Lab Manager MAGAZINE
Run Your Lab Like a Business

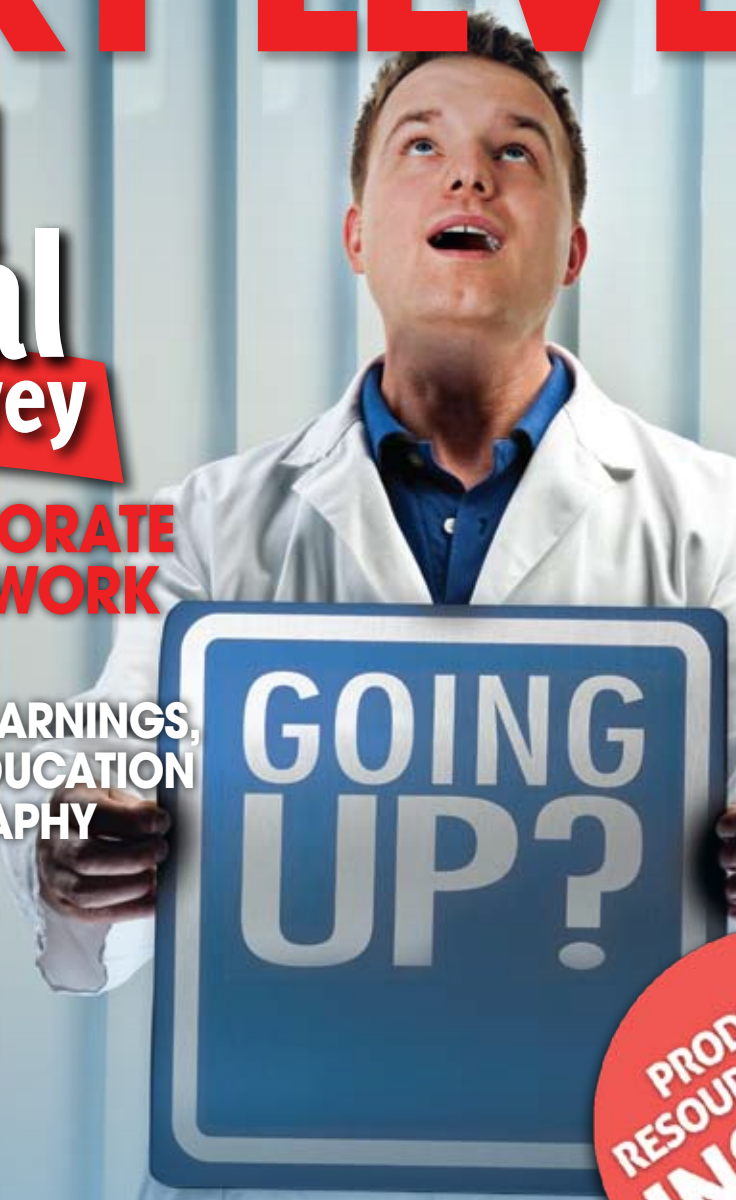
November 2009 Volume 4 • Number 9

TAKING YOUR CAREER TO THE NEXT LEVEL

Third Annual Salary Survey

WAGES, CORPORATE CULTURE, LIFE-WORK BALANCE

AN OVERVIEW OF EARNINGS, INDUSTRIES AND EDUCATION BASED ON GEOGRAPHY



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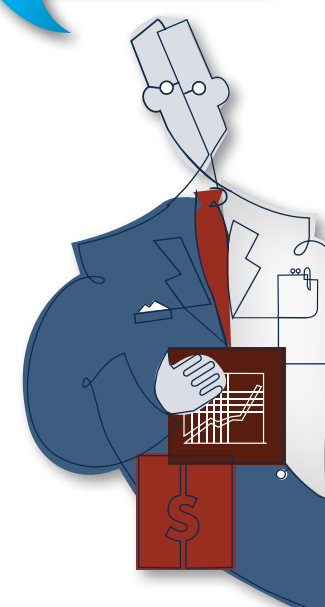

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Job satisfaction

What makes us happy at our jobs is obviously a combination of many factors. But, according to our 2009 *Lab Manager Magazine*– Kelly Scientific Third Annual Salary and Employee Satisfaction Survey, after salary and benefits, criteria for happiness include life/work balance, autonomy and respect. What's remarkable about the scientific professionals who participated in the survey is that their job environments in no way resemble the cubicle-type existence represented in cartoons like "Dilbert" or the television show "The Office." Labs are clearly different and happily so. There are very few complaints about mundane tasks or even bad managers. Something about doing science seems to provide most with intrinsic job satisfaction.

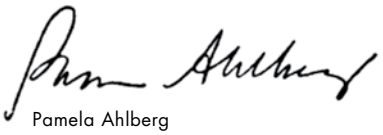
This is not to say that all is rosy. When it comes to opportunities for career growth, many find those lacking. For you, this month's feature article provides some straightforward suggestions. According to the author, the first step to career growth is mapping out a strategy. The basic principle of most self-improvement messages applies here as well—before you can be where you want to be you need to have a clear picture of where that is. Then just move toward it—step by strategic step.

In addition to keeping an eye on your own career, managers must pay attention to the happiness and satisfaction of their staff. For that, Ron Pickett in this month's Leadership & Staffing article offers practical suggestions for motivating your team. One surprise is his advice to fire people. "Managers tell us that this has a big impact on the rest of the staff and has not induced fear. Everyone knew that these poor performers … were having a negative impact on the rest of the staff and that the new manager had done the right thing."

This month's Business Management article makes a case for providing feedback to suppliers in order to help them develop core strengths and identify areas of improvement in manufacturing, delivery, pre- and post-sale support, and product development. Unfortunately, according to the author, most companies rarely solicit feedback. Which means it's up to you, the manager, to initiate contact.

I recently returned from a week's vacation in northern New Mexico. Good vacations can take us outside our normal situations and provide an opportunity to see things in a new and perhaps inspired light. New Mexico's mountains, sky and unique terrain did that for me. I hope a few of these articles can do that for you.

Kind regards,



Pamela Ahlberg
Editor-in-Chief

In the October 2009 issue we published an article by Gloria Metrick entitled "The LIMS Market." In the article, the company Thermo Fisher Scientific was mistakenly referred to as Thermo. We regret any confusion this may have caused. For more information please refer to www.thermo.com. Thermo Fisher Scientific is the world leader in serving science, delivering innovative solutions to the scientific community under two world-class brand names, Thermo Scientific and Fisher Scientific.

We also neglected to include Thermo Fisher Scientific in the October issue's LIMS suppliers list on page 37.

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Movin' Up

HOW STRATEGIC PLANNING CAN TAKE YOUR CAREER TO THE NEXT LEVEL by John K. Borchardt, Ph.D.

What is the next level for your career? The answer to this question will vary for different laboratory managers. For those who are happy where they are, it may mean becoming virtually indispensable in their current job assignments. For others, it's the next step up the laboratory management promotion ladder. This may or may not involve a transfer to another laboratory or a different department. Some lab managers may decide they need to change employers to take their careers to the next level.

"YOU HAVE TO KNOW WHERE YOU'RE GOING IN ORDER TO PLAN A ROUTE TO GET THERE."

Successfully taking your career to the next level is often like using a road map. You have to know where you're going in order to plan a route to get there. Your goals may be unchanged—to become vice president of research, for example. Or your goals may have changed, perhaps due to changes in life circumstances, such as getting married or having children. The need for change can arise from something as simple as boredom with your current job assignment. As a result, people's career goals tend to evolve throughout their lives. For example, the lab manager promoted from group leader to department manager may for the first time seriously consider becoming manager of the entire laboratory or vice president of research.

Skills assessment

To take your career to the next level, you can rely on luck or you can engage in strategic career planning.[1] The first approach doesn't often work well; the second does.

The first step in career planning is for lab managers to assess their skills and determine how best to capitalize on them. They should also do a skills gap analysis to determine what skills they need to acquire to take their careers to their chosen next level. The same approach is useful in becoming indispensable in one's current assignment. Lab managers should not rely only on self-assessment. Performance reviews with their supervisors can help them collect the skills information they need, as can discussions with mentors and highly trusted colleagues.

Another approach is to contact a career coach, though a coach's services are usually expensive and his or her advice can be of limited effectiveness if the coach is not a veteran of the laboratory environment. Laboratory managers taking this approach should be very careful in selecting a career coach. Some universities offer inexpensive career coaching services to their alumni. One's professional society may offer free career coaching to members. For example, the American Chemical Society does this. The more than 70 ACS volunteer career consultants also offer career advice, such as how to achieve that coveted promotion or increase job security. These career consultants come from a variety of technical fields and include current and former lab managers.

"CREATE OPPORTUNITIES TO DEMONSTRATE...THE SKILLS NEEDED TO EXHIBIT EXCEPTIONAL PERFORMANCE AT THE NEXT CAREER LEVEL."

Indeed, becoming a volunteer career consultant for others can be a step in taking your own career to the next

level. Some companies have positions in their human resources departments that focus on professional recruitment and serving the needs of current laboratory employees. Moving into management assignments in human resources can be a fulfilling career for lab managers with excellent interpersonal skills and an interest in this career direction. The ranks of ACS career consultants have included some who have chosen this direction in their own careers, including Dr. Joel Shulman (Procter & Gamble) and Dr. James Burke (Rohm and Haas).

"FOCUSING ONLY ON ROUTINE ASSIGNMENTS IS NOT THE WAY TO GET AHEAD."

Strategy development

After deciding the next career level they want to achieve, and armed with a skills assessment, lab managers should develop a strategy to gain the skills they need while more effectively utilizing current skills. Acquiring needed skills may require taking courses or a temporary assignment in which they can develop these skills. When they feel they have the expertise, they should have a discussion with their own manager to develop a strategy for reaching their next career level. Ideally, this discussion will result in an action plan. Mentors or professional society career consultants can also help lab managers develop this plan.

Executing the plan

Executing your plan comes next. Whatever one's current situation and career goals, the objective is to create opportunities to demonstrate that they have the skills needed to exhibit exceptional performance at the next career level. For example, should the manager desire to transfer to a business function, serving on one or more multidisciplinary work teams that include business managers can be an effective strategy. Discussions with one of your professional society's career consultants can also be useful in this regard.

Focusing only on routine assignments is not the way to get ahead. There is no better way to gain visibility within a company or organization than to undertake a high-risk assignment, complete it successfully and inform the appropriate people of your accomplishment. Of course, do your best to minimize the risks associated with these assignments. Carefully designing and staffing projects with motivated people who can get the job done is the best way to do this. Also, work through appropriate company channels. Don't be a loose cannon by taking on major assignments on your own without appropriate authorization.

Should a high-risk project fail, others must see that you performed in a highly competent manner, doing everything possible to ensure project success. Monitor progress closely during the course of the project and keep all concerned parties informed. This way people will know about problems as your team encounters them. They can offer help and resources and won't have unreasonably high expectations of success. You should also recognize the signs of impending failure and take steps to terminate a failing project in a way that minimizes the time, effort and money spent on it.

If your high-risk project does fail, ask yourself the following questions:

- *What aspects of the project worked well? How can these successes be incorporated into future projects?*
- *Was the initial project timetable reasonable?*
- *Could the initial assessment of the probability of success have been done more accurately?*
- *What caused the project to fail? How can I recognize and respond to these warning signs in the future?*

Don't try to sweep failure under the rug. Prepare a timely report analyzing the reasons for failure. Addressing the above questions can limit or even eliminate any stigma of being associated with a failed project.

Gain exposure for your efforts

Raise your professional profile both within your own organization and outside of it. However, never appear to be doing something only to gain exposure. Remember, people can die of exposure. Their careers can, too, if self-promotion is done ineffectively.

The basic premise of your cam-

paign must be high performance, being the best at what you do. However, experts agree that being the best is not enough alone to achieve career success and position you for the next step in your career. Your efforts to gain exposure will matter little without this key element. Whatever assignments you undertake for your company or for professional organizations must be completed competently and in a timely fashion.

"NEVER APPEAR TO BE DOING SOMETHING ONLY TO GAIN EXPOSURE."

Timely, readable reports and effective presentations are essential to gaining visibility for your efforts and those of your project teams. Writing timely memos and presenting oral reports to your supervisor are also highly useful and could result in you and your team being nominated for a company achievement award.

Of course, demonstrating that you have the skills needed to take the next step in your career is best done in the confines of your own company and laboratory. However, if there are few opportunities to do so, demonstrating them outside these confines can be effective.

Don't overdo your efforts to increase your professional visibility. Remember that your primary goal remains doing an outstanding job in your current management assignment. Your efforts to increase your professional visibility shouldn't compromise your job performance.

Networking—both internally and externally

Developing a professional network both inside your organization and outside of it can provide sources of advice on your career and on your projects that will help you succeed at both. Your professional network can result in opportunities to help you gain new skills and demonstrate your abilities. For example, an internal networking contact may know of your interest in an eventual business management assignment as the next step in your career. This person could appoint you or recommend you for an assignment to a multidisciplinary team that includes members from one or more business operations. Demonstrating your competencies to these individuals may facilitate a later reassignment to one of these business functions. Conversely, as you learn more about the business in question, you may decide that such an assignment isn't for you and avoid derailing your lab management career for months or even years.

"BEING THE BEST IS NOT ENOUGH ALONE TO ACHIEVE CAREER SUCCESS."

Other opportunities to demonstrate skills

There are other ways to demonstrate your skills while helping others. Some, such as teaching internal workshops or short courses, occur most frequently in large organizations. However, lab managers in small organizations can seek out similar opportunities outside their own laboratory or organization. Such opportunities include teaching a short course or workshop for a professional society. Teaching an advanced course as an adjunct professor at a local university is another option. You can also demonstrate new skills by writing articles or research papers and by participating in professional society activities.

Hidden opportunities

Sometimes hidden opportunities lurk within apparently routine management activities. For example, consider hiring. Developing the ability to identify very high achievers when perusing their résumés and interviewing them can result in your developing a reputation for hiring outstanding staff members who make major contributions and do so quickly.

Working closely with patent attorneys can result in more effective and timely protection of intellectual property developed by your work group. Developing the ability to see potential commercial applications of curious laboratory results and encouraging your staff members to do the same can result in you and your work group becoming well-known for being innovative. Developing the ability to turn an adverse outcome to your company's advantage can serve the same purpose.

"YOUR EFFORTS TO INCREASE YOUR PROFESSIONAL VISIBILITY SHOULDN'T COMPROMISE YOUR JOB PERFORMANCE."

Beyond your current employer

Sometimes advancement to the next career level isn't available with one's current employer, or such advancement must wait for someone's retirement and may not be available for years. Developing recognition of your abilities in your industry or profession through trade associations and professional society activities outside your current employer can serve two purposes. First, it may result in employment opportunities at other organizations. Second, the professional recognition you acquire through these activities may persuade your own manager to take a closer look at your abilities and achievements and promote you accordingly.

With a good strategy and excellent execution, lab managers can take their careers to the next level, increasing their job satisfaction and fattening their wallets as well.

References

1. J.K. Borchardt, "Career Management for Scientists and Engineers," ACS/Oxford University Press (2000).

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

THE THIRD ANNUAL SALARY & EMPLOYEE SATISFACTION SURVEY

SURVEY REVEALS CHANGES FROM LAST YEAR, BUT GENERALLY LAB PROFESSIONALS REMAIN A HAPPY LOT

by Pam Ahlberg

It's no secret that attracting and retaining top talent are what drive any organization's success. And, as Ron Pickett points out in this month's Leadership & Staffing article, "It is virtually impossible to have highly motivated employees in an organization with restrictive, antiquated and 'cheap' policies."

To get—and keep—strong performers, compensation needs to remain competitive and management needs to understand the less-tangible aspects of job satisfaction and motivation.

Thanks to the more than 1,200 lab professionals who participated in this year's annual survey, we highlight here some interesting new data regarding base salaries, salary incentives, total cash compensation, equity-based compensation, benefits practices and overall job satisfaction. This year's survey also delved more deeply into questions concerning life/work balance, job security and professional development opportunities.

Longevity

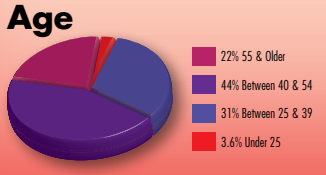
While the survey sought to find out how lab professionals are faring these days in terms of wages and job satisfaction, it is interesting to note that despite mild grievances with their organizations and some hits to their benefits as a result of the recession, longevity within the field is certainly a hallmark of this group. Compared with last year's 32% majority who had been with their current employer between six and 10 years, Table 1 shows that this year 42.18% of respondents sat squarely in the "over 20 years" category. Equally interesting is that nearly 19% of those respondents had spent those "over 20 years" with the same employer.

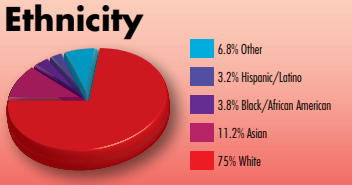
What's in the paycheck?

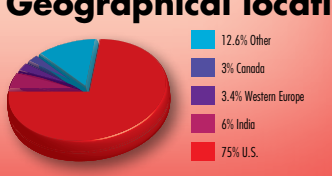
The industries where people worked varied, but the settings were distributed fairly evenly among pharmaceutical, chemical, biotech, environmental, university, govern-

A SNAPSHOT OF OUR SURVEY RESPONDENTS

Lab managers and those in management positions made up 59% of respondents. Scientists—including chemists, microbiologists and biochemists—made up 21% of respondents. The balance included faculty, engineers and technicians. Of these, 47% had a bachelor's degree, 23% had a master's and 18% had doctorates, which represents a minor uptick from last year in both bachelor's degrees and doctorates. The survey (though not a reflection of the overall percentage of men and women in science management positions) had 54% male respondents and 46% female respondents, which was slightly more balanced than last year's split of 60% male, 40% female. To complete the snapshot, the three pie charts below provide age, ethnicity and geographical information about our respondents.







ment, private/contract and industrial labs. The salary ranges are listed in Table 2.

Compared with last year, very little has changed in terms of salaries. The percentage of those making less than $55,000 dropped two points this year and the percentage of those making more than $95,000 rose about three points. So, salaries at both ends of the spectrum increased, which is good news given this year's economic slump.

Table 1. Length of time working as a full- and/or part-time researcher/scientist

Less than 1 year	4.24%
1–2 years	4.99%
3–5 years	10.57%
6–10 years	12.56%
11–15 years	13.06%
16–20 years	12.40%
Over 20 years	42.18%

Table 2. Annual salary, not including bonuses

Under $24,999	6.24%
$25,000 – $34,999	6.81%
$35,000 – $44,999	10.67%
$45,000 – $54,999	12.89%
$55,000 – $64,999	13.88%
$65,000 – $74,999	12.40%
$75,000 – $84,999	8.78%
$85,000 – $94,999	7.55%
$95,000 – $109,999	10.10%
$110,000 - $124,999	4.27%
$125,000 – $149,999	4.02%
Over $150,000	2.38%

Bonuses

Thirty-five percent of participants said that they regularly received cash bonuses in addition to their base salaries. Of that 35%, 42% received less than $1,000 per year in bonuses, 25% received between $1,000 and $3,500, and a lucky few—nearly 12%—reported earning $10,000 or more in annual bonuses. The criteria for bonuses can be found in Table 3.

The happiness factor

In addition to providing data on wages, the survey this year sought to learn more about respondents' job satisfaction, life/work balance and corporate climate.

When it came to whether our respondents liked the type of work they do, a whopping 96% said that they did, which is nearly the same percentage as last year. Eighty-four percent told us that they were given enough authority to make decisions and 79% said that they felt valued at their organizations. In answers that illustrate either an especially strong work ethic or an elevated sense of purpose among lab professionals, nearly 97% of respondents said that they would be "willing to contribute above and beyond what is expected" of them to help their organizations be successful. Another bright spot was a nearly 15% increase among those who agreed or agreed strongly that staffing levels were adequate to provide quality products/services.

Table 3. What bonuses are based on

Meeting individual goals / objectives	25.80%
Meeting department goals / objectives	23.53%
Meeting company financial goals	36.67%
Other	13.99%

Work vs. life

What mattered most to 98% of respondents was having "a good balance between work and personal life." Unfortunately, only 78% said that they were happy with the work/life balance in their current situations. Two other less than-positive responses came from questions concerning recognition and job security, as shown below:

IF I DO VERY GOOD WORK, I CAN COUNT ON BEING ACKNOWLEDGED/RECOGNIZED/ PROMOTED. AGREED:

63.97%

I BELIEVE MY JOB IS SECURE. AGREED:

73.09%

Corporate culture

Despite an obvious dedication to their work and a willingness to put in extra effort to achieve personal and business success, when it came to the larger organization, respondents gave relatively low marks. Corporate communications, recognition from above, confidence in the leadership of the organization and adequate follow-through of corporate objectives were all viewed fairly unfavorably. Other notable complaints seemed to be about training, as indicated below.

THIS ORGANIZATION PROVIDES AS MUCH ONGOING TRAINING AS I NEED. AGREED:

67.97%

THIS ORGANIZATION PROVIDES TRAINING OR EXPERIENCES TO HELP ME EXPLORE OTHER OPPORTUNITIES WITHIN THE COMPANY. AGREED:

51.74%

However, when it came to the entire organization—presumably themselves, their staffs and upper management—72% believed that their organizations shared a spirit of cooperation.

Stay or go

Whether or not they were happy with their wages, their organizations and their work/life balance, most revealing was that nearly 53% of respondents said that given the opportunity they would leave their present jobs. And the probable explanation is that only 47% said that there was room to advance at their organizations. When a mere 57% say that their career goals are being advanced through their current jobs, it's time for management to take notice.

IN THE NEXT FIVE YEARS, I WILL STILL BE WORKING AT THE SAME COMPANY IN THE SAME POSITION. AGREED:

43.45%

IN THE NEXT FIVE YEARS, I WILL STILL BE WORKING AT THE SAME COMPANY WITH A JOB PROMOTION. AGREED:

32.76%

Looking for work

Based on the above data, it appears that there is a bit of career discontent among some of the respondents. Whether they act on that will depend on a host of factors. Table 4 below identifies the preferred places to start the search when it comes time, either by choice or as a result of circumstance, to seek new opportunities.

Table 4. Sources for new career/position opportunities

Internal HR Department/Internal Job Postings	14.96%
Online Job Boards	26.20%
Staffing Firms	10.90%
Personal/Professional Networks	22.92%
Social Networking Sites	7.68%
Classified Ads	14.93%
Other	2.40%

Summary

Given the current recession, it was surprising that most of the salary and satisfaction survey results were similar to those from last year. When we asked respondents whether there had been any significant changes to their overall benefits within the past year, a number identified higher health insurance costs (increased deductibles, higher co-pays), reduced 401K contributions, and pension and salary freezes. However, the overwhelming majority reported no change in their benefits. Despite a few more complaints here and there this year, overall satisfaction in the field of laboratory research and management seems steady.

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SALARY AND JOB SATISFACTION BY REGION

ECONOMY IS NOT IMPACTING EMPLOYEE MORALE by Rich Pennock

In recent years, employees have been searching for positive news in spite of one of the largest economic downturns in history. It seems that science professionals may now have encouraging news that will improve their morale during the coming months. According to the 2009 *Lab Manager Magazine*– Kelly Scientific Third Annual Salary and Employee Satisfaction Survey, compensation does not completely impact the moods of employees. Rather, employees nationwide are realizing that the work they do provides more value than their annual salaries. According to the survey results, the slow economy has not dampened the spirits of a majority of science professionals. A regional breakout of survey responses follows.

Midwest

Throughout the Midwest, survey respondents seem to be rather optimistic about their current positions and futures within their respective industries, despite the ever-changing and uncertain conditions of the region's economy. According to the survey, more than 90% of respondents are pleased with the type of work they perform daily. In addition, a majority of respondents feel valued by their management (70%) and believe their jobs will be secure well into the future.

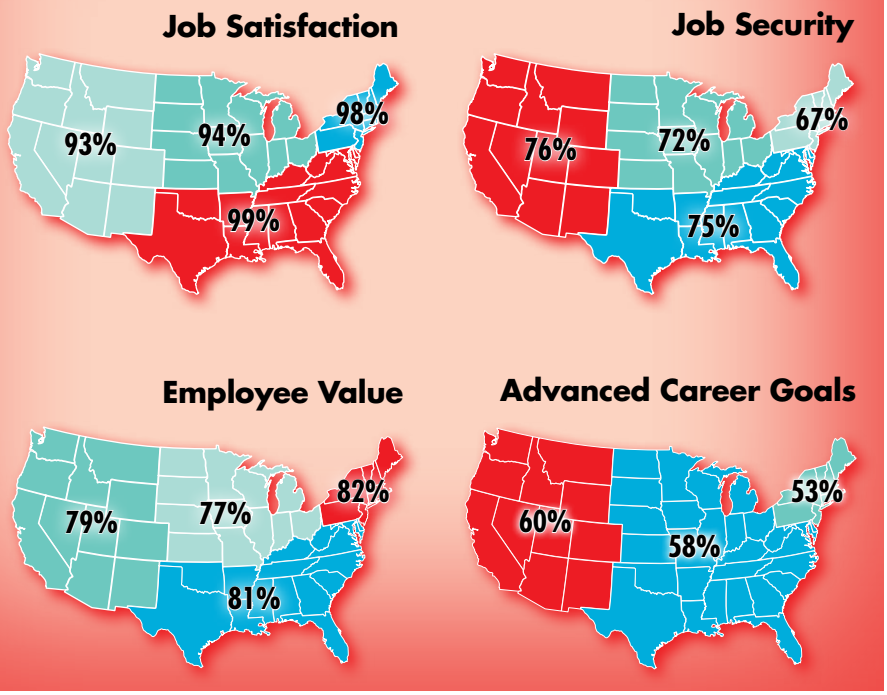
A majority of Midwest respondents also appear satisfied to work at organizations for an extended period of time. On average, employees have worked for their current employers for four years, likely as a result of the value that they feel while working at their organizations. In the meantime, a majority of survey respondents not only believe that their organizations provide them with opportunities to advance to higher-paid positions with more responsibility, but that their career goals are being met within their current organizations.

Of the respondents located in the Midwest, a majority have one of three job titles: lab supervisor/manager/director, chemist/scientist, or technologist/technician. Most respondents either work in research and development, quality control/assurance or validation, or technical services. It is also apparent that Midwest respondents not only have positions that are valuable with regard to their security and positive impacts on society, but are financially rewarding as well. The majority of respondents earn between $45,000 and $109,999 per year.

Midwesterners seem well-prepared for successful careers within their

2009 Salary Survey Regional Data

Percentage of Respondents in Agreement



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organizations and appear determined to maintain their confidence.

Northeast

Within the Northeast region of the country, a majority of survey respondents (70%) feel secure in their current positions. Respondents are also overwhelmingly positive about the type of work they perform every day (97%), as well as the value that they feel on a regular basis at their organizations (80%).

Interestingly, compared to employees located in the Midwest, employees in the Northeast feel that there are no advancement opportunities (around 53%) in their current positions. However, nearly 50% of respondents believe that their career goals are being advanced in their current positions while 40% do not.

Surveyed employees still tend to work for organizations for extended periods of time in the Northeast. On average, respondents maintained positions within an organization for four years. Most survey respondents earned between $45,000 and $124,999 annually.

A majority of respondents have obtained one of the three job titles—lab supervisor/manager/director, chemist/scientist, and technologist/technician, much like the Midwest. Despite the similarities in typical job titles and functions (research and development, quality control/assurance and validation, and technical services), Northeast respondents earn slightly more than respondents from the Midwest, perhaps due to minor differences between the impact the economy has had on each region, as the automotive and engineering-based economy of the Midwest has been especially impacted by the recent recession. Positive outlooks, as well as secure incomes, have helped Northeasterners maintain their career goals.

Southeast

Even more so than respondents in the Midwest and Northeast, Southeast region respondents are overwhelmingly satisfied with the type of work they perform on a daily basis. In the meantime, approximately 75% of respondents believe their jobs are secure and 80% feel valued at their organizations. However, despite the fact that only 42% of respondents believe they will be promoted at their current or-

ganizations, a majority of respondents think that their career goals are being advanced through their current jobs.

The majority of Southeast respondents tend to feel secure in their current jobs. As Southeast respondents typically work in small organizations and laboratories, much like employees from the Midwest and Northeast, they may have opportunities to obtain various job titles and functions during their careers. However, like their Midwest and Northeast counterparts, a majority of respondents are either lab supervisors/managers/directors, technologists/technicians, or chemists/scientists who have quality control, research and development, operations, or technical services roles within their organizations.

Despite the obvious similarities between Southeast respondents in comparison to Midwest and Northeast employees, one noticeable difference does remain—the annual salaries of Southeast employees compared to others. On average, a majority of Southeast respondents earn between $25,000 and $94,999 annually. However, despite a lower average income, employees tend to feel just as satisfied with their current positions as survey respondents from other regions. It seems employees are seeking to add value to their work.

West

While the average salaries of Southeastern respondents tend to be lower than those of employees in other regions of the country, the exact opposite is true with regard to respondents from the West. On average, a majority of respondents earn between $45,000 and $149,000 annually despite working in organizations and laboratories similar in size to those in the Northeast, Midwest, and Southeast. Interestingly, respondents typically work for organizations on an average of four years, similar to employees in other regions of the country.

In addition to typical high salary averages, a majority of respondents are not only satisfied with their positions and the impacts they have on society, but they also feel secure about their positions and are valued within their organizations, much like a majority of respondents from the other regions of the nation. While most respondents wish their organizations provided them with more opportunities to advance to other positions, a majority of employees from the West feel that their career goals are being advanced through their current jobs—a finding similar to respondents from the Midwest, Northeast, and Southeast.

According to salary survey respondents from four different regions around the country, it seems that a majority of science professionals are very satisfied with their current positions. A majority of the respondents are pleased with their day-to-day positions and seem excited about their futures, indicating that the majority of science professionals have a common purpose in mind—to use their educations, experiences and skills to improve the foundations of society.

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MOTIVATING A 21ST CENTURY LAB STAFF, PART I

MANAGERS NEED TO UNDERSTAND WORK GROUPS, ORGANIZATIONAL PRACTICES AND INDIVIDUAL EMPLOYEE CHARACTERISTICS

by Ronald B. Pickett

Think back over your life and recall a high point—a time in your work experience when you felt the most alive, most engaged, or most successful. How did it unfold? What was it about the organization, your management, and your staff that made it stand out? What was it about *you* that made it a high point?

Thinking about this brings up some very interesting stories and recollections; people like to recall these high points and the way that they felt. (This process was described in the article "Honing Your Interviewing Skills," which appeared in the October 2009 issue of *Lab Manager Magazine*.)

"PEOPLE WANT TO WORK, AND IT IS THE WORK ITSELF THAT MAKES THE MOST IMPORTANT AND SUSTAINED CONTRIBUTION TO MOTIVATION."

When 25 or 30 of these stories are analyzed, several consistent themes emerge. These themes define the organizational characteristics that lead to exceptional work experiences—the situations that result in a highly motivated staff. Indeed, if you review your own story, you will probably get a good idea about what motivates you on the job.

If you would like to review some of the seminal work in the field, you might read Douglas McGregor, Abraham Maslow and Frederick Herzberg, authors whose work, while getting a little "long in the tooth," still forms the basis of most of our understanding of human motivation. (Selected references are listed at the end of this article.) The most telling and consistent thrust of these authors' theories is that people want to work, and it is the work itself that makes the most important and sustained contribution to motivation. Certainly that is true for scientists who have spent years preparing for their positions.

A core management responsibility

One of the core accountabilities of a manager is to motivate his or her staff. If the level of enthusiasm is low, the manager must bear the major responsibility. But what can a manager do to improve the motivation level of a diverse, bright, and challenging staff? Hint: If you have worked in organizations with different climates, how many of the differences can you attribute to the actions of the manager?

Managing motivation can best be understood by looking at three areas: the climate or environment in the work group; the policies and practices in the organization; and the characteristics and interests of individual employees.

A motivational climate

Frankly, the U.S. Postal Service does not have a reputation for exemplary management practices. In fact, the term "going postal" has entered our vocabulary—and it isn't positive! Given that, I have been surprised by the attitude of my local post office employees. Every time I go to this branch, I am amazed and delighted by the friendly and positive feeling that all of the employees exude. They are competent, quick in doing the job, and happy in their work.

