrate and form clusters that turn into 3D multicellular tumor spheroids. Initially, these spheroids have a rather loosely organized architecture, but in time the cells secrete an extracellular matrix that results in a compact spheroid having a hypoxic inner core with physiological characteristics resembling what is often seen in the 3D tumor microenvironment. Thus, with 3D models we can replicate in a laboratory some important properties that we see in a tumor. Another advantage with 3D systems is that we can carry out co-culture studies. For instance, we can grow tumor cells with fibroblasts and better understand the cross communication between cells, another important feature of the multicellular tumor microenvironment. 3D cultures certainly resemble the tumor architecture and offer huge benefits, but one has to keep in mind the cost and the added patience needed to optimize these systems in order to maximize the benefits.



▲ *Spheroid Morphologies of various cancer cell lines grown on matrix free 3D plates. Panc-1 (pancreatic cancer), MDA-MB-231 (triple negative breast cancer) HT29 (Colon) MiaPaCa2 (pancreatic cancer) TC71 (Ewings Sarcoma)*

Q: When did you start using 3D cultures in your lab?

A: I was always interested in setting up 3D cell cultures, but when you are running a high-throughput screening (HTS) facility you also have to take into account the costs. A single plate used in a 3D screen can cost you up to $100. So when you run a genome-wide screen you can end up spending approximately $50,000 just for the plates. However, I was convinced that we had to move from 2D to 3D, so I started out by doing very small screens. We saw, and it's also shown by others, that when we compare the expression profiles of a selected panel of proteins important in a particular cell line, there is significant overlap in the expression profiles between 3D cultures and tumor tissues. However, the 2D expression profile is a complete outlier. Hence, for identifying targets for drug development and for drug screening purposes we are moving more toward using 3D cell culture systems.

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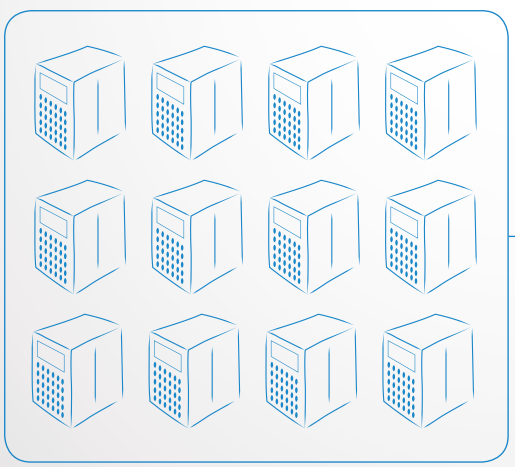

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STEPS TO SETTING UP A 3D CELL CULTURE SCREEN

1. Identify the biological question you want answered.
2. Select the technology to generate the most appropriate 3D culture model.
3. Select the cell line and determine the cell density to generate optimum 3D spheroids.
4. Optimize the design of your assay.
5. Determine the proper readouts for the assay.
6. Develop or obtain the right technologies for data capture and analysis.

However, when using 3D screens, you also have to develop technologies that will help you get reliable and trustworthy data. For instance, we helped develop a 3D scanner that can accurately measure parameters like volume, area, and cell viability to get good readouts. We also have an IN Cell Analyzer 6000 Imager that enables us to capture detailed images of the spheroid morphology and identify relevant treatment-induced alterations of these morphologies. If one spends the time to develop a system and uses it correctly, then the data that you obtain from these 3D screens tend to have significant clinical relevance.

Q: How much of your screening is now in 3D cultures?

A: Right now 30 to 40 percent of our screening is in 3D cultures. We still offer both 2D and 3D models for screening, as some investigators are skeptical about 3D screening. We have completed three screens in 3D and we have three manuscripts coming out soon. At the present time we have two ongoing screens using 3D multicellular tumor spheroid models. Once these manuscripts get published and the 3D systems prove their value, then I expect more folks to start using them. The other factor is the cost. The cost of doing a screen with 3D cultures is at least two to three times more expensive. However, a lot of companies are now coming out with new plates and reagents for 3D culture, and as more laboratories use them I expect the prices will start coming down in a couple of years.

Q: How did you go about evaluating what 3D models to use for your studies?

A: There are many techniques that one can use today to generate 3D cell culture models. These include matrix- and non-matrix-based systems, the spinning flask and the hanging drop methods. As our objective is to use 3D systems for both HT RNAi screens and small molecule screens, it was imperative that we use non-matrix-based systems. We looked around for almost a year and came across a company, SCIVAX Life Sciences Inc. that manufactured cell culture plates of non-matrix transparent cycloolefin resinous sheets comprising nanoscale indented patterns. Since this plate is a non-matrix-based system we can transfect the cells with siRNA and seed cells on this plate, which then form spheroids and, using viability or morphological readouts, determine the biological significance.

Depending on your purpose you have to be very careful in selecting the right technology to generate your spheroids. In a hanging drop method, cells accumulate at the bottom of the drop by gravity and form spheroids. Using this model you get uniformly sized spheroids, whereas in the plate-based system that we use, you get multiple spheroids but they are not all of uniform size. We use the ultra-low-attachment round-bottom plates from Corning, where cells form large single spheroids, just as in the hanging drop method. We are currently, in collaboration with n3D Biosciences Inc., developing an advanced 3D model using polylysine-coated nanoshells and a bio-assembler system. Using this model, we are able to generate a tumor in the laboratory utilizing patient biopsy tissue. Our goal is to optimize this model for it to be used in the new therapeutic approach of personalized medicine. So depending on what system you are using, you can generate 3D structures of different morphology to be used to address very specific and relevant biological questions.

Q: What changes did you have to make in your lab or in the protocols when using 3D cultures?

A: There were no major changes made, except that the plates used were different. The other difference is that when we use 96-well plates for 2D cultures we normally seed between 5,000 and 10,000 cells per well. For 3D cultures, we use 10,000-40,000 cells per well for seeding, because the number of cells is very important in determining the integrity of the 3D structure and is dependent on the cell line used. So once you have identified which technique you are going to use to generate the 3D spheroids, then you have to test a range of seeding densities using your cell line in order to identify the concentration that gives spheroids with the best integrity. The other aspect to consider is that not all cell lines will form spheroids. For example, some lung cancer cell lines will form spheroids two to three days after plating, but then they break up. So you have to be very careful in selecting the right cell line for your study.

There are other simple but really important things to keep in mind. For instance, when washing the cells in a 2D adherent cell line you can just suck out the media and replace it with new media. However, spheroids

Dr. Geoffrey Bartholomeusz is an associate professor and director of the siRNA Screening Services in the Department of Experimental Therapeutics at MD Anderson Cancer Center in Texas. He has worked extensively as a cancer biologist, with expertise in both molecular biology and drug development. A goal of his research is to utilize high-throughput siRNA screens in a 3D cell culture assay to identify novel targets regulating the tumor architecture. His hypothesis-driven study proposes that altering the tumor architecture will lower the levels of hypoxia within solid tumors, sensitizing these tumors to irradiation and/or chemotherapy. In an attempt to confirm this hypothesis, his team has developed a 3D spheroid cell culture model that has similarities to hypoxic regions of solid tumors. They have performed a high-throughput siRNA screen and identified and validated potential targets whose silencing reduced the levels of hypoxia within the spheroid and inhibited HIF1 activity. Studies are currently ongoing to confirm the hypothesis and test small molecules developed against these targets as potential anticancer agents. As a member of a multi-investigator group within MD Anderson Cancer Center, Dr. Bartholomeusz is also involved in developing a technology that will permit them to regenerate tumors in the lab utilizing biopsy tissue, with the goal of developing cancer-patient-specific drug cocktails.

are not attached and they can get sucked out while exchanging the media. So we had to develop a new method for changing the media to enable their continuous growth. At the same time, with spheroids we can get away with changing the media every three to five days, instead of every day.

Q: What are some of the things that need to be optimized for 3D cultures?

A: When doing siRNA screens in 3D, we were using higher amounts of cells as compared with screens in 2D, so we scaled up the siRNA and lipid concentrations accordingly. However, higher concentrations of siRNA and lipids lead to increased toxicity to the cells, and so we had to come up with a fine balance. In the case of small molecule screens, the time when the drug is added to the plate is an important consideration. Some cell lines tend to form tight spheroids and thus, if the drugs are added after the formation of the spheroids, one has to consider the effects associated with drug penetration. Other considerations are drug stability in media and duration of drug treatment before terminating the study. So there are a number of factors that need to be worked out, and we learned this the hard way as we better understood our 3D systems. We are constantly tweaking protocols and talking to companies as they put out new reagents and assay technologies that are specific for 3D culture use. We have developed our technologies over time, through trial and error, and we have fairly good standard operating procedures to get robust and reproducible data for our siRNA and drug screens and also for mechanism-of-action studies. We now have data to show that 3D systems are superior to 2D culture systems, at least for cancer biology.

BREATHING EASY

KEEPING TABS ON INDOOR AIR QUALITY

by Vince McLeod

A building's indoor air quality, known as IAQ—and now broadened to indoor environmental quality (IEQ)—has been a major issue in buildings since the early 1980s. Problems developed from energy conservation measures adopted in the late 1970s that limited functioning windows and introduction of outside air into buildings. The resultant "tight" buildings and 100 percent recirculating heating, ventilating, and air conditioning (HVAC) systems produced myriad problems for building occupants and owners alike. What began as a few cases of tight building syndrome exploded into high-profile cases of multiple chemical sensitivity and indoor mold contamination, and IAQ issues were born.

Today, we are in much better shape thanks to the efforts of the Environmental Protection Agency (EPA); Occupational Safety and Health Administration (OSHA); American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE); and the US Green Building Council (USGBC). Both the EPA and OSHA have extensive information and guidance on their respective websites.[1,2] You can learn as much as you want to know about indoor air quality, building systems, preventing problems, and troubleshooting with the comprehensive materials developed by these government agencies. And the good news is, it is free. Nongovernmental organizations such as ASHRAE and USGBC have also advanced the science of indoor air quality. ASHRAE's ventilation guide is considered by many to be the IAQ designer's bible, providing very important information on fresh outside air quantities.[3] USGBC's Leadership in Energy and Environmental Design (LEED) program presents cutting-edge guidance for designing and building the new generation of green buildings, focusing on occupant health and indoor air quality.[4]

However, even with this wealth of information and today's sophisticated HVAC systems, indoor air quality issues arise due to many different and prevalent reasons (e.g., a preventive maintenance was missed, a belt broke on a crucial exhaust fan, a suite was just renovated with new furnishings and floor coverings, or a delivery truck sat parked in front of the outside air intake for a few hours). We have run into all these issues and spent valuable time running down the causes and correcting the problems. Some transgressions are unforeseeable and unavoidable, but many can be headed off or even prevented with minimal effort focused on routine checking of the facility's indoor air quality.

How do we check our IAQ?

Digging through the massive volumes of indoor air quality information is daunting for most of us and too time consuming. Many people often deal with situations only when they become a crisis. Then they are scrambling to fix the problem or call in experts. But having dealt with IAQ issues for the past couple of decades and pored over the guidance documents, we have developed a tool—an air testing protocol that may help prevent many of the common indoor air quality issues.

This air testing protocol is based on Environmental Protection Agency IAQ studies and USGBC's LEED indoor air quality commissioning requirements. It consists of a complete facility (or area of concern) survey for specific parameters and contaminants and is performed with portable instruments so data is available immediately.

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PROVIDE GUARDS ON ALL VACUUM PUMPS & SECURE ALL COMPRESSED GAS CYLINDERS

By James. A. Kaufman

This is one of the most common OSHA violations. Whenever a pulley/belt assembly is within reach, there needs to be an enclosure to prevent fingers, hair, or clothing from being caught.

Paper cutters are another common device that requires a guard. In both cases, manufacturers can provide the parts to upgrade older units that are missing the necessary protective guards.

Compressed gas cylinders need to be chained in place during storage, transportation, and use. If the valve were to break off, the cylinder will become a rocket causing potentially significant injury and/or property damage. In addition, a falling cylinder can cause crippling injuries.

In the storage area, compressed gas cylinders should be separated according to hazard category: flammables, oxidizers, inerts, and empties. When transported, a wheel cart with a restraining chain should be used. In both cases, the protective cap should be kept on.

There are five different types of valves on compressed gas cylinders. If you don't know and understand the types of valves, you will not be able to open or close the cylinder properly.

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

It is quick, simple, and inexpensive, even if consultants are hired to perform the work (an alternative is to rent the instruments and have in-house staff take the measurements). Best of all, the data is directly compared to existing OSHA, EPA, ASHRAE and LEED standards or recommended guidance levels and related to occupational health conditions.

Base IAQ assessment protocol

Begin the indoor air quality survey by taking measurements of the classic four parameters: temperature, relative humidity, carbon dioxide, and carbon monoxide. This is most easily done using a modern handheld IAQ meter, such as the TSI Q-Trak™ or equivalent, which can measure these four parameters at once. Temperature, relative humidity, and carbon dioxide are important indicators of HVAC system performance as well as occupant comfort. ASHRAE standard 62.1-2010 provides excellent guidance on these criteria. If problems pop up with these indicators, it could mean the system is out of balance or the percentage of outside air is insufficient. Carbon dioxide is also dependent on occupant loading and tends to increase during the workday. If "hot spots" of accumulation are noted, first verify the proper amount of outside air, then check the supply flows for adequate distribution in the area. ASHRAE recommends that carbon dioxide levels be kept below the ambient level plus 700 ppm.[3] The theoretical amount of carbon dioxide in outdoor air is around 350 ppm.

Carbon monoxide is introduced from combustion sources. The OSHA-permissible exposure limit is 50 ppm, a level you should never come close to inside a typical building or research laboratory facility. The EPA and LEED recommend an upper limit of 9 ppm or 2 ppm above the ambient level, whichever is lowest. Our experience indicates that if you see levels of carbon monoxide above a few parts per million, you should seek out the source and eliminate it.

The next step is to survey dust levels. The amount of particulates in the air provides a good indication of HVAC system performance and filter condition when compared to outdoor levels.

