

## ARTICLE

# Planning and Designing Spaces for the Sciences

**Douglas A. Weldon**

*Psychology Department and Neuroscience Program, Hamilton College, Clinton, NY 13323*

Science facility renovation and expansion projects provide opportunities for faculty members to play a role in working with architects and administrators to produce effective spaces for teaching and research. This article summarizes information regarding the process and design features that have proved beneficial for many recent science facilities

projects. Although the context focuses on large projects, the general principles pertain to smaller changes in spaces that individual departments might be pursuing.

*Key words: science facilities projects; construction; design; planning; renovation; expansion; Project Kaleidoscope; teaching and research spaces.*

When major renovations and expansions of science facilities occur on college campuses, they can be transformative for the institutions, faculty and students. Buildings are not renovated or expanded very often, and when they are, faculty members are often involved in the process. This article describes some general guidelines that allow faculty members to make the most of the opportunities to contribute effectively to science facilities projects.

Facilities projects can take many years to complete, and they represent significant investments by the institutions. The process can be daunting, particularly for faculty members and administrators who have not been involved in similar projects previously. Fortunately, there are sources of information on how to approach the challenges. For many years, Project Kaleidoscope sponsored workshops that brought institutional teams together with architects and campus planners to provide information regarding processes and concepts in designing effective science facilities. There is a wealth of information that is available from the Project Kaleidoscope (<http://www.pkal.org/>) and Learning Space Collaboratory (<http://www.pkallsc.org/>) websites.

In order to describe some effective approaches, this paper discusses both the processes involved in planning science facilities and specific design objectives. In serving as the faculty coordinator of the Taylor Science Center project at Hamilton College (Reynolds & Weldon, 2006), the author had the opportunity to learn from that experience and from observing other successful projects around the country. The following narrative describes some basic principles that might be helpful for faculty in the beginning stages of planning science facilities projects at their own institutions. For an example of how an effective planning process can lead to optimal neuroscience facilities, the reader should also consult the description of the Regents Hall of Natural and Mathematical Sciences at St. Olaf College (Muir and Van Wylen, 2009).

## PROCESS

Science facilities projects require the collaboration of many different parties, and an effective coordination between these individuals leads to successful outcomes. Architects

with experience in designing laboratories bring expertise and creativity as they provide their clients with a variety of issues and examples to consider as decisions are made about optimal space configurations. The success of the project is dependent upon the effective teamwork between the client, the architects, and the construction management staff. In the design phase of the process, there is a recursive aspect to the exercise, as concepts get refined and translated to actual construction documents. Although the campus planning, physical plant and administration (e.g., dean of the faculty or financial affairs) staff are critical representatives of the institution, it is also important to have faculty perspectives heard as they pertain to the evolution of the program for the building. As described below, a "faculty shepherd" is a desirable addition to the team. This person represents the faculty and is charged with maintaining the integrity of the program as the design and construction go forward.

The opportunity to provide input into the development of new spaces comes with the responsibility to provide the lab designers with as much information as possible. Descriptions of how teaching and research are accomplished, expectations of new equipment or staffing changes, and needs and desires to have shared spaces are all important issues to raise. It is important to balance the vision for new spaces with a flexibility to seriously consider suggestions from the architects, who have the benefit of knowing designs that have worked well at other institutions.

For any project, one of the first considerations is how the objectives fit into the campus curricular and strategic plans. At some campuses, there might be a master plan indicating how renovations or expansions of science facilities contribute to the strategic objectives of the institution. In some cases, specific curricular programs are considered important to develop as focal points for the science offerings. In others, increases in science enrollments have occurred or buildings that were effective years ago no longer support modern science, both in terms of the increased demand on technology or laboratories that need to be renovated for safety concerns.

One common driving force for renovation of science facilities is that science education has changed over the

decades. One of the main changes at many institutions is the incorporation of student research as a focal point in the way in which students learn science, either in laboratory courses or in conducting independent studies. In other cases, the changes in teaching style might not match the spaces that were appropriate for teaching in a different era. For example, in some disciplines, there is less division between laboratory and lecture; new spaces are constructed to allow for a seamless transition to both types of teaching within the same spaces. These issues might be particularly relevant for undergraduate neuroscience.

Extensive faculty discussions are critical in developing an optimal set of perspectives regarding the needs and the priorities of the spaces to be developed. A self-study serves the purpose of identifying where the opportunities and needs lie. This might include mission statements and descriptions of pedagogical and research approaches. It is through these discussions whereby the vision for the future can be shaped. The discussions of how to build on strengths and how to deal with weaknesses have the potential to alter the educational environment for years to come. If possible, faculty discussions across departments are helpful, particularly when incorporating the opinions of younger faculty who will benefit the most from the new spaces.