I've asked them why they are in such good moods and they find it hard to describe, but it is clear that the manager has set high expectations about the level of customer service that is expected, and also that peer pressure is another important factor. You just can't be a

grouch and work at this branch! Sadly, this workplace is an exception; a negative attitude seems to be easier to spread throughout many organizations.

Research has shown that a healthy organizational climate positively impacts the bottom line. (See "Organizational Climate, Productivity and Creativity" and "Organizational Climate and Company Productivity: the Role of Employee Affect and Employee Level" in the references.)

But what constitutes a healthy climate? The Hay Group has conducted extensive research in this area and has identified six critical climate dimensions:

- *Clarity: everyone in the organization knows what is expected of him/her*
- *Standards: challenging but attainable goals are set*
- *Responsibility: employees are given authority to accomplish tasks*
- *Flexibility: there are no unnecessary rules, policies, or procedures*
- *Rewards: employees are recognized and rewarded for good performance*
- *Team commitment: people are proud to belong to the organization*

When employees rate these dimensions as high, they are saying they are motivated by their workplace; that it is an enjoyable and productive place to be; and that they give their best and are confident they will be recognized for their contributions. When they rate these dimensions as low, they are saying the opposite, and the organization runs the risk of seeing this translated into low morale, performance, and profits. (For more on this topic, visit the Hay Group website at: http://www.haygroup.com/TL/.)

Organizational policies

The second major area includes the policies and practices of the organization. It is virtually impossible to have highly motivated employees in an organization with restrictive, antiquated, and "cheap" policies—policies that do not value and reward employees for their performance. Benefits must be equitable; pay must be fair and at or above the going rate; recognition and rewards must be frequent and tied to the interests of the individuals; and vacation and holidays must be generous. Without these, it is impossible to recruit and retain top-notch employees. This is particularly true in a market in which there are not enough trained scientists to meet the needs.

"Isn't that the HR department's job? Isn't that what the executives are paid to do? What's a manager's responsibility in affecting company policies?"

Yes, it is HR's job, and it is a responsibility of the

THE QUESTION OF WHETHER "SATISFIED EMPLOYEES" PRODUCE MORE, OR WHETHER HIGH-PERFORMING EMPLOYEES ARE MORE SATISFIED, WAS ANSWERED A LONG TIME AGO. HIGH PERFORMANCE PRECEDES AND LEADS TO JOB SATISFACTION!

executives, but as a line manager you have the best view of the way policies affect the employees. You are the one who faces the brunt of the complaints and dissatisfaction; you hear comments about the equity of pay and benefits; and you see people leaving for better working conditions and compensation packages. Optimally, the HR director should be a peer—someone you can talk to about the impact of policies, the results of wage surveys, and other items of importance to your staff.

"IT IS VIRTUALLY IMPOSSIBLE TO HAVE HIGHLY MOTIVATED EMPLOYEES IN AN ORGANIZATION WITH RESTRICTIVE, ANTIQUATED AND 'CHEAP' POLICIES."

We have been conducting some interviews of managers who have been in their jobs for nearly a year. One of the things emerging from these interviews is that they fire people! They find out quickly who is not performing, who is disruptive, and who does not fit in—people the previous manager did not deal with. They set up a specific way for the employees to be "rehabilitated." Then they work with the HR staff to put them on notice and, if they don't perform or change, they let them go. In these interviews, the managers tell us that this has a big impact on the rest of the staff and has not induced fear. Everyone knew that these poor performers were misfits—that they were having a negative impact on the rest of the staff and that the new manager had done the right thing.

"TO UNDERSTAND YOUR STAFF, START FROM THE TRUTH THAT THEIR FUNDAMENTAL PERSONALITY CHARACTERISTICS ARE VERY SIMILAR."

What does this mean for managers who have been in the same job for several years? Review your staff. Is there someone you have been meaning to counsel, or for whom you want to start a process that may lead to his or her dismissal, but you have avoided getting started? If so, in the words of the Nike ad: "Just Do It!" This is especially important when you may be required to reduce your staff size. Otherwise, you may only have the option of losing the newest hires.

Individual characteristics

If there is one lesson that the 9/11 terrorist attacks confirmed, it is that (at the core) we Americans are much more alike than we are different. We have the same dreams, values, and aspirations, and the people of our nation respond to a crisis in a unified and strong manner. Now if you take a group that has similar characteristics and put them through the rigorous testing and trials of a scientific education, the outcome group is surprisingly alike on a variety of dimensions.

The message for managers is that to understand your staff, start from the truth that their fundamental personality characteristics are very similar, and they are probably very similar to yours. This fact makes it easier to establish a motivating environment and find the significant individual differences that can be used to develop a plan to motivate and maintain the motivation of each staff member.

"KNOWING YOUR STAFF'S INDIVIDUAL NEEDS AND INTERESTS CAN TURN A CHALLENGING PROBLEM INTO A CLEAR WIN."

Another important point for lab managers to remember is that the selection and training process for scientists means that you have a group of people who are significantly different from the norm—brighter, more curious, able to concentrate on details for long periods of time, technically savvy, concerned with accuracy, dedicated to the quality of their product. However, that also means that in many respects they are quite similar.

Application

Many laboratories operate in shifts. Most managers set up a rotation and expect their employees to work out differences, and then they stand ready to be the final arbitrators . With the wide variety of different family structures, demands, and lifestyles, it may be that some of your staff members may want to work some of the generally less desirable shifts or holidays. Knowing your

staff's individual needs and interests can turn a challenging problem into a clear win.

In "Motivating a 21st Century Lab Staff, Part II," I will describe the characteristics of the different age cohorts who currently populate the workplace. Recent findings in this field will help managers do a better job of understanding and managing motivation.

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EMPLOYEES ARE SATISFIED, BUT ORGANIZATIONS STILL LOOK TO IMPROVE

The results of the 2009 *Lab Manager Magazine* – Kelly Scientific Third Annual Salary and Employee Satisfaction Survey are in and, somewhat surprising, a majority of the participants have stated that they are content with their current employment situations. Most employees are generally satisfied with their present positions, their employers and their career tracks. The results of the survey, conducted during a difficult economic year, may lead managers to wonder why employees feel so positive despite an ever-changing economy. Are employees satisfied because they have viable job opportunities despite the challenging economy, or are employees sincerely happy with their current positions and roles within their organizations?

"MORE THAN 50 PERCENT OF RESPONDENTS... WOULD LEAVE THEIR CURRENT POSITIONS IF OTHER OPPORTUNITIES CAME THEIR WAY."

According to the survey, it seems that employees are very passionate about their positions and satisfied with their job opportunities. However, while a majority of respondents said they like the work they do, more than 50 percent of respondents said they would leave their current positions if other opportunities came their way.

"WORK SATISFACTION AND VALUE ARE TWO SIGNIFICANT ASPECTS OF OVERALL EMPLOYEE PERFORMANCE."

The research illustrates the importance of valuing employees, not only in terms of compensation, but in terms of workplace flexibility, training and career growth as well. As employees work to fulfill their career goals, managers can provide significant work opportunities for them to utilize their talents and experiences to positively impact other people. When employees are able to display their unique talents and abilities, they may be more apt to continue working at their current organizations because they feel valued.

Science industry continues to provide satisfying positions

The findings of this year's survey are rather promising in terms of employee job satisfaction, as 96 percent of all respondents are pleased with the day-to-day tasks and responsibilities of their current positions. At the same time, a majority of science professionals feel valued at their organizations, leading them to want to contribute more than what is expected to their organizations. Work satisfaction and value are two significant aspects of overall employee performance.

Limited opportunities for growth from within

While science professionals seem to enjoy their everyday responsibilities, many indicated that they are willing to leave their current organizations if opportunities become available. Only 47 percent of all respondents believe their organizations provide opportunities for advancement. In other words, within science organizations across the country, highly talented employees are simply not able to express their true potential, forcing them to pursue opportunities at other companies.

"MANAGERS NEED TO REALIZE THE VALUE OF PROPER WORK-LIFE BALANCE."

Many managers may strive to provide employees with more advancement opportunities so that they are not only satisfied with the work they do on a daily basis but also content working within their organizations. As employees' job performances improve and impact organizations, managers may be able to enjoy success amidst economic uncertainties.

Work-life balance necessary

Employees obviously desire to have a balance between their work and personal lives, especially as they begin to raise their families. According to the survey, 78 percent of respondents are currently pleased with their work-life balance. So the question becomes, why are 22 percent of respondents displeased? Are work hours increasing as the economy shifts? Managers need to realize the value of proper work-life balance and the effects (both positive and negative) such a balancing act has on their employees. While a majority (79 percent) of surveyed employees feels valued at their organizations, more employees might feel more highly valued if they were given flexible work options. Adequate work-life balance can help employees lower their stress levels, which in turn enables them to perform to the best of their abilities.

"TO TRY AND ENSURE EFFICIENT EMPLOYEE PERFORMANCE, AMPLE TRAINING PROGRAMS SHOULD BE MADE AVAILABLE."

Training and recognition programs can boost morale

According to the survey, nearly 68 percent of respondents who work in large organizations believe that current training opportunities are ample and satisfactory, while 64 percent of all survey respondents feel that they are adequately recognized for positive performances. To try and ensure efficient employee performance, ample training programs should be made available, especially as technology and science continually change and advance. By providing proficient training programs within their organizations, managers can almost guarantee that their employees are not only comfortable with their current positions, but also willing to exceed their own expectations.

Overall, a majority of science professionals from around the nation feel valued within their organizations and are satisfied with the type of work they perform each day. Managers can continue to improve the morale of their employees by providing opportunities for career advancement, solutions for work-life balance, and updated training and recognition programs.

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SCIENTISTS ARE FROM MARS, DESIGNERS ARE FROM VENUS

SCIENTISTS AND DESIGNERS NEED TO APPRECIATE THE DIFFERENCES EACH BRINGS TO THE DESIGN PROCESS

By H. Michael Smith, AIA, and David I. Meyer, Ph.D.

With a wink and a nod to John Gray's enormously popular book of 1992, *Men Are from Mars, Women Are from Venus*, it can be argued that differences in communication styles and project perspectives between scientists (laboratory users) and designers (architects and laboratory planners) can be the cause of challenging, frustrating and often failed experiences in the laboratory design and construction process.

"SCIENTISTS BY NATURE TEND TO BE ANALYTICAL THINKERS, WHILE DESIGNERS TEND TO BE INTUITIVE THINKERS."

The good news is that it doesn't have to be that way. The simple truth is that scientists and designers have been known to think differently.

Scientists by nature tend to be analytical thinkers, while designers tend to be intuitive thinkers. Although there are exceptions to this rule, scientists believe that "structure predicts function."

This type of thinking leads them to conclude that if they provide their designers with the essential facts, they can be assured of a successful outcome. They know better than anyone what they need in their laboratory environments, usually based on the experience of working in other laboratories and knowledge of what they need to conduct their experiments.

However, scientists typically do not understand the designer's world in terms of what is necessary to achieve a successful laboratory design. Issues such as building codes and regulatory requirements; the cost, time and information-gathering process associated with design and engineering services; agency review; approval and permitting; and the construction procurement and delivery process are all foreign to their daily lives. It can be like being from a different planet, as Gray might put it.

Designers, on the other hand, believe that "function predicts structure." They know what services to provide based on their architectural training and their prior experience with similar projects. While, admittedly, designers typically do not understand the science involved, they do have an acute sense of the environmental and technical needs of scientists.

Appreciate the differences

Based on the Mars/Venus analogy, to effect a positive outcome in the laboratory design process, both scientists and designers need to recognize and appreciate the differences that each brings to the design process; and in order to be successful, they need to effectively communicate their knowledge and informational needs to the other. They must strive to understand what is essential to the other and work together in the spirit of cooperation to achieve a common goal.

Scientists must make known their programmatic needs and design criteria. This can include space type, function, adjacency and specific environmental requirements, such as air changes, temperature, humidity, cleanliness, power, lighting and vibration control. These all can have ramifications for project scope, budget, schedule and aesthetics.

Designers must take this information and use it to communicate to the scientist what is possible in terms of

building codes, regulatory requirements and existing conditions, whether new construction or renovation, within the organization's budget and schedule. Throughout this communication process, each must approach the other with an understanding that both hold essential knowledge that the other must accept and trust.

Understanding the value

Often, perceiving the value of the design services can be a big stumbling block for scientists. It can be difficult for scientists to understand the value of a designer's services and the cost associated with the design and construction process. They can have a difficult time understanding why it costs so much and takes so long to accomplish the goal of designing and building a laboratory facility. Questions like these are common: "How can this laboratory remodel cost $500 per square foot?" and "Does it really take eight months to design a new lab?"

"THE DESIGNER CAN HELP THE SCIENTIST CHANGE OLD WAYS OF THINKING ABOUT THE LABORATORY ENVIRONMENT."

With this in mind, it is important for the designer to share with the scientist the relative costs associated with the highly complex building systems required by laboratories, such as the heating, cooling, exhaust and plumbing systems, and the power requirements of sophisticated laboratory equipment.

In order to address this type of thinking and to reinforce a relationship of trust with the scientist, the designer must be sensitive to the scientist's perspective and strive to communicate the drivers that impact the design of a laboratory and the costs involved with the complicated building systems they require.

Often it is prior experience that will lead a designer to an early realization that a client's budget does not align with its programmatic needs and desires. In this instance, it is important for the designer to inform the scientist of this disparity, to provide creative solutions to the challenge, and to help the client make decisions that will bring the cost and budget into alignment. Value engineering, a process whereby the costs of various building systems are estimated and evaluated independently on a cost/benefit basis, can be one solution. Also, the designer can help the scientist change old ways of thinking about the laboratory environment in order to create more efficiency and cost-effectiveness through shared, flexible and collaborative work spaces.

Know who the client is

Often when designing laboratory facilities, a designer will interface with an institution's CEO, CFO and COO, in addition to the facility's end users, such as the chief scientific officer, principal investigators, post-docs and laboratory technicians. They all will have their individual perspectives on the project and their own wish list. Unfortunately, not everyone will have the authority to make the final calls. It is extremely important to determine who has the authority to make decisions that will affect the outcome of a project and will effectively communicate those decisions to shareholders.

Collaborate successfully

Ultimately, it is the designer's responsibility to lead the scientist through this process to an acceptance of what is possible based on the limiting parameters—all in an atmosphere of understanding and trust.

By effectively communicating each other's needs and understanding the essential knowledge and information that each brings to the process, scientists and designers can successfully collaborate to make the outcome of the laboratory design and construction process a satisfying and rewarding experience for both the laboratory users and the design professionals who serve them.

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The two authors have worked together as scientist and designer, client and consultant, on a number of laboratory design projects, most recently an animal barrier facility at the House Ear Institute in Los Angeles, where Dr. Meyer held the position of executive vice president of research.

SUPPLYING HIGH-PURITY GASES

MAKING A CASE FOR IN-HOUSE GAS GENERATORS

By Kim Myers and Peter Froehlich

Selecting the most effective source for high-purity gases is a critical issue for laboratory managers. Zero air and hydrogen are used for gas chromatography with flame ionization detection (GC-FID), and nitrogen is used for high-performance liquid chromatography or gas chromatography with mass spectrometric detection (LC-MS or GC-MS). High-purity gases are used with other instruments: CO_2 free purge gas for Fourier transform infrared spectroscopy (FT-IR), highly purified nitrogen for inductively coupled plasma (ICP) systems, dry air for nuclear resonance spectroscopy (NMR) and hydrocarbon-free combustion gas for TOC analyzers.

Many laboratories employ in-house high-purity gas generators to supply the necessary gases, as they provide significant safety, convenience and cost advantages when compared to the use of tank gas.

In-house gas generators

Nitrogen, purge gas, ultra dry gas, source exhaust air and zero air can be obtained from compressed air, and hydrogen can be obtained by the electrolysis of water, using in-house generators. An in-house gas generator can be dedicated to a single instrument or used to supply multiple instruments (e.g., a hydrogen generator can provide fuel gas for 14 FIDs).

a) Generation of nitrogen

Nitrogen is generated from compressed air by the removal of oxygen, water vapor and particulate matter. The heart of an in-house nitrogen generator is a hollow fiber membrane through which oxygen and water vapor permeate and escape through the sweep port while the nitrogen flows through the tube (Figure 1). A large number of fibers are bundled together (Figure 2) to provide an extremely large surface area.

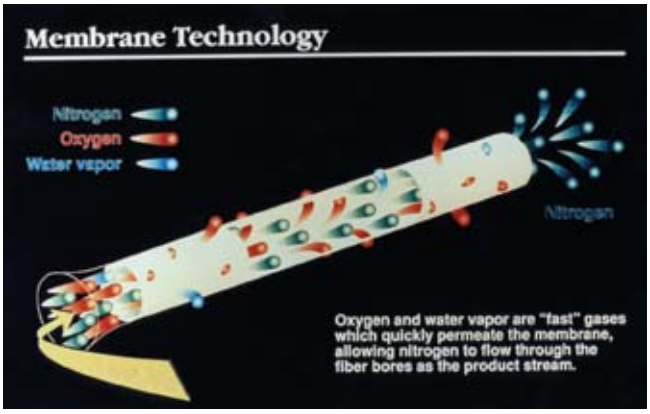

Figure 1. Operation of a Hollow Fiber Membrane

Figure 2. A Hollow Fiber Membrane Bundle

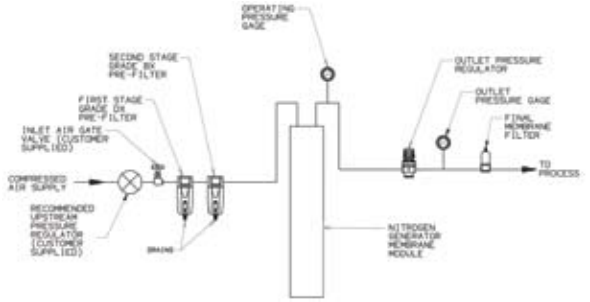

Figure 3. Schematic Diagram of N2-04 Nitrogen Generator (courtesy of Parker Hannifin Corp.)

The schematic of a typical nitrogen generator (Model N2-04, Parker Hannifin Corp., Haverhill, MA) is shown in Figure 3. Compressed air is filtered using a high-efficiency activated carbon filter to remove organic impurities, and a pre-filtration system is used to remove particulate matter >0.01µm. Air passes through a fiber membrane bundle to remove the oxygen and water, while the purified nitrogen is passed through another absolute membrane filter and delivered to the instrument.

The N2-04 nitrogen generator produces 99.5 percent pure nitrogen on a continuous basis (the purity of the nitrogen depends on the operating pressure and the desired flow rate, e.g., 3 L/min of nitrogen at 80 psi). The gas has an atmospheric dew point of -58°F (-50°C), contains no particulate matter >0.01 µm and no suspended liquids, and is hydrocarbon and phthalate free.

b) Generation of hydrogen by electrolysis of water

i)Using metallic electrodes

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An inert anode and a cathode such as a bundle of palladium tubes are used to dissociate water (20 percent NaOH is added to enhance electrolysis). Hydrogen passes through the cathode while oxygen and other impurities collect at the anode, and hydrogen gas with purity in excess of 99.99999+ percent can be obtained.

ii)Using a proton exchange membrane

A proton exchange membrane (PEM) is an ionomeric (ionic polymer) membrane that conducts protons and is impermeable to hydrogen and oxygen. PEMs are used in fuel cells to create an electric current (and form water) from hydrogen and oxygen. When an appropriate potential is applied to a PEM in the presence of pure water (caustic NaOH is not required), water is dissociated to provide hydrogen and oxygen.

c) Generation of ultra dry air, purge gas, zero air and source exhaust air

Several techniques are employed to remove moisture, particulate matter and hydrocarbons from air to provide air with the desired purity. A coalescing compressed air filter, which consists of a matrix of borosilicate glass hollow fibers in a fluorocarbon resin binder, removes water, hydrocarbon lubricants and synthetic lubricants from compressed air. For instrument-grade air, two-stage filtration removes 99.99 percent of 0.01 µm particles and droplets and a three-stage filter system is used to remove compressor oil vapor. A heated catalysis module and high-capacity carbon absorption modules and coalescing filters remove very light methane-based hydrocarbons.

d) In-house multi-gas generating systems

In-house generation of nitrogen and purified air from compressed air is performed with the Source LC/MS Tri Gas Generator (Figure 4), which includes coalescing pre-filtration with timed solenoid drains, self-regenerating compressed air dehydration membranes, a proprietary heated catalysis module, self-regenerating nitrogen retentate membranes, high-capacity high-sensitivity carbon absorption modules and matched final filtration membrane media.

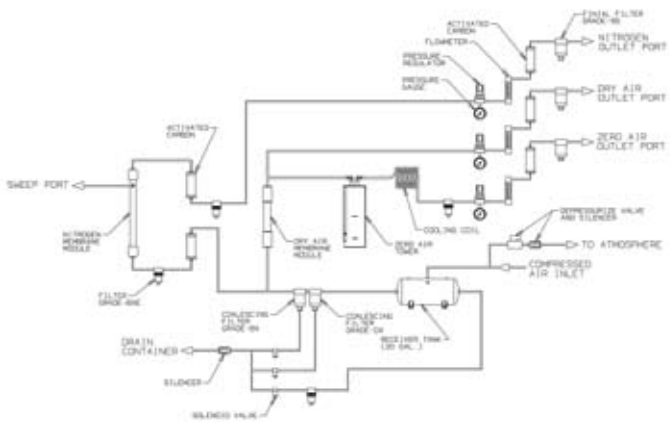

Figure 4. Schematic Diagram of Tri-Gas Generator (courtesy of Parker Hannifin Corp.)

Benefits of in-house gas generators

In-house gas generators provide significant benefits to the laboratory, including a dramatic improvement in safety, an increase in convenience and a lower cost.

Minimizing safety hazards

An in-house generator is considerably safer than tank gas; only a small amount of gas is stored at low pressure at a given time and it is ported directly to the instrument. As an example, the TriGas Generator generates 10L/min of nitrogen at a maximum pressure of 80 psig, 23 L/min of source air at a maximum pressure of 110 psi and 8L/min of exhaust gas at a maximum pressure of 60 psi. If a leak occurred, only a small quantity of nitrogen gas would be dissipated into the laboratory.

In contrast, serious hazards exist if nitrogen is supplied using a high-pressure gas tank or a liquid tank. If a full tank of nitrogen were suddenly vented into the laboratory, up to 9000 L of gas would be released, displacing laboratory air and reducing the breathable oxygen content.

"IN-HOUSE GAS GENERATION ALLOWS FOR CONTINUOUS OPERATION."

An in-house gas generator also eliminates the possibility of injury or damage from the transportation and installation of a gas tank. A heavy gas tank can be a hazard to staff and facilities if the valve is compromised during transport (in many facilities, specially trained technicians replace gas tanks). A leaking hydrogen tank could lead to an explosion. When a Dewar flask or a high-pressure liquid tank is used to supply nitrogen, a leak or spill could lead to frost burns.

New construction or laboratory expansion

An important factor when considering new construction or expanding an existing laboratory is the gas requirements for the instruments being used. It is important to select a supply, manifold and purification system to ensure that the gases supplied will meet your requirements for pressure, volume and purity. Architects and designers will typically allocate space for cylinders or other gas storage options (i.e., Dewars or bulk systems). For many installations, a gas generator will provide a superior gas supply with higher purity for a lower operating cost and will require less floor space. In addition to the need for less lab space, less space for storage of back-up and empty cylinders is required.

Maximizing convenience

An in-house gas generator can supply gas on a 24-hour, seven-days-a-week basis with no user interaction (other than routine annual maintenance). Dr. Chris Ransom, a chemist at MedTox Scientific, a toxicology company in St. Paul, MN, reports that they have used in-house nitrogen and zero-air generators with GC systems and HPLC with MS for over ten years, with little or no maintenance, except for periodic changing of filters.

In contrast, when tank gas is employed, the user must monitor the level of gas in the tank and ensure that there is sufficient gas available for the desired analyses. The in-house system eliminates the need to retain extra tanks; when it is necessary to get a replacement gas tank, the chromatographer may need to find an individual who is qualified to handle the tanks. Tanks are typically stored outside in a remote area for safety reasons, and replacing tanks can be a significant inconvenience, especially in inclement weather. In addition, a pressurized tank could be a significant hazard if the laboratory is located in a seismic zone.

If a gas tank must be replaced during a series of analyses, the analyst must interrupt the work, restart the system, and wait for a stable baseline and perhaps recalibrate. Since in-house gas generation allows for continuous operation, calibration of the detector simply requires the measurement of a standard sample at a user-specified interval to ensure that the system is operating properly.

A major benefit of in-house gas generators is that "once they are installed, you don't have to worry about the gas supply," according to Fran Diamond, a chromatographer at NMSLabs, a clinical and toxicology lab in Willow Grove, PA. This lab has used several Parker Hannifin hydrogen and nitrogen generators since 1996 and presently has ten units, installed into appropriate manifolds. Mr. Diamond reports that the maintenance requirements are minimal. They replace the filters and perform routine maintenance on the compressor for the nitrogen generators on a periodic basis and monitor the water in the hydrogen generators. John Kucowski, facilities manager at NMSLabs, reports that their four Tri-Gas generators have been operating very reliably and preventive maintenance is done about once a year. This maintenance can be conveniently performed on-site using Parker's national third-party service provider, Mettler Toledo.

Minimizing the cost

An important advantage of an in-house generator is the economic benefit compared to the use of gas tanks or liquid nitrogen. The running cost of an in-house generator is extremely low, since the gas is obtained from compressed air or water and maintenance is a few hundred dollars per year for periodic filter replacement.

In contrast, when a gas tank is used, the actual cost is significantly greater than the cost of the tank. Dr. Ransom indicated that zero-air tanks are very expensive and the time and hidden costs including transportation, demurrage and paperwork when tank gas is employed impose a significant cost on the user. In addition, the time required transporting the tank, installing it, returning the used tank to storage and waiting for the system to re-equilibrate must be considered. While the calculation of the precise cost of the use of gas from tanks for a given user is dependent on a broad range of local parameters and the amount of gas that is used, significant potential savings can be obtained by the in-house generation of gas. A comparison of the cost of supplying gas via tanks versus the cost for use of an in-house gas generator is presented in Table 1. In this analysis, a tank of gas costing $60 is consumed per week, and four are in-house (i.e., tanks are replaced monthly). In comparison, the maintenance cost of the in-house generator is for replacement of filters at perhaps $1,000 per year, or approximately $20 per week.

	IN-HOUSE GENERATOR	TANKS
Maintenance	$800	$0
Cylinders	$0	$3120
Demurrage	$0	$336
Labor (changing cylinders)	$0	$1040
Order processing	$30	$360
Shipping	$50	$3720
Invoice processing	$10	$120
Inventory control	$0	$72
Total	$890	$8768

Table 1. Annual costs: in-house generation vs. high-pressure tanks (in U.S. $)

Conclusion

In-house generation of gases provides a safe, convenient and less costly method of providing the required gases. The gases are continually provided, and it is not necessary to replace tanks on a periodic basis. In addition to the cost reduction, less energy is required to supply gas, since tank gas or liquid nitrogen requires distillation of air (an energy-intensive process) and transportation of tanks to the final point of use.

Kim Myers, *Business Development Manager, Parker Hannifin Corporation, can be reached at kmyers@parker.com or by phone at 978-858-0505.*

Peter Froehlich, *president, Peak Media, can be reached at pfpeakmedia@msn.com or by phone at 508-528-6145.*

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For more information, visit www.restek.com. Marketing manager Neil Mosesman can be reached at neil.mosesman@restek.com or by phone at 800-356-1688 x2125.
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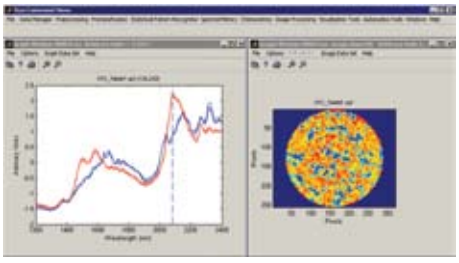

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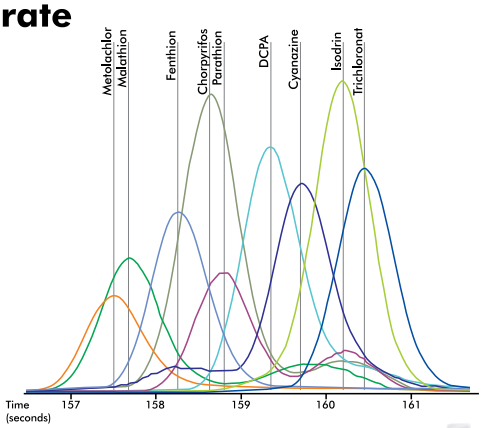

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OVERCOMING TECHNICAL PROBLEMS AND STAYING CURRENT WITH ADVANCES IN THE FIELD IS KEY

by Sara Goudarzi

Contract labs perform scientific research and testing on one or more components of projects for external clients. Contracts can last anywhere from only a few weeks for a single, specific task to many years for extended projects. In every case, the ownership of the project resides with the client, and the work of the contract lab typically represents just one portion of the overall project.

Taylor Technology Inc., a subsidiary of PharmaNet Development Group Inc., is a drug development contract research organization focused on bioanalysis, the measurement of potentially new chemicals or molecular entities (new treatments) in biological samples. Based in Princeton, New Jersey, Taylor Technology works mainly for the pharmaceutical and biotechnology industries in North America, Europe, and Asia, and covers many facets of the work leading up to filing a New Drug Application for permission to market a new drug. That includes clinical stage research and work leading into pre-clinical stage research, such as animal testing.

"Specifically, Taylor develops new analytical methods, performs the appropriate level of qualification or validation for each method, and then uses the method for analysis of our client's samples," says Richard M. LeLacheur, vice president at Taylor Technology.

"We perform similar services for quantitation of biomarkers, endogenous substances that indicate through biochemical changes how a person is responding to a particular treatment.

"WE REALLY ENCOURAGE PEOPLE TO USE HOURS THAT ARE APPROPRIATE TO THEIR PROJECT...AND TO THE CONTEXT OF THEIR OWN LIVES."

"We can also conduct qualitative analysis, working to identify new, potentially unknown substances such as metabolites that may be present in the samples," he adds.

Traditionally, within larger pharmaceutical companies such work was done in house. However, there has been a shift in the industry as pharmaceutical organizations recognized that staffing for their peak needs was not cost effective. Therefore, they have been moving toward staffing only to needed capacity and contracting out some of the work.

Another reason pharmaceutical companies might outsource work is to utilize a specific expertise that their organization may not have. This is especially true for smaller pharmaceutical or biotechnology companies where a significant amount of early drug development work is performed. They generally have a much greater need to outsource because of lack of resources.

The majority of Taylor's work is performed within a framework of regulatory compliance, or Good Laboratory Practice (GLP), required for later submission of results to regulatory bodies such as the U.S. Food and Drug Administration.

For drug discovery, early drug development, and some biomarker analysis, the regulatory framework may be reduced, LeLacheur explains.

"Our work is performed using what are broadly described as immunochemistry techniques such as ELISA (Enzyme-Linked Immunosorbent Assay), or using mass spectrometry techniques such as LC-MS/MS and GC-MS/MS." ELISA is a technique used with large molecules such as protein-based therapeutics to measure the presence of antibodies or antigens in a sample."

▲ *Richard M. LeLacheur, vice president at Taylor Technology.*

Lab structure

Taylor Technology employs about 130 people, 80 of whom are laboratory staff, working in a 55,000-square-foot area. The remaining personnel work in quality assurance, data management, technical writing, and IT and computer systems support, and other departments.

The lab staff is divided into two primary operating groups: immunochemistry and mass spectrometry. Historically, this corresponded with analysis of large-molecule (protein, peptide) and small-molecule therapeutics, respectively. This line recently has shifted significantly, and the mass spectrometry area now covers a range of both small- and large-molecule analyses.

"THE WORKLOAD AT TAYLOR TECHNOLOGY VARIES GREATLY DEPENDING ON THE PHASE OF THE PROJECT."