It also provides valuable information on activity levels—especially in research facilities, where the potential for airborne contaminants is a concern. Measuring dust is a little trickier than measuring the classic comfort parameters, but state-of-the-art instrumentation such as the TSI Dust-Trak™, or equivalent, makes it easier. Dust is usually measured in milligrams per cubic meter of air (mg/M3) and reported for a specific particle size: median diameter of 10 microns or less and designated PM10. As for carbon dioxide, levels are compared to both OSHA-permissible exposure limits and LEED-recommended criteria. And when dealing with indoor air quality, never approach the OSHA PEL, which is 10 mg/M3. The amount recommended by LEED standards is 0.05 mg/M3. Typical ambient levels with normal activity are about half the LEED standard, and indoor office spaces will usually be in the microgram per cubic meter range.

The next step in our base IAQ protocol is to evaluate the levels of volatile organic compounds (VOC). This can also be performed using handheld instrumentation such as our favorite, the RAE Systems ppbRAE™.This nondiscriminating photo-ionization detector measures hundreds of common VOCs and provides a "total" VOC reading in either parts per million or parts per billion in air. While it is true that, in typical office environments, these readings can be the result of perfumes, colognes, and air fresheners, these sources pale when compared to common commercial sources such as paints, adhesives,

thinners, strippers, and lubricants. And in a research setting, the multitude of chemicals in use must be considered. So VOC levels are a very important piece of the puzzle because there are many potential sources and most have serious health and safety consequences as well. The recommended level under LEED is less than 500 ug/M3. For comparison, we typically see levels between 200 and 300 even in hospital and laboratory buildings.

One final contaminate to consider is formaldehyde. If your facility has undergone recent new construction or renovation, testing for this contaminate is worthwhile as formaldehyde is contained in many urea resins, insulation, plywood, particle board, adhesives, and textiles. In addition, given its use as a preservative and sterilizer, research labs should definitely include this parameter. However, real-time measurements necessitate the use of portable infrared spectrophotometers, which are expensive to buy or rent and take some expertise to operate correctly. We would recommend using low-flow sample pumps with appropriate media and having the analyses done by an accredited laboratory. For reference, the OSHA PEL is only 0.75 ppm and the LEED standard for indoor air quality is 27 ppb.

Summary

Now you have the Safety Guys' protocol for regular IAQ assessment. We suggest performing this screening at least annually and more often if your facility has serious issues or lots of employee complaints. By surveying your indoor air quality regularly, you can find and prevent many common problems before they become serious. The Safety Guys welcome your comments and questions. Until next time, remember: "Safety First!"

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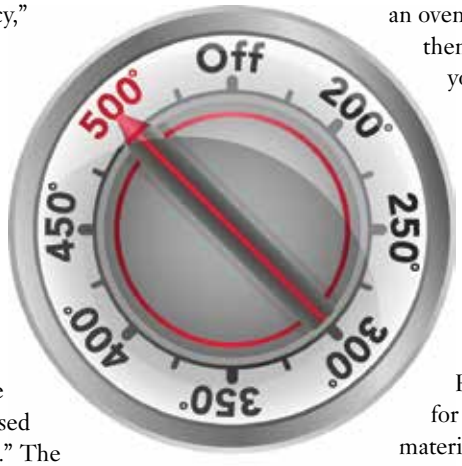
LAB OVENS

EXPANDING THE SPECS OF TEMPERATURE RANGE AND ACCURACY

by Mike May, PhD

Nearly every lab or production facility of any sort needs an oven. Moreover, those ovens get used in a wide range of ways. As Uwe Ross, president at Binder in Great River, New York, says, "Oven applications range from prep work to curing to treating to testing." He adds, "We really find lab ovens in applications from biotech and pharma to heavy-duty material testing."

Historically, ovens and incubators have been distinct cousins in the lab. "Ovens have a wide temperature range but less accuracy," says Ross, "and incubators have less temperature range but more accuracy." He adds, "But they are really closely related." In fact, advances in research demand even closer capabilities from these devices. As Ross explains, "Applications are asking for wider temperature range and close, tight specifications for accuracy. That has to do with the development of new materials like plastics and nanomaterials being used for batteries and all sorts of things." The platform that provides those temperature and accuracy features is really a hybrid between an oven and an incubator.



Beyond the materials placed in an oven, different applications need various devices put in an oven. As Sebastiaan Portier, director, sales and marketing at Spark Holland in Emmen, the Netherlands, explains, "With our ovens, we provide room for more analytical columns—in the best case, up to six analytical columns. That is supported by the column-switching valve inside the column heated department." He points out that "no time is lost changing columns" and that it reduces the leaking that comes from "reusing and reconnecting of columns."

Some users will also look for other ways to speed up oven operations. Portier points out that "the fast heating and cooling of our ovens allow quick temperature gradients where required," so users do not need to wait a long time for an oven to reach a set point.

A real workhorse

Although lab ovens can be extremely robust, working great for years, any device needs some maintenance. For example, says Ross, "If the door seal is not flexible enough anymore, then an oven's specification is out the window."

Even with all the parts in working order, an oven needs calibration now and then. "The big rule of thumb—if you really use the oven, and it's not standing in a corner for occasional use—is that you should get it calibrated once a year," says Ross.

At Michigan State University in East Lansing, Janice B. Harte, an associate professor in the Department of Food Science and Human Nutrition, uses a lab oven for food-storage studies and for drying materials, such as heated beans, before making flours or powders. She also uses it to dry glassware and Drierite for desiccators. To accomplish those tasks, she says, the most important features are "accurate temperature control at lower and higher temperatures, and an easy-to-see display panel." She also wants convection to provide the needed airflow. Like most users, Harte needs an oven that gets her specific jobs done.

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

AUTOMATION MATTERS TO SOME, AND RUGGED RELIABILITY MATTERS TO EVERYONE

by Mike May, PhD

At United Technologies Research Center in East Hartford, Connecticut, staff research engineer Weina Li and her colleagues developed a vanadium flow battery. "It provides 10 times higher power density than previous cells," says Li. This technology is very scalable—capable of providing backup power for a house or a larger building. To better control and make use of these systems, Li and her colleagues rely on potentiometric titration to measure a battery's state of charge. "Newer titrators are much better than old versions," says Li, "because they offer automatic titrations with accurate detection of end points." She adds, "I did lots of titrations by hand, and that is very time consuming."

At JM Science in Grand Island, New York, John MacFarlane in applications support points out other advances in today's titrators. "Most of the changes are improvements in the end-user interface," MacFarlane says. "Software packages make it possible to connect a titrator to a network, for example." He adds, "New software can also include enhanced statistical packages."

The desired features depend on the application. As Hans-Jürgen Bigus, CEO of Hirschmann Laborgeräte in Germany, says, "Many users tell me, if they have a big number of probes to analyze, they want to have a fully automatic titrator, or if they have fewer probes, they want to have a titrator that is very easy to use." Being easy to use means being simple to take apart and clean, for example. Some users, Bigus says, also want to use small volumes of consumables to save money.

Ensuring long life

Some devices can keep titrating for years. As MacFarlane says, "It's not uncommon for us to get calls or have customers come to our booth at trade shows [telling us] they have one of our titrators that's 15 years old and still running." He adds, "We'll still support older units when we can, but the electronic boards can be an issue, because some components are no longer manufactured." His company won't sell a customer a used board, because they can't guarantee it.

To build a titrator that's a sound investment, MacFarlane says, "We emphasize ruggedness, reliability, and reasonable cost. These things really make sure that a customer gets good value for the money spent."

For a lab manager shopping for a new titrator, Bigus says, "I think the first step should be to know how many probes with which type of media will be analyzed. So you can very easily calculate whether it makes sense to work with a glass burette at about $100, a digital titrator at about $1,000, or an automatic titrating system at more than $10,000."

Beyond the upfront cost, though, MacFarlane encourages customers to consider the cost of replacement parts and consumables. "It's like the old printers that cost $49 but replacing the ink cost $98," he says. "You can go to our website and see the cost of consumables."

It pays to check the entire lifetime cost of a itrator and its reputation in the field before making a new purchase.

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CASEWORK

MORE THAN STORAGE IN TODAY'S LABS

by Mike May, PhD

More than just surfaces and storage, today's laboratory casework makes a statement. For one thing, the right casework makes a lab operate more efficiently—putting the right drawers or shelves in the most at-hand places. In addition, casework can even keep track of pieces and parts in a lab. Plus, today's options in cases—from materials to colors—give scientists an opportunity to create a lab with pizzazz.

In Lakewood, Colorado, Richard Peebles needed casework for 7,000 square feet of lab space in the new home for his Peebles Prosthetics, which fabricates dental appliances. When selecting the casework, Peebles thought about how easily items could be accessed as well as making sure that the casework would be durable and easy to keep clean. "I wanted drawers and doors that would be easy to open and close," he says. "It all needed an ergonomic design with no handles sticking out."

"Today's options in cases—from materials to colors—give scientists an opportunity to create a lab with pizzazz."

Peebles also made sure to keep some room to move in the design. "We put in some modular stations," he says. "We've already moved some things around, and it was great to be able to do that." He adds, though, "In some places there was plumbing involved, so that couldn't be moved."

To get the right casework design, Peebles worked closely with his architect. "She was good at understanding my ideas and translating them to paper," he says. "She also made sure that I didn't forget about the colors." That turned out to be crucial. Peebles explains, "We are now opening the building to other groups, because we have an education room, and when people come in they get a good, professional feel."

The right feel and flow, however, depend on the person and the purpose. In today's casework, nearly anything is possible.

Defining the details

Different people define casework in different ways. "In many cases, people are talking about all of the cabinets that support the work," says James Anderson, vertical market and national accounts manager at Lista International in Holliston, Massachusetts. "Also, they are often talking about workbenches." He adds, "From my perspective, lab casework includes stationary and overhead wall cabinets. They support sinks, provide storage or shelving, and so on."

Some designers also consider some moving parts as lab casework. "Casework that is mobile, or movable, adds functionality to a traditional lab setup," says Jim Skillings, design specialist at Workplace Systems in Londonderry, New Hampshire. "You can have mobile lab tables with a wide variety of accessories: shelving, power, computer peripherals, lighting." He adds, "Today's functional lab can be moved around and changed at the drop of a hat, because procedures and the flow of operations can change with advances in instrumentation and the distinct preferences of lab managers."

The changes in science get reflected in adapting casework. As an example, Anderson says, "There are some changes in casework because of changing technology, such as science going more digital and automated, which leads to less wet-lab space in some cases."

But the evolution of technology does not always lead to completely renovating a lab. "Casework can be repurposed to support new technology," says Anderson. "You won't rip out lab casework to support 3-D printers that can just sit on existing casework."

Selecting surfaces and more

The options for today's casework cover a wide range. The cases themselves can be made of wood or even

steel. As Anderson says, "We make steel case goods to be more durable and provide a longer life." Workplace Systems takes a similar approach.

Various options also exist for casework bench tops. At Lista International, says Anderson, "stainless steel tops are probably the most common." There are also laminate options and tops made of various resins. The best material for a top really can depend on the application. "In casting areas where there's lots of heat involved, we see soapstone," Anderson explains. "It's an inert material that doesn't burn or melt, and it's easy to take care of."

> "Today's functional lab can be moved around and changed at the drop of a hat."

Instead of focusing on casework's top only; interesting options also exist underneath. For one thing, casework can include levels, so the bench can be leveled instead of leveling every piece of equipment where necessary. Instead of casters, casework can include glides, which, Skillings says, "let you easily slide a piece over a lab floor."

For the outside, modern casework gives plenty of opportunities for style. At Lista International, customers can select from 10 standard colors. "For a minimal up-charge," says Anderson, "we'll paint it any color they want." He adds, "We do a lot of custom colors, like two-tone with the case one color and the doors and drawers another."

On the inside, special options also exist. As Skillings says, "We use ball-bearing slides on the drawers that give 100 percent extension." Foam cutouts can be placed inside the drawers to organize equipment and specialty instrumentation, such as in a U.S. Environmental Protection Agency 5S/Lean program. "You want something that lends itself to organization—even things like adjustable drawer partitions inside drawers can help," Skillings explains.

To decide what you really need, consider the workflow in a lab: Where do items come in, where do they get used, and what things go back out of the lab? "Then you can analyze how much surface you need, how much storage, what kind of storage," Anderson says. "For heavy items, such as stone, our drawers can hold 440 pounds."

Things can even be mixed and matched—drawers under part of a cabinet and shelves under the rest. The shelves can be open or behind doors, and the doors can slide or open on hinges. Similar options exist for wall storage.

In short, today's range of casework can cover almost any situation imaginable. You just need to decide what casework collection makes the most sense in your lab.

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COLD STORAGE

COLD HARD FACTS FOR MANAGING YOUR ULT FREEZERS

by Trevor Henderson, PhD

Cost and energy efficiency have become critical considerations when purchasing any piece of laboratory equipment. This is particularly true when purchasing laboratory cold storage equipment, especially ultra-low temperature (ULT) freezers. ULT freezers represent some of the most energy-demanding pieces of laboratory equipment available and are ubiquitous in virtually every laboratory environment. When new, ULT freezers operating at their standard set points of -70°C or -80°C consume approximately 16 to 22 kilowatt hours (kWh) per day. After years of service this amount may climb to over 30 kWh per day, an amount in excess of the energy usage of the average American home according to the U.S. Energy Information Administration. For large organizations and academic institutions that may have thousands of freezers on-site, operational costs can be astonishing and even marginal improvements in efficiency can have substantial return.

When considering laboratory cold storage needs, researchers require short- and long-term sample storage solutions that maintain both reliable storage conditions and accurate temperature control. For many lab managers, however, minimizing both energy consumption and operating costs is of primary importance. Fortunately, through simple best practices for cold storage coupled with manufacturer-driven innovations in design and compressor technology, enormous savings can quickly be realized.

A place for everything

Keeping your ULT freezer organized can be a challenge. However, consider that for every minute an upright ULT freezer door is open, it takes approximately 10 minutes for the freezer to recover to its set point. If your inventory is organized, you will greatly reduce the running time of your freezer and minimize the risks of compromising valuable samples by exposing them to fluctuating temperatures. There are several options available to assist in sample organization, including customized racking options, secondary storage containment, and electronic inventory systems that utilize bar codes or radio frequency identification. Software inventory control systems such as RURO's FreezerPro software may also assist in tracking samples both in and out of your freezer while streamlining workflow and identifying old or unneeded samples that should be disposed of. For researchers who desire a fully automated solution, systems such as SmartFreezer by Angelantoni Industrie combine inventory management software with a fully robotic vial retrieval system. These systems have the ability to store thousands of samples and retrieve them quickly without the risk of accidental handling mishaps and without compromising the temperature of the containment area.

> "ULT freezers represent some of the most energy-demanding pieces of laboratory equipment available."

Keeping your ULT freezer properly filled can also keep operating costs down. Freezers that are too bare have little thermal mass and also may lose cold air rapidly when the door is open. This can be remedied by filling empty space with frozen gel packs or bottles full of ice. Conversely, freezers that are overfilled may lead

to wide temperature variations due to passive natural convection potentially damaging sensitive samples. Keeping an accurate inventory and properly disposing of unneeded samples will keep your freezer operating at peak efficiency.

Size matters

Choosing the right size of ULT freezer for your lab may not be as simple as it seems. While smaller freezers would seem to be more efficient, in fact, small ULT freezer units operate with much higher intensity (energy consumption per cubic foot) than larger freezers do. This is owing to smaller freezers having a larger surface-to-volume ratio, coupled with the fact that smaller compressor motors are less electrically efficient and smaller compressors are less mechanically efficient than larger ones. Considering that a small 3 cu. ft. ULT freezer may operate with intensity up to 600 percent greater than a comparable larger model, it is advisable to purchase freezers with capacities of 20 cu. ft. or larger to maximize energy efficiency within the laboratory environment. If your laboratory needs are not so great as to require a full-size freezer, you may consider sharing resources with another lab and gaining some valuable floor space.

In considering size, you should also examine the sample sizes you are working with. If you are storing 0.5 mL samples using 2 mL screw-top vials, your storage is not particularly efficient. In this case, lab managers may wish to encourage or subsidize the use of micro-vials and 96-well plates. These are readily available from most distributors and can increase your sample storage capacity by nearly 60 percent.

Out with the cold, in with new

One of the fastest ways to achieve cost and energy savings is through the retirement of old or outdated ULT freezers. Technological improvements in compressor design, insulation, and cabinet design have resulted in considerable improvements in sample storage efficiencies. Be aware, however, that freezer efficiency will decrease over time owing to inadequate maintenance, seal degradation, coolant loss, mechanical failure, and degraded lubricants. In many cases, unmaintained ULT freezers may be drawing up to four times as much power as a newer or well-maintained freezer. These freezers are often neglected, sitting in hallways, and filled with unneeded or forgotten samples. Regular testing of your lab's freezers will quickly identify those in need of repair or retirement. In addition, regular maintenance is highly recommended for your cold storage equipment if you want it to age gracefully. While many small repairs, when performed early, may be relatively cheap to service, if you wait too long you may be faced with an expensive compressor rebuild or replacement.

If you are engaged in a new build, it might be advisable to consider process cooling with a chilled water loop. Ultra-low temperature freezer manufacturers (such as Panasonic) that offer optional water cooling within their cascade cooling cycle can offer dramatic savings and reduced ecological footprint for your lab. Such systems operate by removing heat from the condenser across a heat exchanger and channeling it out of the system through exiting water. This translates into less heat generation by the freezer unit, allowing for substantial savings in air-conditioning costs for the laboratory. Further, the extracted heat can be used elsewhere in the lab for water or environmental heating systems.

Thinking ahead

To properly manage your cold storage needs, it is necessary to plan for the future. Consider involving your lab in the development of a plan toward continuous improvement. This may mean developing a freezer rebate program to assist with the retirement of aging equipment or creating incentives to clean out existing space. In addition, seek expert advice from manufacturers when purchasing and maintaining equipment that is energy efficient and offers long-term investment benefits. Finally, make certain you engage all the key stakeholders in developing a management plan for your ULT storage needs; small contributions from everyone involved can amount to substantial overall savings.

Trevor Henderson, technology editor for Lab Manager, *can be reached at thenderson@labmanager.com or by phone at 888-781-0328 x 291.*

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FREEZE DRYERS

IT'S ALL ABOUT TEMPERATURE, PRESSURE, AND TIME

by Trevor Henderson, PhD

Freeze-drying, or lyophilization, is a long-established process in the food, biotechnology, pharmaceutical, and diagnostic industries that involves the removal of water or another solvent from a frozen product by means of sublimation. This process is commonly used for improving product stability, for long-term preservation, for product purification, and for sample preparation. While the immediate benefit of freeze-drying is obvious—the ability to store samples at ambient temperatures—freeze-drying also may afford long-term savings by eliminating the need for costly cold storage.

The process of freeze-drying relies on the balance of only three controllable variables: temperature, pressure, and time. Although the process may seem straightforward, freeze-drying can often be problematic. Having an intimate understanding of the physical and chemical properties of the samples you are working with is essential to selecting a process and equipment best suited to your needs.

Knowing your sample

Controlling the freeze-drying process is dependent on two factors: the presence of a deep vacuum and a temperature differential of 15 to 20 degrees between the sample's eutectic temperature (freezing point) and the temperature of the collector. Choosing a freeze dryer that meets the demands of your application can be a daunting task and requires careful consideration of the samples to be prepared. Choose a system that is too small and you will overload your collector; if your system doesn't reach the correct temperature or has insufficient vacuum, you will risk sample melt back.

For many biological samples, including urea, blood plasma, serum, and vaccinia, a standard freeze-drying system with a refrigeration system that reaches -50°C will be sufficient. In the case of HPLC samples where the freezing point of acetonitrile is much lower (approximately -42°C), however, you will require a cascade-type collector. Cascade systems have dual condensers that can reach -84°C and would be a suitable choice for these samples.

Switching to methanol

Many labs are looking at methanol as an alternative to acetonitrile, due to its general availability and affordability. However, methanol has a much lower freezing point of -97.6°C, making lyophilization difficult even when it is diluted. In response to this demand, some manufacturers are offering ultra-low temperature freeze-dry systems. Labconco's FreeZone systems, for example, are able to achieve collector temperatures as low as -105°C, making lyophilization of dilute methanol, ethanol, and acetonitrile possible.

A matter of timing

The most common question concerning freeze-drying is likely, "How long will it take?" The answer, however, is not so direct. The time required to freeze-dry a sample is dependent on a number of factors, including sample volume, thickness, and surface area; the eutectic point and solute concentration of the sample; and the temperature of the collector and the maximum vacuum obtained. In general, samples with a large surface area will freeze-dry faster than those that are thick or dense. Additionally, thick samples require moisture to pass through the layer of dried material, increasing the chance that the sample will thaw and "collapse." Depending on your sample, freeze-drying can be a lengthy process lasting from hours to weeks. While freeze-drying provides superior drying capacity, if time is of the essence, you may consider a vacuum concentrator or evaporator for your application.

Finally, if you are shopping for a freeze-drying system, remember to budget for a rotary vane vacuum pump with vacuum deep enough to pull down to 2 x 103 mBar, as well as any glassware or adapters that may be required.

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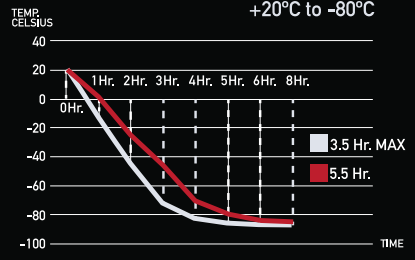

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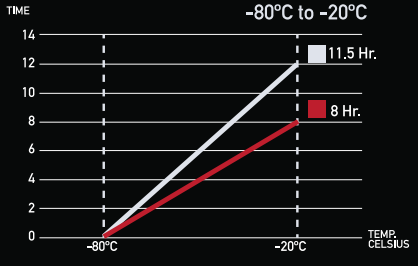

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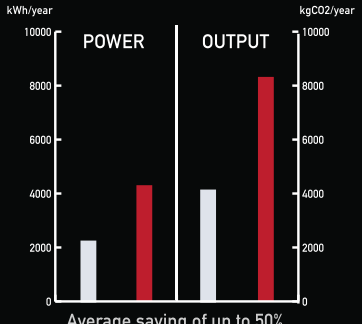

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SCIENCE AND BEYOND

VACCINATION INNOVATION

MAKING A DIFFERENCE IN THE WORLD IS THE MAIN PERK OF WORKING AT THIS LAB

by Rachel Muenz

Extraction of DNA constructs from bacterial clones.

One of the major benefits of working in the sciences is the ability to have a positive impact on the world through research or the development of new products. That's certainly the case with working at Redbiotec AG, a biotechnology company located at the Bio-Technopark in Schlieren, near Zürich, Switzerland.

"We develop vaccine candidates primarily against herpes viruses and, in particular, human cytomegalovirus (CMV)," explains Christian Mittelholzer, PhD, chief technology officer (CTO) at Redbiotec. "In addition, we participate in a project funded by the European Union aimed at developing a universal influenza vaccine."

> "Everyone can focus on what she or he is best at while always knowing whom to ask if a question pops up."

At the heart of this work is the company's rePAX® technology, "a highly efficient and versatile assembly and protein expression platform," Dr. Mittelholzer says, adding that the company "specialize[s] in creating multi-protein, virus-like particles [VLPs] and protein complexes—a process requiring sophisticated molecular biology methods."

That work takes place in about 4,000 square feet of facility space, which includes a cell culture room with state-of-the-art equipment where the company employs single-use technology that is compatible with industry standards. Currently, Redbiotec has 18 employees, most of whom have PhDs, though some are students doing their master of science thesis work at the company.

Andreas Jurgeit, PhD, business development manager at Redbiotec, says the company's number of employees is the perfect size for the stage the company is at.

"Everyone can focus on what she or he is best at while always knowing whom to ask if a question pops up," Dr. Jurgeit says. "All teams interact well, and administration is kept at a practical level. This doesn't just help us in house but is also appreciated by our partners."

When new employees start at Redbiotec, they must go through a thorough introduction process that introduces them to all the key aspects of the company's technology.

"This ranges from the upstream processing part of the workflow—mainly insect cell culture—right through to the downstream processing and analytical steps required to ensure that all final products are of exceptionally high quality," Dr. Mittelholzer explains. "Even with 20 years of molecular biology experience, it took a while for me to really appreciate the true potential of

the rePAX technology, highlighting its inherent complexity and emphasizing the need for intense training when new scientists join our team."

Workload and workers

In addition to the company's main focus on CMV and its secondary focus on influenza, Redbiotec is also currently working on many smaller in-house programs and several projects with their industry partners.

"These can have widely different time frames, requiring a structured approach to project management that ensures that all deadlines are met and projects are completed on time—something we have become especially adept at," Dr. Mittelholzer says. "All of this while also continuing to invest significant internal resources and time to develop our technology even further."

> "Our team needs to be highly flexible, and plans are often revised on a frequent basis."

Redbiotec also keeps those projects organized by storing all documents on a central server that is mirrored and has a physical backup at a remote location.

"There are quite a number of lists and tables with central server access that are updated on a daily basis, allowing all employees, including the senior management team, to keep track of all activities," Dr. Mittelholzer explains. "On a personal level, I have several tools as well as lists, tables, and brainstorming documents collected in written or electronic form."

As CTO, Dr. Mittelholzer's role is to work with the chief scientific officer to coordinate the lab work performed by the Redbiotec team. That involves balancing priorities and resources and translating the company's strategy into practical lab work. He is also responsible for summarizing results, drawing conclusions, and using that information in the ongoing management of every project.

"This allows us to get the best possible results from every program we work on," says Dr. Mittelholzer, who started working in the biotech field 20 years ago when he undertook a 10-month diploma program at a major pharmaceutical company based in Switzerland. "In addition, we conduct internal experiments and prepare data supporting our ongoing business development, often in collaboration with current customers and partners."

In order to motivate his staff, Dr. Mittelholzer does his best to lead by example.

"We work hard to ensure that our knowledge is always up to date and that we are operating at the cutting edge of vaccinology."

"I do my utmost to be hardworking, optimistic, honest, and structured while attempting to be fair and realistic about my strengths and weaknesses," he says. "As we are a small biotech [company] with a range of small and large customers as well as industry partners that we work very closely with, our team needs to be highly flexible, and plans are often revised on a frequent basis. We have a great team that pulls together to drive each other on—and as I'm right in the middle of the projects working alongside them, I can lead by doing as well as by directing."

1. Christian Mittelholzer preparing DNA constructs to be used in Redbiotec's rePAX assembly and expression platform. **2.** Tiago Vicente and Matthias Meier starting and sampling a single-use WAVE bioreactor, the workhorses of Redbiotec for large-scale expression. **3.** Marina Tambasco Studart subcloning a Redbiotec rePAX construct. **4.** Sabine Wellnitz monitoring the expression of a marker-gene to control for transduction efficiency.

An average day at Redbiotec starts off with one or two meetings or telephone conferences with the company's partners and customers in addition to "many short and sometimes very spontaneous interactions with our lab members," Dr. Mittelholzer says. "On top of this, we work hard to ensure that our knowledge is always up to date and that we are operating at the cutting edge of vaccinology, which of course means quite a lot of reading and writing!"

The company has four main steps in its workflow and value chain: experimental design, molecular biology, and upstream and downstream processing. Most projects require all those steps as well as advanced analytics and quality control, Dr. Mittelholzer says. And, of course, Redbiotec's rePAX technology, which is based on the baculovirus expression vector system and is the key technology used in the lab, allowing a high level of protein expression in insect cells.

Dr. Jurgeit adds that the company also uses a number of other technologies in the development process— from bioinformatics to state-of-the-art upstream process development to downstream process development for protein complexes and VLPs.

Industry challenges and change

While working in research and development is rewarding, Dr. Mittelholzer says it's also prone to unexpected results and hurdles. "Helping our customers and partners overcome unforeseen changes and deviations in strategy is a key challenge but also an area where our proactive attitude toward customer support adds a lot of value for our customers," he says. Keeping a strong line of communication between the lab and the Redbiotec business development team is the key to overcoming this challenge.

"This helps me plan and get a feeling for what awaits us in the coming weeks and months," he says. "That in turn enables me to better anticipate different variables and all possible eventualities; being prepared for changes and new directions is crucial as a lab manager and team leader."

That personal interaction, both with fellow employees and with partners and customers, is Dr. Mittelholzer's favorite part of his job.

"Each [interaction] is different and provides interesting dialogue and levels of communication," he says. "I am extremely structured and like to translate ideas from the team and our customers into successful practical work, to really make things happen. I feel that I can make a real difference there, so this is very rewarding."

As far as industry changes go, Dr. Jurgeit says that "Although vaccines represent only two to three percent of the global pharma market, in terms of growth rates vaccines outperform the total pharma market by roughly twofold—a fact fueling innovation in the field." He adds that though the "low hanging fruits" of the vaccine world have already been harvested, a new generation of vaccines such as the papilloma vaccines Cervarix® and Gardasil® have shown that "the market also accepts and supports the development of 'premium' products, even if they have to be paid for by the patient directly. This means that vaccines are no longer a 'commodity type' product with low margins—they have true blockbuster potential."

Dr. Jurgeit says that the success of such vaccines means good things for Redbiotec.

"For us as an ambitious but still rather small biotech [company], this opens a lot of opportunities," Dr. Jurgeit says, adding that Redbiotec's innovative technology enabling novel products that serve an attractive market is "appreciated by both investors as well as larger industry partners."

He adds that the new status of vaccines as profitable products has led to major consolidations such as Pfizer acquiring Wyeth in 2009 and GlaxoSmithKline's recent announcement that it will be taking over Novartis's vaccine division.

"Very practically speaking, this change in dynamics and renewed interest in vaccines both fuels and enables innovation at a level that one used to see only in the drug development space," Dr. Jurgeit explains.

He says the lab's specific plans for the future involve preparing several of its promising vaccine candidates for clinical validation.

"This obviously requires a significant extension of resources from a strong R&D focus towards product-centric personnel and equipment," Dr. Jurgeit says. "As one example, in our R&D lab we are already applying single-use equipment, which allows us to seamlessly scale and transfer processes. The GE WAVE Bioreactor™ process that is applied to test the expression of candidates can be scaled from single liters to big installations. [This] provide[s] enough material for animal studies and even future clinical validation—all from a single scalable process and within a very short space of time."

For Dr. Mittelholzer, a technology called BacMam that was recently introduced in the lab is the coolest thing currently going on at Redbiotec:

"Baculoviruses are species-specific, affecting only their host insects," he explains. "Nevertheless, using a highly artificial lab setup, it is possible to transfect them into mammalian cells. BacMam enables researchers to express their protein complexes and VLPs directly in the host cell, i.e., those affected by a given virus during normal disease development. This is an exciting new method and broadens the application of our expression technology even further."

Apart from the technology side of things, just being a part of the Redbiotec team and being able to have a positive effect on the world are pretty cool for Dr. Mittelholzer.

"Redbiotec is an exciting workplace where I feel that my skills and my experience can make a difference," he says. "I'm proud of being a member of our very talented team."

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

MAIN TECHNOLOGIES USED IN THE LAB:

- Redbiotec rePAX® assembly and protein expression platform
- GE WAVE Bioreactor process
- Bioinformatics (including a collaboration with TeselaGen Biotechnology)

INSIGHTS ON FUME HOODS

EFFICIENCY, MATERIALS OF CONSTRUCTION, OPERATING COSTS PRIME CONSIDERATIONS

by Angelo DePalma, PhD

▲ *Ductless Fume Hood / Aura® Elite Mystaire / www.mystaire.com*

▲ *Ductless Fume Hoods / Patriot™ AirClean Systems / www.aircleansystems.com*

Aside from safety, saving energy is *the* trend in fume hoods these days. Hoods are energy hogs that suck thousands of cubic feet of conditioned air per hour, 24 hours per day, out of buildings; replacement air must be heated or cooled depending on the season. "Fume hoods are tremendously expensive to run," notes Dana Dahlgren, VP of sales and marketing at Kewaunee Scientific (Statesville, NC). "The last decade has been all about fume hoods that are more efficient, that do not require the same air flow as older models."

Facility managers increasingly specify variable air volume (VAV) systems for new buildings. VAV uses a combination of sensors and controls that ramp down exhaust in individual hoods according to demand.

VAV may be combined with proximity sensors coupled to automatic sash closing mechanisms, which engage after the user has been away from the hood face for a specified time. Automated sash closers only make sense, from the perspectives of safety and energy economy, when used with VAV. Contrary to popular belief, closing a sash in a conventional hood provides a safety barrier but does not save energy, because air flow remains constant. This is known as a "bypass hood" or constant volume hood. Otherwise, small sash openings would create a wind vortex within the work space that could disrupt or ruin processes.

VAV and automatic sashes are expensive, but the return on investment is remarkably short, Dahlgren says. "Depending on the climate, the payback is a couple of years at worst. If you're building a 30- or 40-year building, adding those features is a bargain."

NEW STANDARDS

The emergence of the SEFA 9 standard from the Scientific Equipment and Furniture Association (SEFA), an industry group, is expected to improve acceptance of ductless hoods. The standard puts ductless hoods and filtered fume hoods into one of three categories: DHI, DHII, or DHIII. The DHIII category calls for advanced sensors and monitoring and for catch-all filters. "Many organizations have adopted ductless hoods for lab renovations, and that trend will continue as the user base becomes better educated about the benefits," says Kevin McGough, president of AirClean® Systems (Raleigh, NC).

SEFA members, including AirClean Systems, Labconco, Erlab, Kewaunee Scientific, and others, are hoping the international standards organization ANSI will accept the SEFA 9 standard, which should boost even greater acceptance of ductless hoods.

Instead of exhausting conditioned air out of buildings, ductless hoods recirculate air that has been cleansed via HEPA and/or carbon filters. Thus, ductless hoods save energy to an even greater degree than do VAV-based systems with automated sashes.

"VAV uses a combination of sensors and controls that ramp down exhaust in individual hoods according to demand."

Ductless hoods are appropriate in two situations. The first involves very low-risk dilute aqueous chemistry, as one would encounter in a freshman chemistry course. The second category includes higher-risk processes where the hazards are quantifiable and well-understood, and where hazardous vapor concentrations fall within the system's capability for removal.

McGough is adamant about understanding risks. "If you're getting into real R&D," he says, "and you don't know what your products or byproducts will be, or their concentrations, we will not sell you a ductless hood." Even in those situations ductless designs will probably work, but users will need to change filters more frequently and sensors may not detect contaminants at their threshold limit values. For these reasons, AirClean Systems requires purchasers to submit an application worksheet as part of the sale.

ALL-PLASTIC DESIGNS

Traditionally, hoods were fabricated from wood, steel, and stone, and were dedicated to a specific task. New materials greatly broaden a hood's utility. NuAire (Plymouth, MN) holds the distinction of constructing its fume hoods entirely from polypropylene rather than metal, stone, or wood. "Metal eventually rusts," says Polypro sales manager Terry Thompson, "sometimes in as little as two years."

Aside from degradation, metal-free hoods are preferred by labs that conduct trace metal analysis and are concerned about steel and rust particles, agitated by air flows, contaminating their assays.

Metal-free design involves some alterations in how manufacturers build hoods. Instead of chain and sprocket sashes, polymer hoods employ a polypropylene pulley-and-rope assembly. Handles, latches, even screws are fabricated from the durable plastic. Advice: Ask for extra screws if polypropylene hoods are in your future.

▲ *Fume Hood Bench Module Cabinet / NU-156 / NuAire / www.nuaire.com*

"Plastic-lined hoods are 20 to 30 percent more expensive than metal designs, which is something to keep in mind," Thompson advises. "But they're virtually a onetime installation."

USAGE & OPERATION

Aside from cleaning and sash operation, users do not need to worry much about fume hood usage and operation. Following best practices will ensure that usage remains trouble-free.

In her visits to customer labs, Beth Mettlach, sales engineer at Labconco (Kansas City, MO), often notices inappropriate fume hood usage. "They have a lot of things that shouldn't be in there," she says.

▲ *High Performance Fume Hood / Protector XStream Labconco / www.labconco.com*

"Closing a sash in a conventional hood provides a safety barrier but does not save energy."

Kevin McGough has seen similar abuses. "Labs put rotary evaporators inside hoods," he explains. "What terrible utilization of a critical asset."

To ensure optimal operation, Mettlach advises that lab workers remove from hoods everything that does not belong in a protected area. "A fume hood is foremost about safety," she says. "You have to let air through, and that will in turn provide better containment."

Part of safe operation includes working within the exhaust space, beginning about six inches beyond the sash. Hoods will generally protect workers outside those areas, but will not prevent spills from dropping onto users' laps or the floor.

Mettlach is very big on airflow monitors as an essential feature of hoods. Monitors ensure that the device operates within exhaust specifications, and they can diagnose numerous problems related to the blower, the sash, and the exhaust. Some hoods come equipped with monitors; others rely on VAV systems that incorporate facility-wide monitoring. If your lab's hoods lack airflow monitors, consider installing them as an add-on.

Other usage tips include the following:

- Fume hoods are taken for granted, but users still require training in operation and safety. YouTube (www.youtube.com) hosts numerous videos illustrating safe hood usage.
- Organizations that maintain many hoods will probably need a state or local certification that air flow is sufficient for user safety. Certification involves checking exhaust and air flow systems.
- It is important to keep sashes closed when lab personnel are not working directly in the hood. This will not save money (unless your lab has a VAV installation), but it will protect users from explosions and sudden gas releases.
- For labs with automated sashes, Dana Dahlgren advises against automated opening for obvious safety reasons. "The sash should never open unless the user specifically wants it to," she says.

PURCHASE DECISIONS

Safety is always the first factor to consider. What will your lab be using the hood for? High school chemistry-type experiments require a minimum of user protection, if any, whereas high concentrations of heated acid demand the utmost in protection.

Kevin McGough advises purchasers to consider their overall goals. Particularly during renovations, they should consider a ductless design when they cannot afford to stop working for extended periods. Ductless hoods can be located in unoccupied space throughout a facility, allowing end users to keep processes going at full capacity while the renovation is taking place.

Ductless systems cost more to purchase than conventional hoods, but they often pay for themselves within two years through energy savings. "Ductwork removal and installation, HVAC and damping systems, VAV

▲ *Fume Hood / Mistral / Hamilton Scientific / www.hamiltonscientific.com*

▲ *Fume Hoods / Captair® Flow Erlab / www.erlab.com*

controls, add-on features, and the cost of heating and cooling the air you're blowing outside represent serious costs," McGough explains.

Mettlach concurs. "Steer away from considering upfront costs," she says. "Operating costs are far more significant and persist for as long as you own the hood."

New labs increasingly specify a mix of conventional and ductless hoods, a strategy that maximizes facility utilization. The high-risk processes with unknown byproducts still occur in conventional hoods, while less risky and better defined operations go ductless. "It's a better way to allocate resources," McGough says.

> "If your lab's hoods lack airflow monitors, consider installing them as an add-on."

Finally, consider epoxy resin hood liners and floors. Polymers resist most caustic chemicals and are easy to clean, while stainless steel will corrode when exposed to strong acids. Stainless steel lining is suitable for dilute acids or isotope work, where corrosion risk is low, because stainless decontaminates easily.

Users who fully understand their processes, who shop around, and who exploit vendors' wealth of knowledge will be better positioned to acquire the right hood for everyday operation, as well as for exceptional workflow events.

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

TECHNOLOGYNEWS

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PRODUCT SPOTLIGHT

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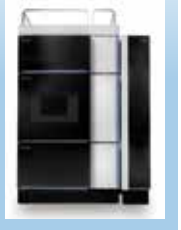

Thermo Fisher Scientific recently launched a new ultra high performance liquid chromatography (UHPLC) system that aims to increase laboratory production levels whether it's used with mass spectrometers or as a standalone system.

The Vanquish UHPLC features a clean design and stands about 25 percent lower than comparable modular stacks for safety and convenience in the laboratory. The instrument itself combines the ruggedness of an integrated system with the flexibility and serviceability of a modular system.

"Rather than making incremental improvements to UHPLC, Thermo Fisher Scientific has designed this system from the ground up," said Fraser McLeod, vice president and general manager of HPLC at Thermo. "The result is a system that combines advantages in separations performance, sample throughput, ease-of-use, reproducibility and method transfer efficiency."

Along with the system comes a new family of UHPLC columns–Accucore Vanquish. The new columns feature 1.5 µm solid core particles utilizing Core Enhanced Technology to take advantage of the Vanquish system's 1500 bar (22,000 psi) maximum pump pressure and flow rate up to 5mL/min for ultra-short diffusion path lengths and highly efficient separations.

The Vanquish also includes a number of other interesting features, such as SmartFlow pumping technology designed for highly reproducible retention times and low baseline noise to enhance detection sensitivity; and an insulated autosampler compartment with new air-to-air cooling, which protects vials from water condensation, even in hot and humid environments.

In addition, there are some cool optional features, such as a handheld tablet that lets users conveniently monitor system status, check runs, and make changes.

For more information, visit www.thermofisher.com/vanquish

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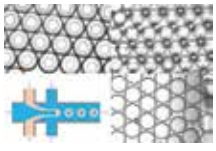

- Designed for creating micron-sized emulsion droplets that contain still smaller droplets inside
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Dolomite www.dolomite-microfluidics.com

Fume Hood

Mistral

- Provides a wide variety of sizes and options to meet users' laboratory needs
- Available in bench, high-line, floor-mounted, perchloric, radioisotope, and demonstration versions
- Meets the industry's highest safety standards combined with quality, reliability and efficiency from a single platform
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Hamilton Scientific www.hamiltonscientific.com

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Labconco www.labconco.com

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Retsch www.retsch-technology.com

PRODUCT SPOTLIGHT

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ROTARY EVAPORATOR BOASTS USER-FRIENDLY FEATURES AND WIRELESS CONTROL

A new rotary evaporator recently released by KNF Neuberger makes flask exchange much more straightforward. One of the key features of the whisper-quiet RC 900 is that it allows a scientist to simply lock the flask into place using just one hand.

