LIFE SCIENCE Tech Trends

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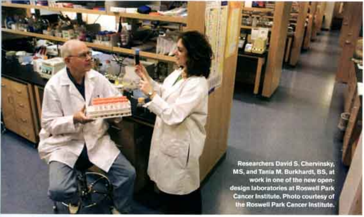
Building Bioscience Labs: Flexibility by Design



Researchers David S. Chervinsky, MS, and Tania M. Burkhardt, BS, at work in one of the new open-design laboratories at Roswell Park Cancer Institute. Photo courtesy of the Roswell Park Cancer Institute.

by Gina Shaw

Michael Friedlander has designed–and redesigned–bioscience laboratory space twice in the last four years. When he joined the faculty of Baylor College of Medicine as chair of the department of neuroscience and director of the College's Neuroscience Initiatives, he had to move and redesign his own lab, as well as redesigning existing space for new faculty. And before leaving the University of Alabama at Birmingham, where he was founding chair of neurobiology, Friedlander oversaw the design of new laboratory space for neuroscience in UAB's $90 million research building.

"At UAB, the pressure was to use a standard laboratory template for all the floors. Most people look at modern bioscience research, and the average investigator needs lots of bench space," he says. "But in my area, there are great differences. We have lots of people doing microscopy who need small dark rooms, and electrophysiology, which requires individual rooms. That was the challenge–designing three floors for neuroscience very differently from the rest of a 12-story building."

That, in essence, is the challenge many scientists face when given the opportunity to design or redesign their lab space: balancing the current preferences for flexible, open-plan design–which often has many advantages–with their own unique needs for cold rooms, microscopy, and other research space that can't simply be carved out of one big shared laboratory.

Striking a balance

It's a balance Dr. Friedlander has been trying to strike with his new laboratory space at Baylor. "We want to have the kind of open access to common areas that maximizes efficiencies. Instead of duplicating things that a lot of people in the lab do, we wanted to identify common needs and serve those for multiple investigators," he says. "So we designed a flow that allowed people to access those things, and, at the same time, allowed them to get into the areas where they did highly specialized work." For example, his multi-photon microscope, which has a combined electrophysiology setup and will be used to do live brain tissue imaging, required a nearly 300-square-foot dedicated room with lasers, ventilation, and floatation tables.

Open lab space, which promotes interaction and collaboration, was also the primary design principle behind a new life sciences complex within the Buffalo Niagara Medical Campus, built jointly by the University of Buffalo and the Roswell Park Cancer Institute. "Open design also promotes quality of life for the individual researcher," says John Cowell, Ph.D., D.Sc., chairman of the department of cancer genetics. "In our old labs, there would be huge freezers with big compressors kicking in and fume hoods with smelly compounds. In our open lab space here, the inner lab is where the person can be quiet and do their work, while attached to the lab spaces are function rooms where the bench equipment will be placed. You go to your work station to do your work, rather than having the work space surround you, and as a user, you don't need to duplicate equipment. People can have easy access because it's in a continuous space."

The Roswell Park facility takes advantage of a popular element of current lab planning: the "ghost corridor." Instead of wasting square footage on hallways, the "ghost corridor" becomes a functional space in itself—at Roswell Park, the linear equipment corridor which holds large items. "It's a completely separate zone, removing the noise, heat, and space requirements of these items from the lab space and putting it all into one area," says Cowell.

The facility also incorporates a few ultra-specialty function rooms, such as darkrooms, cold rooms, and tissue culture rooms, located off the equipment corridor. Investigators book these rooms in two-hour bites throughout the day. "It's a very efficient use of space and equipment," says Cowell, who calls the building "75% efficient." Twice as many people can work in the space as in traditionally-designed labs, he says.

Ghost corridors are also a feature of a new 90,000 square feet bioinformatics building that will soon break ground at the University of North Carolina-Charlotte. It's a hybrid building, part computational facility and part wet lab. "We tried to design the building in such a way that we can have dry labs and wet labs in reasonably close proximity," says Larry Mays, Ph.D., professor of computer science and director of the bioinformatics research center. "That's a challenge, because of the differences in infrastructure." The solution: one side of the hallway features six generic wet labs, of 600 square feet each, and on the other side, some dry labs.

Instead of establishing independent, shared "procedure rooms" as Roswell Park did, UNC gave each wet lab an 8 × 10 procedure room with a closable door for specialized work such as fluorescence microscopy or tissue culture.