Benchmarking data can be helpful to the administration and trustees as they decide on the magnitude of a project. In the case where there is a possible expansion or redistribution of total space, obtaining benchmark data is important. These data are particularly relevant to faculty when there are multiple departments involved in the project. Departments have different needs, and comparative data provide the information to enable appropriate allocation. Once the appropriate determinations of total space have been made, departments might decide to partition the space in different ways.

Communication is fundamental to good morale and an effective design process. One way to accomplish this successfully is to have a faculty member serve as the "shepherd" of the project. Ideally, this person would be involved in all meetings with the administration, architects, and construction professionals to represent the faculty and to be responsible for ensuring that the academic program is maintained as the many decisions occur throughout the duration of the project. As a central figure, this person serves to keep all parties informed of the progress and issues that arise. Faculty shepherds become so familiar with the different faculty and departmental needs that they can be critical in keeping important program considerations at the forefront. They provide an effective way for architects to communicate with the faculty and staff, and they assist the deans in dealing with committees and meetings that would otherwise be organized by an administrator from the dean's office or physical plant.

Particularly in large projects, the constituencies that need to be involved extend to the entire campus. Thus, several committees are helpful to have in place, each with a specific charge. For example, a general building committee would bring together a larger number of people

to review progress of the design, but a health and safety committee might be responsible for reviewing and revising the policies regarding storage of and access to chemicals. In our project at Hamilton, one committee consisted of representatives of the departments or areas included in the project, and this group played a fundamental role in coordinating the deliberations within the different departments regarding their teaching and research spaces. Other items require the input from other members of the campus community who will have a significant impact on the operation of the building, including those in the maintenance, registrar, information technology, and food service areas. If there are classrooms that will serve other departments, then conversations should take place with faculty from non-science departments. It is desirable to include students on many of these committees to provide their perspective on the important and desirable features of new spaces.

Many faculty members are so heavily involved in their own work that they have not had the opportunity to examine the best practices and spaces at other institutions. It is well worth the investment of time and money for them to see the most interesting projects that have been constructed. When the faculty members visit these buildings, they become aware of different approaches and come up with creative ideas of their own.

## DESIGN FEATURES

Although each project has its own unique features, some general characteristics can be seen in many modern science buildings. Sustainable design is a common objective. One of the trends at small colleges has been to bring several disciplines (and sometimes all of the sciences) under one roof. This serves interdisciplinary programs particularly well, but also recognizes the fact that the traditional disciplines have blurred boundaries between each other. These arrangements benefit neuroscience programs in particular, since those students typically take courses in biology, chemistry, and psychology, and the faculty and student research sometimes requires access to equipment that is housed in different departments.

*Visibility.* Modern undergraduate science education is exciting to watch, with students engaging in laboratory work, collaborative activities, and oral presentations with attractive slides (see Figures 1 and 2). Buildings are energized when the activity in the classrooms and laboratories is visible to visitors passing through the building. The presence of glass in doors and walls also provides an element of safety by allowing students to be seen from hallways.

Of course, there are times when visibility is counterproductive to a particular laboratory experiment or demonstration. At Hamilton, a few faculty members have covered the glass windows to their laboratories with shades. In the behavioral neuroscience testing rooms, we have constructed panels that can be secured inside the glass windows. When we are conducting experiments that require privacy, these panels are easily inserted for the times when testing is taking place.



Figure 1. Laboratory with windows to the hallway showing ongoing activity. (Courtesy of Gary Muir, St. Olaf College).

**Adjacencies.** At Hamilton College, offices are located near laboratories to let faculty members always be in close proximity to the student research. The teaching laboratories are also in the same areas, which makes those spaces available for use for research during summer months when they are not being used for classes. When possible, shared prep rooms and support spaces allow for efficient shared access to equipment and chemical storage.



Figure 2. Full glass doors to a neuroscience research laboratory allows for visibility of science in progress. (Hamilton College).

**Flexibility.** Over time, faculty members will change, curricular programs will evolve, new areas of inquiry will develop, and student course selections will differ. Over many years, the distribution of faculty might change from discipline to discipline. As part of the design process, it is useful to ask how the configuration of spaces would accommodate an additional faculty member or a faculty member with a different specialty area. One objective might be to include expansion spaces that are shared and thus not designated for any particular department. As needs change and some programs become smaller and other new ones are formed, these spaces can serve different departments at different times.

Flexibility can also be incorporated into the way



Figure 3. Faculty-student research laboratory for organic chemistry that is shared between two faculty members. (Hamilton College).