"Currently, four people report directly to me," LeLacheur says. "These colleagues manage the mass spectrometry operations at Taylor, including both regulated and non-regulated analyses, and our data management/technical writing team.

"The mass spectrometry portion of Taylor has been in business for more than 15 years. On the immunochemistry side, we've been in business for only a few years, and the relative sizes reflect that," he explains. "The mass spectrometry operation is still larger, while immunochemistry is growing much more rapidly."

The lab staff consists of chemists and biologists, and includes personnel from the pharmaceutical and biotechnology industries as well as veterans of other contract research organization (CRO) labs.

"We have about 15 Ph.D.s on staff at Taylor, with backgrounds ranging from pure analytics to pharmacokinetics," explains LeLacheur, who holds a Ph.D. in environmental chemistry and has experience in environmental processes and analysis, including disinfection chemistry and determination of key pollutants.

The lab staff typically works one shift; however, the workload at Taylor Technology varies greatly depending on the phase of the project. Therefore, a workday at Taylor is not the typical 8:30 a.m. to 5 p.m. that one finds in many labs, but is flexible and dependent on the project each person is working on.

"We'll have people in the door before 7 a.m., we'll have people still here into the evening," LeLacheur says. "So, while we don't formally define it as multiple shifts, we really encourage people to use hours that are appropriate to their project, appropriate to their deadline, and appropriate to the context of their own lives."

For early pharmaceutical discovery and development, the major effort is on the research and development phase—this includes method development in the lab and the appropriate qualification and validation subsequently required. The workload associated with early biomarker development is also focused on research and development.

Sample testing in early development takes relatively less effort and time.

"In later drug development, the situation is reversed, and large numbers of samples are typically analyzed," LeLacheur says. "Overall, we expect to perform tens of thousands of anal-

▲ *Taylor Technology, a subsidiary of PharmaNet Development Group, is located in Princeton, New Jersey.*

yses each month, and to qualify or validate dozens of methods."

Instrumentation

Bioanalysis requires significant sample handling. For this reason, LeLacheur's lab utilizes more than a dozen robotic instruments, particularly for pipetting.

"We use fixed, 96-channel pipetting devices as well as more flexible systems to work with a variety of sample tube types," he explains. "We generally find that semi-automated systems are most flexible and suit our needs; we have therefore avoided the expense and complexity of complete, unattended automation, but remain interested as new developments emerge."

"LELACHEUR'S LAB UTILIZES MORE THAN A DOZEN ROBOTIC INSTRUMENTS, PARTICULARLY FOR PIPETTING."

For final measurement and detection, the immunochemistry assays utilize a variety of spectrophotometric techniques, including absorbance, luminescence, electrochemiluminescence and fluorescence detectors from a variety of manufacturers.

The mass spectrometry group primarily relies on triple quadrupole instruments coupled with either gas chromatography or liquid chromatography.

"The mass spectrometry field continues to advance, and we are moving toward more high-resolution mass spectrometry (HRMS) systems—whether they are triple quad or true HRMS devices such as those based on Orbitrap technology—for improved specificity, sensitivity, and throughput," LeLacheur says. "Similarly, we utilize and remain interested in developments of high-speed chromatography, including ultra high-performance liquid chromatography."

Inventory, maintenance and hiring

When biological samples are received, a dedicated sample management team, whose job includes detailed inventory, notifies clients and team members of sample arrival and initiates electronic information tracking for each one.

"We utilize a specialized laboratory information management system developed and validated at Taylor specifically for management of a bioanalytical laboratory," LeLacheur explains.

For maintaining lab supplies, Taylor utilizes a "just-in-time" principle—supplies are ordered as they start to be depleted—in order to minimize

internal inventory without ever limiting operations. This strategy saves both space and money.

"We both work directly with vendors and leverage our larger corporate relationships in obtaining and managing key supplies," LeLacheur says.

Maintenance of laboratory equipment is primarily performed in house, even for the most complex analytical systems.

"We have an exceptional level of internal knowledge and experience, and draw upon talented personnel from IT, electrical engineering, and applications chemistry backgrounds to achieve and maintain the high performance required from sophisticated laboratory equipment such as triple quadrupole mass spectrometers and robotics," LeLacheur explains.

Hiring is managed locally at Taylor, coordinated through an internal human resources staff. Relevant operations personnel conduct interviews with potential colleagues. For example, chemists will interview chemists and QA auditors will interview QA auditors. Taylor management uses this method to ensure that the current staff is deeply invested in selecting candidates and training their new colleagues.

Turnover is very low at Taylor. Even those who leave to go elsewhere have been known to return. LeLacheur happens to be one such employee: "I worked at Taylor in the 1990s and returned several years ago. The actual work and science may be similar to other laboratories, but the culture in this company is very supportive and very unique."

Key challenges and solutions

The essence of the business at Taylor Technology may be more scientific and research-oriented than some of the more routine testing laboratories where the work tends to be similar each day. Therefore, LeLacheur and his staff are often faced with very difficult technical problems that can prevent the staff from making progress. During such times, morale can become an issue.

"SUCCESS IN BIOANALYSIS, ESPECIALLY REGULATED BIOANALYSIS, REQUIRES A FOCUS ON AND MASTERY OF DETAILS."

"Most experienced managers know how to keep their heads while all those around them might have a tendency to lose theirs," LeLacheur says. "This helps bring in a little perspective and perhaps keeps everyone grounded."

Those hard moments, LeLacheur notes, can also be used as teaching moments. "So it's important to get people to realize that a research challenge is a learning opportunity that helps us grow, and ultimately it's going to work to the benefit of our client to work through these problems."

Having been through such experiences many times, LeLacheur encourages his staff to relax during difficult periods, work through problems, stay in very close contact with the client, and then ultimately see the project through to success.

"Success in bioanalysis, especially regulated bioanalysis, requires a focus on and mastery of details; success of the overall business makes me lift my head up from the daily details to make sure we check on where we're going and how we're getting there," LeLacheur says. "My job presents me with the continual challenge of integrating the big and small pictures."

In addition to helping his team technically, LeLacheur and the management team help boost morale at the workplace by organizing fun events during which the employees can enjoy the lighter side of Taylor Technology and PharmaNet.

"For example, we just had a large corporate-level picnic for families, with lots of entertainment and great food," LeLacheur says, "and we have Pie Day later this week—Pie Day is just what it sounds like, we bring in a ton of really good pies from a local orchard/bakery, and just use it as an excuse to interrupt the day. We do it almost annually as a fall harvest kind of thing."

In addition to a summer party and a holiday event, Taylor organizes other events aimed at improving techniques in the lab, facilitating internal communications, and raising the spirits of employees. For example, the lab is shut down about once a month for something called a training day, when everyone gets together for formal sessions about new standard operating procedures and informal sessions where the staff can discuss new developments within the industry.

"ANOTHER WAY TO STAY AHEAD OF THE FIELD IS THROUGH CLIENTS, WHO THEMSELVES ARE ALSO TRYING TO STAY CURRENT AND FIND WAYS TO IMPROVE."

"We have a big meeting with catered food to open the day, and we create very light-hearted moments. We update company news, and we give awards—typically called ABCDs (Above and Beyond the Call of

Duty)—to people who have really risen to the task on behalf of a client through late nights, weekends, and so forth," LeLacheur says.

Staying current

Because of the research and development aspect of Taylor, it's imperative for the staff to stay current with advances in the field. For this reason, the management ensures that appropriate personnel attend relevant workshops and conferences covering both the scientific and regulatory aspects of bioanalysis.

"There are a number of conferences that we from Taylor attend regularly," LeLacheur says. "This includes some of the big, industry-standard conferences such as the American Society for Mass Spectrometry, Biotechnology Industry Organization, and some of the smaller, more focused meetings.

"We try to get a lot of people out to conferences, not just management but also our technical leaders, our bench chemists, our QA auditors. We want to let people get out, hear what's happening in the industry, and listen for new, emerging technologies," LeLacheur explains.

Another way to stay ahead of the field is through clients, who themselves are also trying to stay current and find ways to improve.

"Collectively, between our experiences and their experiences, by drawing upon our combined expertise, we really start to see emerging technologies earlier," LeLacheur says. "Everybody who is in touch with clients, everybody who is circulating at conferences, is bringing home information about what's new.

"Maintaining the scientific and regulatory expertise of our staff is critical to the on-time delivery of the highest-quality results to our clients. We work daily to keep Taylor an exceptional place to work and to make the right investments for our staff and clients."

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

CONSTRUCTIVE FEEDBACK

PROVIDING FEEDBACK TO YOUR SUPPLIERS ALLOWS THEM TO MAKE IMPROVEMENTS AND REACT TO MARKET DEMANDS by Deborah Farnham

An employee's performance evaluation is often a scheduled, structured process in which the feedback provided is both positive and practical. The employee can use this opportunity to further develop core strengths and identify areas of professional improvement.

In the vendor-customer relationship, feedback is just as important. Positive and negative feedback helps companies to develop core strengths and identify areas of improvement in manufacturing, delivery, pre- and post-sale support, and product development.

A good company will proactively seek feedback by contacting customers and listening and responding to their comments; by analyzing feedback for product/service improvements, market trends and opportunities; and using this information to develop a plan of action. Unfortunately, most companies rarely solicit feedback, so it's up to the customer to initiate contact, and more often than not, this contact is the result of a problem.

Although the offer of feedback is always appreciated by a company, the manner in which the feedback is crafted can sometimes be destructive rather than constructive. At the same time, the manner in which a vendor chooses to respond to feedback can ultimately benefit or damage its reputation. Constructive feedback is a valuable tool, while destructive feedback is simply critical. It behooves both sides to work constructively together to reach a resolution to the issue.

"CUSTOMER SERVICE IS OFTEN JUST AS IMPORTANT AS THE QUALITY OF A VENDOR'S PRODUCT OR SERVICE."

Providing feedback

When providing feedback to a vendor, focus on the topic at hand and provide as many details as possible. These include how the product is used, where or when it was purchased, and the chain of events that led to this feedback. The more detail you can provide, the easier it is for the company to assess the situation, incorporate any necessary corrective action and respond to the feedback. Even complimentary feedback should include detail so that the company knows exactly why your experience was positive; this information can be applied to benefit other customer experiences.

If the feedback is the result of a problem, a polite and professional tone can go a long way toward encouraging a dialogue and resolving the problem. Don't be afraid to voice your expectations for the best possible solution; it doesn't hurt to ask, but neither is the company obligated to comply.

Bad Example: *My Lucky Cup coffeemaker just exploded, sending coffee everywhere. It soaked my notebook, and now I have to repeat 16 hours of work. I can't even go to our annual ice cream social, and I was looking forward to that all week! Do you even look at your products before you ship them? Lucky Cup is awful. You owe me a new coffeemaker!*

Better Example: *I purchased your Lucky Cup coffeemaker six months ago and have been using it twice per day ever since. Today, as I poured coffee, the carafe handle broke where it was joined to the glass carafe neck, sending hot coffee all over my notebook. My notes are destroyed, data must be recreated, and I have no coffee to drink. To compensate for my lost productivity and decreased energy level, would you send me a free Lucky Cup coffeemaker?*

MEET THE AUTHOR

To see an interview with *Lab Manager Magazine* contributing writer, Richard Daub, visit www.qorpak.com/labmanager.

Richard Daub is a writer and journalist based in New York City. He is the author of three books and the former North American editor of Animal Pharm, a pharmaceutical trade publication produced by international publishing house Informa PLC. His first article for *Lab Manager Magazine* ("Show Me the Money", October 2009) is a piece about how U.S. stimulus funds have so far done little to help laboratories. His second article, to be featured in the December issue, will explore the results of the magazine's recent business management survey that revealed a major communication gap between upper management and lab managers and the effects it can have on the business of running a laboratory.

To learn more about Richard, visit the link above.

Look for more 'Meet the Author' video links in upcoming issues of *Lab Manager Magazine*.

Responding to feedback

In today's crowded and competitive scientific landscape, customer service is often just as important as the quality of a vendor's product or service. So, whether a customer is called upon to share his or her experience with a company or its product, or volunteers the information, he or she should be taken seriously and answered with the utmost professionalism.

When feedback is handled properly, the customer's overall experience can be improved or strengthened, increasing the chances that he or she will continue to purchase from the vendor or recommend the vendor's products or services to other potential customers. The company can also apply the experience toward uncovering underlying root causes and making improvements for future customers.

On the other hand, when the situation is mishandled, the customer's experience can go from bad to much, much worse. An adverse experience, especially in an era of social media and instant communication, has the potential to resonate far and wide. It's no longer simply a matter of the vendor losing the business of one unhappy customer; if that customer is motivated to take action, news of the experience could spread, damaging the company's reputation within its core markets.

Bad Example: *Lucky Cup claims no liability for personal property damage due to carelessly poured coffee.*

Better Example: *Thank you for bringing this to our attention. We're sorry to hear that your notebook and notes were destroyed. We are currently investigating this matter internally and, if necessary, will contact you for additional information. While we cannot send you a free Lucky Cup coffeemaker as requested, we hope that you will accept a free replacement carafe and a $5 coupon for our Mountain Roast ground coffee as a token of our regret.*

Feedback analysis

In addition to the immediate actions of responding to and resolving individual customer comments, an analysis of all feedback over time can highlight trends for process, product or service improvements, or even avenues for providing additional value to customers. This analysis can be compiled internally or by specialized external firms, and an overview with recommendations to management ensures that everyone is aware of any actions to be implemented.

In the aforementioned *Lucky Cup* coffeemaker scenario, the problem may have been a single manufacturing defect, a change in the manufacturing process or even careless handling by the operator. With such isolated feedback, it's nearly impossible to determine why the carafe broke; but when this feedback is compiled with information from other customers, potential causes can be eliminated or confirmed.

With analysis in hand, the company is tasked with weighing improvements and additional valuations against feasibility. Additionally, the analyses can be used proactively to shape new products and new features for existing products.

"WHEN FEEDBACK IS HANDLED PROPERLY, THE CUSTOMER'S OVERALL EXPERIENCE CAN BE IMPROVED OR STRENGTHENED."

Summary

Customer feedback is an important piece in the understanding of a customer's experience. Customers who share their experiences with a vendor receive direct improvements where necessary and feasible, and also benefit in the long run from the resulting improvements to that company's products.

At the same time, the demonstration that a customer's feedback is valuable to a vendor, and the improvement of a negative situation, can ultimately lead to a positive customer experience. Without receiving feedback, it's hard for a company to anticipate improvements and react to changing market demands.

Deborah Farnham *is director of marketing & sales operations at BioTek Instruments, Inc. Deborah can be reached at farnhamd@biotek.com or by phone at 888-451-5171.*

KEEPING SAFETY IN SIGHT

SAFETY GLASSES, GOGGLES AND FACE SHIELDS – KNOW WHAT TO USE WHEN **By Vince McLeod**

"A SIMPLE SCRATCH FROM A FINE DUST PARTICLE CAN LEAD TO CORNEAL EROSION AND LIFETIME RECURRING PAIN."

Many of us have probably heard the horror stories or seen the gruesome photos of nails stuck in the eyes of employees and other such grisly accidents. Many research laboratory professionals are familiar with basic eye protection, but did you know that about 2,000 eye injuries occur on the job *every day*?[1] And did you ever stop to think that even "minor" eye injuries can cause long-term vision problems and suffering? For example, a simple scratch from a fine dust particle can lead to corneal erosion and lifetime recurring pain. Have you ever considered that simply passing through an area can result in an eye injury? Or, that workers around and next to you may be generating the hazard? Consider these examples compiled by the American Industrial Hygiene Association's Laboratory Health and Safety Committee[2]:

"RESEARCH LABORATORIES HAVE THEIR OWN UNIQUE EYE HAZARDS."

Case #1: A laboratory worker was pouring chloroform though a gel column inside a fume hood. Due to incorrect equipment configuration, pressure built up in the column and caused the glassware at the top of the column to break, spraying chloroform out of the hood, onto the worker's face, eyes and clothing.

The laboratory worker was wearing safety glasses, rather than chemical splash goggles. The chloroform seeped through the opening at the top of the glasses and burned both eyes. The lenses of the safety glasses were partially dissolved by the chloroform.

Case #2: An undergraduate student was working on an experiment in a hood. When she removed the reflux condenser, the solution bumped, splashing her face and chest. Despite the fact that she was wearing goggles, the solution managed to go past the seal and into her eyes.

Many injuries happen every day in construction and manufacturing. However, research laboratories have their own unique eye hazards and some that are not so unique. So, take a few minutes and answer these questions:

- *What are the potential eye hazards in my laboratory? Or in my facility?*
- *What are the most dangerous jobs (either in terms of task or tools used)?*
- *Where are the most hazardous areas for eye safety?*
- *What type of eye protection is appropriate for these jobs or areas?*
- *Are other preventative measures available?*

Start at the beginning

As with every safety program we discuss, prevention is the key. Look at your answers to the questions above and start by determining how you can eliminate eye hazards at your site. First, develop an eye safety strategy based on job hazard analysis. This should incorporate engineering solutions, administrative solutions and proper eye protection. Engineering controls are best and, ideally, implemented first. They include guards to prevent particles and splashes from being dispersed, hoods to capture dust particles and vapors and other such equipment. Administrative controls include setting up hazard areas as "off-limits" and locating passageways and thoroughfares away from active work areas. The last piece of the puzzle—proper eye protection—is the focus of this article. Keep reading to learn more on the basic types of eye protection and when to use them.

When should eye protection be worn?

"I didn't think I needed it!" That is the most common response by those unfortunate workers with eye injuries when asked why they were not wearing eye protection. One question we need to answer for our employees is: When do I need to wear eye protection? The simple answer: Any time there is a risk of something getting into the eyes. In general, this includes common laboratory tasks such as mixing, pouring, weighing out materials and similar jobs that create dust or particles or present a splash hazard. For specialty research, hazards vary depending on the task and technology employed and whether one is doing field investigations or working in the lab. Researchers can be exposed to vapors, sprays and powders, so keep eye protection in place when mixing or using chemicals and cleaning solutions, and when doing any job that can produce a splash. Do not overlook the less common operations such as lasers and radiation that pose special hazards. Finally, pay attention to common maintenance activities that may occur in the lab or facility such as welding, soldering, hammering, sawing, grinding and other such tasks.

"DO NOT OVERLOOK THE LESS COMMON OPERATIONS SUCH AS LASERS AND RADIATION THAT POSE SPECIAL HAZARDS."

In my experience with research laboratories we have identified a number of tasks where eye protection should be mandatory. These range from routine housekeeping duties to hazardous light sources to working with solvents and chemicals in analytical labs.

What type should I be using?

The major groups of eye protection are safety glasses, goggles and face shields. There is an optimum type of eye protection for each of the tasks listed above. First, suitable eye safety wear should bear the Z87 marking. This refers to meeting the American National Standards Institute (ANSI) testing criteria for safety eyewear[3]. Safety glasses (non-prescription) must withstand a ¼-inch BB shot at 100

mph and an impact from a one pound pointed weight dropped from 4 inches above. The lenses must not break in either test to receive the Z87 mark. Prescription safety glasses must withstand the impact of a 2-inch steel ball dropped from 4 inches above, unless they have the Z87+ mark indicating they passed stricter tests. Most safety lenses are made of polycarbonate, a material much more impact-resistant than glass or plastic. Polycarbonate tends to crack when impacted, whereas glass and plastic will shatter into many small, sharp pieces.

"GOGGLES ARE THE NEXT STEP UP IN PROTECTION, BEING STRONGER THAN SAFETY GLASSES."

By far the most common, safety glasses are used for impact hazards such as sawing, hammering, drilling and optical radiation from lasers and torch soldering. If flying particles are present then side protection should also be used. Older style safety glasses used side-shields whereas newer styles provide wrap-around designs.

Goggles are the next step up in protection, being stronger than safety glasses. If the particles are bigger, heavier or falling from above, goggles provide more impact resistance and complete coverage. Goggles are also used to guard against splash hazards like mixing or using chemicals and cleaning solutions. Many goggles are designed with venting to prevent fogging during use but these are not suitable against splashes or very fine dust. We tested a set recently where if you were splashed on the forehead the liquid was directed to the eyes by the vents, so be careful in your selection.

Face shields offer an extra level of protection. They provide higher impact resistance and protect the wearer's entire face, not just the eyes. However, they should always be used with either safety glasses or goggles as splashes, particles or chemicals can get around the shield and into the eyes. Also, it is a common tendency to lift face shields to check the work progress thus leaving the eyes unprotected if used alone. Face shields are typically used for work involving spraying and pressurized equipment.

Keep an eye out for safety

Vision is one of our most precious senses. Injuries can lead to long-term problems or permanent disability. With the cost and performance of today's safety eyewear, the risk for potential injury is a price not worth paying. Take the time now to ensure your employees are keeping safety in sight.

1. National Institute of Occupational Safety and Health (NIOSH) Eye Safety, http://www.cdc.gov/niosh/topics/eye/default.html
2. Laboratory Safety Incidents: Chemical Exposures and Burns, American Industrial Hygiene Association, Fairfax, VA. February 2004. http://www2.umdnj.edu/eohssweb/aiha/accidents/chemicalexposure.htm
3. American National Standards Institute (ANSI), http://www.ansi.org/

Vince McLeod *is an American Board of Industrial Hygiene Certified Industrial Hygienist and the senior IH with the University of Florida's Environmental Health and Safety Division. He has 22 years occupational health and safety experience at UF and specializes in conducting exposure assessments and health hazard evaluations for UF's 2200 plus research laboratories.*

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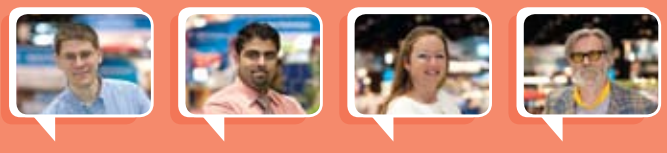
ANNY S. LAU | *Senior Chemist, Orange County's Groundwater Authority*

"We are currently looking to purchase new instrumentation, so we are really interested in new products and technologies that are released at Pittcon. The poster sessions and seminars are great for learning about new techniques, and I really enjoyed meeting technical reps and other scientists who are working in my area of interest."



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VÉRONIQUE PERES | *Maître de Recherche, Ecole Nationale Supérieure des Mines, Saint Etienne*

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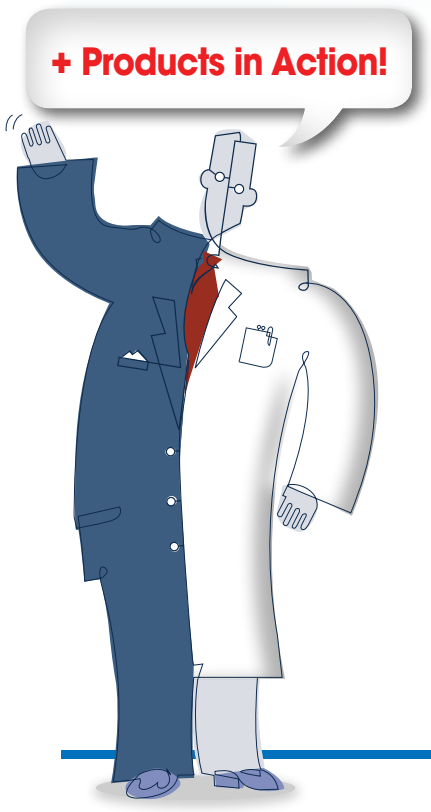
LAB MANAGER MAGAZINE'S NEW PRODUCT RESOURCE GUIDE



ALLEVIATING ACETONITRILE SUPPLY ISSUES

Problem: Acetonitrile costs have soared by 6 to 8 times since the summer of 2008 due to a global shortage of this key chromatography solvent. The factors contributing to the shortage are primarily related to the global economic downturn. Unlike the situation with other solvents, such as methanol, there are no facilities dedicated to the manufacture of acetonitrile. Instead, raw acetonitrile is obtained as a by-product in the production of acrylonitrile, a plastic used in automobile components and other products. As a consequence of the collapse in the automotive industry and the associated overall reduction in demand for acrylonitrile, there has been a significant decrease in the supply of acetonitrile.

It is anticipated that the supply and pricing issues around acetonitrile could well continue, due in part to a forecast growth in global consumption of 5 percent per year over the next five years. This is based on the expected increasing use of acetonitrile in the production of engineered drugs, generic pharmaceuticals and pesticides, particularly in China and India. Consequently, many laboratories continue to seek solutions to conserve solvent usage within their chromatography protocols.

Solution: There are a number of potential strategies that can be adopted by chromatographers to alleviate the ongoing acetonitrile supply issues, such as reducing the amount used by decreasing column length, width and particle size, or by replacing it completely with an alternative solvent. However, changing HPLC methods may require protocol development and revalidation. Alternatively, to eliminate the need for time-consuming protocol development, chromatographers could simply recycle their eluent, particularly if using an isocratic solvent system.

Although solvent recycling has both economic and environmental benefits, it has previously not been extensively practiced. This is because traditional recycling systems have tended to be cumbersome, requiring frequent manual resetting to allow for baseline drift, take up valuable bench space, and can only be used to recycle a single solvent or set mixture. However, modern recycling systems such as the Thermo Scientific SRS Pro Solvent Recycling system, are now microprocessor controlled and can overcome many of these issues, helping to reduce mobile phase consumption by up to 90 percent.

▲ *Thermo Scientific SRS Pro Solvent Recycling system*

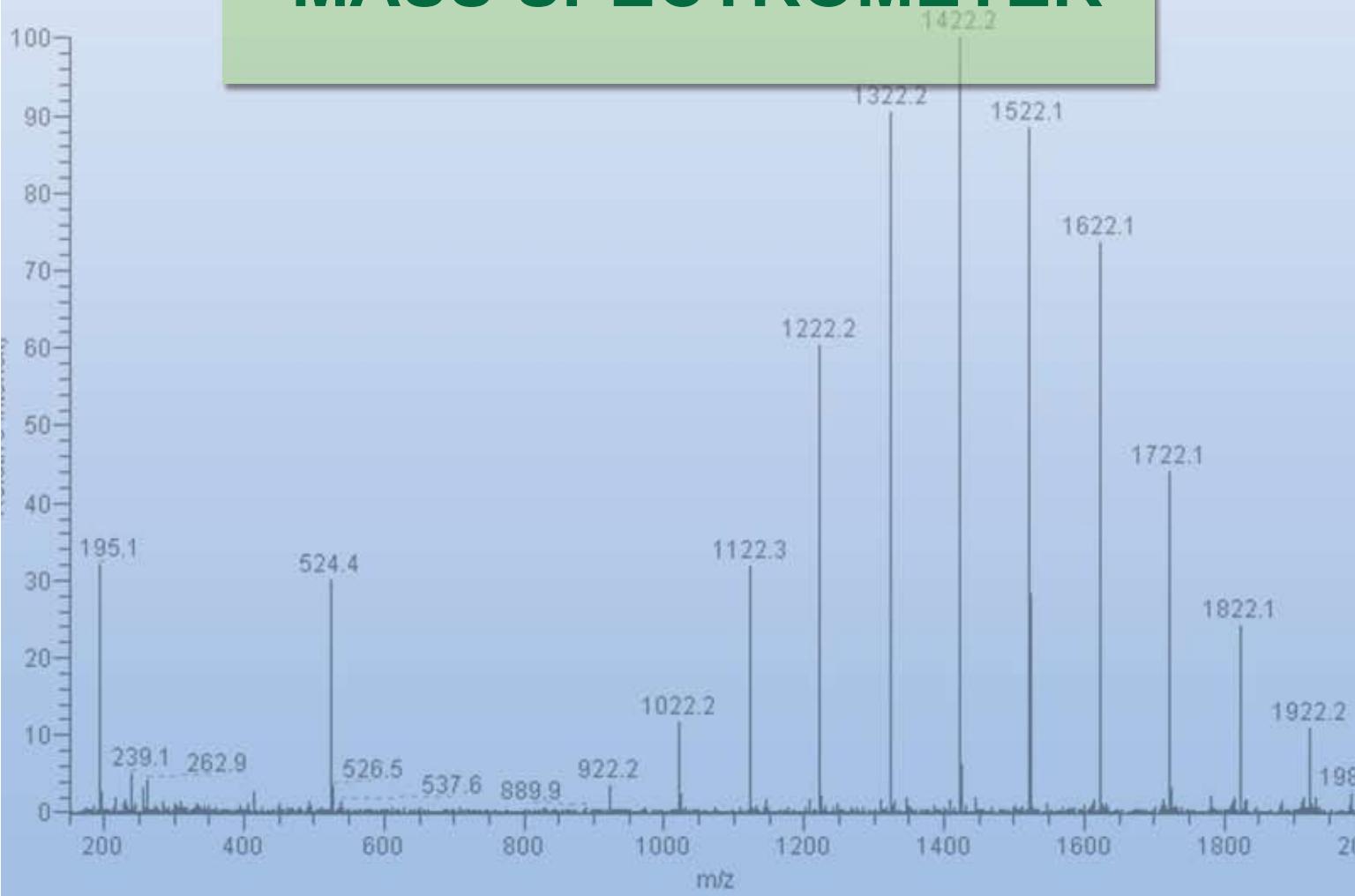
The innovative SRS Pro redirects untainted mobile phase to the solvent reservoir during isocratic HPLC operation. Through the continuous monitoring of the chromatographic detector output signal, the mobile phase is only recycled to the solvent reservoir when the baseline is below a threshold value. When this value is exceeded as a peak is eluted, the tainted eluent flow is redirected to waste, accounting for the transport time from the detector to the switching valve. Once the signal returns below the threshold, the mobile phase is switched back to the reservoir.

The modern and compact design of the SRS Pro eliminates the need for a power adaptor, as the solvent saver is powered directly from the chromatography data system PC, via a USB connection. Furthermore, the easy-to-use software enables simple configuration of the system parameters and online monitoring. Additionally, the SRS Pro is designed to recycle the mobile phase only when switched on. Even in the case of a power failure, the valve is automatically positioned in the waste position to ensure that the mobile phase reservoir remains uncontaminated.

To summarize, while the shortage of acetonitrile has certainly been a key driver for the uptake of modern solvent recycling systems in chromatography laboratories, solvent recycling is not limited only to acetonitrile and can be applied to most isocratic mobile phase. Any reduction in the consumption and disposal of organic waste, leading to "greener" HPLC and reduced costs, is surely a benefit in the long run.

For more information, please visit www.thermo.com/recyclesolvent.

A BASIC GUIDE TO PURCHASING A REFURBISHED MASS SPECTROMETER



...AND CHOOSING A REPUTABLE PROVIDER

A BASIC GUIDE TO PURCHASING A REFURBISHED MASS SPECTROMETER
...AND CHOOSING A REPUTABLE PROVIDER

FIRST; determine the needs of your laboratory. Ask the following questions:

- Do you have a limited budget for purchase?
- Will you need proven technology?
- Are you interested in a demo of your instrument before purchase?
- Are you interested in long term support?
- Do you have instruments to trade in from other manufacturers?
- Do you have existing components that will be integrated into the MS you purchase?
- Are these components from different manufacturers?

If you answered YES to any of these questions then you are most likely interested in purchasing REFURBISHED equipment. Please read on!

SECOND; What is your Application? Your application will help you determine what type of MS you will need. (Broad Range of Analyses or 1 or 2 routine ASTM, EPA methods)

THIRD; Do you need a GC or LC system for your separation? Consider the characteristics of the system that best suits your needs.

GC/MS Considerations

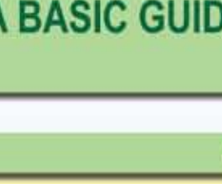
Single Quad MS

Features:
Mass Range 10-700 amu (Typical)
Small Footprint
EI or CI Capability
Introduction by GC or Solids Probe
Quantitative Analysis
Spectral Library
SIM

Typical Models:
Agilent-597X
Thermo-DSQ, SSQ
Shimadzu-2010, QP 5000
Perkin Elmer-Clarus, Turbo Mass

Ion Trap MS

Features:
Mass Range 10-700 amu (Typical)
Small Footprint
EI or CI Capability
Introduction by GC or Solids Probe
Qualitative Analysis
SIM



Typical Models:
Thermo-GCQ, Polaris Q
Varian-Saturn

Triple Quad MS

Features:
Mass Range 4 - 4000 amu (Typical)
Parent/Daughter Ion Identification
EI or CI Capability
Introduction by GC or Solids Probe
Quantitative Analysis
Neutral loss Precursor Ions
Spectral Library
True MS/MS
SIM

Typical Models:
Thermo-TSQ
Varian-1200L
Waters/Micromass-Quattro

LC/MS Considerations

Single Quad MS

Features:
Mass Range 50-2000 amu (Typical)
ESI/Turbo Ion Spray
APCI / Heated Nebulizer
Quantitative Analysis
SIM

Typical Models:
Thermo-SSQ
Agilent-1100
ABI-150
Waters-ZMD

Ion Trap MS

Features:
Mass Range 50-4000 amu (Typical)
ESI/Turbo Ion Spray
APCI / Heated Nebulizer
Nano Spray
Qualitative Analysis
Extended Mass Range Available
MALDI
SIM

Typical Models:
Thermo-LCQ Family

Triple Quad MS

Features:
Mass Range 50-4000 amu (Typical)
ESI/Turbo Ion Spray
APCI / Heated Nebulizer
Nano Spray
Quantitative Analysis
Parent/Daughter Ion Identification
Neutral loss Precursor Ions
SIM

Typical Models:
Thermo-TSQ
Waters/Micromass-Quattro LC
ABI-365, 2000, 3000

FINALLY; When buying refurbished, the most important decision is choosing a reputable provider for your instrumentation. Ask your provider if they offer the following Value-Added Benefits:

Technical Support:
- Do they provide installation in your facility with their own engineer or do they have to rely on a subcontractor?
- Do they have multiple engineers on staff?
- Are their engineers trained and capable of multi-vendor support?
- Do they have chemists on staff to assist you?
- Do they have the ability to service past and present models?
- Do they offer expert technical telephone and field support?
- Are their engineers experienced instrument operators?
- Can you talk directly to the service engineers prior to purchase?
- Will they provide you with the manuals to operate your instrument?
- Do they have proof of insurance to work at your facility?
- Do they stock hard to find parts?
- Do they offer additional customized training courses for operation, maintenance and methods?

Business Philosophy:
- Do they deliver a high quality, fully refurbished tested instrument or is it simply a used mass spec?
- Does the company service what it sells?
- Do they own, not broker, the equipment they sell?
- Do they have a proven track record and a distinguished reputation?
- How long have they been in business?
- Do they send test and calibration data to prove instrument performance?
- Does the vendor custom crate instruments before shipping?
- Are they willing to provide references prior to purchase?
- Is the instrument thoroughly cleaned and carefully packed prior to shipment?
- Do they offer a 1 YEAR WARRANTY?
- Do they offer a satisfaction guarantee with every instrument they sell?
- Does the vendor have an up-to-date, well-maintained web site or just a list of equipment for sale?
- Do they have a large inventory or just 1 or 2 instruments?
- Will they provide you with photos of the actual instrument from their inventory?
- Can you visit the vendor and see the instrument in operation prior to purchase?
- Is the integrity of the company reflected in their Dun & Bradstreet and BBB profiles?
- Do they have the instrument in inventory or will they purchase it to fill your order?

Pricing:
- Do they offer flexible payment terms or do they always require payment up front?
- Are financing solutions through Lease/Rental available?
- Do they offer reasonable labor and travel rates?
- Will they take your existing equipment in on trade? Is the trade-in price fair?
- Are they willing to offer a quantity discount?
- Do they provide a detailed quote outlining the pricing, warranty and shipping/installation?
- A refurbished Mass Spec should cost 30% to 50% of list price when it was new. Is their pricing in line with this?
- Do they have competitive prices and offer added value?

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Problem: The determination of mercury has become a routine test in many analytical laboratories. In the past, laboratories have had a choice of using either Cold Vapor Atomic Absorption (CVAA) or ICP-MS to do their mercury analysis. Although both techniques are effective, each requires tedious sample preparation prior to analysis. This is not only costly and labor-intensive but can be challenging due to the element's volatile nature. In addition, both techniques allow the operator a relatively small dynamic range in which to work.

▲ *Milestone's DMA-80 Direct Mercury Analyzer allows for prep-free, matrix-independent analysis in as little as five minutes.*

Solution: The DMA-80 Direct Mercury Analyzer (Milestone Inc.) is a bench-top mercury analyzer that requires no sample preparation steps and delivers results comparable to CVAA and ICP-MS in as little as five minutes per sample. The DMA-80, as referenced in U.S. EPA Method 7473, can be used for the determination of mercury in a variety of matrices including biological tissue, soils, coal and coal by-products and petrochemicals. Other methods which reference direct mercury analysis include U.S. EPA Draft Method 30 B and ASTM Method D6722-01.

The DMA-80 incorporates the following sequence: thermal decomposition, catalytic conversion, amalgamation, and atomic absorption spectrophotometry. A sample is simply weighed and loaded into the built-in autosampler. From here, the sample is placed inside a quartz tube where controlled heating first dries and then thermally decomposes the sample. A continuous flow of oxygen carries the decomposition products through a hot catalyst bed where halogens, nitrogen, and sulfur oxides are trapped. All mercury species are reduced to Hg(0) and then carried along, with reaction gases, to a gold amalgamator where the mercury is selectively trapped. All non-mercury vapors and decomposition products are flushed from the system. The amalgamator is then subsequently heated which releases all mercury vapors to the single beam, fixed wavelength atomic absorption spectrophotometer. There, absorbance is measured at 253.7 nm as a function of mercury content.

The DMA-80 has a dynamic range of 0.0015 ng – 1000 ng, enabling for a wide variety of applications. A forty position, removable autosampler allows for virtually limitless unattended analysis. The analyst can simply load the sample and press 'START'. Because no sample preparation is required, there are substantial cost and labor savings and no chemical waste is generated.

The DMA-80 provides the laboratory with an easier, more cost-effective mercury analysis instrument. Comparative charts have shown that the DMA-80 saves the laboratory approximately 70 percent of costs when compared to CVAA—with comparable results.

For more information, go to www.milestonesci.com

LAB MANAGERS' BEST PURCHASING PRACTICES

GREATER FOCUS ON BUSINESS VS. PERSONAL RELATIONSHIPS WITH VENDORS

by Bernard Tulsi

Direct technology spending and the time and effort expended by a variety of laboratory personnel to source, assess and buy equipment, raw materials and consumables make the acquisition and maintenance of tools and lab wherewithal a dominant expense category on the balance sheets of laboratories. In fact, in its annual laboratory investment study, *Lab Manager Magazine* found that 37%—more than one of every three dollars—of laboratory expenditures was linked to the acquisition of instrumentation, systems and supplies.

"MORE THAN ONE OF EVERY THREE DOLLARS OF LABORATORY EXPENDITURES [IS] LINKED TO THE ACQUISITION OF INSTRUMENTATION, SYSTEMS AND SUPPLIES."

Still, no substantive guide delineating the best practices for acquiring laboratory technology and materials currently exists. In a number of cases, lab managers and their staff evolve ad hoc and idiosyncratic evaluation and acquisition approaches, or they rely on or are expected to comply with often arbitrary organizationwide guidelines designed to satisfy multiple departmental requirements.

Focused on its role as the business management publication for professional decision makers, *Lab Manager Magazine* recognized the need for a guide that shares the best approaches on choosing vendors, selecting equipment and materials, negotiating with vendors and formulating return-on-investment parameters for technology investments, among other key issues.

This seemed all the more urgent in light of the financial pressures emanating from the global economic downturn. The wise use of available funds and the realization of maximum returns seem almost imperative for survival in the current economic environment.

It became clear that the time to address this important unmet need was at hand. As a result, *Lab Manager Magazine* initiated original research aimed at identifying some of the best practices in laboratory equipment acquisition to share with its readers. It was felt that such findings likely would translate into greater confidence and competence among lab personnel charged with making acquisitions for their operations.

In mid-2009, *Lab Manager Magazine* initiated the first of what is expected to become an annual broad-ranging survey of lab staff in leadership roles. In the survey, 767 staffers drawn from a large number of laboratories in the United States and Canada provided responses to a range of questions about their acquisition practices.

Laboratory Setting	(%)
Industry Lab	25
University/College Lab	22
Government Lab	17
Contract Lab	3.6
Private Research lab	6.4
Clinical Research Hospital/Medical lab	12
Distributor/Dealer (New and Used Equipment)	2.4
Manufacturer	10
Other	1.6

Table 1. Survey participants by research, market or industry settings

Most (77%) of the respondents worked in facilities where the total workforce was 25 or fewer people. Only 7% operated in labs with 100 or more workers, 8% worked in labs with 51-100 workers and almost a tenth (9.6%) were attached to labs with 26-50 workers.

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More than half (52.2%) of the survey participants were attached to organizations that employed more than 251 workers. About a quarter (24.9%) belonged to organizations that employed less than 50 workers, 8.4% worked for organizations with 51-100 workers and 14.5% were with organizations employing 101-250 workers.

Job Activity	(%)
R&D	22.4
Quality Control / Assurance, Validation	19.2
Manufacturing / Processing	5.2
Engineering / Design	0.8
Corporate Management	10.4
Regulatory	3.2
Purchasing	5.2
Technical Services	16
Analyst	5.6
Teaching	6.4
Other	5.6

Table 2. Distribution of survey participants by job activity

Less than half (42.5%) of the participants identified themselves as the leaders in their labs/organizations, while just less than a third (30%) described themselves as one of a handful of leaders. About 18% indicated that they were part of a larger group that provided leadership and less than 10% reported that they were not involved in any leadership role.

The labs spanned a broad cross-section of industry and academia, with almost half of the participants, when combined, attached to either industry (25%) or university/college (22%) labs. Most of the other participants were drawn from government labs; clinical research, hospital and medical settings; and manufacturing labs, among others, as indicated in Table 1.

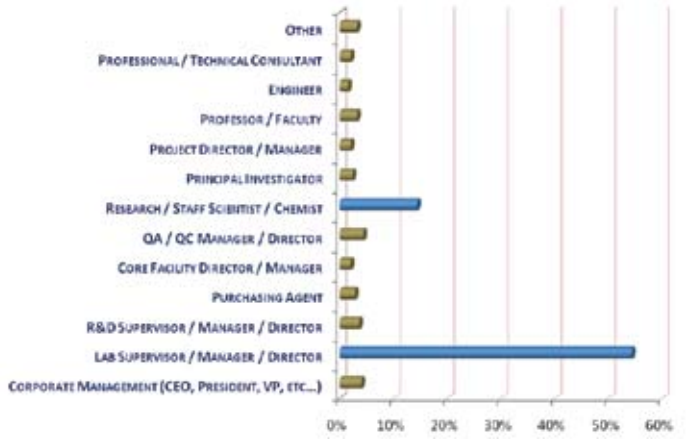

Figure 1. Distribution of survey participants by job title or function

Almost a quarter (22.4%) of respondents were involved in research and development. The proportion of participants in quality control, assurance and validation was close to 20%, 16% listed their job functions as technical services and a little more than 10% listed their roles as corporate management. These and other categories are shown in Table 2.

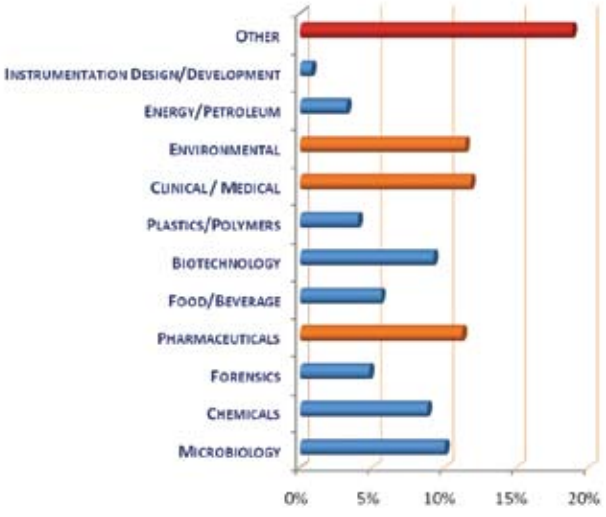

Figure 2. Proportion of participants by field of work

The participants, all whom are *Lab Manager Magazine* readers, have a broad range of technical and managerial responsibilities. More than half (54.4%) of the respondents held the title of supervisor, manager or director. Researchers, staff scientists and chemists made up the second largest segment (14.4%) of survey participants. The proportion of participants in all other title or function categories was under 10%, as indicated in Figure 1.

The participants work in a variety of disciplines, with the largest proportion (more than 10%) in the microbiology, pharmaceuticals, clinical/medical and environmental areas. The distribution of these and other disciplines among the participants is shown in Figure 2.

Turning to the issue of changes that likely will occur in their labs within the next two years— those changes that will require the purchase of new laboratory equipment and related technologies—more than a quarter (25.5%) of the participants indicated that they will be involved in updating current technology needs. While the survey

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makes no scientific claim about completeness or being all-embracing, the responses of the participants provide a useful microcosm of likely changes and activities in the laboratory sector in coming years. Activities planned at varying scales for the next two years include initiating new research projects, expanding existing and building new laboratories, and hiring more staff, as shown in Figure 3.

"LAB MANAGERS AND THEIR STAFF ... ARE EXPECTED TO COMPLY WITH OFTEN ARBITRARY ORGANIZATIONWIDE GUIDELINES DESIGNED TO SATISFY MULTIPLE DEPARTMENTAL REQUIREMENTS."

The survey addressed the roles of the lab leaders who participated in the survey and focused on how they were involved in identifying new technology needs and in evaluating vendors. More than 10% of the participants reported involvement in each of the following areas: assessing resources to determine the needs of their labs, directly gathering information from vendors and making initial contact with vendors. The exact proportions of these and other responses from among the participants are provided in Table 3.

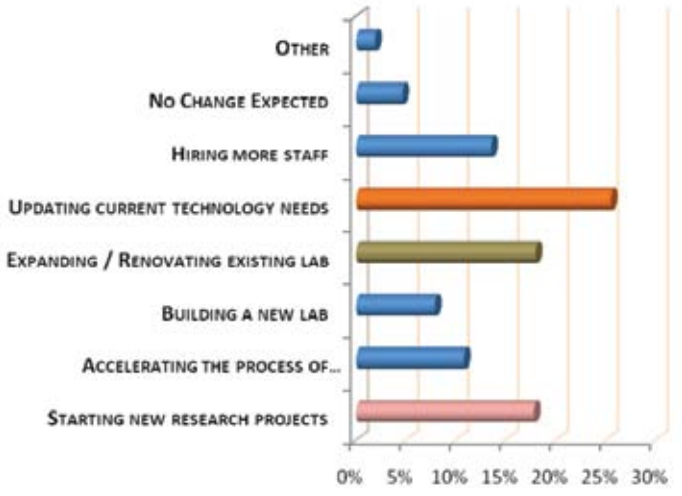

Figure 3. Changes within the next two years that will require the purchase of new lab equipment and related technologies

In an attempt to attribute key roles to specific lab leaders, the participants were asked to identify who in their labs (for example, lab manager, engineer or IT manager) is engaged in four major areas of activities: exploring

Need and Assessment Activity	(%)
Assess resources to define lab's needs	11
Gather information from independent sources and directly from vendors	12.7
Explore solutions - prepare plans / budgets	10.7
Implement the plan - set the timeline, assign responsibilities, etc…	9.2
Supervise the evaluation process	8
Make the presentation to management	8.3
Make the initial contact with vendors	10.2
Negotiate with vendors	8
Participate on teams that review various proposals and make the final decision	6.6
Determine whether the final selection meets the lab's needs	9
Approve the vendor recommendations of others	5.9
No involvement	0.32

Table 3. Participants' involvement in identifying new technology needs and evaluating vendors

solutions—writing and implementing the plans; negotiating with vendors; making final vendor selections; and identifying categories of personnel who are not involved in the process. Lab managers, according to 43% of the participants, are involved in making the final vendor selections. More than a third (36.7%) of the participants identified a role for lab managers in solution exploration and in writing and implementing the plans, while more than half (55.5%) see this as the role for researchers—scientists and chemists. On the other hand, 69% of participants indicated that in their settings, engineers had no role in this process, while 67% did not recognize these as roles for IT managers, 45% did not see them as roles for financial management and 50% identified no role for corporate management in these areas (Table 4).

"MORE THAN HALF OF ALL PARTICIPANTS HOLD THE VIEW ... THAT THERE WAS LESS FOCUS ... ON PERSONAL RELATIONSHIPS, IN FAVOR OF PROFESSIONAL ... RELATIONSHIPS."

On the question of how the relationship between lab leaders and equipment and technology vendors has changed over the past few years, the survey showed that more than half of all participants hold the view—11% strongly agree and 48% agree—that there is less focus

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Lab Function	Explore solutions- write and implement the plan (%)	Negotiate with vendors (%)	Make final vendor selection (%)	Not involved in the process (%)
LAB MANAGER	36.7	15.2	42.6	5.5
RESEARCHER - SCIENTIST/CHEMIST	55.5	10	12	22.5
ENGINEER	21.2	4.9	4.9	69
IT MANAGER	21.6	6.1	5	67.4
FINANCIAL MGMT	10.9	28.3	16.3	44.6
CORP MGMT (CEO, PRESIDENT, VP)	13.3	6.9	30.3	49.5
UNIVERSITY/COLLEGE PROFESSOR GRADUATE STUDENT	22.8	1.6	6.5	69
PURCHASING MGR/AGENT	4.2	49.2	15	31.6
FACILITY MGR	18.8	8.3	16	56.9
ARCHITECT	9	1.7	1.7	87.6
TECHNICAL CONSULTANT	31.2	5.4	3.8	59.7

Table 4. Involvement of lab personnel in key equipment acquisition processes

currently on personal relationships, in favor of professional, business-like relationships. Labs now require vendors to create more custom solutions for their needs, according to about 50% of the participants, while 54% reported that vendors are being held more accountable for performance and are expected to stay involved after the sale. In addition, the data showed that while about 42% of the participants saw a trend toward lesser-known brands, 58% reported reliance on the industry's well-known brands for laboratory products and equipment.

Changing Relationships with Vendors	Strongly Agree (%)	Agree (%)	Disagree (%)	Strongly Disagree (%)	Don't Know (%)
WE NOW FOCUS LESS ON PERSONAL RELATIONSHIPS AND HAVE MORE OF A BUSINESS-LIKE RELATIONSHIP	11	47.5	23.8	6	11.5
WE REQUIRE VENDORS TO CREATE MORE CUSTOM SOLUTIONS TO MEET OUR NEEDS	18.6	49.8	25.9	2	3.6
WE HOLD VENDORS MORE ACCOUNTABLE FOR PERFORMANCE, EXPECTING THEM TO STAY INVOLVED AFTER THE SALE	37.9	54.3	4.5	0	3.3
WE ARE TRENDING TOWARD ASSESSING LESSER-KNOWN BRANDS TODAY.	5	41.5	38.6	6	8.7
WE RELY MORE ON THE INDUSTRY'S WELL-KNOWN BRANDS OF LAB PRODUCTS AND EQUIPMENT	11	57.6	26	1.7	3.3
WE ARE REQUESTING THAT THE VENDOR DEMONSTRATE THE EQUIPMENT IN OUR OWN LAB	25	48.8	20	2	4.2
WE ARE NOW EVALUATING A BROADER RANGE OF VENDORS AND PRODUCTS BEFORE MAKING A PURCHASE.	24	58	11.6	1.2	5
WE ARE PLAYING ONE VENDOR AGAINST ANOTHER TO OBTAIN BETTER PRICING, EXTENDED WARRANTIES AND BETTER CUSTOMER SERVICE	14.4	37	31.3	8.6	8.6
WE ARE BUYING MORE DIRECTLY FROM DISTRIBUTORS AND LESS FROM THE MANUFACTURER.	7.5	32.9	40.8	5.4	13.3
WE ARE BUYING MORE FROM MANUFACTURERS	5.4	28.9	46.3	7	12.4
WE ARE BUYING MORE USED/PRE-OWNED EQUIPMENT	9	24.8	32.6	25.2	8.3

One innovation that has evolved over the years is the purchasing consortium, in which labs seek to integrate themselves in hopes of increasing their negotiating clout with equipment suppliers. The survey showed that 63% of the participants reported that their labs were not affiliated with any such consortia, which are essentially aimed at procuring better pricing and support from vendors. Of the participants (about 37%) whose labs used such consortia, 36% reported that they have been effective at obtaining better pricing, 44% reported that they were only occasionally able to obtain better pricing and 16% reported that the consortia approach did not help them to get better pricing.

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

OPERATING COST SAVINGS IS THE LEADING ROI METRIC

by Bernard Tulsi

Return on investment (ROI) resides at the very foundation of all commercial enterprises. It is unlikely that businesses will be able to scale up, prosper or even survive absent an adequate rate of return on the investments they make to produce goods or provide services. The return rate itself is influenced by a number of factors, including the kind of business, the industry in which it operates and, perhaps most important, the prevailing economic climate.

In the current global economic downturn, characterized by a constricted flow of funding, particularly of credit, ROI considerations have catapulted to the top of the priority list—and the *Lab Manager Magazine* 2009 lab practices survey, as well as follow-up discussions with a number of the participants, suggest that it will remain there for some time.

"ROI CONSIDERATIONS HAVE CATAPULTED TO THE TOP OF THE PRIORITY LIST."

G&T Metallurgical Services (Kamloops, BC, Canada) is an integrated mineral process R&D facility that provides mineral process testing and mineralogical and chemical analysis services, among others, to all the major mining companies in the world. At G&T, the expectation is that any piece of equipment installed in the lab should pay for itself within one year, according to Derek Blundell, analytical laboratory manager.

Blundell says that G&T buys directly from suppliers and vendors, adding, "We have never acquired a piece of equipment that did not pay for itself in a year. It took just eight days for an atomic absorption spectrometer that we acquired to pay for itself."

There was widespread agreement (about 85%) among the survey participants that their organizations are always more receptive to projects in the research labs if they have real business value and show possible ROI. More than a third (35.4%) of the participants completely agreed with this premise, while 49% indicated that they were in agreement with it. Only about 16% of the respondents disagreed.

Still, the mechanisms to conduct ROI assessments are not readily available in many laboratories. In fact, 59.3% of the participants indicated that the management of their organizations did not require formal ROI studies of potential investments against the opportunity and risk. Almost 41% of the participants reported that their organizations do require just such formal studies before making laboratory investments.

When the survey questionnaire drilled deeper among participants whose organizations did not require formal ROI studies, 78.5% responded that they knew of no plans within their groups to adopt procedures for formal ROI studies within the next 12 months—only 21.5% of them said that such plans were afoot in their organizations.

To be sure, ROI is not a primary concern in a number of organizations. John Bardzik, laboratory certification officer at the Wall Experiment Station of the Massachusetts

State Facility for Environmental Test Research, says his organization is involved in the certification of commercial and environmental laboratories. He says that his laboratory is not profit-driven and there is no formal ROI process. "Still, we have reasonable expectations about the efficiency and durability of the equipment that we buy," he says, adding that all vendors must submit to state processes, which include bidding for larger items. "The idea is to find the best value based on different criteria: availability and quality of service, parts, warranty and overall reliability."

Figure 1. Leading ROI Metrics

In organizations where formal ROI studies are required, almost a quarter of the survey participants indicated that operating cost savings is a specific metric employed to determine a reasonable estimate of the value the laboratory is likely to receive after the purchase. The relative importance of cost savings and other important metrics, including staff productivity, are shown in Figure 1.

To be sure, ROI calculations are not always clear-cut. Judy Yen, a laboratory manager at the Whitehead Institute for Biomedical Research at MIT, says, "It is hard to put an exact measure on ROI. We make sure we get our money's worth, but it is really hard to quantify."

Barriers to measuring ROI	(%)
DIFFICULTY IN MEASURING ECONOMIC BENEFIT OF TECHNOLOGY	26.3
INABILITY TO DETERMINE TECHNOLOGY RETURNS	17.7
CHANGES MADE TO PROJECT GOALS	15.7
LACK OF GOOD METRICS	13.9
INCOMPLETE ACCOUNTING OF TECHNOLOGY INVESTMENTS	13.9
DON'T KNOW	9
OTHER	3.3

Table 1. Barriers to Measuring ROI

The difficulty of measuring the economic benefit of technology was identified by more than a quarter (26.3%) of the survey participants as a barrier to measuring ROI. Eighteen percent of participants also reported being unable to determine technology returns. These and other barriers are shown in Table 1.

Overall, there seems to be a solid sense among lab leaders that they are getting value for the money they spend on new technology, but putting exact numbers on the return can be elusive. Melissa Porter, laboratory manager at the National Institute of Arthritis and Musculoskeletal and Skin Diseases (Bethesda, Md.), says, "ROI is measured in terms of the use we are getting out of the equipment that we buy, how many users we have on it, the projects it is involved with, how the equipment will progress the science and, of course, its durability—that is, how many years we will be able to get out of the equipment."

Eric Buckstein, manager of validation at Sanofi Pasteur (Swiftwater, Pa.), who runs a quality control (QC) laboratory with about 200 workers, says, "ROI is an important concern that has gotten bigger in the past few years because of the tighter economic conditions."

Like most other commercial enterprises, Buckstein says, "We want to ensure that the equipment we acquire makes its money back in a relatively short time. As a result, we always do ROI evaluations and justifications prior to purchasing systems.

"We are a GMP facility, so there is always the question of how long it will take to get a system up and running, qualified and validated. That has always been a deterrent for bringing in new technology or replacing existing systems with better equipment.

"Like-for-like is a bit easier because validation, documentation and qualification are already in place—it is more streamlined. In general, it is easier to tweak and make incremental additions than to replace or improve systems entirely."

Still, the likelihood of a shorter payback period is always an attractive prospect. Buckstein says that his QC facility is currently looking to acquire a system that will reduce the number of full-time people typically needed to run an operation. "In such a case, the ROI would probably be shorter," he says.

KEY TECHNIQUES FOR MAKING THE BEST EQUIPMENT DEALS

by Bernard Tulsi

Sometimes the acquisition of new laboratory equipment can be quite simple. "Most of the time it is because what we currently have is broken," says Mala Burton, laboratory supervisor with the Hopewell Regional Wastewater Treatment Facility in Hopewell, Va.

She is quick to acknowledge that it is not always that uncomplicated. "Sometimes upgrades are done based on new technology becoming available, and at other times it is necessary to upgrade because of the need for automation."

Janet Cushing, laboratory administrator in the orthopedic department at Rochester University (Rochester, NY), says that most of her laboratory's new acquisitions are based on "changes in technology, new regulations and new standards."

"MOST ... NEW ACQUISITIONS ARE BASED ON "CHANGES IN TECHNOLOGY, NEW REGULATIONS AND NEW STANDARDS."

Explaining how new acquisitions are approached at her facility, Melissa Porter, laboratory manager at the National Institute of Arthritis and Musculoskeletal and Skin Diseases (Bethesda, Md.) says that the need is generally identified by principal investigators. "Then, I look at the available options. If it is a sole-source offering, there is no choice but to buy from the vendor that offers the equipment. If there are multiple systems that do the same function, I tend to bring them in for demonstrations. These sessions are attended by the end users in our laboratories who get some hands-on time on the systems. In the end, they help to decide which systems to buy."

Sooner or later all lab managers face the acquisition decision. They have to take into consideration factors such as cost, reliability, supplier's reputation and user requirements, according to Eric Buckstein, manager of validation at Sanofi Pasteur (Swiftwater, Pa.). Other important criteria identified by participants in the *Lab Manager Magazine* 2009 best practices survey include training, footprint, cost of repair/replacement parts, labor savings, ease of use and willingness of vendors to provide training and compliance with regulatory and consensus organization requirements, among others.

Layered on top of these considerations is the requirement to select from among hundreds of vendors offering products. Buckstein says that the sifting out process can be challenging. "Sometimes the equipment you need is sole-source and you have to buy from a particular vendor. For others, we either invite them in or visit their facilities to evaluate their offerings, usually by viewing demonstrations of the systems we are interested in acquiring."

In selecting a vendor, Porter does not always start out with a preferred list. "For the most part, we use the main, largest vendors, and we always make careful comparisons of what they are offering."

For vendors seeking to do business with her lab, timing is very important, especially for the smaller, less-established vendors, she says. "We work with government rules and we have to get a minimum of three quotes for any particular instrument.

"We do not always go with the lowest price in our acquisitions. Price is only one factor, and there are other very important considerations. Does the instrument meet our needs? We have often paid premiums to satisfy this requirement.

"Equally important is our experience with the supplier and its reliability with maintenance contracts.

"We want to ensure that we are getting our money's worth and that the equipment will hold up—especially with the bigger ticket items, which are shared and heavily used. As a result, we have to take much more than price into consideration."

Still, price is a major factor. Judy Yen, a laboratory manager at the Whitehead Institute for Biomedical Research at MIT, says, "Pricing is very important for us, for large equipment as well as for smaller items and consumables."

Cushing concurs and adds, "We generally do not pay list

price. We always obtain quotes and get the best pricing, and we generally use price variations among vendors as a negotiating tool."

The *Lab Manager Magazine* 2009 survey revealed that this approach was popular with some participants not only to obtain better pricing but also as a way to secure from vendors extended warranties and better customer service, among other benefits. A number of participants outlined their approach for accomplishing this. In general, this approach seems to be: Let the vendor know that the same product can be obtained at a lower price from another vendor—this usually leads to concessions on price, warranty period and service contract.

This approach was, however, eschewed by others. "I don't do this. I ask for the best price and expect to get it the first time," one participant commented. Another said, "I don't do this. I simply do what is right for the lab." In the same vein, another participant stated, "I will look at several companies and let each know. We will then choose the best. I do not like to play one against the other." Still another offered the following advice: "Ask what they can offer based on your needs. Emphasize that service is everything. Mention previous purchase history and the value placed on the relationship."

Still, such bargaining has been identified repeatedly as being effective in dealing with vendors. Some participants indicated that they were able to obtain concessions by pointing out that the equipment or other product was cheaper elsewhere, that it was inferior when compared to those of competitors and that customer service was inadequate.

Some participants recommend using the purchasing power of entire organizations rather than individual labs when negotiating. One way to accomplish this is to use corporate purchasing departments to do the negotiating. And, of course, use the old standby whenever possible—three competitive bids.

Zeroing in on the equipment itself, some participants recommended comprehensive knowledge of the systems. This will ensure that the equipment and services that are being acquired are precisely those that are needed. In essence, one participant recommended: "Do your homework and know the critical features required—do not pay for unnecessary features."

A number of participants shared steps that could be implemented to hold vendors more accountable for performance. Tighter contracts and monetary penalties if the equipment does not perform as expected top the list. One participant pointed to the need for immediate follow-up with vendors by end users: "This allows the vendors enough time to correct errors and is crucial in making vendors more accountable for performance."

A large number of valuable solutions were provided by the participants, including the standard requirement to have everything that was agreed to put in writing, requiring vendors to provide references from other users and getting them to agree to assign the most-qualified service technicians to your project.

Entire solutions were also proffered. One such solution was to implement a supplier report card that rates each vendor on timeliness of delivery, cost-effectiveness, customer service and quality. One participant stated that these reports were generated from data gathered by his company's receiving, purchasing and quality departments. "Vendors falling below 75 percent are placed on a warning list and, if they do not improve their performance, they are removed from the approved vendor list and we do not purchase from them."

GC Systems

Tanuja Koppal

Gas chromatography (GC) systems are similar to HPLC systems in that they are used to identify, separate and quantify compounds of interest. However, GC systems use an inert, gaseous mobile phase, as opposed to a liquid phase, to bring about the separation of molecules. The basic components of a GC system include an injection system, an oven, a column, a detector and a computer system to analyze results.

There have been significant changes in GC in the past decade, and most of them have focused on maximizing throughput and decreasing run time. One of the factors limiting throughput has been the rate at which proper oven temperatures can be reached. Recent efforts have led to the development of ultrafast GC systems that incorporate advanced column heating devices and controls that can rapidly heat and cool columns. Improving speed of analysis also has been the driving force leading to changes in column technology. The use of small, nanobore capillary columns has improved throughput without sacrificing efficiency or precision. "There is a market out there for ultrafast GC columns, although they need specialized instrumentation to run it," says Rob Bunn, product manager for GC columns & consumables at Thermo Fisher Scientific. The GC columns also have undergone improvements in sensitivity that offer lower detection limits and ultralow column bleeds. "The deactivation process has improved significantly in the past few years and has led to low activity on the column," says Bunn.