At the University of Puget Sound, now in the midst of completing a $56 million Science Center which includes both a new science building and a complete refurbishing of the university's original science building, labs are also becoming "less idiosyncratic" and more uniform in design, says Betsy Kirkpatrick, Ph.D., associate professor of biology. "There's a lot of equipment shared across teaching and research labs. For example, we placed the cell biology and microbiology teaching labs almost adjacent to one another, and between them is a shared equipment room with a separate entrance from the hallway." Because of UPS' focus on marine biology, two separate communal areas for cold chambers were built into the design—one for student research and one for faculty.

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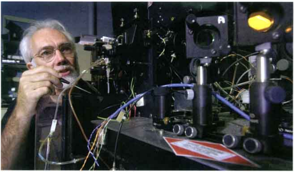
New heights in flexibility

Possibly one of the most flexibly designed bioscience spaces recently constructed is the Bindley Bioscience Center, a $15 million facility in Purdue University's Discovery Park. Bindley's 18,000 square feet can be configured for individual projects as needed—indeed, it was not designed to provide permanent laboratory or office space for any specific faculty. "The building provides highly flexible research space focused on multidisciplinary projects that would involve many different faculty members, shifting from project to project with many investigators who may or may not be overlapping," says Charles Buck, Ph.D., the building's director of operations. Other than James Leary, a recently-recruited professor of biomedical engineering and nanomedicine, who joined Purdue specifically to function in the new multidisciplinary atmosphere, no scientists will "live" in the Bindley building—rather, they will have their own labs and offices elsewhere in campus.

The building has six main laboratories of 2,200 square feet each. These large open spaces may simultaneously house researchers from up to 10 faculty groups at one time. All the lab benches are mobile benches on wheels. The utilities are not fixed to the walls, but drop down from the ceiling in utility drops under which scientists can wheel benches, tables, and other specific pieces of equipment. One of the six, a chemistry lab, does have some immovable equipment, such as fume hoods.

"What Bindley did was to establish a base of research equipment and infrastructure that was-



J. Paul Robinson, a Purdue professor of biomedical engineering, makes an adjustment on the multispectral analysis instrument in his laboratory at Discovery Park's Bindley Bioscience Center. With the instrument, Robinson can study 32 colors from a single cell flowing past a laser beam in a fraction of a second, yielding data about cells for applications ranging from medicine to homeland security. (Purdue University photo/David Umberger).

n't otherwise available at Purdue. We organized that infrastructure around four core capabilities: cytomics and imaging, computational life sciences and bioinformatics, biomolecular technologies, and bio/nanotechnology," says Buck. Senior level scientists with deep expertise in these technologies are housed in the center, serving as part of research teams and consulting with faculty researchers as needed. "So when the faculty comes out to access the research infrastructure, they don't have to be experts in how to prepare a sample for proteomics analysis and how robots operate."

Totally Automatic

For some new labs, design decision-making doesn't just include where to put the benches and how many cold rooms are needed, but how much automation is required and what space it will take up. Smaller teaching facilities don't require a lot of high-throughput instrumentation and robotics, but at other institutions, automation is a critical element of design.

"We've had historic strength at Purdue in mass spectrometry and analytical chemistry, but high-throughput analysis of compounds wasn't available here, and that's one of the things we invested in," says Buck. At the Bindley Center, high-resolution spectrometers with automated sample loaders and robotic systems which automatically derivatize and ionize samples will allow scientists to examine thousands of samples and thousands of molecules.

The facility has also taken an innovative approach to high-throughput screening. Instead of establishing a true high-throughput screening facility, they've replicated those conditions with two high-end liquid-handling robots. "That enables us to identify, for example, cell-based or biochemical assays developed by Purdue faculty that might be relevant in drug discovery," Buck says. "If a biochemist develops an assay on the benchtop using conventional means, it can be brought out to our screening facility, where we have the robotics as well as the compound library to implement it in a high-throughput context to see if it is sufficiently robust and what needs to be changed to make it attractive to a drug company."

At Baylor, Dr. Friedlander had a clean slate for his automated instrumentation, such as that needed to run fluorescence activated cell sorting (FACS). "We decided to do this in an area where we could work completely from scratch, gut it, and design it exactly to our specifications. If we had had to set this equipment up in a typical existing wet lab, we would have probably had to build some sort of Rube Goldberg contraption." But the new arrangement is so impressive, he says, that they've designed the corridors so that passersby can look in and see the automated processes running. "It's normally behind closed doors, but we thought it would be interesting to let visitors see these very sophisticated instruments at work."