"At KNF Lab, we pride ourselves on our strong reputation for producing solid, high-performance equipment for real laboratory situations," said Jim Findlay, marketing manager of laboratory products at KNF. "The new RC 900 is a perfect example of this, making rotary evaporation more user-friendly than ever before."

Other new features that make the system easier to use include an adjustable knob that lets users set their optimum flask angle and wireless control of all evaporation functions through a touchscreen and control knob. A cordless heating bath with a pour spout encourages safe emptying without spilling and the system requires only minimal space on the lab bench.

Dr. Alexander Scherer, chair of organic chemistry at the Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany, who has beta-tested the new system in his laboratory, said he was happy with the instrument so far.

"We exposed the RC 900 to real laboratory conditions, such as corrosive and aggressive solvents, and made further suggestions on how to make the system even easier to operate," Dr. Scherer said. "KNF Lab took these suggestions on board and the result is a high-performance system that features a user-friendly, intuitive touchscreen and automated functions which really make life easier, helping to guarantee highly efficient and safe operation."

For more information, visit www.knfusa.com

Ergonomic Footrest

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- Provides ergonomic support for the feet, legs and back by promoting proper blood-flow while sitting
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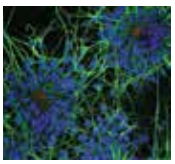
- Footrest is made from polystyrene, and is also available in a black ESD option
- Dimensions: 19.69" x 14.57" x 3.94"

Sovella USA www.sovella.us

CELL CULTURE

iPSC Derived Neural Cells



- Include normal and Alzheimer's disease neural progenitor cells, and cerebral cortical neurons
- Derived using integration-free, fully defined neural induction conditions
- Capable of generating a spectrum of cortical neurons that are electrically active and have the ability to form functional synapses and circuits *in vitro*

AMSBIO www.amsbio.com

Micromanipulator

TransferMan® 4r

- Combines an intuitive user interface with excellent precision for rapid and simple microinjection
- Suited to a broad range of applications, including microinjection and manipulation of suspension cells such as oocytes and blastocysts
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Eppendorf www.eppendorfna.com

High Content Screening Platform

CellInsight CX5

- Powered by new proprietary HCS Studio™ 2.0 cell analysis software
- Now with near-IR (infrared) capability, the system is enabled with true five-color spectral illumination, allowing access to a greater range of fluorescent reagents
- Seven new validated assays were added to the platform, as well as the capability to accept images for analysis in many different formats

Thermo Fisher Scientific www.thermoscientific.com

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- Designed for basic stem-cell research, disease modeling, drug development, and regenerative medicine
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Lonza www.lonza.com

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INFORMATICS

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ArtelWare

- For use with the MVS® multichannel verification system
- Enables MVS users to track and manage the performance of their automated liquid handlers over time
- Aggregates the standardized measurements from the MVS for all of a user's liquid handlers, providing detailed, actionable performance information and a new level of insight for the management of these critical laboratory tools

Artel www.artel-usa.com

Liquid Handling Control Software

LHC™ SiLA

- Allows any proprietary LHC-controlled washer or dispenser to be integrated into a robotic system with SiLA compliance
- Provides flexibility in instrument component and automated system selection—users choose the best instrument for assay vs. being limited to what can be integrated into current systems
- Conforms to international standards set forth by the Consortium for Standardization in Lab Automation

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Rheometer Software

Rheo3000 V.2

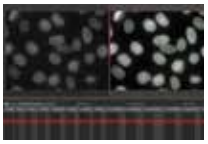
- For use with the new family of RST touchscreen rheometers
- 21 CFR compliant, including controlled user access and data integrity/security
- Can perform a wide variety of tests including: viscoelastic modulus, yield stress, viscosity vs. shear rate profile, thixotropy calculation, creep behavior, recovery after flow, and temperature sensitivity

Brookfield Engineering www.brookfieldengineering.com

Microscopy Software

Advanced Fluorescence 4.0

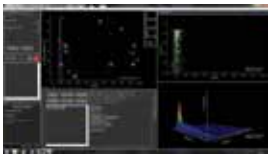
- Now allows researchers to perform 2D image analysis on multi-channel experiments and fully control the environmental conditions of an experiment
- Users of widefield systems can now connect to the acquisition station remotely anywhere, at any time
- Includes a workflow that guides users step by step through the 2D image analysis



Leica www.leica-microsystems.com

Nanoparticle Tracking Analysis System Software

NTA 3.0



- Features an improved, easy-to-use interface
- Makes accessing programs and protocols quick and convenient
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- Designed for use across the complete NanoSight NTA
- Included with all new systems shipped, while existing users can download a free upgrade

Malvern www.malvern.com

Assay Requesting Module

Mosaic 6.0

- Will be introduced with the release of Mosaic 6.0 in September
- Provides requestors with a very simple user interface and consolidates requests throughout the user's organization
- Generates major time-savings, improves assay platform efficiency and minimizes waste of reagents and consumables
- Assay preparation details, such as dilution concentrations, delivery form (neat/solution), volumes and plate layout, need only be entered once

Titian Software www.titian.co.uk

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- The LabChip GX system can enhance genomics research processes by precisely quantifying nucleic acids while the GXII Touch system helps to accelerate the development of biotherapeutic drugs by automating the protein characterization process

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Dual Z Arm for the Cavro® Omni Robot

- Available with a broad choice of lengths, orientations and options for all three axes
- Robot is designed to combine precision OEM liquid handling with straightforward integration
- Option offers two independent pipetting channels in a single housing, doubling the robot's liquid handling capacity without having to mount an additional arm

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Disposable Transfer Tool

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- Allows the Freedom EVO's liquid handling (LiHa) or air LiHa arm to pick up and dispose of empty trays
- Implementation is designed to be as easy as possible using Freedom EVOware® (v2.6 SP1 onwards)

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Laboratory Automation Solution

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- Designed to offer end-to-end automation of cell-based and biochemical assay protocols, providing exceptional simplicity, productivity and confidence for the automation of experiments
- Provides high precision, excellent throughput and extended walkaway time, making it easier to get more done, more confidently
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LIFE SCIENCE

Proteomics Platform

TripleTOF 6600

- Includes SWATH Acquisition 2.0, which allows researchers to develop simple, universal assays
- Brings new power to proteomic data challenges for advanced biomarker discovery and systems biology
- Enables the quantification of thousands of proteins across large sample sets with a level of data completeness and quantitative accuracy and precision that have only been achievable by "gold-standard," targeted MRM in the past

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Universal Inhibitor-Tolerant SYBR® Green Supermix SsoAdvanced™

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- Optimized and validated to tolerate a wider spectrum of PCR inhibitors than other SYBR® Green reagents
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Bio-Rad www.bio-rad.com

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Zetasizer Helix

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Malvern www.malvern.com

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Zephyr

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- When measuring gas or vapor concentrations with an analytical instrument or different detector tubes, multiple screening tests can be performed onsite with a single VeriAir Flex manual-inflating sample bag

Nextteq www.nextteq.com

ARE YOU IN THE MARKET FOR AN... EVAPORATOR?

Rotary evaporators have for decades been staples in labs and industries performing chemistry, including labs in the chemical, environmental, materials, life science and forensics industries. Key applications include sample concentration, solvent recycling, extractions, and separation of solvent mixtures.

In their simplest embodiment, "rotovaps" consist of a temperature bath, rotating flask, condenser, collection flask, and vacuum source. Solvent distills from the sample under the combined effects of heat and vacuum, and collects after condensation in the collector. Recovered single-phase organic solvents may be dried and re-used; binary, tertiary, or quaternary solvent mixtures are also re-used but may need adjustment for composition.

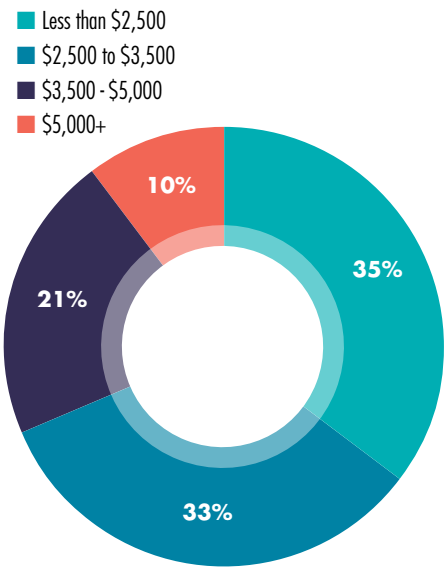
Primary evaporator application(s) as reported by survey respondents

Concentration of substances	26%
Distilling of low-boiling solvents	19%
Extractions	12%
Distilling of temperature-sensitive substances under vacuum	11%
Drying of powders	10%
Separation of material mixtures	10%
Recycling of solvent waste	8%
Distilling of oxygen-sensitive substances under inert gas	3%
Chemical synthesis under reflux	1%

Rotary evaporator components used by survey respondents.

Condensate trap	14%
Diaphragm pump	13%
Recirculating cooler	13%
Vertical condenser	13%
Digital bath	12%
Chiller	11%
Dry ice condenser	7%
Diagonal condenser	6%
Reflux condenser	5%
Cold finger condenser	4%
Other	1%

Nearly 37% of respondents plan on purchasing a new evaporator in the next year. The estimated budget ranges for these purchases are as follows



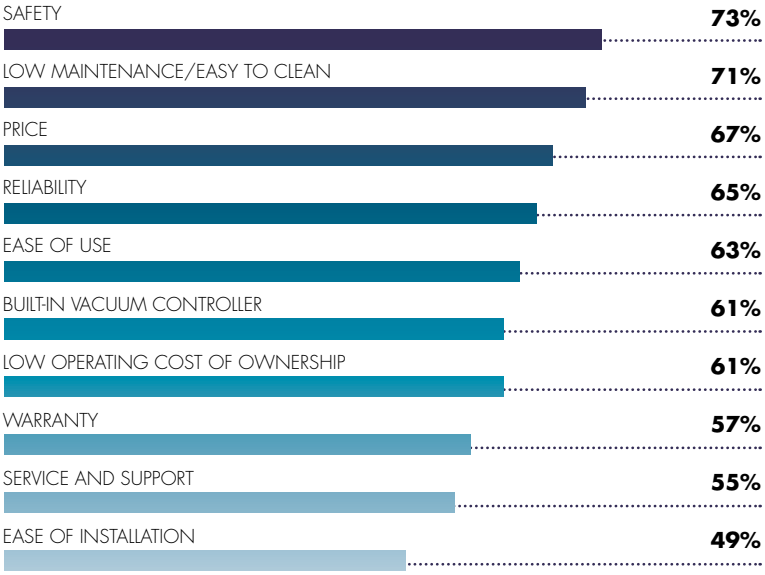
TOP 5 QUESTIONS

You Should Ask When Buying an Evaporator or Evaporator System

1. What are your sample sizes? Microtiter plates and micro centrifuge tubes work best in a centrifugal vacuum concentrator. For large samples up to 450mls, a vortex evaporator is recommended.
2. What are your samples? Acids require an acid resistant system. Solvents damage plastic and rubber components; an appropriate system to prevent damage is recommended. A -50°C cold trap is ideal for aqueous based samples, a -85°C cold trap traps most solvents and a -105°C cold trap is recommended for alcohols.
3. Are your samples heat sensitive? Even at ambient set point, vacuum concentrators add heat through friction. A concentrator that has refrigeration built into it will give you the temperature control recommended to maintain the viability of heat liable samples.
4. Do you have limited space? A floor model with casters or small all-in-one benchtop model can be moved out of the way when not in use.
5. Do you prefer vacuum evaporation or nitrogen blow down? Some samples require evaporation under nitrogen (which is more gentle) for volatile solvents.

TOP 10 FEATURES/FACTORS

respondents look for when purchasing an evaporator.



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

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ARE YOU IN THE MARKET FOR AN... AUTOMATED LIQUID HANDLER?

Automated liquid handling (ALH) systems span the range from semi automated multichannel pipettors to room-sized systems. The industry is trending toward versatile, modular ALH systems—seemingly for every budget. Likewise, instrumentation, software, and methods have followed the trend toward greater user accessibility.

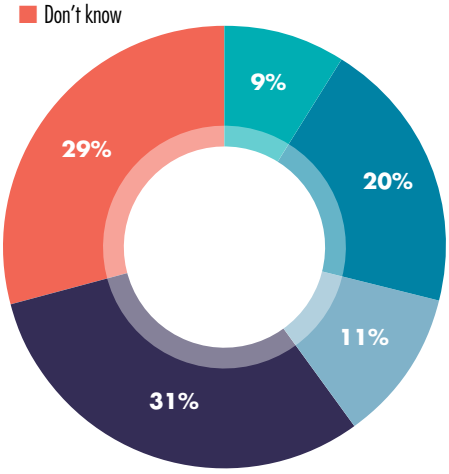
Types of automated liquid handling instruments used by survey respondents

Standalone	46%
Individual Benchtop Workstations	30%
Multi-Instrument System	22%
Other	2%

When asked which of the following procedures respondents used ALH systems, for they replied as follows:

Serial dilution	23%
Plate reformatting	14%
Plate replication	14%
PCR setup	14%
High-throughput screening	11%
Cell culture	6%
Whole genome amplification	4%
Array printing	1%
High-density array printing	0%
Other	13%

Nearly 38% of respondents plan on purchasing a new ALH system in the next year. The estimated budget ranges for these purchases are as follows



TOP 7 QUESTIONS

You Should Ask When Buying an Automated Liquid Handling System

1. What kind(s) of dispensing technology is used? Peristaltic pump dispensing offers low prime volumes and back-flushing; microprocessor- controlled syringes have fast output and high precision. Hybrid detection systems combine both technologies in one and can even add washing functions.
2. Is plate handling automatable? Manual plate handling can slow productivity. Automating the process with a compatible microplate stacker increases throughput with walk-away operation.
3. Can it accommodate magnetic or plastic bead-based assays? If using bead-based assays, it should be equipped with appropriate magnets or vacuum filtration for critical wash steps.
4. What is the volume range, and how many different sample vessel types may be used?
5. Ask about the software—is it integrated and user-friendly? Does it allow for pre-programmed and custom protocols?
6. What is the flow rate spectrum? A wide flow rate spectrum allows use with sensitive cell-based assays to viscous liquids.
7. What assay validation data is available for this specific liquid handler? This provides proof that the instrument performs as indicated.