Figure 4. Electrophysiology laboratory with moveable tables and racks. In this arrangement, the laboratory has equipment in the center and tables arranged in a star configuration so that several work stations are formed. An adjacent room is configured as a seminar/computer room for easy access from this space. (Courtesy of Bruce Johnson, Cornell University).

individual spaces are arranged. For example, for wet lab bench work, it might be useful to have a shared student-faculty research lab that serves more than one faculty member. In this way, during a semester when one faculty member needs more space and another one less, their use of the area in the laboratory can expand and retract accordingly (see Figure 3). For other situations, all other things being equal, a larger number of small spaces might be more helpful than fewer spaces that are larger in size. One example of this might be for spaces used for behavioral testing. Some neuroscience teaching laboratories have incorporated both laboratory and seminar areas in the same space, and others have had adjacent rooms configured for wet lab and seminar or computer work, thus making it easy to have students engage in both types of activities in the same class period (see Figures 4 and 5).



*Figure 5.* Renovated teaching laboratory/seminar room combination. This space includes four electrophysiology rigs and moveable tables to allow for student seminar activity. (Courtesy of Ann Jane Tierney, Colgate University).

Another form of flexibility can be seen in furnishings. If built-in benches are not required, then sturdy but moveable tables can be considered. In teaching laboratories, this can make it easy to have different configurations from semester to semester or even from week to week (see Figure 6). For those classes where reconfigurations are frequent, casters might be placed on the legs of the tables. Tables with built-in outlets and umbilical cords to connect to floor boxes keep sight lines free.



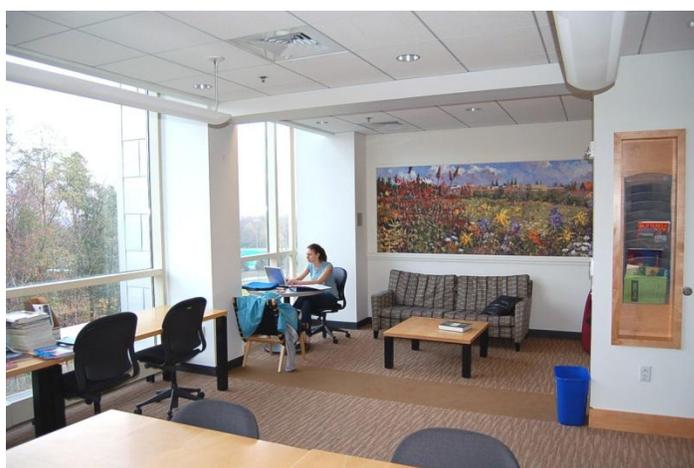
*Figure 6.* Neuroscience teaching laboratory that contains moveable tables and a low bench on one side with electrophysiology stations. When necessary, computer stations on moveable carts are placed at those stations. A high bench is located on the wall not shown in this picture. (Hamilton College).

Behavioral neuroscience laboratories often require lighting, curtains, and cameras that are sometimes suspended from the laboratory ceilings. Metal framing systems typical of physics laboratories are particularly helpful in this regard. They are connected to the steel structure of the building, can be configured to provide power, and have tracks to make the position of equipment easy to adjust (see Figure 7).



*Figure 7.* Metal framing support system suspended from the ceiling in a recording area of an electrophysiology laboratory. In this example, lights, a commutator, and a video camera are securely attached to the system. (Hamilton College).

Finally, although the teaching and research areas are the focus of the attention of faculty members, there are other types of spaces that create a successful academic building. When students are asked about the spaces that are the most important for them, they place good study areas at the top of the list (see Figure 8). Similarly, a science center that has a café and attractive classrooms is used by students and faculty from all disciplines and ensures that the building serves the entire campus.



*Figure 8.* Departmental study area containing soft seating, tables, and a kitchenette. (Hamilton College).

## CONCLUSIONS

Effectively designed science facilities produce long-term benefits, not only in teaching and research, but also in admissions and in the success of the institutional mission. Although the examples and descriptions mentioned above have been in the context of large renovation and expansion projects, there are lessons that can easily be applied to small projects. It is remarkable how providing appropriate furnishings to a room can change the effectiveness of the space. Regardless of the magnitude of the projects and

their eventual design features, the process is critical. When all parties become involved in the discussions, then they can all contribute constructively in the difficult choices that sometimes have to be made because of budgetary limitations. The increases in the effectiveness of the spaces and in the morale of the users can be impressive.

## REFERENCES

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Address correspondence to: Dr. Douglas A. Weldon, Psychology Department, Hamilton College, Clinton, NY 13323. Email: [dweldon@hamilton.edu](mailto:dweldon@hamilton.edu)