Another development in the GC field has focused on the use of multidimensional systems that incorporate different columns and detection systems to improve sample resolution and throughput. The strategy involves using multiple columns to facilitate the separation of co-eluting peaks, such as enantiomers, or of samples that contain complex mixtures or a large number of components. A switching valve is used to route portions of effluent from one column to another column, and under certain conditions, the columns can be operated independently to increase throughput. The ability to incorporate a variety of different detectors within the system also is a huge benefit. "Mass spectrometry is fabulous as a universal detector, but we are seeing resurgence in the use of selective detectors for very specific types of applications," says Laura Chambers, senior product specialist for chromatography products at OI Analytical Corp., who works with customers to help them reconfigure their GC systems. "In some systems you can now have an MS and three other detectors that can work in tandem."

However, to take advantage of these improved technologies, customers must first understand what it is that they need. "Customers really need to know what they want to do with the system or they are going to waste a lot of money buying things they don't need," says Chambers. Since most methods for GC analysis are well standardized and documented, the application and protocol often determine the types of columns, detectors and other accessories to be used. Chambers therefore advises lab managers to think carefully about what the GC system is going to be used for, the skill level of the personnel using it and where it is going to be used. "That will help them make cost-effective decisions as they go through their configuration processes," she says. Taking the type of sample, the sample load and the sample preparation into consideration also is important. Thinking through these issues will determine if any special equipment is needed and will ensure that the samples don't overwhelm certain components of the GC system. There also are other accessories like syringes, filters and septa that play important roles in sample analysis. "When people are involved in new method development, they try a series of different columns and sometimes find that they are not getting the results they are looking for," says Bunn. "Often, when things don't work people blame it on the GC column, but the choice of liner and the septa are equally as important."

Planning ahead and consulting with the vendor are important, as technologies and applications continue to evolve. "Talk to your vendor, because they have experts who know those instruments and applications inside and out, and they can be an extraordinarily valuable resource," says Chambers. Bunn also advises GC users to regularly scan resources on vendor websites. "There is not just product information, but there is detailed information on specific applications [as well as] work flow solutions—from sample collection to analysis. A lot of companies have resources on their Web pages that help users make informed decisions," he says.

HPLC Systems

Tanuja Koppal

While the fundamental components of a high-performance liquid chromatography (HPLC) system—pumps to deliver solvent, an injector, a column for separating the constituents of a sample, a detector and computing software—have remained the same, there continues to be innovations in their design and capabilities. The selection of an HPLC system is predominantly driven by the end users' needs; however, the availability of specialized, customizable platforms has given rise to many more options. Preparative HPLC, for instance, is ideal for large-scale purifications of small molecules or peptides, while high-throughput HPLC systems, optimized for short run times and integrated with autosampler units, allow for rapid analysis of large numbers of samples.

HPLC accessories such as columns and detectors also can be modified to suit the application. While a fluorescent, UV or visible light detector is often a standard component in an HPLC system, customizable platforms include other detection technologies ranging from radiometric to electrochemical to mass spectrometry (MS). Multiple detectors also can be integrated, such as tandem MS/MS systems that offer more focused, quantitative analyses. Two major variations in the pump design include high-pressure and low-pressure gradient systems. High-pressure gradient systems mix the solvents after reaching the pump and are more suitable for low flow-rate applications, such as high-throughput sampling. In contrast, low-pressure gradient systems mix solvents before the pump inlet and may operate in a

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higher flow-rate range. Additional components, such as column ovens and autosamplers, also can be integrated, depending on the customers' needs.

There also has been significant innovation in column technology. Newer columns, such as the monolith, amide, polar embedded and fused particle, are more resistant to changes in temperature, pH and flow rates, and they allow users to explore new methodologies and applications. The recent shortage in acetonitrile, the most common solvent for HPLC analysis, also is causing people to reevaluate their protocols and chromatography systems. "We have gotten used to using acetonitrile as a solvent, but there are many other options," says George Limpert, advisory scientist for the Analytical Services Division at Celsis International plc. "You can solve some problems with what we have on hand without investing in very expensive equipment." Some of the new column technologies, for instance, are certainly amenable to the use of other solvents like water, methanol and THF.

Using columns with smaller particle size not only reduces costs but also improves the throughput. "Smaller particle size is where the industry is headed," says Elizabeth Hodgdon, senior product manager in the Waters Division of Acquity UPLC Systems. Ultra performance liquid chromatography (UPLC) systems use columns with polymeric particles less than two microns in size that allow rapid analysis of samples at sub-micromolar flow rates. "We have always focused on chemistry, and UPLC is really a chemistry change," says Hodgdon. Although the separation principle for UPLC is exactly the same as for HPLC, the differentiation is in the design of the system, which takes advantage of the smaller particle size. "We found that we could reduce the particle size and yet have a particle that was robust enough to withstand high pressures and could be suitably packed in a column. Then we realized that in order to truly reap the benefits of the increase in efficiency with using a smaller size particle, we needed to redesign the system."

Besides the systems and the accessories, the software programs for HPLC also are getting more sophisticated in order to handle and organize the large and complex data files generated. Web-based operations now allow data sharing across multiple users and multiple sites, while enabling complete automation and access. While these new technologies do exist, users have to carefully evaluate what they need. "Lab managers need to evaluate their lab procedures and hone in on processes or products that are slowing down their work flow, and find ways to improve their efficiency and performance in critical areas," says Hodgdon. For their part, vendors and service providers are becoming more proactive in sharing information and offering technical support. Companies are becoming increasingly aware of the need for customer service and periodic monitoring and troubleshooting. "We can't always predict when maintenance will be needed, but we can certainly plan for it," says Hodgdon.

HPLC Systems

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HPLC Detectors

An appropriate HPLC detector has the ability to sense the presence of a compound and send its corresponding electrical signal to a computer data station. The choice of a detector depends upon the characteristics and concentrations of the compounds that need to be separated and analyzed.

"Diode array detectors on the market today vary considerably in performance specifications and pricing. Researchers need to consider what they truly need - as it can dramatically impact the price they will pay," says Moroni Mills, senior marketing specialist, Gilson, Inc.

"A customer should be aware of the advantages a photo diode array detector brings to their analysis," says John Pollard, vice president of sales, JASCO. "For example, some customers require a spectrum of the sample. A PDA detector offers spectra in addition to single wavelength data. The PDA detector also offers the added benefit of a generated library that is compiled as samples are run to help ensure sample purity and identification," adds Pollard.

"Regarding technological advances, PDA detectors have been redesigned in recent years to allow faster data acquisition rates to ensure compatibility with UHPLC systems," says Pollard.

According to Mills, "The researcher today really needs to determine what their true needs are in order to make the best decision on which diode array detector to choose."

Many diode array detectors on the market today improve resolution up to 1024 diodes. Does the researcher require this amount of resolution? With the movement toward ultra fast HPLC, many diode array detectors have much faster acquisition speeds for detecting accurately peaks with widths as low as one second. Wavelength range is also something that differs greatly between different diode array detectors on the market. Some detectors approach NIR ranges (Near Infrared), while others may only go up to 600 nm. Some diode array detectors

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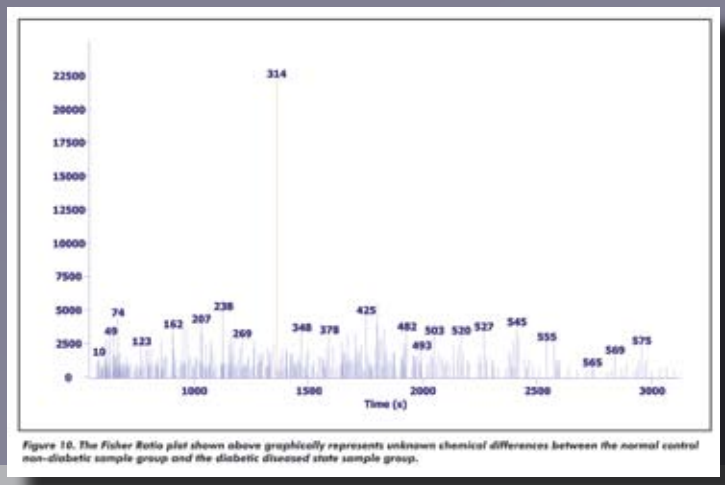

Figure 10. The Fisher Ratio plot shown above graphically represents unknown chemical differences between the normal control non-diabetic sample group and the diabetic diseased state sample group.

However, acquiring large amounts of data with any time-of-flight detector, particularly a GCxGC system, presents a new challenge—processing that data. LECO's exclusive software package aids in the processing of data for its separation science instrumentation. In addition to powerful True Signal Deconvolution and Automated Peak Find algorithms, ChromaTOF® includes a number of integrated features designed to help the user go one step further. Statistical Compare and Fisher Ratio Calculations are just two of these features that have become extremely helpful to those analyzing metabolomic samples where it is necessary to compare samples.

Statistical Compare allows the user to process comparison data for multiple groups of samples. These sample groups are divided into different subsets or classes, then the data is aligned for the specified group of samples from the processed peak tables. Once peak alignment is complete, statistical information such as minimum, maximum, average, or relative standard deviation for various peak properties can be viewed in the Compound Table. A statistical calculation that can be used to discover variance between analytes of known classes, or Fisher Ratios, in complex samples can then be calculated from the Compound Table. Once Statistical Compare and Fisher Ratio Calculations are complete, the data can be easily exported as a .csv file into a variety of additional software programs for multivariate analysis.

Recent research performed using a Pegasus 4D with ChromaTOF v4.20 software compared the small metabolite profiles of both diabetic and non-diabetic urine samples. The non-skewed mass spectra and fast acquisition rates of the GCxGC-TOFMS were necessary in order to deconvolute complex overlapping peaks; the data density was required to characterize the very narrow peaks (<100 ms) within the small metabolite profile. Once the data was obtained, Statistical Compare and Fisher Ratio features in the software compared the two samples, aligning a large set of data and defining the highest variance for analytes between the subjects. Finally, these results were exported into a separate multivariate analysis program, where PCA plotting and Clustering were applied. For more information on this analysis, including a complete listing of parameters and sample conditions, contact LECO Corporation and refer to application note 203-821-372.

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feature fiber optic technology that allows flow cells to be positioned outside of the detector and connect directly to the column output. All of these functions have a purpose.

LC Columns Tanuja Koppal

There is no dearth of options—both in terms of variety of columns and vendors—for analyzing samples using column chromatography. The challenge is to be able to pick the right analytical column to analyze the right sample correctly. The decision is based on several factors: column specifications, dimensions, media particle and pore sizes, and chemistry of the bonded phase, all of which can affect separation efficiency, inertness, durability, pH range, batch-to-batch reproducibility, resolution, solvent usage, and more. There is also the complexity and quantity of the sample available and the desired cost and accuracy of analysis to be considered.

"What is really important to the consumer is lot-to-lot and column-to-column reproducibility," says Dafydd Milton, product manager, LC and LC/MS columns, at Thermo Fisher Scientific "They have to have the confidence that the column will elute the analyte peaks at the same time, every time." Along with elution times, the ability to get good peak shapes—sharp, narrow, symmetrical peaks— is also important, especially for applications such as method development.

Conventional liquid chromatography uses plastic or glass columns that can range in size from a few centimeters to several meters in length. Commonly used lengths vary from 10 to 100 cm, with longer columns being used for preparative scale separations. High-performance liquid chromatography (HPLC) columns are made of stainless steel and are typically shorter, approximately 10 to 30 cm in length. Short, highly efficient HPLC columns allow shorter analysis times, better peak shapes and better quality data while also reducing cost per analysis. Narrower columns also offer better mass sensitivity and significantly reduce solvent use.

Milton mentions that in recent months there has been a shortage of acetonitrile, a solvent routinely used for HPLC analysis. Acetonitrile is a by-product of the automobile industry and, since there are no dedicated plants to manufacture acetonitrile, the recent slowdown in the production of cars has caused scarcity of the solvent. "We find many customers moving to smaller columns, packed with smaller particles (sub2-micron) because they use less solvent," says Milton. Even before the solvent shortage occurred, the trend had been toward increasing the use of columns packed with smaller particles because of advantages associated with costs and efficiency, although slower, longer columns that offer better resolution are sometimes preferred to separate sample components in extremely complex samples. "It's been a couple of years since the sub2- or 2.5-micron columns were introduced into the marketplace, and the smaller particle-size columns are now proving to be very important," says Maureen Joseph, product manager in the Columns and Supplies division at Agilent Technologies Inc. These columns have proved very efficient in terms of cost and performance, and they cover a wide range of applications in industries that span food, environmental, pharmaceuticals, biofuels, and others.

There is also an increased demand for the analysis of polar analytes for applications in both drug discovery and development, such as the identification of metabolites. Hence, many companies have now introduced hydrophilic interaction chromatography (HILIC) columns for analysis of such polar analytes. "More and more drugs that are being developed seem to have a polar component, which the traditional C18-type columns don't seem to retain very well," says Milton. The HILIC columns use hydrophilic interactions to facilitate the transfer of polar analytes to the stationary phase for increased retention and better sensitivity.

There are a lot of changes also taking place in the area of biomolecule analysis. "Along with preparative and process analysis, there are also analytical columns being introduced for the fast and accurate detection of biomolecules," says Taegen Clary, who is also a product manager in the Columns and Supplies division at Agilent but is involved more with biomolecule analysis. People involved in antibody sizing, analysis of protein isoforms, and clinical samples are becoming increasingly concerned about time and cost of analysis. Reducing the time needed to analyze samples, increasing efficiency, and improving data quality can result in significant savings for laboratories that run hundreds of samples per day. Such laboratories are also continually evaluating alternative methodologies that can overcome some of the limitations associated with column chromatography. Microfluidics, for instance, is beginning to play a role in analyzing samples that are rare and available in small quantities, such as for proteomics. However, it has yet to play a role in mainstream analytical applications. While there is definitely a trend toward miniaturization, microfluidics is unlikely to completely replace column technology. "There will always be a place for traditional column technology," says Joseph.

Microscopy Tanuja Koppal

In recent years there has been a growing trend to work with live cells, for instance, in high-throughput screening for drug discovery, for stem cell research or for such applications as *in vitro* fertilization. "Certainly there is a lot more interest in live-cell imaging for looking at dynamic events, and microscopes are being built to achieve that," says Joseph LoBiondo, product planning manager for Nikon Instruments Inc. "There is a lot of optics design going into achieving live-cell imaging."

Self-contained, fully integrated live-cell imaging systems now come equipped with a built-in cell incubation chamber and a microscopy unit. Such companies as PerkinElmer, Carl Zeiss, Molecular Devices and Nikon all offer imaging systems with environmental controls for temperature, CO2 levels and humidity in order to ensure that cells can grow and survive for an extended period of time. "Cells stay alive for days in these incubation systems," says LoBiondo. And in some instruments the cells don't ever have to be taken out of the system for observation since the microscope is a part of the controlled environ-

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SGE Analytical Science	Austin, TX	800-945-6154	www.sge.com
Shimadzu Scientific Instruments	Columbia, MD	800-477-1227	www.ssi.shimadzu.com
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Sigma-Aldrich	Bellefonte, PA	814-359-5452	www.sial.com
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ment. Units also come equipped with a full-sized incubator that can hold a variety of chamber slides and well plates. "Nikon's BioStation CT has a motorized arm that pulls out the specified dish or plate, with minimum vibration or disruption to the cells," says LoBiondo. "The unit is very methodical and slow and very carefully picks up the dish and takes it to the microscope." The units also have some level of built-in security provided. "Certain program locks can be put in place so that if [researchers] are doing different experiments, each researcher will have access to only [his or her] cells."

Manufacturers started offering integrated units when interest in live-cell imaging began to grow. Initially researchers, themselves, were integrating such individual components as motorized stages, filter wheels, shutters, cameras and software packages from a number of different manufacturers to create a system that would meet their needs. "Depending on how it is done, there are a lot of components that are needed to work together in order to make an integrated system," says LoBiondo. "Integrated systems also tend to be less expensive. It could be about half to one-third of the costs of buying and putting together individual components." The disadvantage is that an integrated system is less customizable and may compromise certain features, such as speed when switching between wavelengths, or flexibility in terms of number of objectives or software that can be used (the latter being crucial for certain applications). However, integrated systems work well for those laboratories in need of multiple units that can perform in a routine and reliable fashion but lack the time or expertise to build them.

However, with microscopes now being designed to cater to several different applications and supported by image analysis software and high-end computing hardware systems, matching products to a specific application may soon be a thing of the past. "Microscopes now have multimode capabilities to be used in multiuse facilities," says LoBiondo. "They can now switch between total internal reflection fluorescence, confocal and live-cell imaging, with software control and motorization to do all those modalities." Soon we may have a system that can do it all.

Mass Spectrometry

Tanuja Koppal

Mass spectrometry (MS) has been a widely used research and analytical tool for routine as well as specialized analysis of simple and complex samples. A truly versatile and powerful analytical technique, MS has continually evolved to meet the ever-changing demand for its expanding applications. The need for increased speed, sensitivity and resolution always has driven innovations in MS, but researchers now are asking for enhancements that go beyond performance-related attributes. "A theme that has been growing in intensity for the past year or so is the demand for MS systems to be as versatile as possible," says Allan Millar, senior product manager for time-

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of-flight (TOF) MS at Waters Corp. "Versatility is becoming an increasingly important driver for new purchases in most laboratories. Particularly in a service lab environment or in a lab that faces a multitude of analytical challenges, having versatility in the instrumentation is a very attractive proposition."

Customers also are demanding increased accessibility and ease of use in MS systems. "The feedback that we get across many applications is that there is an increase in demand for instruments to be more accessible, as they need to be operated by people whose skills and experiences often are outside analytical chemistry and mass spectrometry, in particular," says Millar. Hence, in newer systems, a lot of effort is put into matching the analytical performance of the mass spectrometer with its integration, data handling and automation capabilities. Newer systems are equipped with software programs that not only guide the user through the initial calibration and experimental design but also help streamline the workflow and simplify processes in the long run.

Informatics packages combining chemometrics with mass spectral de-convolution are being built specifically around the demands of certain applications. Applications such as proteomics, metabolomics and others demand mass analysis that probes deeper into the samples and offers a lot more detail, whereas other applications like forensic analysis and food safety require resolution of unknown and trace-level contaminants in complex and sometimes archived samples. This has led to the creation of chemically intelligent informatics to rapidly sift through very complex data sets for specific applications. "These informatics packages are the result of the embodiment of nearly a decade's worth of experience and exposure to the challenges in that application area," says Millar.

While instrumentation and bioinformatics are working to simplify the analysis, the samples that are being analyzed are getting more complex. "The trend is toward near real-time analysis and providing mass spectral confirmation of target compounds buried in complex matrices with great certainty," says Nick Bukowski, product manager at ALMSCO International, a manufacturer of TOF MS and related software products. This trend toward analyzing increasingly complex samples, in real time, is in turn driving the need for turning high-quality data into high-quality information. The basic quantitative techniques measuring the integrated peaks and comparing them with calibration standards has not changed, says Bukowski. "What has changed however is the use of mathematical algorithms for pulling out information from trace signals buried in complex matrices and getting meaningful qualitative and quantitative information from them."

"In broad terms, MS is striving for better analytical performance, greater efficiency and productivity, ease of use and expanding its use beyond its core markets which have been proteomics, metabolism and drug discovery into environmental and clinical toxicology and food safety applications," says Lester Taylor, strategic marketing director of Life Sciences Mass Spectrometry at Thermo Fisher Scientific Inc. Similarly, customers also are looking for more efficiency in terms of speed, time for sample prep and analysis, ease of use and streamlining workflow. "Customers always are looking for techniques that provide them more sensitivity, greater selectivity or specificity, and the ability to analyze complex samples," says Taylor.

While in the past a single mass spectrometer had many interfaces, these days most labs have dedicated units for hyphenated applications like GC-MS or LC-MS. Hence, the choice of MS system, such as TOF, quadrupole or ion trap instrument, the nature of the sample, its complexity, the level of sensitivity required for analysis, the rate of data acquisition, the ease of use, and the skill set of the users are all important criteria that drive the decisions to buy or upgrade a system. The other attribute that customers have come to value is service. They tend to prefer solution providers that have dedicated field-based application scientists who can offer extensive in-house training and continued technical assistance. "There are challenges associated with adopting any technology," says Millar. "There is the initial familiarization, and then there are other questions that come up as the user gets more proficient in operating the system. Hence, training is a critical step in the adoption of these types of techniques and is something that often is overlooked."

Mass Spectrometry

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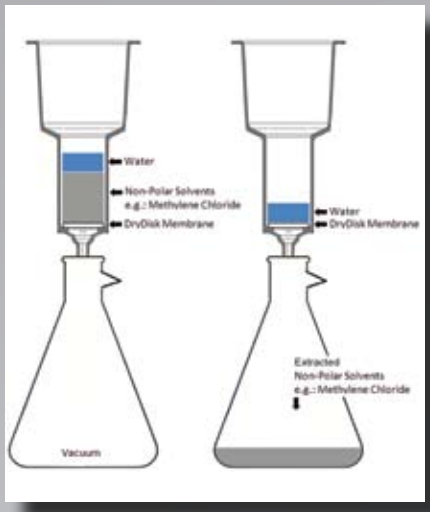

▲ *Figure 1. Use of DryDisk® 50 mL Disposable Barrel. Flow of extracted non-polar solvents through the DryDisk® Separation Membrane.*

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Automated Liquid Handling Tanuja Koppal

Manual pipetting, even using multi-channel pipettes, is slow, monotonous, variable, and has the potential to cause repetitive stress injuries to laboratory workers. Automated liquid handling systems, on the other hand, are precise, accurate, fast and consistent. They also decrease errors within and between operations, help conserve expensive reagents and rare or hard-to-produce samples and save time.

Liquid handling systems are very diverse in their applications and cater to the throughput and speed of automation that the user needs. They range from single-channel pipetting systems to those with 8-, 96-, or 384-channel pipette heads. Modules are also equipped to handle a wide range of volumes from nanoliters to microliters. Generic operations performed by a liquid handler include serial dilution, plate reformatting, plate replication and array printing. Specialized applications include PCR set-up, whole genome amplification, high-throughput screening, high-density array printing, cell culture and more. For such specialized applications the liquid handling systems are often coupled to or integrated into other robotic systems. "We have liquid handling aspects integrated into a few of our microplate readers," says Joseph Machamer, product manager, Market Development at Molecular Devices (now part of MDS Analytical Technologies). "In some assays there is so little time from when the reagent is added to when the signal is generated that you need to have the plate and the optics in close proximity."

In cell culture, the liquid handler is often integrated into the microplate handler and washer to facilitate proper dispensing of reagents and washing of cells. "Washers and dispensers to do cell-based assays need to have features and controls that are different and above those that are typically used for biochemical assays," says David M. Donofrio, director, Market Development at Molecular Devices. "For cell-based assays the cells have to be kept intact since the signal intensity is intimately tied to the number of cells in a well." Hence, the speeds at which reagents are being dispensed and aspirated become very important. There are systems currently on the market designed specifically for use in either cell-based or biochemical assays. These systems have the appropriate software programs that can control and fine tune variables like dispensing pressure, aspiration pressure, probe height and position, all of which can affect the integrity of the cell layer. However, having one system that can work well for both types of assays would be ideal and is something that is currently being worked on.

Some other factors to consider when choosing a liquid handling system are the system's expandability, ability to operate in an x, y, and/or z direction, fixed or disposable tips and their configuration, volume range, individual channel control, layout flexibility, size and budget. Budget is of course one of the biggest considerations and while the cost of the robotic instrument is certainly important, the cost of consumables for long-term use cannot be overlooked. Most users need to decide up front whether to purchase a liquid handling system that uses fixed or disposable pipette tips. Fixed tips are re-used again and again, so while they might seem like the most cost-effective option, they can cause erroneous results due to sample carryover and are expensive when the entire array must be replaced. While carryover is not a concern for disposable tips, which are replaced after each assay or pipetting function, there is the matter of quality, fit, range, availability and price. Hence, when choosing fixed over disposable tips, the types of samples that will be used, accuracy and precision needed for specific applications, and the length of time the pipettes will be used, are all factors that have to be carefully evaluated.

Another factor is the availability of laboratory space. Some liquid handling workstations are compact enough to be used on a benchtop or inside a laminar hood. Some systems also offer flexibility and multiple configurations for set-up and are more efficient in their use of the available workspace. There are also modular and scalable liquid handing systems can meet the needs of the laboratory now as well as in the future as user needs increase.

Automated Liquid Handling

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Balances Tanuja Koppal

Balances and scales used in laboratories today come in various shapes and sizes. Although often used interchangeably, scales and balances have different uses. A balance compares the mass of two sets of objects, while a scale determines the mass of an object or set of objects. The most common types in use today are beam balances, spring balances, top-loading balances, analytical balances, precision scales and moisture analyzers.

Spring balances are the simplest type, consisting of a coiled spring suspended from a fixed point with a pan at the other end. Beam balances are used to weigh solids, liquids, powders, and even animals, generally with a capacity from 610 g to 2,610 g; they are often used in classroom situations due to low cost, ease of use and durability.

Analytical balances are designed for great precision in quantitative chemical analysis. They yield readability to four decimal places to the right of the decimal point (up to .0001 g). They are extremely sensitive and, since air currents can affect their measurement, must be covered by a draft shield. They are used for samples up to about 320 g. Top-loading balances, which can measure objects up to 200 g, are less expensive but less exacting than analytical balances. They are considered semi-analytical balances, with a readability of up to three decimal places to the right of the decimal point (up to .001 g). Precision balances have a readability of 0.01 g. They produce steady readings in a wider range of environmental conditions than analytical balances, being less sensitive to temperature fluctuations. They can have a capacity from 600 g to 34,000 g.

Microbalances and ultra-microbalances are used to weigh the smallest samples. They offer a capacity of up to 6 g with readability up to seven decimal places to the right of the decimal point (.0000001 g). Moisture balances measure the moisture content in a material sample by using halogen heating with precise weighing technology.

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Electronic scales and balances can provide weights in more than a dozen units, including grams, kilograms, pounds, newtons, grains, and ounces, and often in several operating languages. Application modes can be set for statistics, formulation, differential weighing, density determination, pipette calibration, parts counting, animal weighing, check weighing, percent weighing, filling, gross-net-tare weighing, and statistical quality control. Therefore, it's important to choose a balance that can report the information specified by the laboratory protocols and quality control systems.

Balances today can be connected to a PC, a data printer, an analytical instrument, or a laboratory robot using serial, parallel, or USB cables. The newest models are equipped with Bluetooth technology, to enable wireless communication. High-contrast backlit displays improve readability and allow accurate readings even in brightly lit conditions. When choosing scales and balances for their laboratories, users should understand that it may be more advantageous to purchase several scales and balances designed for specific applications than to try to find one that can handle all of their needs. They should consider the capacity, resolution, weight, containers, and size of their samples, as well as the speed at which results are needed.

The environment of the lab, operating temperature, humidity, vibration, and ventilation currents can all affect performance. Consequently, it's important to keep the balance inside an enclosed space, keep it clean, make sure it is leveled correctly, and make sure it is regularly maintained and serviced. There are also personnel considerations that need to be monitored, such as who will operate and maintain the device and the type of training they have received. Finally, as with any other piece of equipment, it is best to always follow the manufacturer's operating instructions, calibration frequency and maintenance recommendations.

Balances

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Biological Safety Cabinets

Angelo DePalma

Biological safety cabinets (BSCs) are specialized work areas that provide protection to users/operators and/or samples. BSCs are categorized as Class I, Class II or Class III, depending on their construction, airflow characteristics and exhaust systems. These classifications are based on each BSC's suitability for samples at various biosafety levels. Class I and Class II cabinets handle Biosafety Levels 1, 2 and 3 (low to moderate risk), while Class III BSCs are intended for use with Biosafety Level 4 agents (high risk).

BSCs are distinct from other safety enclosures. Laboratory fume hoods pull air over the work item and out into the environment through a vent, whereas controlled atmosphere glove boxes are completely enclosed, protecting both users and samples through an airtight barrier. A distinguishing component of BSCs is their use of high-efficiency particle air (HEPA) filters, which scrub effluent between 99.5 percent and 99.99 percent of airborne particles, or at least 99.97 percent of particles larger than 3 microns.

Class distinctions: Class I BSCs protect personnel and the environment only. Samples are vulnerable because workspace air is swept over them before filtration and venting. Class II cabinets represent a broad category, with varying capabilities that are further subdivided into categories A1, A2, B1 and B2. The main differentiator between Class I and Class II BSCs is that Class II cabinets employ a HEPA-filtered, vertical, unidirectional airflow within the work area. Class III BSCs, which provide the highest level of protection to both workers and samples, are reserved for highly contagious or virulent biological samples.

Class II A2 cabinets are by far the most common BSCs in use today, comprising about 95 percent of installations, according to David Phillips, technical applications specialist at Thermo Scientific (Asheville, N.C.).

Class II cabinets have open fronts. Workers are protected by the steady vertical airflow. An ongoing controversy for specifying certain Class II cabinet types involves NSF Standard 49, which states that Class II A2 and B2 cabinets are designed to handle "minute" amounts of toxic chemicals and radionuclides. "But nobody has defined the term 'minute' quantitatively," admits Phillips, who works on the NSF joint committee that determines BSC specifications.

To satisfy whatever that requirement might be, and to err on the side of caution, most laboratories automatically specify the use of Class II B2 cabinets, which Phillips describes as "complex, infrastructure sensitive and 10 times trickier to run" than Class II A2 cabinets. "A lot of people get stuck with B2s, but half of them should never have been installed. Users would be much better served by canopied A2 cabinets."

Jim Hunter, senior project engineer at Labconco (Kansas City, Mo.), suggests using B-type cabinets in situations where workers are consistently working with volatile toxic agents, isotopes or anticancer drugs that you don't want coming back into the lab. Otherwise, the acquisition and operating costs are simply not worth it. "B cabinets cost a lot of money and use a lot of energy. Unfortunately, architects assume a B cabinet is always better because it's more expensive or because the letter 'B' comes after 'A' in the alphabet. All too often they simply override a customer's decision on which type of cabinet to purchase," says Hunter.

As a former certifier of BSCs, Phillips has a unique perspective on the evolution of these cabinets. In the past, he says, cabinets were commodities that barely differed as one considered the product offerings of numerous vendors. "They basically all looked like battleships," he says. Beginning in the 1990s, cabinets began incorporating ergonomic designs that allowed operators to move forward and backward in comfort. Enclosures became brighter and air-handling systems quieter (through the adoption of DC motors and computer-controlled airflow compensation). "Cabinets evolved from being cookie- cutter-type products to having more choices and options. It's a really fun time to be in this industry," says Phillips.

One improvement affecting both operating costs and the environment is energy consumption. Older-model BSCs were energy hogs, but today's units are downright miserly. Phillips recalls an event at the University of Michigan, where one of his Thermo Fisher colleagues was accused of low-balling the power consumption of a Thermo Fisher BSC. The assembled scientists were forced to eat their words after they tested the product and measured its energy usage. The result was a paper you can find at http://bit.ly/N9bwz.

PRODUCTS IN ACTION

Thermo Scientific Herasafe KS Class II, Type A2 Biological Safety Cabinets
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The New Thermo Scientific Herasafe KS and KSP Class II, Type A2 biological safety cabinets deliver unique safety, comfort and convenience. The SmartFlow™ technology and Digital Airflow Verification (DAVe) systems continually optimize airflow parameters, and the brushless DC motor and Night-set-back mode provide excellent energy efficiency. Combined with additional advanced ergonomic and safety features and a broad selection of options for excellent flexibility, these cabinets ensure compliance with the Americans with Disabilities Act (ADA) for users with mobility, sight and hearing impairments. Our Herasafe® KS and KSP are ideal for use in research laboratories, pharmacies, clinics and hospitals. They are compliant with the most stringent regulatory standards in the world and independently tested and certified to NSF/ANSI 49, EN12469 (Herasafe KS) and DIN 12980 (Herasafe KSP).

Unique technologies adapted for Thermo Scientific biological safety cabinets ensure safe air filtration, avoiding sample contamination or environmental hazards.
The best-in-class containment guarantees a filtration efficiency of 99.995 percent at the most penetrating particle size (MPPS). The advanced Herasafe KSP offers an additional filter system below the work area providing 100,000 times higher filtration efficiency than standard Class II cabinets, making it ideal for handling cytotoxic substances and hazardous drugs.
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A comfortable cabinet design promotes user safety. The 10° sloped front allows an ergonomic, fatigue-free working posture. With its frameless front sash and side glass windows, the Herasafe KS and KSP offer an unobstructed view of the complete work area from all angles. The programmable electric adjustable stand (option) allows more legroom under the cabinet with only the touch of a finger. A line of sight interior display eliminates the need for the user to adjust seating position to view safety alarms. The handheld controller ensures that programmability of the cabinet functions is always within easy reach of any user. The excellent product flexibility ensures compliance with the Americans with Disabilities Act (ADA).

Thermo Scientific Herasafe KS and KSP feature advanced technology for maximum energy efficiency. The products are designed with innovative DC motors which offer significant environmental advantages over traditional AC motors, due to dramatically lower energy consumption. The operating life of a DC motor is nearly twice as long as an AC motor.
The Herasafe KS and KSP consume hundreds of kilowatts less energy than competing cabinets. Not only is our Herasafe KS and KSP the preferred cabinet for enhanced containment, comfort and convenience – but it saves your lab money and reduces your lab's overall carbon footprint.

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Biological Safety Cabinets

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Sentry Air Systems	Houston, TX	800-799-4609	www.sentryair.com
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Environmental concerns have become a huge factor in BSC purchases, according to John Peters, assistant marketing director at NuAire (Plymouth, Minn.). "Customers look for energy efficiency as well as total cost of ownership, the life of HEPA filters and the types of motors used to drive the air handlers," he explains. Unlike many other laboratory products, purchasers of BSCs must perform their own due diligence, as no third-party organizations provide energy-efficiency ratings for cabinets.

Laboratory Casework

Tanuja Koppal

Laboratories are complex workplaces and all require easy-to-maintain storage cabinets and countertops with appropriate safety mechanisms in place as well as room to satisfy multiple users. Cabinets and countertops must also fulfill the specific needs of the laboratory in terms of accommodating various types of equipment, and they should be able to withstand long-term exposure to various radioactive, biological, and other hazardous materials to which they may be constantly exposed. Cabinetry, or casework, includes base and wall cabinets, storage and supply cabinets. Other components may include fume hoods, sinks and plumbing options, and power outlets.

Choosing the right laboratory cabinetry depends on a number of criteria, including the type of work being done, safety, durability, budget, and long-term plans. Options range from fixed installations to modular cabinets and mobile units and from custom-designed and installed systems to generic units. Modular cabinets can be adjustable and designed to meet changes in procedures, instrumentation and personnel. Mobile units can be reconfigured by technicians, without the need to wait for maintenance personnel.

Casework can be made of several different materials, including wood, metal, or plastic laminate. Stainless-steel metal cabinets are extremely durable and used in labs with aggressive atmospheres or ones that require decontamination. Wood casework, usually made of oak, birch, or high-grade plywood, is useful in all types of commercial, industrial, and research laboratories. It offers a traditional decor, provides a stable base for equipment, and can withstand decades of use. Plastic laminate is economical and offered in colors and patterns that blend with or accent any decor. Phenolic resin cabinets are very durable and can be used in custom configurations. They are useful in wet or corrosive environments. Polypropylene cabinets, while high in cost, are useful in metal-free and corrosive environments. Mobile benches, made of high-grade steel, can be useful when flexibility and mobility are required.

Countertops experience the most day-to-day use, and abuse, in laboratories and should be chosen to withstand the work being conducted. There are more than ten categories of countertop materials used, including epoxy resin, solid phenolics, plastic laminate, stainless steel and natural stone, as well as wood or wood composites, calcium silicate, ceramics and modified plastic composites. Although no material is impervious to everything and suitable for every application, there are a number of options now available that help researchers meet their specifications for unique applications. Casework manufacturers and other vendors often work with researchers to help customize the designs and choose materials best suited for their budgets and applications.

Centrifuges

Angelo DePalma

Centrifuges are among a select group of laboratory instruments that are as scalable as they are configurable. Individuals who have used benchtop centrifuges that handle sub-milliliter volumes may be surprised to learn that centrifuges—some as large as rooms—are used in industrial processing.

Basic centrifuge designs are simple, consisting of an enclosed compartment inside which a rotor spins rapidly. Rotors, which can usually be interchanged, contain equally spaced openings into which sample tubes

Casework

Duralab	Parlin, NJ	888-805-1740	www.duralabcorp.com
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Genie Scientific	Fountain Valley, CA	800-545-8816	www.geniescientific.com
Hanson Lab Furniture	Newbury Park, CA	805-498-3121	www.hansonlab.com
Hertz Furniture	Mahwah, NJ	888-793-4999	www.hertzfurniture.com
InterMetro Industries	Wilkes-Barre, PA	800-433-2232	www.metro.com
ISEC	Englewood, CO	303-790-1444	www.isecinc.com
Kewaunee Scientific	Statesville, NC	800-932-3296	www.kewaunee.com
Laboratory Construction Specialists	Irvine, CA	800-757-5227	www.lcslab.com
LABREPCO	Horsham, PA	877-522-7372	www.labrepco.com
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are inserted. Samples will either spin at a fixed angle relative to the rotating axis or "swing out" to perpendicular under centripetal force as the rotor speed increases. Forces generated as the rotor spins cause components in the sample to migrate toward the bottom of the sample tube, according to weight or density.

Entry-level mini-centrifuges easily fit on a benchtop, operate at a single, relatively low speed, generate low gravitational *(g)* forces, and cost only a few hundred dollars. "Minis" are used for samples whose components are easily separated by density. Most medical and veterinary office centrifuges are of this type. The next level up, compact benchtop centrifuges, spin tubes of up to about 2 mL and create tens of thousands of *g*s. Researchers use them to separate DNA, proteins and cellular components.

There are many ways to differentiate centrifuges by type, speed, and features. Beckman Coulter (Fullerton, Calif.), for example, divides its product line into three basic platforms: benchtop devices operating at up to about 10,000 rpm, "washing machine" centrifuges that provide up to about 100,000 *g*, and ultracentrifuges that deliver in excess of one million *g*. In fact, one could argue that all centrifuges exist along a continuum of features that may be mixed and matched, which include *g*-force generated, sample tube size, refrigeration capabilities, rotation angle, computerization, and others.

Michael Rosenblum, marketing VP at Labnet International (Edison, N.J.), offers the following considerations when purchasing a lab centrifuge:

- What size tubes do you expect to run?
- How fast does your sample need to spin to achieve the desired separation?
- Is an angled rotor or a swing-out rotor best for your application?
- Does your sample require refrigeration?
- What is the range of applications you are likely to encounter?

Angled vs. swing-out tube design affects speed and *g*-force, and provides sample collection options (spin-out is slower but provides a clean pellet). Refrigeration is desirable because samples heat up during a long run. It all comes down to your expected application range and the likelihood that the instrument you buy will be flexible enough to meet your needs.

Price was conspicuously absent from the list because lab centrifuges tend to be inexpensive compared with other high-use lab instruments. The price "sweet spot" of about $300 for unrefrigerated, single-speed mini-centrifuges up to about $6,000 for high-speed, refrigerated benchtop instruments covers most applications in the life sciences and other industries.

Because their operation depends on applying physical forces to samples by spinning, centrifuges have not experienced the miniaturization of, say, mass spectrometers or gas chromatographs. But like other lab devices and instrumentation, centrifuges have benefited over the past two decades from advances in computerization and control software.

Computerized methods have been particularly useful as biology experiments become more complex and focus on smaller or less easily distinguishable materials. Sample complexity has caused an increase in the use of gradient centrifugation, and the need for computerized methods as well.

Gradient centrifugation uses sucrose, cesium chloride, or some other dense material to separate particles or molecules by weight. The sample is placed on top of the gradient and, as the centrifuge spins the analyte, migrates to the region that matches its density. The analyte may then be removed for further studies. Sucrose gradients, which are the most common, are discontinuous, consisting of layers of sucrose solutions in increasing concentrations. $CsCl_2$ solutions are continuous and permit much finer separation.

"There is very little [centrifugation] method development going on in most labs," says Paul Voelcker, centrifugation product manager for Beckman Coulter. "People either inherit a protocol that was used for other experiments, or they find it in a paper and adapt it to their conditions." Beckman's Optima™ eXPert software, which works with the company's ultracentrifuges, allows users to design or optimize protocols by entering the molecular weight, sedimentation coefficient and gradient, and more completely define the run conditions.

Without computerized methods, operators often let a run go much longer than they need to, says Mr. Voelcker. "Computerization helps investigators optimize run time, which saves energy and, in the case of labile samples, can help preserve high-value material."

Centrifuges

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Hettich Instruments	Beverly, MA	978-232-3957	www.hettweb.com
Iris Sample Processing	Westwood, MA	781-551-0100	www.statspin.com
Labnet International	Woodbridge, NJ	888-522-6381	www.labnetlink.com
MP Biomedicals	Solon, OH	800-633-1352	www.mpbio.com
New Brunswick Scientific	Edison, NJ	800-631-5417	www.nbsc.com
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The Drucker Company	Phillipsburg, PA	814-342-6205	www.druckerco.com
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Tomy Tech	Fremont, CA	800-545-8669	www.tomytech.com
Thermo Fisher Scientific	Hudson, NH	800-345-0206	www.thermo.com

Glassware Washers

Most manufacturers offer standard and large capacity washers and, as with most things, your first consideration should be your actual requirements. In terms of energy efficiency, "there is a huge difference in operation costs between a washer that takes 9 gallons to fill and one that takes 15 gallons to fill. When you consider that a wash program is usually 5 or 6 fills, this has a large impact on water consumption, detergent amount needed, electricity needed to heat the water, and water treatment/sewage costs," says Miele Professional Laboratory Division Manager, Ken Austin.

Another efficiency feature to consider is a delay start option which, in places where electricity is less expensive during off-peak hours, facilitates running your washer at night.

Efficient use of time is also important. Cycle times can range from 1 to 3 hours, based on water heat-up times, circulation/spray method and other factors. Consider how important a faster wash program is to your lab.

In addition to capacity and efficiency requirements, you need to consider what types of glassware are used in your lab. "Variations in the types of glassware a washer can accommodate now and in the future is an important consideration. Ideally, a washer should accommodate both spindle racks for narrow-neck glassware and open racks that hold baskets for wide-mouth and specialized glassware, such as beakers and Petri dishes," says Jenny Sprung, Product Manager, Labconco Corporation.

Also, be certain that the glassware washer you're considering is not simply a home dishwasher converted to have a DI water rinse cycle. "This type of washer cannot be compared with a commercial grade washer that is designed for laboratory applications—from the construction materials (chamber and water path capable of handling 18 megohm 95°C pure water), to wash programs designed for organic

PRODUCTS IN ACTION

THE G7893
Brilliant cleaning and fast drying in a compact footprint

Miele introduces the G 7893, a compact washer that combines the legendary cleaning capabilities of Miele's undercounter washers with true HEPA-filtered forced-air drying. This is the first 24-inch wide glassware washer capable of complete drying in 15 – 30 minutes, which offers labs with limited space and high-throughput demands an excellent glassware washing option. This is the perfect laboratory glassware washer for drying times and temperatures are fully adjustable (up to 115° C). Miele also offers a cool down step so that glassware can be safely handled after the drying cycle. While some other brands of glassware washers can take 3 or 4 hours to complete a washing and drying cycle, the Miele G 7893 can do the same job in approximately 1 hour.

G 7893 Fast Facts:

- Only 24" wide space needed
- Eliminate transfer of glassware to oven, or waiting for glass to air dry
- Reduction in amount of glassware needed for your research
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- Elimination of solvents such as acetone from the cleaning process
- Reduction in DI water use
- Safer for your laboratory staff. Less handling of solvents and chemicals, less glassware breakage

Here's another reason to invest in the G 7893. All Miele laboratory glassware washers are made of high grade 304/316 stainless steel for years of rust-free use. All plastic components are clearly marked to facilitate recycling. In addition, these systems have a factory rated machine life of 15,000 operating hours which translates into 10 years of operation if you run the machine 6 hours a day, 5 days a week. Many last far beyond this time frame.

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SP Industries	Stone Ridge, NY	845-687-5445	www.spindustries.com
Washer Solutions	Fairport, NY	585-742-6388	www.washersolutions.com

and inorganic compounds, to pumps with 4 times the circulation rating of a home dishwasher," says Austin.

Since lab glassware may be soiled with a variety of substances—some requiring high heat for effective removal and others, such as plastic ware, requiring lower temperatures, a washer with multiple temperature and cycle time options is important. And "request that glassware cleaned in your washer has been analyzed for cleanliness, such as with EPA methods for residual metals, volatile and semi-volatile compounds," says Sprung. Also, make sure that the washer is advanced enough to monitor temperatures, dispensing, water flow and other parameters and be able to "notify the user if something in the wash process is not correct, which is important in achieving consistent, validated cleaning results," says Austin.

Lastly, consider the noise level of various washers. Knowing the product's dBA level, which measures quietness, is important, "particularly with large capacity washers. Some brands are very loud," adds Austin.

Incubators Tanuja Koppal

Laboratory incubators are used to grow and maintain cell cultures and are available in a variety of sizes and types. The incubator market is divided into two main categories: the gassed incubators which are the CO2 incubators, and the non gassed or microbiological incubators. The CO2 incubators are mainly used for cell culture and provide control over factors such as temperature, CO2 for maintaining proper pH levels, and humidity, all of which affect cell growth. CO2 incubators are typically heated to 37°C and maintain 95% relative humidity and a CO2 level of 5 percent. Microbiological incubators are essentially temperature-controlled ovens that work within the biological range of 5°C to 70°C and are mostly used for growing and storing bacterial cultures. Most incubator units are water-jacketed, air-jacketed or use direct heat to maintain the temperature around the culture chamber.

Available from 1.4 (table-top) to 40 cubic feet (freezer-like), incubators generally last about 10 years and can be used in a wide variety of applications including cell culture, biochemical studies, hematological studies, pharmaceutical and food processing. Shaking incubators are often used for cell aeration and solubility studies. Refrigerated Biochemical Oxygen Demand (BOD) incubators, with a temperature range of 20°C degrees to 45°C below ambient, are commonly used for applications such as insect and plant studies, fermentation studies and bacterial culturing.

"The cell culture market today is thriving predominantly due to new applications in areas like stem cell research and hence there is more potential for growth in these products," says Douglas Wernerspach, Global Product Manager, CO2 Incubation at Thermo Fisher Scientific.

Many manufacturers are working toward addressing some of the common challenges associated with culturing cells, the most important of which is reducing aerial contamination. A number of incubators now offer a high-temperature decontamination cycle that works much like a self-cleaning oven. "With the press of a button, the customer can heat-sterilize the incubator and get rid of any decontaminants or hazardous spills," says Wernerspach. This option also eliminates the need to take apart individual components for autoclaving. "It's convenient, safe, and ensures proper, uniform cleaning that can be recorded as a part of standard operating procedures."

Besides units that can be activated when needed, there are also continuous contamination prevention units that work all the time and do not have to be initiated manually. One technology uses HEPA filtration to continuously cycle the air and remove airborne particulates and contaminants. The other technology that is gaining a lot of interest is the use of incubators that have interiors made of solid copper components. "Solid copper or 100% pure copper is naturally antimicrobial and for the first time the U.S. EPA has also recognized copper, a nonchemical, as an effective antimicrobial agent," says Wernerspach. This has led to a number of companies developing copper-based products.

Incubators also come with options that can further increase user ease and convenience. Thermo Fisher has recently introduced a CO2 incubator with an integrated, interactive touch screen display built into the control panel. "It has all kinds of built-in user prompts and safety features so that you won't mistakenly change settings and damage the cultures inside," says Wernerspach. "It also has the ability to operate in many different languages. Individual users can customize the display

Incubators

BINDER	Great River, NY	866-885-9794	www.binder-world.com
Boekel Scientific	Feasterville, PA	800-336-6929	www.boekelsci.com
Carbolite	Watertown, WI	920-262-0240	www.carbolite.com
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Darwin Chambers	St. Louis, MO	314-534-3111	www.darwinchambers.com
Grant Instruments	Cambridgeshire, UK	+44 (0)1763 260811	www.grant.co.uk
Hach Company	Loveland, CO	800-227-4224	www.hach.com
Jeio Tech	Woburn, MA	781-376-0700	www.jeiotech.com/eng
Labnet International	Woodbridge, NJ	888-522-6381	www.labnetlink.com
New Brunswick Scientific	Edison, NJ	800-631-5417	www.nbsc.com
NuAire	Plymouth, MN	800-328-3352	www.nuaire.com
Sanyo Biomedical	Wood Dale, IL	800-858-8442	www.sanyobiomedical.com
Sheldon Manufacturing	Cornelius, OR	503-640-3000	www.shellab.com
So-Low	Cincinnati, OH	513-772-9410	www.so-low.com
ThermoFisher SCIENTIFIC THE WORLD LEADER IN SERVING SCIENCE	Waltham, MA	866-984-3766	www.thermo/com/incubators
Torrey Pines Scientific	San Marcos, CA	866-573-9104	www.torreypinesscientific.com
UVP	Upland, CA	800-452-6788	www.uvp.com
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Select™ models feature advanced digital LCD 4x20 character display, microprocessor control system with key pad. Includes audible and visual high/low alarms, 2 product sensors with glycerin bottles, 2 to 10 volt DC output, remote alarm contacts, door ajar alarm, password protection of set points and factory settings, real time clock, operation diagnostic monitoring of defrost, compressor and fan, low and high alarm test, event logging and sensor failure alarm.

Cabinet construction features include white painted exterior front, sides and back, with galvanized steel on the top and bottom. The interior is white and there are three epoxy-coated shelves per door, which can be adjusted in 1" increments. Standard features include interior lights (switch activated), easy roll low profile casters, magnetic door gaskets, key door locks, and 1"diameter lead sensor port.

Cabinets are formed-in-place with high-density CFC-free polyurethane foam insulation. Doors have heavy-duty pivot hinges and pull handles. Select™ Refrigerators and Freezers feature top-mounted refrigeration, air-cooled condensing unit and automatic condensate evaporation. The combined features of the Select™ control refrigeration system and cabinet construction produce a precise, uniform controlled temperature environment and energy efficient operation for long lasting reliable and durable performance.

Available options (depending on model) include: extra shelves, stainless steel drawers, sliding basket drawers, temperature chart recorder and chart paper, stainless steel interior and/or exterior, reverse hinge doors, 4-20ma output, RS485, seismic mounting, Secure Guard lock system, internal electrical outlet, access port 2" sleeve with cover and export crating.

▲ *Nor-Lake® Scientific pass-thru refrigerators have a front door and a rear door, so they can be accessed from two sides. They are available with one pair, two pairs or three pairs of doors in a variety of materials: with glass front door and solid back door, with all glass doors or with all solid doors. Available with sliding baskets as shown.*

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to how they want to see it, which helps to minimize user error and training." Additional options include data storage and communications packages that enable data logging to the computer, removable shelves and programmable alarms for temperature set points and duration.

At the end of the day what customers really care about is having a reliable unit in which to grow their cells. Hence, the lab environment, the application and the customer's comfort level with the technology is what plays a big role in the selection of the equipment. "Ultimately you want to go with something that best meets your requirements," says Wernerspach.

Milling and Grinding

Angelo DePalma

Milling and grinding are common operations in the manufacture of foods, chemicals, materials and other products, and equally important at the laboratory scale for analyzing those products, quality control of large processes or preparing samples for analysis.

Grinding may seem low-tech, but after thousands of years of confronting particle size reduction problems, engineers have still not fully characterized the process mathematically. Engineers attempt to predict grinding and milling behavior through a patchwork of three grinding equations: Kick's law (for particles larger than 50 mm in size), Bond's law (about 50 mm down to 0.05 mm) and Rittinger's law (below 0.05 mm). Today, academic institutions devote millions of research dollars to grinding and milling; one example is the Rutgers University (New Brunswick, N.J.) Dept. of Chemical Engineering's Mixing in Fluids and Powders Group, headed by Prof. Fernando Muzzio.

Grinding and milling remain empirical sciences, says Stanley Goldberg, director at grinding machine distributor Glen Mills (Clifton, N.J.), who prefers the scientific term "comminution" to "size reduction."

"Since it's hard to predict mathematically how a grinding machine will behave, you have to prove it works on the actual material, with the customer's own sample," says Goldberg. Before customers purchase an instrument from Glen Mills, they typically put it through its paces on actual samples, either at their facility or at the vendor's.

Patricia Jung, president of particle reduction instrument firm Retsch (Newtown, Pa.), has seen a lot of interest over the past several years from plastics, electronics, pharmaceutical and food companies, and in particular from the renewable energy and nanotechnology industries. Problems with human and pet food supplies have spurred the need for strict quality control measures that involve grinding meal for subsequent analysis. "Animal feed companies have to test every shipload, particularly when it comes from overseas," Jung told *Lab Manager*.

The need for strict particle size control in biofuels and nanomaterials is a relatively recent trend as well, as both industries are in their infancy. Nevertheless, most industries are abandoning manual and other legacy grinding techniques in favor of higher-precision methods that deliver consistent, reproducible results, Jung says.

Pharmaceuticals is another sector where attention to particle sizing is evolving rapidly. Drug firms traditionally micronized active pharmaceutical ingredients to improve blending in pills, tablets or liquid formulations, and to alter how the drug is absorbed. Today, pharma is much more concerned with fine-tuning properties of drugs and other ingredients, to the point where pharmaceutical formulation and nanotechnology overlap. Pharmaceutical quality and development scientists increasingly use particle reduction of raw materials to create suspensions and even solutions.

Maintaining sample integrity is a recurrent theme in milling and grinding, particularly with mechanical milling. The "coffee grinder" approach to mechanical size reduction works with relatively inert materials such as stone, but introduces heat- and shear-related anomalies for foods, pharmaceuticals and many materials.

One way around this is through jet mills, which propel samples around a chamber at the speed of sound, reducing particle size continuously through high-speed collisions. Since jet mills use no moving parts or screens and generate little heat, they work exceptionally well with heat-sensitive materials.

Cryogenic grinders, also called freezer mills, process materials that are first rendered brittle by exposure to liquid nitrogen, then pulverized. Freezing samples before milling maintains chemical integrity while creating powders from virtually any material. Applications include biotechnology, materials, chemistry, geology, DNA extraction, plant research and pharmaceuticals. "The more brittle the material gets when frozen, the finer you can grind it," observes Jung.

Cryogenic milling is possible with any grinding mechanism (e.g., high-speed rotor, impact ball and planetary ball mills) by employing a separate liquid nitrogen bath. Retsch claims to be the only vendor that offers a cryogenic mill that is directly connected to a liquid nitrogen reservoir, a factor that improves safety and convenience.

Nanotechnology has played a huge role in industry's appreciation for smaller particles. "As particles approach the 500 nm scale, their color, mechanical and electrical properties change dramatically," observes Goldberg. "Classic size reduction equipment can't achieve that level of fineness, at least not economically." Nanotech and stringent demands for particle characterization have driven demand for bead mills that, according to Goldberg, economically achieve nm-sized particles with predictable size distributions.

The rise of nanotech drives two additional trends related to quality and analysis. Materials of construction for milling instruments have become "very critical," Goldberg says, "because contamination from the instrument is unacceptable" in drugs and high-tech electronic or optical nanotechnology. Vendors are therefore moving toward inert product contact surfaces; for example, high-strength zirconia ceramics.

Similarly, nanotech has created an extraordinary need for analysis of very small particles and monitoring of the grinding process itself, particularly in regulated industries. "When the field first developed bead mills that could create nanoparticles, no one had instruments that could characterize them," says Goldberg. Today, advanced instruments enable capture of data, related to the milling process, which comprises the quality documentation that accompanies regulatory applications or data sheets.

Particle Size Analyzers

Angelo DePalma

Particle size measurement has become a critical application for chemicals, foods, paints, cosmetics, coatings, materials, and many other industries. Particle size, shape, density and distribution affect the physical properties and chemical behaviors of all products comprised of particles or that use them as ingredients: The size of stationary phase particles affects chromatography retention time, pigment particles dictate hue and finish in paints, and physical dimension imparts mechanical, op-

Mills and Grinders

BioSpec Products	Bartlesville, OK	800-617-3363	www.biospec.com
Cianflone Scientific	Pittsburgh, PA	800-569-9400	www.cianflone.com
E.A. Fischione Instruments	Export, PA	724-325-5444	www.fischione.com
Fritsch	Idar-Oberstein, Germany	+49/67 84/70-0	www.fritsch.de/en
Glen Mills	Clifton, NJ	973-777-0777	www.glenmills.com
Hosokawa Micron Powder Systems	Summit, NJ	800-526-4491	www.hmicronpowder.com
IKA Works	Wilmington, NC	800-733-3037	www.ika.net
Retsch® SOLUTIONS IN MILLING & SIEVING	Newtown, PA	267-757-0351	www.retsch.com
Spectrum Chemicals Laboratory Products	Gardena, CA	800-813-1514	www.spectrumchemical.com
Spex SamplePrep	Metuchen, NJ	732-549-7144	www.spexcsp.com
UDY	Fort Collins, CO	970-482-2060	www.udyone.com

PRODUCTS IN ACTION

Retsch Sample Preparation Mills for Phthalate Testing

RETSCH is an active leader in homogenizing solid substance laboratory samples and particle size characterization. For over 90 years, they have been on the cutting edge of the latest technologies, procedures, and research methodologies. With its 2009/2010 generation of innovative mills, Retsch offers a number of options for plastics sample preparation for phthalate testing, as outlined by the Consumer Product Safety Commission (CPSC). Under test method CPSC-CH-C1001-09, the CPSC recommends the use of a cutting mill and cryogenic ball mill for thorough homogenization of the sample to a < 500 µm particle size.

Methodical sample preparation is essential for accurate trace testing using a GC-MS; if the sample is not properly homogenized, erroneous measurements will result. Retsch offers four different mills for the preparation of plastics for phthalate testing.

For large samples including dolls, trucks/cars and baby bottles, the Cutting Mill SM 2000 is best suited. The SM 2000 is ideal for primary size reduction of large, bulky samples to a fineness of < 1 mm. Available in January 2010, the Cutting Mill SM 300 boasts a 3 kW (4 horsepower) motor and variable speed drive from 700 – 3000 min-1. With twice the power as the SM 2000 (1.5 kW), the SM 300 can quickly and easily homogenize samples with high rubber content (tires, shoe soles) that give other cutting mills difficulty. At 3000 min-1, samples can be ground as fine as < 500 µm.

Once the sample has been initially reduced in a cutting mill, fine-grinding can take place in an Ultra Centrifugal Mill ZM 200, down to < 250 µm. The ZM 200 is also ideal for small samples (< 10 mm) like Legos, beads and bottle nipples. As Retsch's most versatile mill, it can grind at ambient temperatures as well as cryogenically. Its Cyclone attachment helps to alleviate localized heat build up in the grinding chamber, which is crucial for plastic samples.

Cryogenic grinding of samples from 25 ml – 0.5 ml can take place quickly and efficiently in the new CryoMill! As many plastics require embrittling prior to grinding, labs are always looking for the safest way to work with liquid nitrogen. The CryoMill is specifically designed to deliver a constant flow of LN^2 from a storage tank to the grinding chamber, keeping the sample at a consistent -196°C for the duration of the milling process. The user never comes in contact with the liquid nitrogen, and plastic samples usually take less than 10 minutes to process.

▲ *The CryoMill with AutoFill dewar is the safest and easiest way to mill temperature-sensitive samples. In minutes, the CryoMill prepares a powder ready for GC-MS analysis of phthalates.*

Retsch®

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tical, and electronic properties to nanomaterials. Within critical size domains from nanometers to about 10 microns, the physical state can be as important as chemical composition.

Numerous technologies have emerged for measuring particle size. Sieving and sedimentation, among the oldest methods, provide quantitative sizing from millimeters upward. Optical sizing under a microscope, where particles are visualized and counted against the backdrop of a graticule (grid of evenly-spaced horizontal and vertical lines) and counted manually, is still used for many applications. Microscope-based sizing has been semi-automated through software that counts particles either directly or from photomicrographs.

The most sophisticated particle sizing techniques exploit the interaction between light, sound, or electricity and particle analytes. Electroresistive methods rely on the fact that non-electrically-conductive particles reduce the flow of electricity through a conductive fluid. The most common electroresistive particle sizing instrument is the Coulter counter, which quantifies suspended cells. Light- or laser-based techniques measure dimensions and distributions of suspended or, in some cases, dissolved species or particles suspended in air.

Although one of the oldest methods for particle sizing—and still the least expensive—sieving still serves many industries for particles in the size range up to about 4 mm. Sieving uses various techniques to get particles through the sizing mesh, including oscillation/shaking and sound. Several instrument makers offer sieve-based particle sizing. Most, including Retsch (Haan, Germany) and W.S. Tyler (St. Catharines, ON) and Hosokawa Micron (Summit, NJ), also specialize in particle-generating machines.

Hosokawa's particle-sizing devices employ pneumatic sieving, most notably in the Micron Air Jet Sieve product line. The benchtop device, just slightly larger than a test tube agitator, measures particle sizes from 20 to 4,750 microns and serves primarily the food, pharmaceutical, mineral, cement, powder coatings and chemical industries. "Laser techniques work best below about 20 microns," says Tim Calvo, Lab Equipment Product Manager.

Micron Air Jet particle size instruments use a large air volume, up to 97 cfm, to pull a negative pressure on the system, which generates an air jet emitted through a rotating nozzle located below the sieving screen. The air flow disperses material atop the sieve and carries the finer particles through the screen and into the collection apparatus. Where systems that rely on oscillating or sound operate through a stack of up to six screens, Micron Air Jet systems use a single screen and perform the analysis in anywhere from 15 seconds to 5 minutes.

Particle sizers that rely on dynamic light scattering (DLS) serve a sweet spot for particle analysis, between 0.6 nm and up to about 6 microns, while laser diffraction operates optimally in the 1-10 micron range.

Noting a maxim of measurement science, Jeff Bodycome, Ph.D. of Brookhaven Instruments (Holtsville, NY) observes that "life gets more difficult at the extremes. DLS has a broad range for very small particles but once particles get too large, it's hopeless. If all your particles are larger than a few microns, you're better off with diffraction and, larger than that, with sieving."

Interest in DLS began in the fine chemical industry, particularly for latex materials used in paint. Today its principal markets are biotech, where it characterizes protein and protein aggregate solutions, and nanomaterials.

It may surprise that DLS uses light at 637 or 660 nm to measure characteristics of species that are much smaller than the wavelength. That is impossible to do with conventional microscopy, for example, whose limit is objects roughly half a wavelength in size. DLS works because it does not "detect" the molecule or particle, but calculates its hydrodynamic radius as a function of its mobility through the solution. "It measures how far the particle moves under Brownian motion," notes Dr. Bodycome. Because this effect is a function of the sixth power of the hydrodynamic radius, DLS picks up species in very low abundance provided they are much larger than the analyte.

Purchase decisions for particle size analyzers are based on matching the analyte particle with instrument capabilities. Users with low- or sub-micron particles will require a light- or laser-based system, while those with larger particles can usually get by with a much less expensive "sieve shaker." Quality control labs that analyze samples from large vats of material should consider purchasing separate sample prep equipment, known as a riffler, to improve the likelihood that analysis samples will be representative of the batch. Price is of course a consideration, but users should weigh the consequences of regrinding against instrument acquisition costs, cautions Tim Calvo of Hosokawa.

Particle Size Analyzers

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Brightwell Technologies	Ottawa, ON	613 591-7715	www.brightwelltech.com
Brookhaven Instruments	Holtsville, NY	631-758-3200	www.bic.com
Cilas	Madison, WI	608-274-7719	www.particle-size.com
Clemex Technologies	Longueuil, QC	888-651-6573	www.clemex.com
Dispersion Technology	Bedford Hills, NY	914-241-4777	www.dispersion.com
Fluid Imaging Technologies	Yarmouth, ME	207-846-6100	www.fluidimaging.com
Formulaction	Wynnewood, PA	610-649-1650	www.formulaction.com
Fritsch	Idar-Oberstein, Germany	+49/67 84/70-0	www.fritsch.de/en
Horiba Instruments	Irvine, CA	800-446-7422	www.horibalab.com
JM Canty	Lockport, NY	716-625-4227	www.jmcanty.com
Laval Lab	Laval, QC	888-667-7077	www.lavallab.com
Malvern	Westborough, MA	508-768-6400	www.malvern.com
Micromeritics	Norcross, GA	770-662-3630	www.micromeritics.com
MicroTrac	Largo, FL	888-643-5880	www.microtrac.com
New Star Environmental	Rosewell, GA	770-998-0296	www.newstarenvironmental.com
Shimadzu Scientific Instruments	Columbia, MD	800-477-1227	www.ssi.shimadzu.com
Sympatec	Lawrenceville, NJ	609-844-1020	www.sympatec.com
Thermo Fisher Scientific	Waltham MA	866-984-3766	www.thermo/com
TSI	Shoreview, MN	800-335-5577	www.tsi.com
Wyatt Technology	Santa Barbara, CA	805-681-9009	www.wyatt.com

Pipettes Angelo DePalma

Pipettes are familiar to any lab worker who needs to transfer small quantities of liquid. Research and development labs in the chemicals, foods, materials, and paints industries use pipettes routinely, but the life sciences arguably consume the largest volume of pipettes and related supplies.

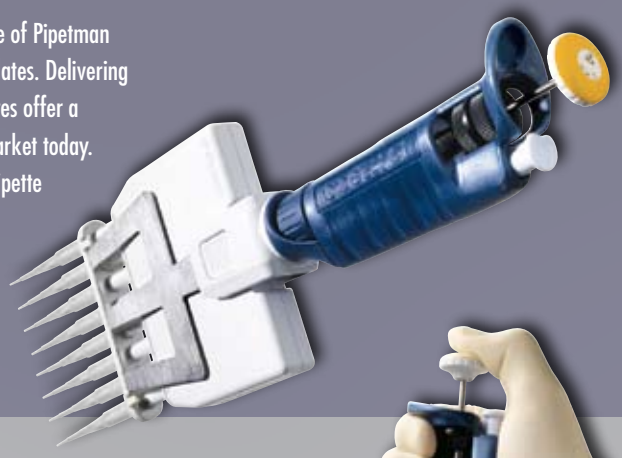
Pipettes come in many varieties, and most feature plastic disposable tips. Note that syringes serve many of the functions of pipettes but tend to be less accurate. Syringes typically are used in situations where the liquid must be delivered to a closed or sealed system, such as a reaction vessel or chromatograph.

While pipettes are handheld, their delivery mechanism may be manual or electronic. Manual delivery refers to the operator's thumb depressing

PRODUCTS IN ACTION

Gilson Pipetman Neo Multichannel Pipette

As the newest member of the renowned Pipetman® family of pipettes, Gilson's line of Pipetman Neo Multichannel pipettes is the ideal choice when working with 96 and 384 well plates. Delivering unrivalled performance, precision and durability, Pipetman Neo Multichannel pipettes offer a unique level of comfort that is unmatched by other multichannel pipettes on the market today. Designed using lightweight materials, Pipetman Neo Multichannels allow users to pipette longer without the concern for arm or wrist fatigue. The patented Gilson trident tip-ejector equalizes tip-ejection forces across each channel, making the disposal of tips virtually effortless and newly engineered springs help to battle susceptibility to RSI by reducing spring forces up to 50%.



If you're using micro plates in the lab, you understand the importance of using a quality, comfortable and reliable multichannel pipette for your research. The Pipetman Neo Multichannel combines the legendary robustness, accuracy and precision of the original Pipetman pipette with new technologies, for the most comfortable and efficient pipette experience available today.

All the materials used to manufacture the Pipetman Neo Multichannel are extremely durable and chemically resistant. The handle, made of PVDF, resists aggressive chemicals and limits the hand warming effect. The tip-holder, ejector spacer and cover are made of a chemically resistant polymer and offer worry-free autoclaving, while the tip-ejector is made of stainless steel. Any cleaning solution used in laboratories, such as ethanol or antibacterial and antifungal solutions, can be used to clean these parts.

The unique and versatile tip-holder has been specifically designed to correspond to the variation in the geometry of the major brands of tips available on the market today. Successive sealing rings have been positioned on the tip-holder, depending on the pipette volume range, to guarantee a snug fit of most tips, regardless of what brand is used in the lab. And because of the unique design of this tip-holder, minimal force is needed when fitting tips, making pipetting much more comfortable.

To help protect users from Repetitive Strain Injuries (RSI), the tip-ejector and ejector spacer have been designed to distribute ejection forces evenly over each tip, significantly reducing the force required to eject tips.

In fact, Pipetman Neo Multichannel tip ejection forces are one of the lowest on the market, with only 40 Newtons required for the 12 X 200 µL model.

A common downfall of multichannel pipettes that are available today is the disparities between channels of the volume distributed. To remedy this, the Pipetman Neo Multichannel has a patented "rack rail" piston drive mechanism. This unique mechanism guarantees that pressure is applied consistently and simultaneously on each piston when aspirating and dispensing, delivering absolute identical performance from each channel.

The handling of hazardous samples, such as bacteria, cells and viruses, can necessitate decontamination by autoclaving. The new design of Pipetman Neo Multichannel's lower part gives immediate access to the tip-holder for easy and instant contamination. The entire lower part of the pipette is autoclavable as well. Simply unscrew it and place it in the autoclave. No calibration is required after reassembling. The autoclave stand that comes with every Pipetman Neo Multichannel has been specially designed to relieve the plastics of the tip-holder from the stresses of autoclaving. Its use ensures that the tip-holder maintains its compatibility with the most commonly used tips available.

Available in 8- and 12-channel models; Pipetman Neo Multichannel can cover the volume range of 2µL to 200µL using just two pipettes and is a perfect pipette for such applications as PCR and DNA sequencing, cell cultures, enzymatic reaction and ELISA tests.

▲ *Pipetman Neo Multichannel's new "rack rail" piston drive mechanism guarantees absolute consistency between channels in volume distribution.*

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Pipettes

Biohit	Neptune, NJ	732-922-4900	www.biohit.com
BrandTech	Essex, CT	888-522-2726	www.brandtech.com
Crystalgen	Plainview, NY	516-293-1468	www.crystalgen.com
Dragon Medical	Berlin, CT	860-977-3588	www.dragon-med.com
Drummond Scientific	Broomall, PA	800-523-7480	www.drummondsci.com
Eppendorf North America	Westbury, NY	800-645-3050	www.eppendorfna.com
GILSON UNMATCHED EJECTION FORCES	Middleton, WI	800-445-7661	www.pipetman.com
Globe Scientific	Paramus, NJ	800-394-4562	www.globescientific.com
Hamilton	Reno, NV	800-648-5950	www.hamiltoncompany.com
Hirschmann	Louisville, KY	828-268-1502	www.hirschmann-inc.com
Jencons Scientific	Bridgeville, PA	800-846-9959	www.jenconsusa.com
Labnet International	Woodbridge, NJ	888-522-6381	www.labnetlink.com
Nichiryo	Maryland Heights, MD	877-548-6667	www.nichiryo.com
Oxford Worldwide	Garner, NC	866-552-1531	www.oxfordworldwide.com
Rainin Instrument	Oakland, CA	510-564-1600	www.rainin.com
Thermo Fisher Scientific	Hudson, NH	800-345-0206	www.thermo.com
TTE Laboratories	Hopkinton, MA	800-242-6022	www.pipettes.com
USA Scientific	Ocala, FL	800-522-8477	www.usascientific.com
ViaFlo	Hudson, NH	603-578-5800	www.viaflo.com
VistaLab Technologies	Mount Kisco, NY	888-652-6520	www.vistalab.com
Wheaton Science Products	Milville, NJ	800-225-1437	www.wheatonsci.com

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or releasing a piston to deliver or withdraw liquid. Electronic pipettes still require the user to activate withdrawal and dispensing, but the work is done by an electric motor.

Pipettes are sold in two basic formats: fixed volume, which always dispenses the same quantity of fluid, and adjustable volume, which delivers a range of volumes. Adjustable pipettes are accurate from about 10 percent up to 100 percent of the volume range. Single-channel pipettes use one tip at a time, whereas multichannel devices hold multiple tips for simultaneously delivering fluids to multiple locations. Biologists who work with microtiter plates, immunoassays or polymerase chain reaction probably will be interested in multichannel pipettes.

"The big advantage of electronic pipettes is ergonomics," says Jason March, marketing director at Hamilton (Reno, Nev.). "They also allow you to do more; for example, filling the tip once and dispensing multiple times." Those researchers who use pipettes occasionally or who switch volumes often probably are better off with a manual pipette, he advises.

Ergonomics is a huge issue in pipetting. Most vendors, including Hamilton, Mettler Toledo (Columbus, Ohio), VistaLab (Mt. Kisco, N.Y.), Cole-Parmer (Vernon Hills, Ill.), and BrandTech Scientific (Essex, Conn.), manufacture ergonomic pipettes. "There's no denying that excessive repetitive motion can be bad for you, be it in pipetting, typing or other tasks," notes Akbar Anwari, marketing manager at BrandTech.

Pipette manufacturers have tried to minimize the forces used in single-channel pipettes in a number of ways, as Mr. Anwari explained.

Reduction of static strain by reducing the pipette's weight and redesigning the device so it drapes over the operator's hand instead of being held are two fixes. BrandTech has achieved these through its Transferpette pipette line, for example.

Another technique is to reduce the force required to draw liquids. Most pipettes use "softer" springs or a shorter stroke length to reduce these forces. Anwari claims that the Transferpette line "harnesses the power of the muscles used to move the thumb."

Tip ejection forces tend to be the largest forces used on pipettes, especially multichannel pipettes, where tips are ejected eight or 12 at a time. Ergonomic strategies based on lessening these forces reduce the spring tension or involve redesigns that minimize contact between the tip and the tip cone. "But if there's too little contact, the tip either will not seal properly or will not sit straight on the tip cone." Manufacturers have attempted to solve this problem by introducing O-rings or V-rings to reduce the forces required to obtain a good seal but that allow the tip to be ejected more easily. Another innovation for multichannel pipettes involves ejecting tips two at a time rather than eight or 12 at a time.

Mr. Anwari also believes that non–ergonomic design features can make pipettes easier to use. For example, positioning the display so it is not covered by the hand during use reduces the need to shift the instrument to verify volume settings. Another feature is the ability to adjust the volume with one hand without shifting the device.

Accuracy and precision are the two major factors that play into pipette purchases, says Mark Dostalek, marketing communications manager for Gilson (Middleton, Wis.). "Customers have to know that they're aliquoting the right volume." Like other laboratory devices, pipettes must be calibrated and validated for the type of work they do, particularly in regulated industries. Pharmaceutical and biotech work, for example, is done under Good Laboratory Practices (GLP), which is a regulatory designation. Many end users today choose motorized electronic pipettes for GLP work. The devices record volumes and number of cycles and even can provide out-of-specification warnings.

"Plus, once you introduce a motor, you can do things like mixing within the tip, reverse-pipetting, and interfacing with a computer to track data and calibration intervals and perform advanced maintenance."

Vacuum Pumps Tanuja Koppal

Vacuum is an integral part of many laboratory processes, but costs associated with generating a vacuum, such as process costs, user costs and cost to the environment, have never really been considered seriously. Although technology has advanced to provide smaller, cleaner and quieter options, not many people are taking advantage of it. "Vacuum pumps last a long time and many people go through their careers without actually buying one," says Peter Coffey, vice president of sales and marketing at Vaccubrand Inc. "Hence, people tend to replace their vacuum pumps with what they have used before and not take the time to find out about the alternatives."

Vacuum pumps used in laboratories can be classified into two main types—rotary vane pumps, sometimes referred to as oil-lubricated pumps, and dry (oil-free) pumps. They operate in different ways to create vacuum and aspirate fluids. Centrifugal pumps use centrifugal force to push the fluid through an outlet; metering pumps, such as diaphragm, peristaltic, piston and syringe pumps, pull fluid into a chamber and then push it through the outlet valve; while positive displacement pumps use bellows, piston, rotary lobe and rotary vane to push fluid through a cavity, leaving a vacuum that pulls in more fluid.

Oil-lubricated pumps have been around for many decades, while the oil-free diaphragm pumps are a more recent addition. Although oil-free pumps tend to be one and a half to two times more expensive than oil pumps, there are a lot of advantages to their use as well as significant lifetime savings. First of all, no oil is used, and therefore there is no cause for oil contamination and no necessity for oil change or disposal. Oil-free pumps can be built to be corrosion resistant and hence do not require regular maintenance. "Service intervals on better oil-free pumps exceed 10,000 operating hours," says Coffey. "If you use your

PRODUCTS IN ACTION

EasyChem Discrete Analyzer

Wet chemistry historically has been labor intensive and problematic. Manual methods resulted in wide variation from analyst to analyst depending on the technique employed. Automated systems such as segmented flow analysis (SFA) and flow injection analysis (FIA) were developed to improve reproducibility and increase productivity. However, several problems still existed with these technologies, such as lengthy start-up and shutdown times, carry-over, hydraulic noise, clogging valves, etc. SFA and FIA analyzers still required highly trained personnel to operate. Changing from one method to another was very labor intensive. True unattended operation was not possible with these types of analyzers.

As time progressed, the market demanded that laboratories become more efficient and reduce overall operating costs. At the same time, less skilled personnel became available or could be afforded to perform these functions. Liability associated with operating a laboratory and producing quality defensible data increased. Turnover remained high in positions that perform the most labor-intensive functions.

The EasyChem discrete analyzer was developed to meet the needs of the changing marketplace. The EasyChem can best be described as a robotic system that performs manual and automated chemistries on a micro scale. The EasyChem employs a computer-controlled needle connected to a high-precision micro syringe, for transferring and dispensing precise amounts of sample and reagent. After preheating in a coil positioned in the body of the needle arm, sample and reagents are inserted into a reaction cuvette that is temperature controlled up to 50°C. A proper wash cycle between movements ensures there is no carry-over from the previous sample or reagent. Upon completion of incubation, the reacted sample is then drawn into a temperature-controlled flow cell where the optical density is measured by a colorimeter at the desired wavelength. The system accommodates the use of flow cells up to 40mm in length for greater sensitivity, thus achieving much lower detection limits than other discrete analyzers. EasyChem uses micro quantities, on average 3-500µl/ test, minimizing reagent consumption. Waste generation is dramatically reduced, saving laboratories money and reducing potential liability.

EasyChem is a flexible instrument, able to perform several different tests all on the same sample, without operator intervention. EasyChem requires no specific experience to operate, and can be learned by anyone in a matter of minutes. Operation consists of simply loading the sample tray and reagents, selecting the tests to be performed, and clicking start. Virtually no time is required for start-up or shutdown. Labor costs are greatly reduced and productivity increased, enabling technicians to perform other tasks.

Virtually any manual or automated wet chemistry method can be adapted to run on the system. Since the system is software based, methods can easily be developed by selecting a desired amount of reagent, sample, incubation time, and wavelength. The system precisely mixes and then reads the reacted product, performing all of the labor for the chemist. Method ranges can be modified simply by adjusting the reagent to sample ratio. Several hundred methods have already been developed due to the system's versatility, ease of use, and speed. USEPA approved methods are available for analyzing environmental nutrients in raw wastewater, industrial effluents, drinking water, treated wastewater soil extractions, acid digests, and other matrices. A new non-hazardous "green" nitrate method developed specifically for the analyzer recently received USEPA approval for both drinking water and wastewater. The method eliminates problems associated with nitrate analysis such as: matrix interferences, poor reproducibility and recovery, hazardous waste generation, and exposure of laboratory personnel to carcinogenic compounds such as cadmium used in method 353.2 Rev 2.0. Other methods are available for industrial, pharmaceutical, tobacco, wine, plant and soil extracts.

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Varian Vacuum Technologies	Lexington, MA	800-882-7426	www.varianinc.com
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vacuum pump 20 hours a week, 50 weeks a year, that's 10 years before the first scheduled service!"

The other misunderstanding that leads to the choice of an oil-lubricated pump is that people think that more vacuum is always better. Oil-free diaphragm vacuum pumps can provide vacuum levels from atmosphere to below 0.5 mbar/torr, whereas oil-lubricated pumps offer high capacities and higher vacuum levels up to 10-3 mbar/torr. "What is more important is matching the vacuum to the application, and almost any application can now be performed using an oil-free pump, with the exception of freeze-drying," says Coffey.

For certain applications he also recommends considering buying a pump with controls that provide a good balance of speed and control. "Even manual controls are better than none, but electronic controls offer huge productivity advantages," he says. "In many applications, the type of vacuum control used will determine how much scientist time is needed for oversight and how fast the application proceeds."

It is often very helpful to talk to someone from a vacuum pump company, who can recommend a pump and offer a demonstration about what will be right for your application and budget. There are also interactive online vacuum pump selection guides available that ask a few questions about the planned use for the pump and recommend a series of pumps to satisfy a range of budgets. "It is not a glamorous technology but it is one that can affect the costs, comfort and convenience of your laboratory," says Coffey.

Water Baths

Water baths maintain samples at constant temperature—usually above ambient, but cooling is possible as well. Compared with heating mantles and hot plates, water baths provide tight temperature control. Leading manufacturers of water baths include Julabo, Boekel Scientific, Brookfield Engineering, AquaLogic, Sheldon Manufacturing, Techne, VWR, and Fisher Scientific.

Many water bath applications, particularly in the life sciences, also employ some sort of shaking or agitation. Devices incorporating these features, known as water bath shakers, are used for thawing and warming, hybridization, enzyme assays, gel staining, and cell culture. The popularity of water baths has waned somewhat with the advance of accurate, precise incubators, but water baths have the dual advantages of higher sample capacity and wider operating temperature range. Where incubator working temperatures top out at around 80°C, baths operate up to 100°C. In addition, water baths may be cooled through the addition of an optional external chiller. Several vendors, including Techne, Brookfield Engineering, VWR, and Thermo Scientific offer built-in refrigeration in circulating-style water baths.

The ability to replenish water as it evaporates is a feature of most modern water baths, although some lower-end units still require manual replacement. "Another critical feature is precise temperature control," says Rick Passanisi, product manager for shaker baths at New Brunswick Scientific (NBS; Edison, NJ). New Brunswick's Innova® 3100, is typical of high-end units. The 3100 incorporates auto-fill, adjustable level control, operating temperatures from 5°C above ambient to 100°C, and temperature control to within 0.1°C. Even low- to mid-range bath shakers employ microprocessor control of both temperature and shaking.

One knock against water baths is they can become messy as minerals build up in the water through evaporation. Also, baths turned off at night become breeding grounds for bacteria, yeast, and fungi. Maintenance—consisting of replenishing and replacing water, and adding a biocide to inhibit microorganism growth is a minor but persistent issue.

Bath-style heating devices employing oils, ionic fluids, and metal alloys are more common in chemistry and physics labs than in the life sciences. Other interesting alternative baths are bead baths, which use metal beads as the heat transmission "fluid." Beads provide several advantages over water but are severely limited in their shaking capabilities.

Where water baths work only between that fluid's freezing and boiling temperatures, bead baths operate from cryogenic temperatures (-80°C) to 300°C. Bead baths consume less than a third of the energy of water baths—15 watt vs. 50 watt, a consideration if the devices are used constantly. Another environmental concern, disposing of "gray" wastewater containing biocides and minerals down the sink, is eliminated with bead heaters.

Anyone who has used a conventional water bath has had to deal with wet labware, a possible source of contamination for any type of experiment, but especially troublesome for biology. This issue disappears since metal beads are dry. Another problem with conventional baths is how to support the flask or vial while it sits in a bath of water or liquid nitrogen. Since metal is significantly denser than most labware, vials and tubes may be "stood up" among the beads with no chance of tipping over.

Beads also provide a measure of portability. "Users can scoop out beads in a flask and keep their sample at the desired temperature while they transport it to another location in the lab," notes Rich Jarvis, technical manager at Lab Armor (San Antonio, TX). Samples may also be stored, submerged in a container of metal beads in refrigerators or freezers, and transported in insulated containers. "No need to fill a bucket with ice or other coolant when moving samples," Jarvis says. Lab Armor sells beads suitable for use in conventional water baths, as well as bath containers and smaller units that replace heat blocks.

Bead baths can be used in applications that require low-speed agitation by using a standard laboratory rotator (such as a Lab-Line Maxi Rotator, a bead tray, and a general-use incubator.) In one configuration, samples are added to a tray placed atop a rotator inside a laboratory incubator and agitated at the desire temperature. Another option involves using warm beads in an insulated tray rotated on a bench top. "In an incubator, the beads transfer thermal energy more efficiently than air alone, and the beads stay at the desired temperature even when the incubator door is opened and closed repeatedly.

PRODUCTS IN ACTION

GenTech Scientifics' Customized Training and Instrument Service

In today's challenging economic environment, companies and organizations MUST make the most from every hour and every dollar they spend. Accurate instrument performance, minimum downtime and skilled operators can make the difference between success and failure. In order to ensure success, many companies are focusing on cost-effective instrument service providers that can also train their staff in operating, troubleshooting and performing routine maintenance on many instruments.

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Water Purification Systems

Tanuja Koppal

Water is perhaps the most utilized reagent in a laboratory and is often critical for an experiment. As instruments have become more sensitive and applications increasingly complex, the demand for high-purity water has also increased. "A few years ago, parts per million (ppm) was a very small level of contamination, but now people are looking for parts-per-billion (ppb) or parts-per-trillion (ppt) levels of contamination," says Renaud Bardon, director for North American Sales Lab Water at Millipore Inc.

There are several types of contaminants in water, such as particulates, organics, inorganics, microorganisms and pyrogens. In the past, people were mainly concerned with ionic contaminants and measured ionic conductivity or resistivity as a way to determine water purity. "Today people are more concerned with organic contaminants, particulates and microorganisms, such as bacteria and gases that are dissolved in water," says Bardon.

There are eight commonly used methods to purify water: distillation, deionization, reverse osmosis, activated carbon filtration, microporous filtration, ultrafiltration, ultraviolet oxidation and electrodialysis. The National Committee for Clinical Laboratory Standards (NCCLS) has specified three types of water: I, II and III, as well as special-purpose water, depending on their use. While Type I refers to water with minimal interference and maximum precision to be used for most analytical applications, type III water refers to that used for general washing. The special-purpose water refers to water that has been treated to remove specific contaminants.

When selecting the right system for purifying laboratory water, several factors need to be considered. However, according to Bob Applequist, product manager at Labconco, the most important one is to "fit the product to the application." You have to differentiate between the need for pure and ultrapure water. In most cases, the pure water generated from tap water can be used for most applications, while ultrapure water generated from a point-of-use system can be used for applications that have more specific and stringent purification needs. "The first-step purification or the system that is used to convert tap water into pure water has to be very good and efficient," says Bardon. "If you have that first step right, then converting that pure water into ultrapure water is going to be very easy and consistent."

When considering a water purification system, both the quality and the quantity of water have to be taken into account. "You have to take into account instantaneous as well as daily water volume requirements," says Bardon. For labs that have variable demands on quality and quantity, flexibility and modularity become very important. "The key then is to invest in a flexible system that will meet your needs today and can grow with the lab and change with the applications," says Matthew Hammond, global sales and marketing director for ELGA LabWater.

After choosing the right system, performing regular, preventative maintenance is equally important. The newer versions have built-in alarms and calibrators that warn customers if certain components are coming to the end of their life cycles. "Sample the water routinely to make sure that it doesn't contain the impurities that will interfere with your analysis," says Hammond. The level of monitoring can be done daily, weekly or monthly, depending on the stringency of the application and the laboratory environment. "Whatever system you buy, make sure it's dynamic, so that the water can recirculate regularly," says Hammond. "Water needs to be kept moving, as still water ends up building biofilms quicker. So look for a system that is easy to sanitize." If properly maintained and used, most water purification systems can last up to two decades.

Finally, ensure that the pure water obtained is being used in the right way. "I know of customers who will invest a large amount of money buying an ultrapure water purification system and then dispense that water into a plastic container before they use it," says Hammond. "It's an unfortunate truth, but for most people, water is just a utility. It's the most pure reagent that is available at a relatively low cost, and so it often doesn't get the respect it deserves."

Water Purification

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PRODUCTS IN ACTION

Thermo Scientific Revco PLUS ultra-low temperature freezers

Thermo Scientific Revco PLUS ultra-low temperature freezers combine the highest reliability and superior performance with cost-effective operation and innovative features. All Revco® PLUS ultra-low temperature freezers feature an advanced technology platform, refrigeration system, microprocessor controls and a high-quality construction delivering: maximum temperature recovery, operational efficiency and environmentally-friendly benefits without compromising sample protection. A quiet, comfortable operation allows the freezers to reside directly inside the lab, creating a more productive and efficient work environment. Available in 17, 21 and 25 cubic foot (493, 578, 702 liter) capacities, Thermo Scientific Revco PLUS upright freezers include three models with varying levels of monitoring, reporting and alarms to meet the sample storage and protection requirements of different lab environments.

Revco Ultima PLUS freezers are designed for laboratories requiring advanced electronic controls, monitors and alarms for the highest level of sample protection. Revco Elite PLUS freezers are suited for environments that require a moderate level of electronic controls, monitors and alarms for sample protection. Revco Value PLUS freezers are suited for laboratories that require a fundamental level of electronic monitors and alarms without compromising sample protection.

New 25 and 32 cubic foot (702 and 889 liter) Thermo Scientific Revco PLUS HD upright freezers feature a highly-efficient, innovative, thin wall insulation technology. This allows for expanded interior storage capacity without increasing the exterior cabinet footprint. The 32 cubic foot Revco PLUS HD freezer delivers the industry's highest capacity and vial to footprint ratio: Store up to 70,000 sample vials in 35 inventory storage racks. Available in 3, 12.7, 17 and 20 cubic foot (85, 360, 481, 566 liter) capacities, Thermo Scientific Revco PLUS chest freezers provide a variety of configurations to accommodate diverse lab storage and footprint requirements. Like the Revco PLUS uprights, these chest freezers feature an advanced technology platform, refrigeration system, microprocessor controls and high-quality construction.

Delivering the highest quality to ensure sample protection, all Thermo Scientific Revco PLUS freezers feature robust, high-quality construction, flexible storage and precision controls. The PLUS Power Management System with low voltage surge protection and buck/boost capabilities eliminate the costs and down time associated with tripping a circuit breaker after a power failure. Easy to use microprocessor controls program temperature alarm set points and on-board diagnostics. A state-of-the-art, robust refrigeration system improves temperature control for more consistent temperature cycling and recovery, resulting in a more stable temperature for safer sample protection. An optional seven day, 6" (152 mm) circular chart recorder (standard on Revco PLUS HD freezers) is available for validation and regulatory requirements.

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Cell Culture Automation

Tanuja Koppal

For high-throughput, multi-user laboratories that are involved in running diverse assays and demand high capacity and walk-up capabilities, investing in the right robotic systems becomes critical. There are several factors that come into play when choosing the right system to adopt. Cost and availability of space are always important considerations. Expandable capacity, the ease of use and integration of multiple systems are particularly important for labs looking to grow significantly. Reliability and technical support are critical to labs dealing with multiple users and round-the-clock use. Options for automating are often expensive and labor-intensive and customization is not always feasible. Hence, making the right choices early on is critical.

A lot of processes involved in cell culture, which were once performed manually by skilled technicians, are now being automated by robotic systems connected to each other by software programs that help coordinate all the various activities. The use of cells in the drug pipeline has also increased in recent years.

"Pharma is now moving towards biopharma, which is driving the need for cell culture automation," says Graham Threadgill, director, Life Science Automation, Discovery Products Business Center, Beckman Coulter Inc. Cells are used for primary and secondary screening in early discovery all the way to drug manufacturing. Hence, the systems designed for automating cell culture are both plate-based and flask-based to accommodate small and large cell volumes. Particularly in drug discovery, more companies are migrating from biochemical to cell-based assays.

"There is a continued trend to more cell-based assays and we are observing this trend in the large number of requests that we are receiving for environmentally controlled systems for assays and plate-based cell maintenance," says Debra Toburen, senior product manager, Integrated Systems at Velocity11 (now a part of Agilent Technologies). "50-80% of the assays that some of our customers are running are cell-based."

The robotics for cell culture automation range from the large, motion-controlled, table-top systems that incorporate several robotic components and can perform multiple washings, incubations, and readings all in one run to those that consist of only the basic components needed for an assay, such as the dispenser, washer and reader. Here, the trend being observed is the replacement of large automation platforms by smaller workstations that are individually managed by a few people, as companies shift their screening strategy from shot-gun approaches with large libraries to screening with smaller and more targeted libraries.

"Five years ago we saw giant rooms full of automation and we now find that it is trending down to more individually managed laboratory systems," says David M. Donofrio, Director, Market Development at Molecular Devices (now part of MDS Analytical Technologies).

Automation is also becoming less specialized and is being incorporated in various labs within the same organization. "In the past, researchers wrote their own methods, programmed and tested it. But now, all they are looking to do is push a few buttons to change a few variables," says Threadgill. "You no longer have the automation expert in the organization and so you need to make the automation systems much easier to use, more simple and 'appliance-like'. The automation systems for cell culture are specially designed to offer a protected, contamination-free work area that can be controlled for temperature and humidity. Hence, the software control is turning out to be a critical aspect.

"For cell culture, seeding and feeding cells can take days if not weeks and the robotic systems are often running overnight. The software has to be able to handle and coordinate all those processes throughout the long time period," says Threadgill. The software also manages data handling and sample tracking to know what is happening to each sample throughout the entire process.

Users are also looking to vendors for more service and technical support and many companies have started offering multiple levels of customer training. "We provide on-site, end-user training on how to write a protocol and access the system," says Toburen.

However, for those customers looking to become the resident expert at their company on the use of the platform, they provide more extensive technical training. "They [customers] will come on-site and get trained on all instruments and software to help them gain the necessary expertise."

Cell Culture Automation

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Microarray Technology

Tanuja Koppal

Microarrays spotted with oligonucleotides, DNA, RNA and proteins have been routinely used as tools for expression profiling for more than a decade. What's exciting about this technology is that it has continually evolved to incorporate new assays, novel probes and diverse design formats to keep up with advances in science and technology. Over the years, microarray technologies have improved to offer better specificity, sensitivity and reliability. However, one limitation inherent to their design has yet to be overcome: the fact that microarrays cannot be used to find something completely novel, since the arrays consist of a set of predefined, pre-spotted genes or proteins. They can never be a truly hypothesis-free discovery platform.

"Microarrays are a starting point and are rarely sufficient for reaching a true biological conclusion," says Jon Sherlock, product manager of TaqMan Array Plates and Express Plates in Applied Biosystems' genomic assays business. "Often, you have to take that information to the next level," says Sherlock, and according to him, the TaqMan arrays aim to do just that. The TaqMan arrays, offered in a card-like format, consist of 384 pre-spotted probes that measure levels of RNA in a sample, using the PCR-based quantitative TaqMan technology. "The TaqMan provides a definitive, quantitative answer and no validation is necessary with any alternative technology," says Sherlock.

This technology is also offered in 96-well plates called TaqMan Express Plates, in which customers can select from more than 50,000 predesigned assays for different targets in rat, human, mouse, dog and other genomes. "[Customers] can select a certain cluster of genes that represent a cellular pathway that they are interested in exploring," says Sherlock. By May 2009, 130 new assays based on representative gene sets for predesigned pathways—including cytokines; stem cells; kinases; and genes for oncology, inflammation and many others—have been launched on the TaqMan Express Plates.

As companies update their arrays with new sets of assays and probes, customers are looking for more cost-effective options that offer higher flexibility and throughput. Agilent Technologies, Inc., recently expanded beyond its comparative genomic hybridization (CGH) arrays into a new area for measuring copy number variation (CNV). "The CNV arrays are an extension of the CGH platform, where we are still looking for DNA copy number changes," says Dione Bailey, product manager for the CGH/CNV Microarrays at Agilent. The CNV arrays have probes designed for regions of the genome that are fairly complex or are highly repetitive and not unique. "We have now expanded our probe database and catalog offerings to target those known regions of CNV," says Bailey.

Using Agilent's eArray web portal, customers can also design their own CGH arrays using information from a database that contains nearly 24 million probes. "Some customers like to design arrays based on their specific needs, while others like to look at our catalog

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Molecular Devices	Sunnyvale, CA	800-635-5577	www.moleculardevices.com
NuGEN Technologies	San Carlos, CA	888-296-6544	www.nugeninc.com
Promega	Madison, WI	800-356-9526	www.promega.com
Roche NimbleGen	Madison, WI	800-262-4911	www.nimblegen.com
SciGene	Sunnyvale, CA	800-342-2119	www.scigene.com
SeqWright	Houston, TX	800-720-4363	www.seqwright.com
Tecan	Durham, NC	800-338-3226	www.tecan-us.com

designs and make some minor modifications to them," says Bailey. "It doesn't cost you any more to design a custom array than it does to purchase a catalog array. There is no design fee, setup fee or any minimum quantity to place an order." The flexibility for customers to design their own arrays and choose from different array formats helps reduce experimental costs. Costs can also be reduced by using a technology in which inter- and intra-assay variabilities are low and the amount of hands-on time is decreased. "Customers should be looking for the best value," says Sherlock. "Having a technology that will work, getting a result that you can trust—without any pre-validation, optimization or post-validation needed, and without any repeats or failures—is very important."

Microplate Readers

Angelo DePalma

Microplate readers (MPRs) detect light-releasing chemical reactions occurring within the wells of microtiter plates. Since reactions can be associated with biological, physical, or other chemical events, plate readers are popular in the life sciences, particularly in cell biology and drug discovery research.

MPRs may use any one of several types of detection, including absorbance, fluorescence intensity, luminescence, time-resolved fluorescence, and fluorescence polarization. Absorbance-based plate readers, which have been around for three decades, operate by measuring the reduction of intensity of light through the plate due to the presence of an absorbing molecule. Luminescence refers to the release of light as the chemical reaction occurs. Fluorescence techniques are all based on release of light at one wavelength as a consequence of excitation at a different wavelength. In fluorescence intensity the excitation and emission are simultaneous; in time-resolved experiments the emitters flash several nanoseconds after the excitation. Fluorescence polarization resembles fluorescence intensity, but includes polarizing light filters along the light path.

Wavelength capabilities, linearity, throughput, sensitivity and read time are the critical features to look for in an MPR. The choice depends on the types of analysis and workload you expect in your lab.

Since modern MPRs are relatively similar within an instrument class, the market has become extremely price-sensitive. Prices for readers range from about $6,000 to $20,000. Differentiators include detection modes (more are costlier), scanning with a monochromator or filtering at fixed wavelengths, sample heating/chilling capabilities and software. User-friendliness of software is particularly important in commercial labs where operators are not degreed scientists or when turnover is high. Software that stores and helps generate methods is an important feature for high-throughput labs or those operating in a regulated environment.

MPRs are of two general types: single-mode devices detect one type of signal or wavelength, while multi-mode MPRs detect multiple signals. Single-mode instruments are often dedicated to one type of assay and tend to cost less, while multi-mode devices are more versatile and therefore more expensive.

Less expensive MPRs use single-wavelength filters to dial in the desired wavelength of light whereas more sophisticated instruments employ monochromators, which can be thought of as tunable optical filters. Single-wavelength filters provide high sensitivity but only permit one wavelength through; monochromators can dial in any wavelength. Specialized band-pass filters may be used to refine monochromators further. Monochromators are desirable early in assay development, or when working with unknowns, because they require prior knowledge of assay characteristics.

"Microplate readers have been on the market for a long time," says Xavier Amouretti, product manager at BioTek Instruments (Winooski, VT). "And nearly every instrument gets decent performance although higher-priced models tend to do better. But the real differentiators are specialized features such as run recognition, software, user-friendliness, and wavelength selection methods."

BioTek is one of a handful of large manufacturers of MPRs that include PerkinElmer, Molecular Devices (now part of MDS Analytical), Tecan, BMG LabTech, Berthold Technologies, LabSystems (a Thermo Fisher Scientific company), Beckman Coulter, and Turner Bio Systems. Numerous Chinese instrument-makers have sprung up recently in the MPR market, mostly to serve domestic demand.

BioTek's flagship MPR, the Synergy™ 4 Hybrid, combines filter-based and monochromator detection. "A lot of light is lost with monochromators," Amouretti notes. "Some assays, particularly those with weak signals or employing poorly-fluorescent species, may do better with filters."

Modularity, says Barry Landis, Ph.D., detection channel sales manager at Tecan (Research Triangle Park, NC), is a notable trend in how MPRs are designed and ultimately purchased. Landis defines modularity as the ability to mix and match analysis modes as needed. The benefit: users can select and purchase only the functions they desire, and add to them later on without the need to purchase a new instrument. "Until recently, if you didn't need a particular detection mode—for

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▲ *Two-drawer lab refrigerator provides superior access.*

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Berthold Detection	Oak Ridge, TN	865-481-8181	www.berthold-ds.com
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Bioscan	Washington, DC	800-255-7226	www.bioscan.com
BioTek Instruments	Winooski, VT	888-451-5171	www.biotek.com
BMG LABTECH	Durham, NC	877-264-5227	www.bmglabtech.com
Hudson Robotics	Springfield, NJ	973-376-7400	www.hudsoncontrol.com
Innovatis	Malvern, PA	888-283-1564	www.innovatis.com
Labnics Equipment	Fremont, CA	925-271-4322	www.labnics.com
Luminex	Austin, TX	888-219-8020	www.luminexcorp.com
Molecular Devices	Sunnyvale, CA	800-635-5577	www.moleculardevices.com
PerkinElmer	Waltham, MA	800-762-4000	www.perkinelmer.com
Seahorse Bioscience	Chicopee, MA	877-738-4109	www.seahorsebio.com
Tecan	Durham, NC	800-352-5128	www.tecan-us.com
Thermo Fisher Scientific	Waltham, MA	781-622-1000	www.thermo.com
Tomtec	Hamden, CT	877-866-8323	www.tomtec.com
Turner BioSystems	Sunnyvale, CA	888-636-2401	www.turnerbiosystems.com

example absorbance or luminescence—you still had to buy it."

LED (light-emitting diode) excitation and quadruple monochromators represent recent MPR technology advancements. LEDs provide a tenfold increase in the intensity of excitation light compared with conventional excitation mode, xenon bulbs. Provided the sample is not quenched, LED excitation will increase the signal from fluorescence and other assays proportionally to the increase in excitation intensity. The quadruple design uses two monochromators for excitation and two for emission. According to Tecan's Landis, when used together, these technologies out-perform filter-based systems in terms of sensitivity.

"The extra monochromators block stray light, and with it false peaks," says Landis.

RNA Technology

Tanuja Koppal

With intense research in such areas as RNA interference (RNAi) and micro RNAs, there is renewed interest in studying and using RNA. DNA/RNA synthesizers are used to synthesize oligonucleotides for a variety of applications that include PCR, sequencing, microarrays, RNAi, antisense and others. Laboratories using RNA on a large scale are looking to synthesize their own oligonucleotides, while others are seeking reliable custom oligonucleotide providers. Reliability, scalability, flexibility, ease of use, throughput, cost efficiency and service are some of the features that people look for.

There are different types of RNA that can be synthesized for different applications—namely, unmodified RNA, modified RNA, RNA conjugates, RNA chimeras and labeled RNA probes. Unmodified RNAs are de-protected, de-salted, endotoxin-free products, while modified RNAs can have a variety of modifications, internally as well as at the 3′ and 5′ positions. Dual-labeled RNA probes have fluorescent quenchers and reporters tagged to the RNA molecule for use in applications such as PCR and microarrays, while RNA conjugates are coupled with cell-penetrating peptides for use in gene expression, antisense, cell delivery and uptake. There are several proprietary synthesis and de-protection technologies that are in use for synthesizing RNAs with high coupling efficiencies, fast de-protection and a high level of purity.

Mark Behlke, MD, Ph.D. chief scientific officer at Integrated DNA Technologies (IDT), deals with multiple scales of RNA synthesis on a routine basis. IDT uses all in-house-designed-and-built synthesizers. "We have a column-based platform that handles all medium- to large-scale synthesis and a 96-well plate-based system that does mostly small-scale synthesis," says Behlke. While the plate-based system handles small-scale synthesis around the 100 nmol range, columns are used for synthesis in the 250 nmol to micromole range and large-scale reaction vessels can be used for synthesis from 10 mg up to 10 g. Synthesizing oligos on a plate-based system is cheaper and more efficient than using the column-based system. However, it's much more difficult to maintain high coupling efficiency in a plate-based system, because it's an open architecture system, while a closed column is much easier to keep environmentally sealed from atmospheric water, which is detrimental to nucleic acid synthesis. "Our specially engineered plate-based system can be kept in an isolated and controlled environment that is

RNA Technology

Agilent Technologies	Santa Clara, CA	877-424-4536	www.agilent.com
Altogen Biosystems	Las Vegas, NV	800-658-7009	www.altogen.com
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Asuragen	Austin, TX	877-777-1874	www.asuragen.com
Baytek International	Corpus Christi, TX	361-887-8988	www.baytekinternational.com
Biomatrica	San Diego, CA	858-550-0308	www.biomatrica.com
Genomic Solutions	Ann Arbor, MI	800-935-8007	www.genomicsolutions.com
Lucigen	Middleton, WI	888-575-9695	www.lucigen.com
NuGEN Technologies	San Carlos, CA	888-296-6544	www.nugeninc.com
Promega	Madison, WI	800-356-9526	www.promega.com
Qiagen	Hilden, Germany	800-426-8157	www.qiagen.com
Roche Diagnostics	Indianapolis, IN	800-428-5433	www.roche-applied-science.com
Roche NimbleGen	Madison, WI	800-262-4911	www.nimblegen.com
Thermo Fisher Scientific	Asheville, NC	866-984-3766	www.thermo.com

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friendly for oligo synthesis and maintains high coupling efficiency," says Behlke.

Maintaining high coupling efficiency and product quality is also more challenging with RNA synthesis than it is with DNA synthesis. "Last year we were able to convert the plate-based systems to do RNA synthesis," says Behlke. Besides synthesis, purification and quality control are also important. IDT has set up an affinity-based purification system to be done in a rapid and cost-effective way on all its samples. "Our base price for siRNA duplexes and dicer substrates is now below $100 for full-catalog single orders, and obviously for large orders, the pricing can be substantially discounted," says Behlke. "While we can still make HPLC-purified small- and large-scale RNAs like we always have, this approach offers a more economical, high-throughput alternative."

LIMS Gloria Metrick

LIMS (Laboratory Information Management System) products have been around for decades. Like most products, they began with someone writing software to meet a company's specific needs. Some of those homegrown products grew and became commercial, and an industry was born.

LIMS products vary from software for small laboratories to systems for enterprise-class distribution, where large implementations can cost millions of dollars and encompass licensing, training, validation and all the other services required. As with other software products, there are many ways to implement and purchase a LIMS, from boxed software to commercial licenses for COTS (Commercial Off-the-Shelf) to open source to SaaS (Software as a Service). Possibilities vary greatly regarding the choices appropriate and available for the specific type of laboratory where the LIMS will be implemented.

Minimally, a LIMS manages the laboratory's samples, tests and results. It manages and coordinates the work, performs calculations and stores data. It indicates how much work has been finished on a sample and provides many other related features. LIMS products often include features that do not fall into this simple model, but that seem to be natural extensions of the work being done.

Additionally, some LIMS offer features that you might find available for purchase as standalone software. A few common examples are the features to manage instrument calibrations and preventative maintenance, or features to manage drug dissolution testing. Although features such as these are available separately, there are certain situations in which it is appropriate to do this work directly in the LIMS.

It is important to note that a LIMS and an ELN (Electronic Laboratory Notebook) are not the same thing. An ELN is a literal replacement for your paper laboratory notebook. As such, it is a place to enter and keep your laboratory notes and get signoff; you use it just as you would use a paper notebook.

The confusion between LIMS and ELN occurs partly because there is some overlap between them. Additional confusion arises now that some LIMS include ELN features, some ELNs contain LIMS features, and some products combine LIMS and ELN. Beyond the LIMS/ELN question, there are yet other products that sound like they might be a LIMS but have different names. There are still other products that are called "LIMS" but do not appear to be like anything that has just been described.

Why you cannot just go buy a LIMS:

Selecting and buying a LIMS takes effort and time in advance of the actual purchase for the following reasons:

1. The functions and distinguishing factors among available products are always changing.
2. Right now, LIMS is in a period of especially high transition as LIMS and ELN software continue to converge. Things might become even more confusing before this period is over.
3. Even before LIMS, ELNs and other products took on some of the functions of each other; now, the types of LIMS available are somewhat overwhelming. There are Environmental LIMS, general-purpose LIMS, Web-only LIMS, PC-only LIMS, R&D-focused LIMS, QC-focused LIMS and Forensic LIMS—to name just a few. Products have been developed for specific industries, company sizes and specific technical solutions as well.

As our laboratory informatics industry continues to change, I recommend that you ignore the labels and look closely for the features that meet your needs. We can watch the progress of the transition, but whether products will be combined into one-size-fits-all solutions or kept separate remains to be seen. Today, we have both types of solutions because different customers need and desire different solutions. It is quite possible that we will see the same split continue in the market. Ken Rapp of VelQuest, whose product combines LIMS and ELN features, explains, "VelQuest believes that the GMP-ELN and LIMS layers contain very different functionality. However, market pressures are forcing a "convergence" of the requirements into a fully integrated Commercial Off-the-Shelf (COTS) solution available either from one solution provider or as a best-of-breed integrated solution." At Thermo Fisher Scientific, where an integration plan is used to turn specialized products into a single solution, Informatics marketing director, Susan Najjar, says, "…from a usability perspective, if users are working with a well-integrated solution, the merging of these technologies becomes irrelevant."

What all this means is yet more choices for you to consider. But even though more choices may make the selection process lengthier, there is an increased likelihood that the best solution for your laboratory will be out there and readily available.

LIMS

Baytek International	Corpus Christi, TX	281-218-8880	www.baytekinternational.com
Bio-Rad	Hercules, CA	800-424-6723	www.bio-rad.com
Chemware	Raleigh, NC	919-855-8716	www.chemware.com
H&A Scientific	Greenville, NC	252-752-4315	www.hascientific.com
Illumina	San Diego, CA	800-809-4566	www.illumina.com
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Labtronics	Guelph, ON	519-767-1061	www.labtronics.com
LabVantage Solutions	Bridgewater, NJ	888-346-5467	www.labvantage.com
LabWare	Willington, DE	302-658-8444	www.labware.com
McLane Advanced Technologies	Temple, TX	254-770-6165	www.mclaneat.com
Novatek International	Montreal, QC	514-668-2835	www.ntint.com
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Starlims	Hollywood, FL	954-964-8663	www.starlims.com
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BETTER THAN NEW?
SOURCING PRE-OWNED EQUIPMENT

ONCE DOMINATED BY SMALL FIRMS AND STARTUPS, INTEREST IN USED LAB INSTRUMENTS IS SPREADING TO LARGE, MULTINATIONAL COMPANIES by Angelo DePalma

Everybody loves a bargain, particularly when it comes to big-ticket items like laboratory instrumentation and equipment. Thanks to tough economic times, smart shoppers can find gems among the hundreds of thousands of available instruments and lab devices—provided they shop smart.

Purchasing used equipment is significantly cheaper than buying new. A reconditioned high-performance liquid chromatography (HPLC) system might cost 30 percent to 40 percent less than a similarly configured new instrument—not bargain-basement pricing, but genuine savings. And most pre-owned items are available for immediate delivery, a huge benefit since leading original equipment manufacturers (OEMs), in an effort to keep inventories low, can take three or more months to deliver a piece of equipment.

The best price to pay for pre-owned instrumentation is $0. Donations are an often-overlooked source of used equipment. Bob Krouse, president of Phoenix Instruments (Rochester, N.Y.), advises schools and nonprofits to seek out local companies, which are generally eager to donate surplus equipment. Kodak, which is headquartered in Rochester, has donated a "tremendous amount" of equipment to universities, he says. "When you get equipment free, even if you can't fix it, you can sell it or scrap it, and you haven't lost anything." Krouse also suggests that universities set up internal equipment networks for sharing or transferring unwanted instruments between groups or departments.

Small, self-financed companies and entrepreneurial firms are more likely to purchase used equipment at startup and continue with the practice, although the demographics of a "typical" purchaser are changing.

For seven years after its founding in 1993, BioSource Pharm (Spring Valley, N.Y.), which discovers antibiotic drugs, was financed by its principals. With money for equipment scarce, the company turned to the pre-owned market for laminar flow hoods, autoclaves, chemistry hoods, incubator shakers and lyophilizers. "We've never had any problems or negative experiences," says Hans Bazlen, senior VP at BioSource, who 16 years after founding the company continues to source from Phoenix Equipment.

Service sells

Much of the equipment servicing at BioSource is performed by staff, but that situation is rather uncommon: BioSource's eight employee-owners are all professional scientists, and all but two hold doctorates.

Service is a huge factor in the choice of a used-equipment vendor. Most resellers began as service organizations and some, like Phoenix, make three-quarters of their

income from repairing, refurbishing and reconditioning equipment that they or other dealers sell. Phoenix offers a 90-day warranty on parts and labor for most equipment. Warranties, says Krouse, assure customers that malfunctions are not a result of pre-existing conditions that were missed during reconditioning.

Phoenix sources its pre-owned equipment from companies and large laboratories that are downsizing or upgrading, as well as from auctions and a few select equipment brokers. But Krause cautions end users to avoid auctions and brokers unless they possess the technical expertise to handle problems.

"AS MOST LAB MANAGERS KNOW, PURCHASING NEW IS NO GUARANTEE AGAINST ACQUIRING A LEMON."

Auctions, however, need not be disasters, particularly when buyers can inspect items in person and "kick the tires." Sheri LaRochelle, QC manager at Innovative Foods (Mississauga, Ontario) recently purchased a large autoclave from a nearby dairy that was going out of business. "That turned out great for us," she says.

When RongChao Jin, Ph.D., assistant professor of chemistry at Carnegie Mellon University, took his position in 2006, equipment funds were tight. Dr. Jin purchased magnetic stirrers, glassware, gloves, a centrifuge and an HPLC from online auctioneer LabX (Midland, Ontario). "We saved approximately half the cost on that particular model, and we're still using it," he says. "I would definitely recommend online auctions like LabX, particularly for groups that are just starting out."

Most purchasers shop locally to take advantage of a vendor's service offerings, with on-site service particularly desirable. RMC Pharmaceutical Solutions (Longmont, Colo.), which provides drug development services, has purchased used analytical equipment, balances, HPLCs, rotary evaporators, spectrophotometers, pH meters, particle-sizing equipment, hoods, incubators, lab furniture and pilot-scale processing machinery. RMC sources from auctions, brokers and refurbishers, but its favorite vendor is Analytical Instrument Recycle (AIR; Golden, Colo.).

The reason RMC prefers AIR? AIR offers on-site service and its eight-step refurbish protocol enables it to bundle one-year warranties—long by most standards—with most items. "Since we're not equipment specialists, we prefer purchasing from companies like AIR because they take the burden off the buyer's shoulders," says RMC COO Scott Rudge. AIR's offices are a 40-minute drive from RMC's offices, which allows technicians to get on-site quickly. "It would be difficult for us to purchase equipment from a vendor in a different state," Rudge observes, "unless a nearby service organization could take over our maintenance and repair needs."

AIR can provide service on an as-needed or contract basis, but for critical instrumentation RMC prefers a service contract. A contract ensures regular maintenance, but more important, since it is structured at a fixed price, a contract creates incentives for vendors to sell equipment that works.

Siltech (Toronto, Ontario), which manufactures silicone polymers and surfactants, has purchased used ovens, vacuum pumps, balances and chromatographs (GCs, GPCs, HPLCs) from LabEquip (Markham, Ontario), and relies on the vendor and other local instrument specialists to service its HPLCs and GCs.

Caveat emptor

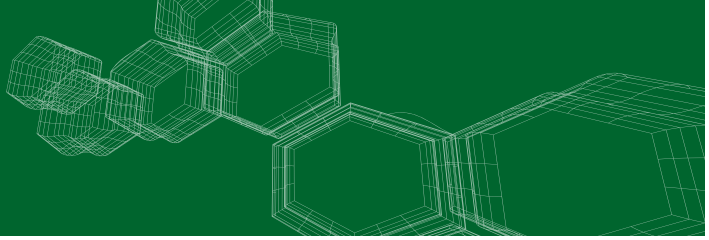
Not all used equipment transactions turn out splendidly. The downsides include lack or loss of warranty, unknown chain of custody, and incomplete maintenance history. Previous owners may have altered or tampered with the instrument in a way that voids an existing warranty or service contract (which is only rarely transferrable anyway). Yet, purchasers can improve their odds by dealing with reputable vendors who can spot and correct problems before putting equipment up for sale.

But inevitably, purchasers sometimes will come across a "lemon"—a piece of equipment that never functions properly, for whatever reason.

Susan Boutros, Ph.D., president of Environmental Associates (Ithaca, N.Y.), has had mixed experiences purchasing used equipment, "but the good definitely outweighs the bad," she says. "Eighty percent of the time we are pleased." Boutros has purchased centrifuges, biohazard hoods and incubators. One of the eight hoods she acquired on the pre-owned market "didn't work out, but, by far, the money we have saved more than makes up for that bad experience."

Raj Moonsammy, QC manager at Siltech, also notes that some used-equipment purchases have not gone as smoothly as expected, "but it's hard to say whether the fault lays with the equipment itself or our operators."

As most lab managers know, purchasing new is no guarantee against acquiring a lemon, either. Boutros relates



that a new, high-priced incubator purchased from a "very well-known supplier" not only was defective (to this day it does not hold constant temperature) but that the vendor did not live up to its obligations under the warranty. "The vendor didn't do anything for us," she explains.

Rudge believes that the likelihood of buying a lemon from a reputable dealer is lower for a brand-new instrument. Quality among OEMs is quite high, but since it can take months for defective parts to wear or fail on a new instrument, OEMs may miss problems that refurbishers routinely fix before selling.

Another drawback with used equipment is potential lack of software support. Equipment makers tend to build in upward and downward compatibilities, but after adopting an entirely new software platform they eventually stop supporting old programs. Used-instrument vendors and refurbishers typically lack programming-level software expertise, which leaves customers with software-orphaned instruments on their own.

Before buying, purchasers should therefore check with OEMs to make sure that software is still supported and in situations where it is not, should ask if an upgrade is possible. In Rudge's experience, manufacturers and their representatives are forthcoming on such issues, despite the fact that they are "losing" sales.

Unique circumstances

Many companies have special circumstances that lead them to purchase pre-owned equipment. Aside from cost savings, purchasers value the trust, personalized service and satisfying business relationships built over the years with refurbishers.

Boutros laments the lack of a "main street" feel to purchases from large, multinational vendors, attributing it to consolidation within the OEM instrument market. "The big companies don't value small purchasers as much as they should," she says. "In our experience, used-equipment vendors are knowledgeable about what they sell and are very eager to keep their customers happy."

Used lab equipment is not right for every situation. Despite his unabashed preference for used, Rudge would not hesitate to purchase new equipment that provides a strategic advantage. He has his eye on GE Healthcare's latest ÄKTA™ HPLC system, a high-throughput instrument with industry-leading methods-development software. Rudge says he will purchase one—new—as soon as an instrument becomes available, because ÄKTA's capabilities are "essential for my lab."

"Buying used won't get you the latest and greatest technology, but it's a great way to furnish a lab with routine instrumentation," Rudge observes. "Unless there's some revolutionary or must-have technology that will position your company ahead of its competitors, tried and true is preferable to latest and greatest."

Angelo DePalma *holds a Ph.D. in organic chemistry and has worked in the pharmaceutical industry. A full-time freelance writer for more than 20 years, DePalma has written nearly 2,000 trade magazine articles on pharmaceuticals, biotechnology, materials and supporting industries. You can reach him at angelo@adepalma.com.*

THINKING POINTS FOR POTENTIAL PURCHASERS OF USED EQUIPMENT

- Due diligence: Know your vendors and their experience, technical expertise, service capabilities, inventory and ability to broker deals for equipment they do not have in stock.
- Carefully assess your needs to avoid over-purchasing.
- Consider timing, as new equipment deliveries can take up to 12 weeks.
- Study the warranty.
- Don't be afraid to consult with the original manufacturer; many are quite helpful.
- Rentals may be a viable alternative for new or one-off projects.
- Do you need a backup for critical instrumentation? If so, a used unit might be the answer.
- Test used equipment, whenever possible, before buying.

USED PRODUCTS TO AVOID?

Every used equipment purchaser has a unique comfort zone with respect to the types of equipment he or she would buy and which he or she would avoid. Susan Boutros of Environmental Associates purchases equipment with which she is comfortable and knowledgeable. "Since we are not electronics experts, I am wary of buying used electronics-heavy instruments."

Scott Rudge of RMC stays away from "durable consumables"—items that are potentially fouled or changed by contact with a product. "I would readily buy used HPLC modules or pH meters, but not an HPLC column or a pH probe."

Sheri LaRochelle, QC manager at Innovative Foods, has purchased used big-ticket items like incubators, autoclaves and even a nuclear magnetic resonance spectrometer, but prefers to source smaller items like stirrers or hot plates new.

Raj Moonsammy of Siltech adds glassware, chromatography columns and computers to his no-buy list. "Computers are cheap enough new," he says.

Pre-Owned Equipment Marketplace

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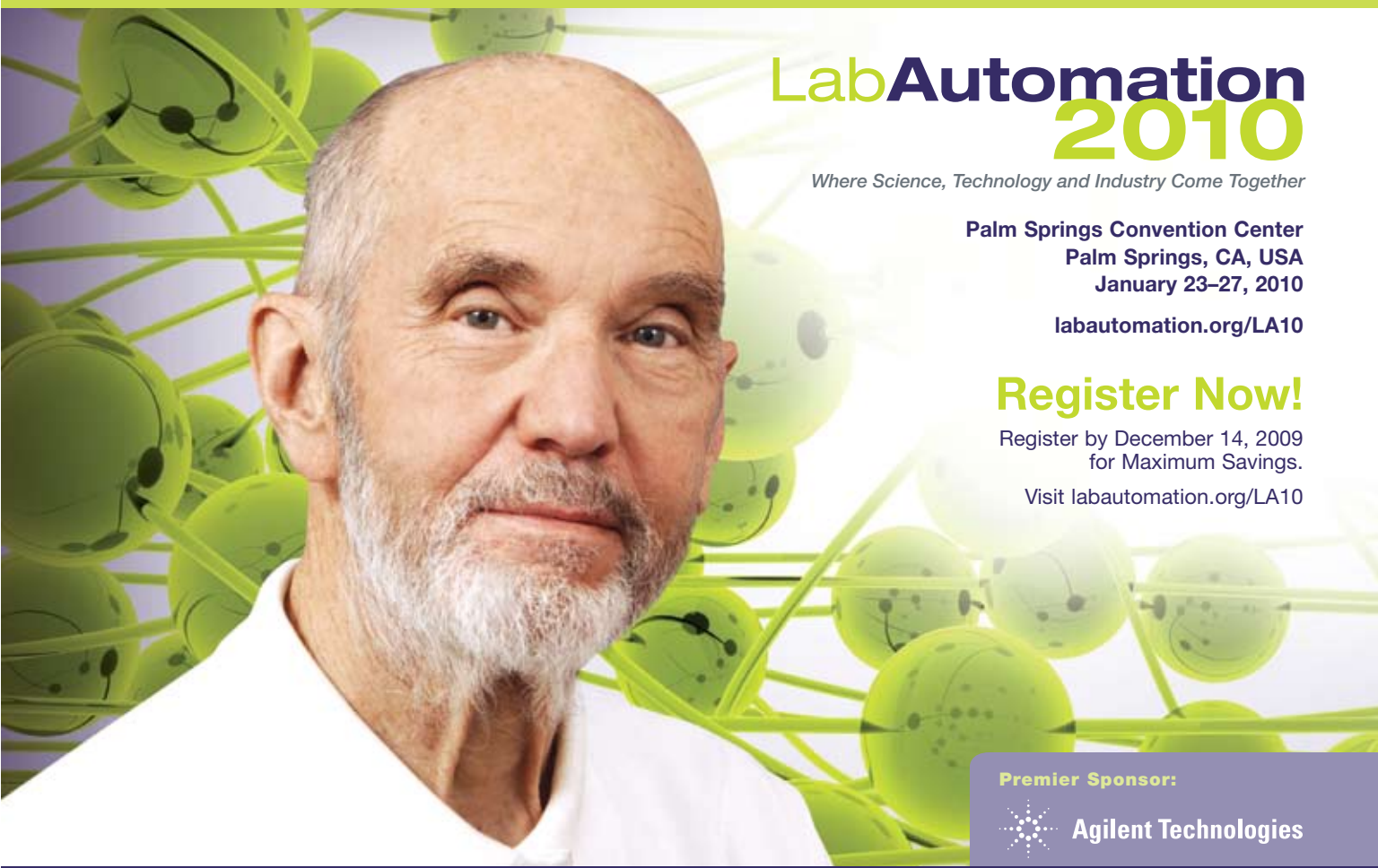

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PARTING POINTS

Takeaways from this month's issue:

Taking Your Career to the Next Level, p. 10

Moving up the laboratory career ladder is a lot like using a roadmap. You need to know where you're going in order to plan a route to get there. The following tips can help you achieve your career goals:

- Assess your skills and determine what additional skills you'll need
- Establish a strategy to acquire those skills, whether by taking a course or an extra assignment
- Create opportunities to show your colleagues/manager that you have the skills needed to take your career up a level
- Develop a professional network inside and outside your organization
- If the opportunity to move up in your present workplace doesn't exist, consider other options outside of your organization

Motivating a 21st Century Lab Staff, p. 22

One of the core accountabilities of a manager is to motivate his or her staff. A key component to a staff's motivation is a healthy organization climate. The Hay Group has identified the following six critical climate dimensions:

- Clarity: everyone in the organization knows what is expected of him/her
- Standards: challenging but attainable goals are set
- Responsibility: employees are given authority to accomplish tasks
- Flexibility: there are no unnecessary rules, policies, or procedures
- Rewards: employees are recognized and rewarded for good performance
- Team commitment: people are proud to belong to the organization

Scientists are from Mars, Designers are from Venus, p. 28

Differences in communication styles and project perspectives between scientists and designers can cause challenging, frustrating and often failed experiences in the laboratory design and construction process. To generate a positive outcome in the laboratory design process, both sides should:

- Communicate the essential information that each needs to make decisions
- Understand and be realistic about cost and time involved with design and construction
- Work together to seek creative solutions to inevitable challenges
- Know who the client is, and identify who has the authority to make final decisions

Constructive Feedback, p. 46

Feedback helps companies develop core strengths and identify areas of improvement in manufacturing, delivery, pre- and post-sale support and product development. Both the vendor and customer can benefit from working together to reach a resolution to an issue. The following tips are useful for providing constructive feedback and responding accordingly:

- Provide as many details as possible
- A polite and professional tone can go a long way toward encouraging a dialogue and resolving the problem.
- The customer should be taken seriously and answered with the utmost professionalism
- Properly handled feedback can improve the customer's overall experience

Keeping Safety in Sight, p. 48

Most lab professionals are familiar with basic eye protection, but about 2,000 eye injuries still occur on the job every day. Here are some tips for choosing proper eye protection:

- Suitable eye safety wear should bear the Z87 marking.
- Side protection should also be used for tasks involving flying particles
- Goggles that feature venting are not suitable against splashes or very fine dust
- Face shields should always be used with safety glasses or goggles

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