TOP 10 FEATURES/FACTORS

respondents look for when purchasing an ALH system

SAFE SAMPLE HANDLING – NO CROSS-CONTAMINATION	68%
ACCURACY AND PRECISION FOR A WIDE RANGE OF COMPATIBLE FLUIDS	66%
MAINTENANCE / SERVICE / AVAILABILITY OF ACCESSORIES AND REPLACEMENT PARTS	59%
PRICE	52%
RAPID THROUGHPUT	42%
PIPETTING FLEXIBILITY – PIPETTE WITH 384, 96, 24, 16, 12, OR 8 TIPS	41%
MAXIMUM OPERATOR SAFETY	40%
SAMPLE TRACKING – AUTOMATED RECORDING AND SAMPLE DATA DOCUMENTATION WITH A CHOICE OF BAR CODE READER OPTIONS	30%
ABILITY TO EXPAND ON INSTRUMENT AS REQUIREMENTS CHANGE	23%
SIZE - SMALL FOOTPRINT	21%

For more information on automated liquid handling systems, including useful articles and a list of manufacturers, visit www.labmanager.com/liquid-handling

ARE YOU IN THE MARKET FOR A... LABORATORY SHAKER?

The wide variety of lab-shaker designs on the market reflects the increasing diversity of scientific experimentation. Labs now use a greater range of sample sizes than ever before, from liters to microliters. And while replicate and combinatorial studies increase the number of samples, requirements for environmental control create yet a third dimension that shaker designers must consider.

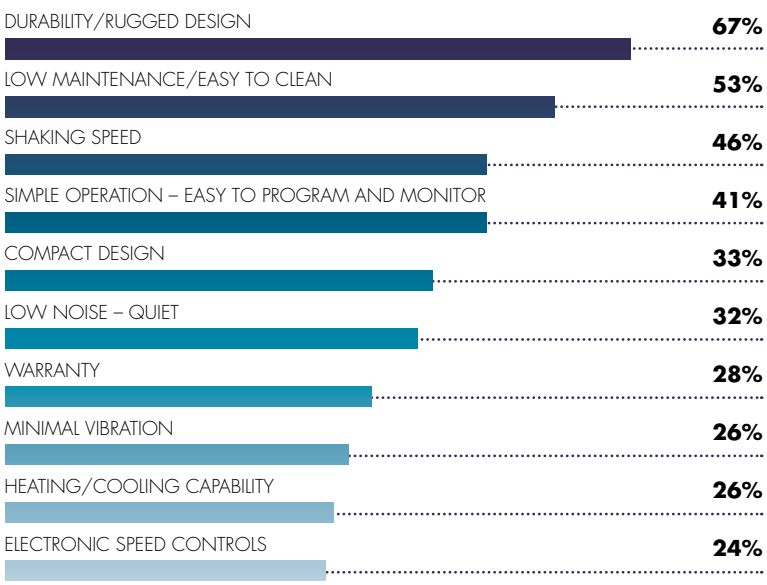
TOP 5 QUESTIONS

You Should Ask When Buying a Laboratory Shaker

1. What is the capacity of the unit (both for total weight and volume)
2. What accessories are available?
3. What is the RPM range and what increments can it be controlled in?
4. What are the temperature and humidity operating conditions for the unit?
5. What programming functions, if any, does the unit have?

TOP 10 FEATURES/FACTORS

respondents look for when purchasing a laboratory shaker



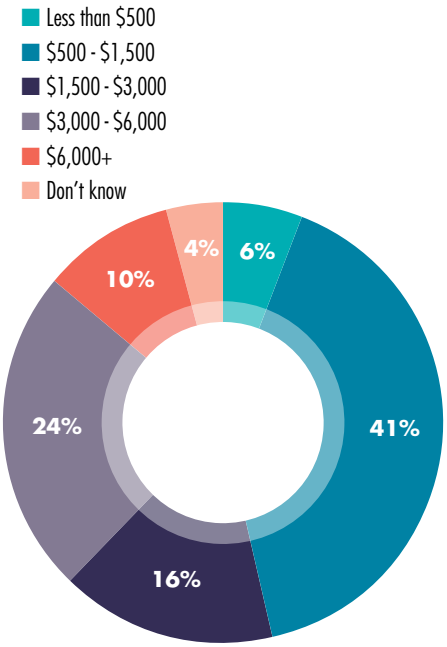
Type of laboratory shakers used by survey respondents

Vortex shaker	24%
Orbital shaker	18%
Incubator shaker	17%
Rocking shaker	17%
Vibrating shaker	10%
Biological shaker	6%
Reciprocal shaker	5%
Nutating shaker	3%
Other	1%

Number of hours per day shaker is in operation.

less than 1 hour	25%
1 - 3 hours	26%
3 - 5 hours	11%
5 - 7 hours	9%
>7 hours	29%

Nearly 27% of respondents plan on purchasing a new laboratory shaker in the next year. The estimated budget ranges for these purchases are as follows



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

SIMPLIFYING YOUR APPROACH TO ANALYTICS

Problem: There has been an explosion in the growth of information. So much growth, that traditional informatics solutions are no longer sufficient. The labs of today, and most certainly the labs of tomorrow, need new tools to gather the data generated, make sense of it and turn it into actionable knowledge.

We all understand the potential value of analytics, but implementing new solutions and making them work can be a daunting undertaking. Add in the new demands of the consumerized, mobile-driven world, and labs have to rethink how they manage operations. Lab managers know it's time to make a systems change, but they struggle to identify the benefits that will justify the financial investment, and the transition from legacy systems and their methodologies.

Solution: Informatics solutions all promise to make your lab smarter and more efficient, but they don't all deliver on that promise. In order to adequately assess the features of various platforms, it is essential to evaluate how a potential purchase will enable interoperability, prepare you for future demands and changes, and impact your end-users. There are three fundamental questions that can help simplify the process and keep the larger picture in focus.

Are you investing in an open system?

Connectivity and interoperability are critical in the modern marketplace. New solutions that operate as "islands" are of little or no value to today's labs or the labs of the future. The technology needs to be based on open standards and be accessible by all stakeholders, possibly even other vendors, from anywhere at any time. This will not only streamline your workflow, reducing redundancies and the chances for error, it will make you more appealing to customers who are looking to partner with a lab that can connect easily to their other vendors or their own internal technology solutions.

Are you future-proofing your lab?

Don't just look at an informatics solution through the lens of today. You need to consider the future. Legacy platforms tie you down to one way of doing things. What you need is the flexibility to grow and evolve as needs and technology change. No one can predict with 100 percent certainty what labs 15 years from now will need in order to work faster, smarter, and deliver better results, but you want to position yourself to best meet the challenge of those future demands. Transitioning to a new informatics solution is a significant investment, both financially and in the hours it takes to train staff and integrate equipment. You want to be able to look back years down the road and see that it was time and money well spent.

What will an informatics solution do for the end-user?

As mobility fosters an increasingly connected world, more and more people are going to want access to the data your lab is generating and they likely won't be accessing that information from inside your headquarters. They could be hundreds, if not thousands of miles away, using their phone or tablet to tap into your network.

In healthcare, a push toward personalized medicine indicates patients will increasingly want direct access to their medical information and lab results. As forensics labs continue to take advantage of remote access capabilities, there will be an even greater push for information on demand. These are just a couple of examples. Across all industries using informatics, anyone with the responsibility to read and act on results will no longer have to stand next to a machine in the lab to get that information. Information-on-demand will be the name of the game and labs will have to step up to ensure they can deliver if they want to stay competitive.

To this end, information must be presented in an intuitive and easy-to-digest way. Remember, not everyone reading the data will have an advanced degree or understand highly technical reports. Informatics solutions must process the data and export it in a format that is easy for the end-user, whoever that may be, to understand and act upon.

For more information, visit www.Starlims.com

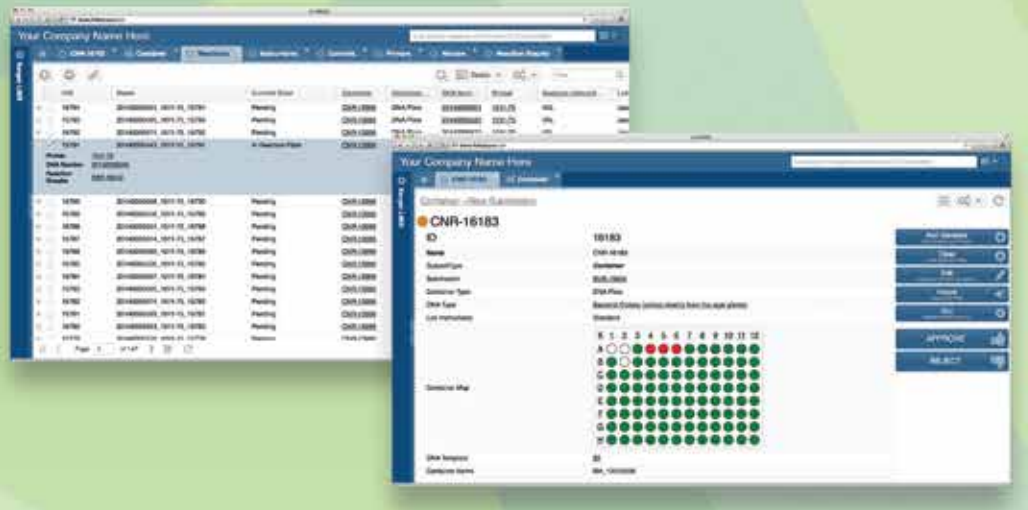
Abbott's informatics solutions are available on various devices, including the ones pictured here.

RuRo

Laboratory Information Bliss™

Limfinity®

Information Management System



Limfinity® presents a unique opportunity for Life Science organizations to comprehensively gain control of program work and data. What makes Limfinity® different is its methodology - Limfinity® tools put the powers of configuration, deployment, extension, general administration of one of the most advanced Information Management Systems available today in the hands of admin customer staff, with or without IT expertise.

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RNase H-DEPENDENT PCR—FOR DETECTION OF RARE OR VERY SIMILAR TRANSCRIPTS

Problem: PCR is used to detect or quantify nucleic acid sequences in research and diagnostic settings. While high specificity is often achieved, experimental design sometimes necessitates that primers be placed in suboptimal locations. This can lead to problems like the formation of primer dimers or off-target amplification of homologous sequences. The formation of primer dimers consumes primers and other reaction components, which can result in reduced target amplification. These structures can also generate false positive signals in real-time PCR assays that use DNA intercalating dyes to monitor amplification. Off-target amplification is particularly problematic with low copy-number targets because of the high number of cycles required for amplification and in multiplex assays, where many different primers must function well together.

Solution: To eliminate primer dimers and increase PCR specificity, scientists at Integrated DNA Technologies have developed a novel method called RNase H2–dependent PCR (rhPCR), which uses a thermophillic RNase H from *Pyrococcus abyssi* and blocked primers that include a single RNA base (Figure 1A).[1] Little to no modification of reaction temperatures, cycling times, or analysis procedures is required for integrating the RNase H2 enzyme into current end-point and quantitative PCR protocols (using either 5′ nuclease fluorescent probes or intercalating dyes for detection). The rhPCR primers are designed to contain an RNA residue and are modified (usually with a C3 spacer) at or near the 3′ end of the oligonucleotide to "block" extension by DNA polymerase. During the annealing step of rhPCR, RNase H2 recognizes and cleaves the RNA:DNA base pair in the primer:target hybrids. Cleavage occurs at the 5′ end of the RNA base, leaving a 3′ hydroxyl on the prior DNA base of the primer. This cleavage removes the RNA base and blocking modification, so the unblocked primers are available to support extension in the next stage of the PCR cycle.

rhPCR primers provide improved specificity when compared to unmodified primers through two main mechanisms. First, the unblocking step is sensitive to correct base pairing and will be inhibited by the presence of a base mismatch in the vicinity of the cleavage site. This RNase H specificity minimizes subsequent off-target amplification of closely related sequences by DNA polymerase.[2–3] Second, the unblocking reaction requires hybridization of the modified primer to create the RNA:DNA duplex. Together, these requirements prevent template-independent reactions, such as the formation of primer dimers (Figure 1B).

rhPCR amplification technology can facilitate many applications, including:

- SNP genotyping—discrimination of closely related genes due to high specificity of blocked-cleavable primers
- Detection of rare alleles—detection of rare alleles in a background of high levels of wild-type DNA due to high specificity of blocked-cleavable primers
- Highly multiplexed amplification—reduction of primer dimer formation among all oligonucleotides
- Next generation sequencing library construction—reduction of library contamination with primer dimer "blank reads"

For more information, visit www.idtdna.com (Products > Genotyping > RNase H–Dependent PCR).

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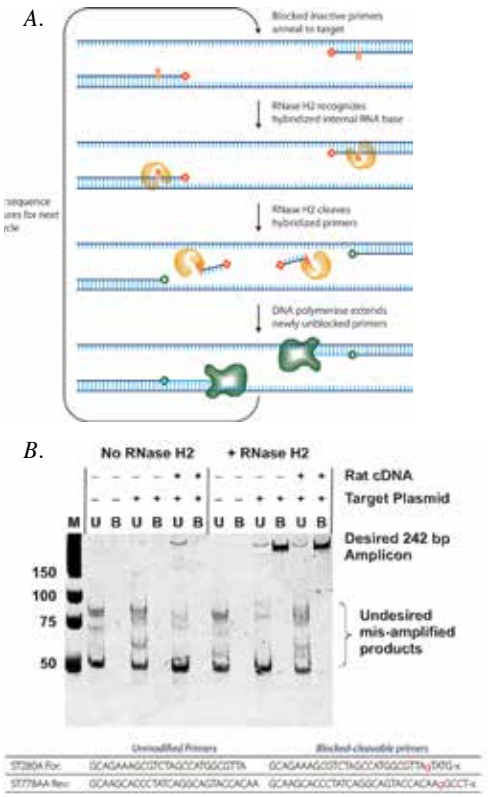
3. Boucard AA, *et al.* (2014) Latrophilins function as heterophilic cell-adhesion molecules by binding to teneurins: Regulation by alternative splicing. J Biol Chem, 289(1):387–402.



▲ *Figure 1. schematic and representative results from RNase H-dependent PCR (rhPCR). A: rhPCR uses blocked primers that become activated by cleavage with thermophilic RNase H2 after primer-template hybridization. B: Elimination of primer dimers in a PrimeTime® assay (target: HCV) using rhPCR. M — electrophoresis gel marker; U — unmodified primers; B — blocked-cleavable primers. CAGT = DNA, g = RNA, and x = C3 spacer (blocking group).*

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Modern Business Transformation Begins in the Lab

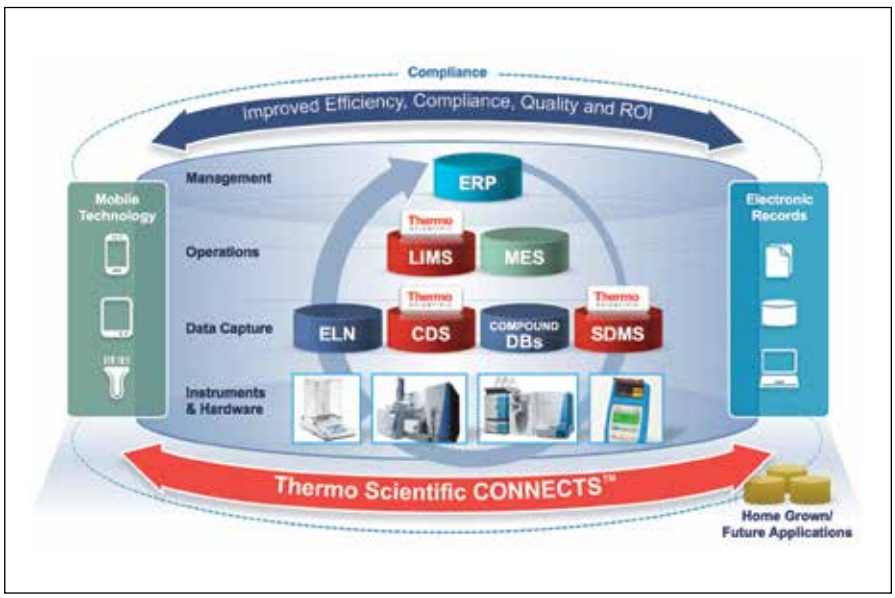
By Kim Shah, Thermo Fisher Scientific

Transform your business before it's transformed for you. This sentence speaks to the hard realities businesses face today. From geopolitical and economic macro trends to global threats to health and the environment, businesses now face unprecedented—and increasingly more unpredictable—challenges. Without pre-emptive strategies to combat these headwinds, some businesses risk slowing growth or, even worse, failure.

To thrive in an environment of constant change, companies must rethink how they address R&D investment, international expansion, human resources and other critical drivers of growth. Fortunately, many elite enterprises have spent years investing in new technology and processes that, at least in theory, position them for growth. Yet all this investment may be worthless to some companies if they fail to strategically align non-integrated, often dissimilar resources in ways that enable maximum responsiveness. And for science-based companies relying on laboratory data for management metrics, a great place to start doing this is in the lab.

Many labs are now discovering that advanced instruments with greater and greater sensitivities and accuracies are only part of the advancing technology equation. Mobile and cloud computing technologies, for example, are driving equally important changes that dramatically increase business velocity, but also lower barriers to entry, encouraging and equipping new entrants. While technology is undeniably an enabler, it's also a catalyst of equal opportunity, spurring competition that places even more pressure on CIOs and IT teams to stay ahead of the curve.

While the role of new technology is clearly understood, the importance of data is often underappreciated. Nonetheless, it's now the new currency of business, and nearly every business, especially one with a high-throughput lab, must have a plan to manage it. True business transformation—the kind that enables rapid response to competitive threats and market externalities, is inescapably linked to effective data management. A laboratory may have the latest instruments and information technology infrastructure in place, but winning the instrument arms race or having a mature ERP system is certainly a false security if



By automating the lab and bridging those islands of data, you gain time and cost savings, as well as access to real-time information that can be used across the enterprise.

data management isn't world class as well. Without full transparency into laboratory operations and outputs, there are no early warning systems and, even worse, no visibility into what's possible.

What's needed is more agile decision-making, informed by data that can be represented enterprise-wide. This is why best-in-class enterprises regard a Laboratory Information Management System (LIMS) as much more than just a data management or even a workflow solution for the lab; when utilized to its fullest potential, a LIMS becomes an operating system for enterprise-wide knowledge sharing and an enabler of business transformation.

> While the role of new technology is clearly understood, the importance of data is often underappreciated.

Since LIMS are tightly integrated with other enterprise systems, insights from the lab can—and must—be central to any business that seeks true enterprise-wide agility. Smart businesses don't simply capture and collect data; they are making data actionable across the enterprise, putting management in a position to operate their companies as flexible organizations. This means they're capable of responding quickly to market trends or new regulations and agile enough to identify and capitalize on cost-saving or margin-growing opportunities in the future.

Four Pillars of Transformation

For the agile enterprise, one that is truly business-transformation ready, there are four drivers: integration, innovation, automation and business intelligence. The good news is that many companies already have some facet of these already in place, so final alignment is less burdensome than most realize. But the time to get started is now.

- Integration – When people, processes, technology (and data) are stuck in silos, business agility is impossible. True visibility—to inform business decisions—is only possible when an executive dashboard is built from comprehensive, near real-time data in open digital formats.
- Innovation – From accelerated drug discovery to more efficient ways to manufacture product, liberating laboratory data in dashboard form can be a new catalyst for continuous change. And the ability to recognize and exploit pathways for innovation is as much cultural as it is process-oriented.
- Automation – Automating time-consuming tasks such as instrument calibration, compliance, user training and maintenance liberates more time for science, investing this perishable intellectual capital back into business transformation.
- Business Intelligence (BI) – In many enterprises, if a manager or executive wants to see laboratory progress or productivity reports, the IT department has to step in. Today, however, thanks to more mature BI approaches enabled by cloud computing, lab personnel can create real-time dashboard reports that are accessible to managers and executives 24/7 via desktop, tablet or mobile devices.

> Smart businesses don't simply capture and collect data; they are making data actionable across the enterprise, putting management in a position to operate their companies as flexible organizations.

These four pillars provide a technological roadmap to build a business transformation-ready organization. The first step is to liberate information that is often isolated in laboratories where it does little good. Once that lab data is free to circulate across the organization, employees at every level are empowered to do more with vast stores of knowledge and apply it in innovative, new, and optimally, more profitable ways. When all four of the drivers listed are in sync, business transformation isn't just an aspiration anymore—it's a reality.

Kim Shah is the Director of Marketing and New Business Development, Informatics, Thermo Fisher Scientific.

For more information, please visit www.thermoscientific.com/informatics or contact marketing.informatics@thermofisher.com.

CO_2 INCUBATORS

DISINFECTION AND CLEANING ARE THE KEYS TO HAPPY CELLS

by Rachel Muenz

CO_2 incubators are the heart of cell-based work in many labs. When they stop, work in the lab stops. Yet, these units are often ignored—until disaster strikes.

"As long as the incubator's running smoothly, it's kind of the end of the sentence—you put your cells in there and that's that," says Mary Kay Bates of Thermo Fisher Scientific (Waltham, MA). "Suddenly, when the incubator has a problem, everything stops because everything depends on the cells growing and if the cells aren't growing, then you can't do much else until you get that fixed. That's where routine maintenance of the incubator is really so important."

Not doing regular maintenance can also turn a high-quality incubator into a bargain one, according to Uwe Ross, president of BINDER Inc. (Bohemia, NY).

"People do all kinds of research before buying a CO_2 incubator, but they could have bought the cheapest piece of garbage because that's what they have now," Ross says of what can happen when users don't look after their incubators.

Luckily, a few key maintenance tasks can keep CO_2 incubators running smoothly. Ross says two main ones are calibrating the unit at least once each year and making sure the door is closed. Half of incubator problems are caused by the door not closing correctly. To those, Bates adds users should make sure they change the water completely at least once a week and that they clean and disinfect the unit regularly, as both of these steps will help prevent contamination. Researchers should also take extra time to take a close look at their cells since any signs that cells aren't healthy could be signals that something is wrong with the incubator, she adds.

Bates says that one common mistake users make is to use highly pure water rather than sterile, distilled water.

Water types such as deonized or highly pure Type I "have few ions so they will actually pull ions from the materials in the incubator like the stainless steel and, over time, that will cause corrosion," she explains.

Using bleach to clean and disinfect incubators is another mistake.

"Bleach can also corrode incubator components but, more than that, the fumes can make the cells sick, so we recommend only a quaternary ammonium disinfectant," Bates explains. To those issues, Ross adds that many users forget to change the HEPA filters on incubators that use them.

"People forget the next step," he says. "It's not as if particulates go through the filters and are gone—they're still there." Ross says that filters should be changed every six months or so and adds that a good way to avoid cross-contamination is to change the filters and clean the incubator between experiments.

▲ Making sure your CO2 incubator's door is closed properly is very important to keep it running at optimum levels.

▲ When placing your incubator in the lab, make sure you keep it away from sunny windows or A/C vents.

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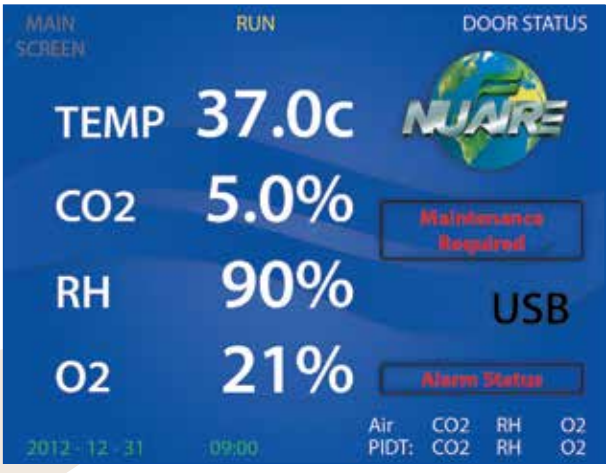

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Incubator placement is also important. Ross says users should avoid placing the incubator in a sunny window or near an A/C vent and make sure the surface the incubator rests on is kept clean to avoid contamination issues.

Users need to perform regular maintenance themselves to keep their incubators operating properly, but, depending on the applications, a service plan can help.

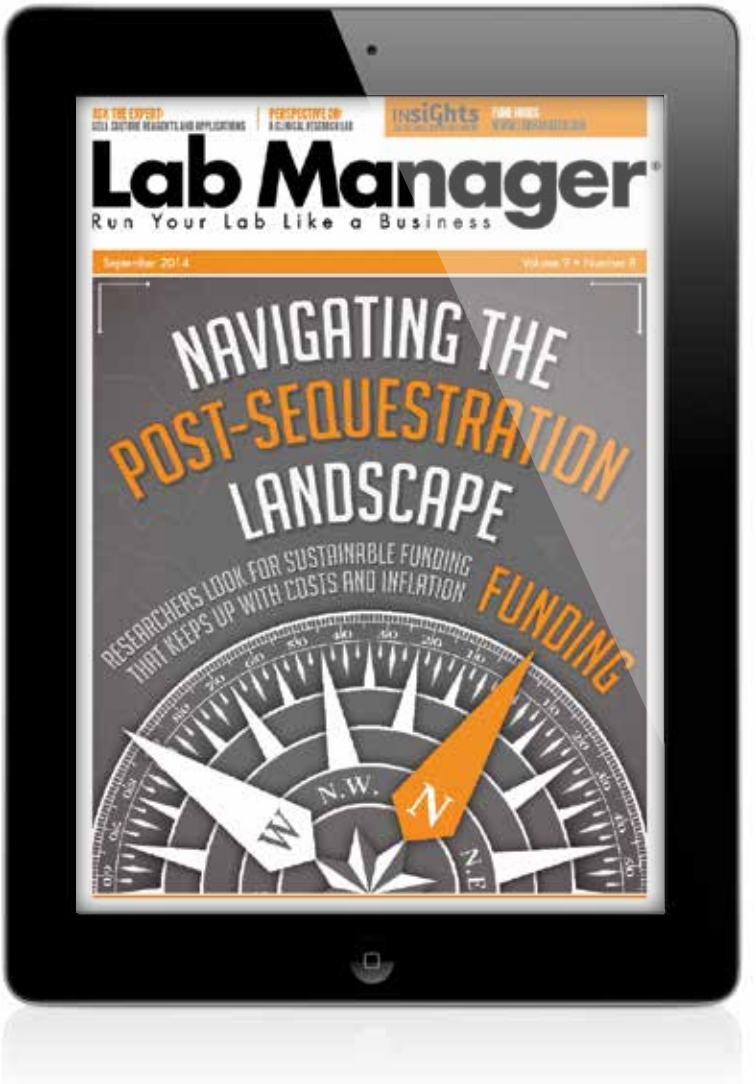
Ross says that often users are concerned with the added costs associated with getting a service plan, but bigger problems and costs are incurred if, for example, the unit's sensors aren't working properly.

"How much is it worth for what you're doing?" Ross asks users, adding that most people see maintenance as something to be done after the incubator breaks. However, if the unit isn't calibrated or serviced regularly, the incubator isn't providing ideal conditions and any experiment results will be inaccurate. "It's not about a breakdown; it's about how reliable your research is."

Be sure to check back with our Maintenance Matters column next month, as we share tips on how to best look after your pipettes.

OTHER CONSIDERATIONS:

- A handheld infrared (IR) CO_2 tester is usually a good thing to have for incubator maintenance, though these testers must be calibrated once a year and some of the newer incubators have IR CO_2 sensors that are more accurate than handheld IR sensors
- User's manuals, sales teams, application notes, and the manufacturer are all good resources to consult about incubator maintenance
- Things to look for in your cells: Do the membranes look nice and tight? Are they peeling up at all? Are there vacuoles in the cytoplasm? Do you see crystals around the nuclear membrane? All of those are signs that something's not right with the growth conditions and you may want to check the incubator



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SERIAL DILUTION IN 96- & 384-WELL MICROPLATES

INTEGRA has introduced a **Row Dilution Plate Holder** accessory for its VIAFLO 96 and 384 handheld benchtop pipettes.

The new row dilution plate holder adds the functionality to perform serial dilutions in rows. Serial dilutions are often carried out in row format because it allows experimenters to dilute more samples (12 instead of 8 in a 96-well plate). The plate holder can easily be adapted to work with either 96 or 384 well plates. An instructional video demonstrating the new product may be seen at http://youtu.be/Pg-Z2fNLhG3c

Serial dilution of assay components is a key technique in drug discovery and life science research. In assay development, serial dilution can be used to determine appropriate concentration ranges, in secondary screening to evaluate pharmacological response, and in early ADMET studies to determine toxicological effects. The ability to accurately and reproducibly produce dilution curves is essential to improving assay throughput and quality. Serial dilutions are also regularly used in microbiology when, for instance, initial concentrations of bacteria are orders of magnitude too high to perform a plate count.

The VIAFLO 96/384 offers high sample throughput without a robot. It is a handheld bench top pipette, capable of 96- and 384-well pipetting with a choice of various pipetting heads. The VIAFLO 96 benchtop electronic pipette offers an affordable solution to increase productivity when working with microplates. It closes the gap between traditional manual

pipettes and robotic systems, allowing for accurate and reproducible 96-channel pipetting. The VIAFLO 384 is a more advanced system, which can work with both 96- and 384-channel pipetting heads to maximize productivity. It features the same footprint and intuitive user concept as VIAFLO 96.

For further information on the VIAFLO 96/384 please visit www.integra-biosciences.com/sites/96_384_channel_pipette.html or contact INTEGRA Biosciences in Europe / Asia on telephone +41-81-286-9530 / email info@integra-biosciences.com or in North / South America on telephone +1-603-578-5800 / email US@integra-biosciences.com.

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HIGH THROUGHPUT SCREENING OF NOVEL PROTEIN THERAPEUTICS

Integrating an **INTEGRA VIAFLO 96 multi-channel pipette** into their high throughput test facility has enabled **Molecular Partners** (Zurich, Switzerland) to streamline the discovery and development of a novel class of targeted protein therapeutics termed DARPins.

DARPins are as target specific and potent as monoclonal antibodies. Yet, being small proteins, they overcome the known limitations of conventional protein-based therapeutic approaches. The exceptional potency and target specificity of DARPins gives them the potential to surpass existing antibody drugs and revolutionize protein therapeutics.

Andreas Lehmann, an Expert Technical Assistant working in Molecular Partners high throughput text facility commented "Our lab is extremely satisfied with our decision to purchase and incorporate INTEGRA's VIAFLO 96 into our development protocols. The main application we are using the system for currently is protein purification using IMAC (Immobilized Metal Affinity Chromatography). The VIAFLO 96 is used for various steps in the process starting from the preparation of bacterial cultures right through to the actual purification. Overall our protocol involves 63 full plate liquid transfers; such a workload would not be feasible with a traditional handheld multichannel pipette. We have found that the VIAFLO 96 is easy to integrate into our standard operating protocols because parameters can be defined: pipetting mode, volume, pipetting speed, pipetting height and processes automated. We particularly like the repeat dispense function on the VIAFLO 96 as it saves the lab a lot of time and improves the overall reproducibility of tests as all samples processed at the same time in the same way".

Mr. Lehmann added "Being responsible for new staff, I also appreciate that the VIAFLO 96 is user friendly and intuitive to use because very little training is required".

The INTEGRA VIAFLO 96 is a handheld 96-channel electronic pipette that has struck a chord with scientists looking for fast, precise and easy simultaneous transfer of 96 samples from microplates without the cost of a fully automated system. The VIAFLO 96 was designed to handle just like a standard handheld pipette - a fact borne out by consistent end user feedback that no special skills or training are required to operate it. Users immediately benefit from the increased productivity delivered by their VIAFLO 96. Fast replication or reformatting of 96 and 384 well plates and high precision transferring of reagents, compounds and solutions to or from microplates with the VIAFLO 96 is as easy as pipetting with a standard electronic pipette into a single tube. Four pipetting heads with pipetting volumes up to 12.5 µl, 125 µl, 300 µl or 1250 µl are available for the VIAFLO 96. These pipetting heads are interchangeable within seconds enabling optimal matching of the available volume range to the application performed.

▲ *VIAFLO 96*

◀ *Andreas Lehmann of Molecular Partners*

For further information please visit www.integra-biosciences.com/sites/96_384_channel_pipette.html or contact INTEGRA Biosciences in Europe / Asia on telephone +41-81-286-9530 / email info@integra-biosciences.com or in North / South America on telephone +1-603-578-5800 / email US@integra-biosciences.com.

Molecular Partners (www.molecularpartners.com) is a privately owned biopharmaceutical company that is pioneering the development of novel DARPin based protein therapeutics. Molecular Partners is developing a broad and differentiated pipeline based on DARPin products to treat diseases in oncology, immunology and ophthalmology. The proprietary pipeline of Molecular Partners is complemented by programs developed in collaboration with leading pharmaceutical companies.

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LABCONCO'S TRIAD FREEZONE FREEZE DRYERS USED IN NANOTECHNOLOGY RESEARCH

Biological applications such as bioimaging, cancer treatment, tissue engineering and optical coding are just a few ways nanomaterials are being used in the lab today. Unfortunately, factors of nanoparticles, such as internal collisions with molecules, thermal motion, and gravitational forces affect the physical stability of nanoparticles making them difficult to work with in clinical applications or materials science. Lyophilizers, or freeze dryers, are used to increase the long term stability of nanomaterials and make nanomaterial development easier. When selecting a lyophilizer for nanoparticles it is important to remember that nanoparticles can be difficult to freeze dry and may require extreme conditions in a lyophilizer.

Freeze drying requires three steps: pre-freezing, primary drying and secondary drying. When formulating nanoparticles, you must determine the correct types of bulking agents, stabilizers and lyoprotectents that work with your specific nanoparticles of interest. Certain processes of freeze drying, such as pre-freezing and sublimation can destabilize nanoparticles, so the above factors are important to consider prior to lyophilization.

Pre-freezing involves freezing the sample prior to pulling a vacuum to prevent loss of sample and ensure proper lyophilization. Once the samples are frozen, primary drying begins by adding controlled heat to the samples through the shelves and pulling a deep vacuum with exposure to a very cold condenser. Frozen water molecules will sublimate or leave the sample and collect in the coldest spot in the closed system. For best results, we recommend setting the shelf temperature 3° to 5°C below the sample's collapse temperature for primary drying. During primary drying, 92 - 93% of the moisture is removed. A crust forms at the sample surface and heat is required to drive out the residual moisture remaining in the sample.

Secondary drying begins when the only water molecules remaining are the unfrozen ones that are bound to the sample. To release these bound water molecules, heat is required to break the bonds. After the moisture in the sample is reduced by another 5%-6% secondary drying is complete and the samples can be stoppered under vacuum or nitrogen for long term storage if desired. The small size of the nanoparticles makes it is hard to predict their properties under varying conditions. Because nanoparticles can be very challenging to freeze dry, they require a sophisticated freeze dryer that can provide a wide temperature range in the sample shelves and condenser.

The Labconco Triad Freeze Dry System has a 2.5L collector condenser that reaches -85°C, which can handle some solvents such as chloroform. The shelves can pre-freeze to -75°C and during primary drying can go as low as -55°C. These deep temperatures are not reached on standard freeze dryers and are often utilized when a sample is difficult to freeze dry or has solvents in the sample.

Once a freeze drying protocol has been developed, the Triad's microprocessor controlled temperature programming with 5 user set programs and 6 segments per program make freeze drying a simple, one button operation. After the freeze dry run is complete, the Triad can be backfilled with nitrogen or simply remain under vacuum as the samples are stoppered with the single, stoppering shelf ensuring long term sample stability. The Triad can accommodate up to 196 x 10ml samples per run.

Nanomaterials offer so many promising breakthroughs in science and prove to researchers that face the challenges of handling them, that smaller is not always easier. However, the Labconco Triad has the features and versatility to make freeze drying the most challenging samples easy.

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Every year countless measurements are performed at testing labs worldwide. These tests may include stability testing to ensure the shelf-life of a pharmaceutical product, microbiological testing to ensure the safety of food products or environmental testing to monitor the quality of drinking water, to mention just a few.

Labs have to critically assess their ability to perform these measurements, as inaccurate measurements could lead to potential legal action and possible loss of accredited status, customers and revenue.

One of the most useful tools available to assess the lab's ability to perform these measurements is regular participation in a proficiency testing program. Proficiency testing provides an opportunity for labs to receive an independent appraisal of their data compared against a reference value and the performance of peer labs.

Proficiency testing, in simple terms, comprises a sample sent to a group of labs for measurement. The participating labs know what might be in the sample, but they don't know exactly what is there or the concentration. Participating lab results are compared with the known or true value of the sample and/or the study mean. The lab is assigned a "Z" score to show how closely their result came to the target.

The most common use for proficiency testing is to demonstrate to a regulatory body or an accreditation body, that a lab is capable and competent to perform a specific analytical test or technology. A second and sometimes overlooked benefit of proficiency testing is as a critical tool for quality assurance and continuous improvement. Proficiency testing performed over time can give a lab a true picture of their testing quality, identify and realize continual improvement opportunities and help avoid non-conforming test results.

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The NuTouch Electronic Control System is a user-friendly color touch screen available in English, Spanish, German, and French. The touch panel permits operator entry of data, designed to service the precise control requirements of the chamber environment providing optimum programmable conditions for culture growth, operating control parameters, and status indicators. On-screen descriptions are available to clarify unknown parameter icons. Step-by-step directions aid users through procedures such as calibration and how to run a sterilization cycle.

A microprocessor-based, non-dispersive, single source dual wave infrared (IR) sensor controls CO_2 levels within the chamber. The wavelengths used are absorbed by only CO_2 making the measurement insensitive to other components such as water vapor. Advanced design provides a very stable output minimizing drift and requiring less frequent calibration.

Chamber walls are heated directly by heating elements on all six (6) sides of the growth chamber providing superior temperature uniformity. Dual temperature sensor probes monitor the growth chamber environment making necessary changes when needed. High-density insulation with a high "R" rating covers the complete outer surfaces of the incubator inner chamber.

Two heated sterilization cycles can be selected to eradicate contaminating agents. The chamber will heat up to 95°C humidified decontamination or 145°C dry sterilization.

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* Laboratory testing shows that, when cleaned regularly, *CuVerro®* antimicrobial copper surfaces kill greater than 99.9% of the following bacteria within 2 hours of exposure: MRSA, *Staphylococcus aureus, Enterobacter aerogenes, Pseudomonas aeruginosa, and E. coli O157:H7*. *CuVerro®* antimicrobial copper surfaces are a supplement to and not a substitute for standard infection control practices and have been shown to reduce microbial contamination, but do not necessarily prevent cross contamination; users must continue to follow all current infection control practices, including those practices related to cleaning and disinfection of environmental surfaces EPA Reg No 85353-5, EPA Est No 088257-MN-001.

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PARTING POINTS

Takeaways from this month's issue:

NAVIGATING THE POST-SEQUESTRATION LANDSCAPE

Job satisfaction and morale among researchers relying on government grants were body slammed by the sequestration. Currently, researchers are concerned with:

- The increased congressional scrutiny of grants
- The challenge of Congress working to achieve consensus on research funding
- Nondefense discretionary funds being at the lowest they've been in 60 years
- The brain drain of American scientists leaving for opportunities overseas

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THE EIGHTH ANNUAL SALARY & EMPLOYEE SATISFACTION SURVEY

Though it seems that little has changed for many of our 1,199 survey respondents, when we revisit the results of earlier surveys, it appears that the demographics of the scientific workplace may be changing. Main changes shown in the results were:

- Management responsibilities appear to be increasing among lab professionals
- A noticeable reduction in the numbers of new researchers
- Hiring may be on hold for many labs
- Baby boomers remain the primary earners and are not retiring as quickly as predicted

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MAKING DATA MEANINGFUL

Despite today's enormous amount of data, there is a shortage of knowledge and infrastructure, meaning that lots of companies are having challenges accessing the data they need. As a result, major trends in informatics now include:

- Increased flexibility in terms of what to present to whom and in what form
- The continuing evolution of thin-client technologies
- Increased productivity from informatics systems
- Labs developing strategies to harmonize, globalize, and standardize their technology

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ASK THE EXPERT: CELL CULTURE REAGENTS AND APPLICATIONS

Geoffrey Bartholomeusz, PhD, associate professor in the Department of Experimental Therapeutics and director of the siRNA Core Facility at the University of Texas MD Anderson Cancer Center, discusses the growing interest in replacing some 2D cell culture applications with 3D cell cultures. He covers:

- Why scientists are advocating the switch from 2D to 3D cell cultures
- How he started using 3D cell cultures and what that change involved
- The advantages of 2D over 3D
- Steps to setting up a 3D cell culture screen

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PERSPECTIVE ON: A CLINICAL RESEARCH LAB

Having a positive impact on the world is a big perk to working at Redbiotec AG, a biotechnology company near Zürich, Switzerland. The company's chief technology officer and business development manager share:

- An overview of the lab's work in developing vaccine candidates
- The challenges and best parts of working at Redbiotec
- The role of the company's rePAX assembly and protein expression platform
- How the renewed interest in vaccines is fueling innovation in the field

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