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2010 Laboratory of the Year

Science in the Public Eye

Chicago Botanic Garden puts science, nature, and sustainability on display.

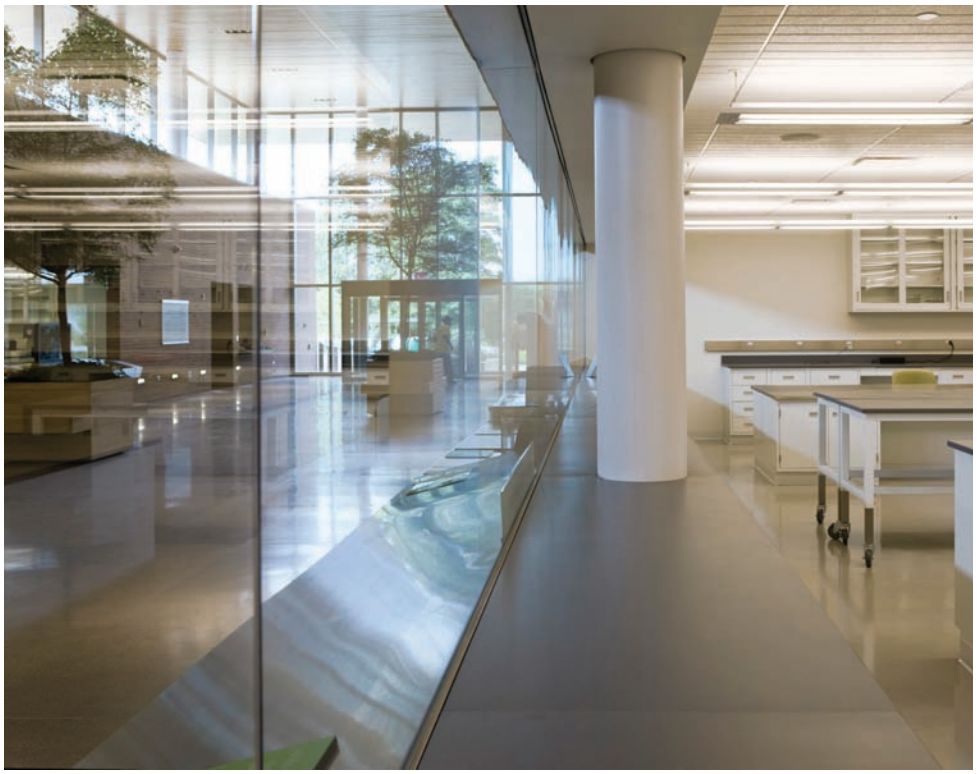
Plants provide the air we breathe, food and water to sustain life, clothing, shelter, and medicine. By 2050, the United States could lose 25% of its existing plant species. The world could lose about 150,000 species, along with insects, birds, and other animals that depend on plants. The disappearance of even a single species of plant can impact an ecosystem and change the way people live.

The mission of the **Chicago Botanic Garden** (CBG) (Glencoe, Ill.), is to promote the enjoyment, understanding, and conservation of plants in the natural world. The concept and design of its **Daniel F. and Ada L. Rice Plant Conservation Science Center** fittingly illustrates this mission, providing a sustainable laboratory that puts science on display and makes it accessible to researchers and the public alike.

For its innovation in incorporating education (both public and private), transparency, and sustainability— the Plant Conservation Science Center has earned the title of *R&D Magazine's* 2010 Laboratory of the Year.

The 385-acre CBG features 24 display gardens and three native habitats situated on nine islands surrounded by lakes. It is one of the nation's most visited public gardens and a center for learning and scientific research.

The 37,700-ft^2 masonry and glass Plant Conservation Science Center houses 10 laboratories and offices for 40 researchers, an herbarium, seed vault facility, seminar and conference rooms, and a plant science library. The Center's resources provide laboratories and teaching facilities for more than 200 PhD scientists, land managers, students, and interns whose research is critical to the CBG's goal to save the planet by saving the plants.



Transparency between laboratory and atrium allows scientific research to be available to the visitors. Photo: Michelle Litvin

2010 Laboratory of the Year

The Plant Conservation Science Center works in partnership with Northwestern Univ.'s plant conservation program, offering a new doctoral program in plant biology and conservation. Laboratories are dedicated to ecology, soil, population biology, plant systematics, genetics, economic botany, reproductive biology, seed bank preparation, and microscopy.

"This building serves to educate both researchers and the public by actually bringing the plant research out into the open, but also draws in the public through direct observation, the green roof, and exhibits," states Victoria David, AIA, VP director laboratory design, from **Leo A Daly**, Denver, Colo., a Laboratory of the Year (LOY) judge.

Making science transparent

Architect **Booth Hansen**, Chicago, Ill., designed the building from the "inside-out." A two-story central gallery area runs the length of the building, with clerestory windows providing natural light to the space. Windows line both sides of the gallery, providing a direct view into working laboratories. Hands-on exhibits to engage visitors (nearly 800,000 a year) and provide details about the CBG's research projects.

All educational and laboratory spaces have a direct connection to nature through plants, outside views of the garden, and natural light. From the inside of the laboratory, scientists can engage the public and other scientists; every open lab has a view to every other open lab. Scientists' offices, located at the building's perimeter, provide views of the garden outside, to spark creativity and discovery from nature.

"Meaningful transparency can create a delightful building," says Erik Mollo-Christensen, AIA, principal at **TSOI/Koubus & Associates**, Cambridge, Mass., and LOY judge. "In this case, [the building] engages visitors in the actual science function, not just a static display in the lobby, and also provides a beautiful environment for the researchers. Many labs have token atria, often used as substitute windows for half of the labs in buildings too wide for an optimal design, and many of these atria look out on nothing. And while this project may be hard to duplicate in a multi-story version, the connection between visitor and scientist is very immediate and tangible, without being intrusive."

Minimizing impact

The Plant Conservation Science Center not only had to fit into the environment, it had to have minimal impact on it. The Center sits in a floodplain, so the building itself was raised above the flood level on steel and concrete piers. This not only prevents flooding of the building, but also maintains an undisturbed grade, and allows for a rain garden for site runoff.

The safety entry zone in the lab is identified with color, as shown at the right. Photo: Michelle Litvin

Lesson Learned

"Not every great lab building has to be a $100 million biomedical behemoth. A small building devoted to a niche lab need can also be programmatically perfect and a delight to work in and a destination for lab visitors."

–Richard R. Reitz, LOY judge

The natural brick, glass, wood, and steel used to construct the building fit into the overall design of the CBG. On the interior, recycled rubber flooring, exposed concrete floors, and countertops made from recycled slate were used for optimum durability and functionality, and to minimize off-gassing. The materials selected also help enhance the sustainability of the building, having no- or low-volatile organic compounds.

Roof overhangs are constructed of photovoltaic cell panels that provide more than 6% of the building's power. The design of the solar panel installation also provides for shading on the windows, reducing glare and heat gain.

The Center features a living laboratory on the envelope of the building. The 16,000 ft^2 green roof garden will be used to study the adaptability of regional and North American plants on a roof, leading to more information and best practices for roof gardening for other facilities.

The roof garden, along with light-colored roofing, make the sustainable design more visible to the visitor. The green roof reduces storm water run-off and naturally filters any remaining storm water. It also reduces the heat island effect.

"The project is very low profile. It fits right into the botanical garden setting, yet has all the features of a modern lab, "says Richard R. Reitz, PhD, Helena, Mont., LOY judge. "The public visitors probably don't even know all the lab systems that are operating in the building."

Sustaining science

A rainwater glen, which surrounds the building, collects the rainwater draining from nearby parking areas and filters it within the Garden's plant community. The use of native plants reduced the need for irrigation by 50%; no potable water is used for irrigation. Low-flow plumbing fixtures and valves use 30% less water.

In order to earn a LEED Gold Certification from the U.S. Green Building Council, the Cen-

The roof garden at the Plant Conservation Science Center. Photo: Michelle Litvin

ter's designers chose sustainable mechanical, electrical, and plumbing systems.

Energy saving measures include high-efficiency lighting with occupancy sensors, photocells on exterior walls to allow a maximum of daylighting and a reduction of energy use for lighting, and 23 metered electrical panels to monitor and verify predicted energy savings. The building envelope includes thermally broken windows, low-E and high-performance glass, continuous insulation of exterior walls and roof, and air lock vestibules at all entrances.

Two variable air volume (VAV) low-velocity air handling units (AHU) serve the building. A heat recovery system recovers heat from the laboratory exhaust systems. Fan-assisted natural ventilation of the central atrium viewing gallery adjusts when the temperature rises above a setpoint.

Two high efficiency condensing hot water boilers serve the air handling unit preheat coils, space reheat coils, and in-floor radiant heat. The temperatures for the radiant heat return water and heating hot water are adjusted to the outside temperature. Lower water temperatures are used in the heating equipment, increasing the efficiency of the condensing boilers.

A high efficiency 150-ton chiller, which uses pond water for the condenser water, distributes chilled water the AHU cooling coils and an in-floor radiant cooling system. The design assumes that the radiant cooling will provide for 1.5 W per square foot of cooling. An energy model estimates that this method can reduce the cooling required from the air system, with savings of 145,400 BTU per hour as compared to the building without radiant cooling.

"The project set goals and design features to minimize not just energy, but ways to reduce carbon usage. The sustainability features were well thought out from creative application of chiller using pond water for condenser water, to use of solar voltaic and natural ventilation of the central atrium spin," comments Andy Vazzano, FAIA, LEED AP Science and Technology practice leader, office director, **SmithGroup**, and LOY judge.

The building will, according to E-Quest building energy use analysis software, have an annual electric savings of 192,850 kW-h/year, annual gas savings of 17,280 therms/year, and annual energy cost savings of 39.6%. This achieves 9 out of 10 LEED EA_{C1} points, as compared to the ASHRAE Standard 90 Base Case building. The Center also shows a reduction of carbon emissions, 27% lower emissions than if the building had simply satisfied ASHRAE Standard 90.

View of the Plant Conservation Science Center from within the Botanic Garden. