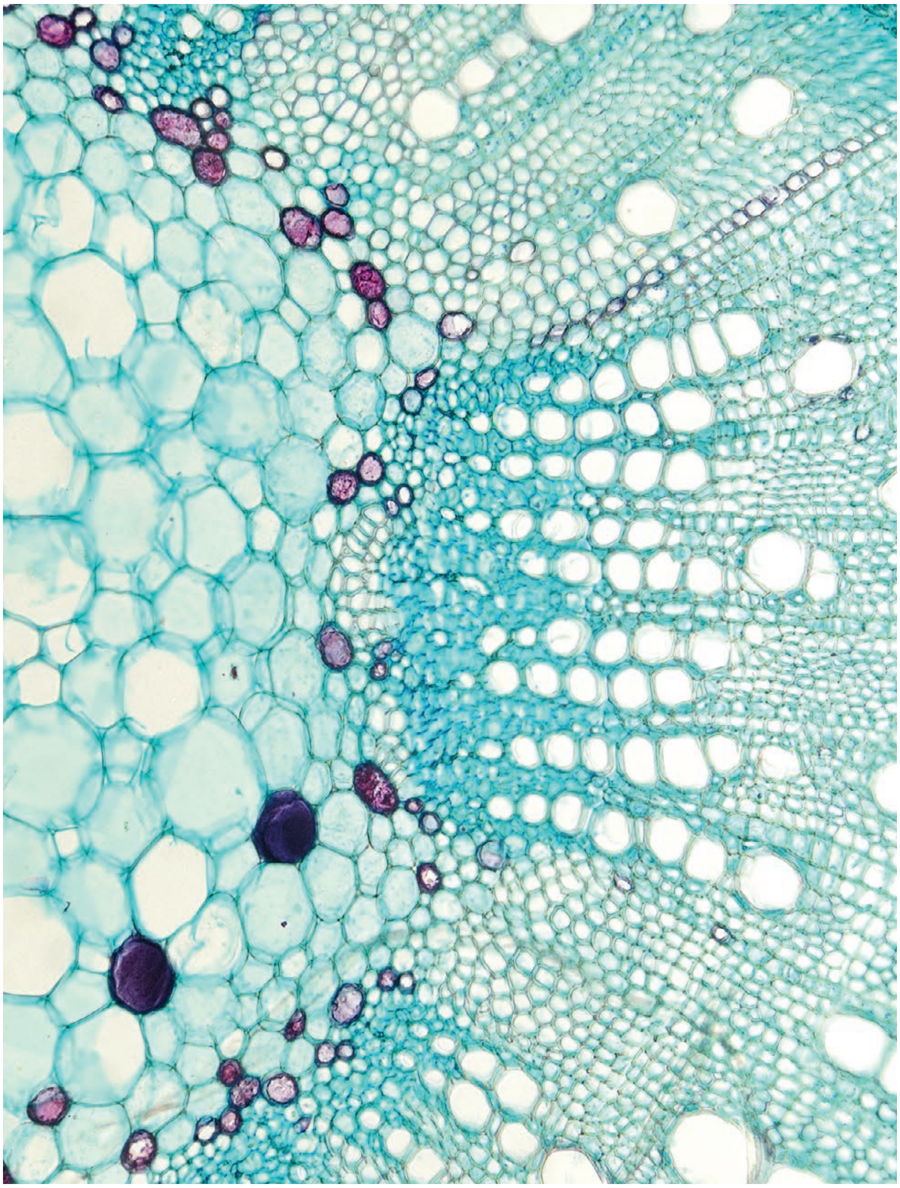

MULTIDISCIPLINARY BUILDING

FOR PROBLEM-BASED SCIENCE

BY PETER COFFEY

Research and teaching approaches to science are becoming increasingly problem focused rather than discipline focused. This shift means that today's science buildings often incorporate multiple disciplines, from chemistry and biology to engineering and computational work, each of which needs different workspaces and instrumentation. As the problems studied change, the composition of the project teams changes, and the buildings themselves have to be able to adapt to support the needs of each new group.

Problem-Focused, Team Approaches

Problem-focused, team approaches to science are a big departure from the past where science buildings—or the labs within them—were dedicated to biology, chemistry, or physics, and expected to stay that way for the life of the building. A shift away from this model leads to questions like these: What does that mean for the design of these new buildings? How can a lab building possibly economically accommodate whatever science or engineering discipline is the priority of the day?

McCourtney Hall of Molecular Science and Engineering

A few years ago, the University of Notre Dame built the McCourtney Hall of Molecular Science and Engineering; this project highlights the challenges and creative solutions to building a modern, multidisciplinary science and engineering building.

> Notre Dame decided to develop a new East Campus Research Complex with "research neighborhoods" to permit the kind of interdisciplinary research that Notre Dame believes is so important. The notion was to co-locate scientists and engineers with overlapping interests; one potential scenario would be polymer chemists who are working with engineering groups to test these new materials in real-world applications.

Notre Dame had committed some years previously to expanding its already substantial scientific program, with the goal of enhancing its capabilities in analytical sciences and engineering, chemical and biomolecular engineering, and drug discovery. The university already had numerous science and engineering buildings distributed about the campus. The new initiative required not only new research space but also new research faculty who would be recruited to the university and organized as problem-based, cooperative research teams.

Developing Research Neighborhoods

The university decided to develop a new East Campus Research Complex with "research neighborhoods" to permit the kind of interdisciplinary research that Notre Dame believes is so important. The notion was to co-locate scientists and engineers with overlapping interests; one potential scenario would be polymer chemists who are working with engineering groups to test these new materials in real-world applications. Conversely, a similar scenario imagines the engineering team identifying critical applications and presenting those needs to the polymer chemists as a research objective. The university envisioned bringing these disciplines together in a building that not only provides a setting most conducive to innovation, but also one that can evolve with the science and engineering challenges undertaken.

Bringing Disciplines Together in an Innovative Setting

McCourtney Hall was the product of that vision, and named for a generous donor with long ties to the university. The 219,500 GSF building, with 100,000 SF scheduled for lab space, was designed by BSA LifeStructures and completed in 2016. Because Notre Dame planned to recruit new faculty to the building, as well as relocate some faculty from other buildings on campus, some 40% of the lab space was reserved as shell space for later build-out.

BSA LifeStructures employed numerous approaches to support the multidisciplinary program while maintaining the building's ability to respond to program changes in the future:

- **A collaborative core:**
The L-shaped building locates faculty offices, conference rooms, and informal spaces at the junction of the two wings to create an environment that encourages informal interaction and collaboration.

- **Open, configurable labs:**
Lab spaces are open, with broad sightlines and modular, moveable casework that can be rearranged as needed to accommodate project teams with different instrumentation, storage, and work-surface needs. The open spaces encourage collaboration. "Flex space" can be assigned to either laboratory or lab-support functions as needed.

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• **Creative approaches to lab utilities:** To ensure versatile use of lab space, air supply and exhaust ductwork was designed to maximize the number of fume hoods possible on each floor, so that any type of lab could go on any floor in the future, as needed. To avoid excessive, potentially under-utilized utility investments, the building employs a mix of central and local approaches to supply. Certain utilities—such as natural gas—were designed for central supply, but with point-of-use delivery only to those labs that needed them. Other utilities, such as the lab vacuum systems, were provided as in-lab, local networks that are installed only where the need is clear.

Modular Vacuum Systems

The modular vacuum systems illustrate how a departure from traditional practice can help achieve both technical performance objectives and the adaptability goals of a problem-based organization of research or teaching. By installing the vacuum only where needed, the university avoids overbuilding of a utility that may well be needed in a chemistry or biology lab, but may not be needed in a physics or computational lab.

At the same time, should vacuum be needed for a new research program in a space where it is currently not provided, the installation can usually be accomplished in a day or two per lab. Lab-by-lab installation also prevents any risk of inter-lab cross-contamination through vacuum lines.

Vacuum is typically used intermittently in most labs. If produced in-lab and only as needed by that lab, on-demand vacuum production by small, local pumps saves energy and extends maintenance cycles. At Notre Dame, early monitoring of the local vacuum system usage suggests future energy savings of greater than 50% compared with a central vacuum system designed to serve the same number of users. The local network approach to vacuum also solved a problem that had plagued another science building at Notre Dame. The central vacuum system in the Stepan Chemistry Hall had to be shut down several years before when solvents were occasionally sucked into the system, damaging the pumps and leading to expensive repairs.

Improving Lab Safety and Operating Efficiencies

In the past, scientists had needed to buy their own pumps, hitting departmental budgets. The local vacuum networks installed in McCourtney Hall rely on chemical-resistant pumps and tubing, and ensure that the entire building vacuum system is not at risk should someone inadvertently aspirate corrosive solvents into the lines. Net, a technology chosen largely to address the need for adaptability in a multidisciplinary facility, also overcome a longstanding maintenance challenge and should provide continuing operating savings. Other utilities that are typically supplied as fixed, whole-building systems but could be supplied modularly deserve investigation when the varied needs of multidisciplinary teams call for specialized local requirements.

Examples of such utilities include the following:

1. Modular electrical raceways that permit delivery of electricity of the needed voltage—120V, 240V, 480V—anywhere in a lab, eliminating the need for invasive rewiring when instrumentation changes.

2. Point-of-use ultrapure water systems and in-lab gas generators or cylinders instead of piped gases. Both of these eliminate the cost and inflexibility of building-wide piping systems.

3. Filtered fume hoods, which operate without ductwork needed by fixed hoods, permitting the hoods to be relocated as needed. While most commonly used for teaching labs, filtered fume hoods can be adapted for specific project requirements and can lower long-term energy costs.

An early test of the adaptability the new McCourtney building to an unpredictable research program occurred when the Notre Dame science-recruiting effort found quick success. Within a year of occupying the new building, the university has already had to fit-out 25% of the reserved lab space for four labs for new research teams. The fundamental planning vision—a building that can accommodate the varied and changing needs of a wide range of scientific and engineering disciplines—has produced a building that can be quickly and economically outfitted for new faculty with new research problems to solve.

ABOUT THE AUTHOR: Peter Coffey has served since 2009 as Vice President at Vacuubrand, Inc., where he has been working to bring to North America energy and water-saving lab vacuum technology developed by Vacuubrand of Germany. Coffey holds degrees in biology, natural resources management, and business.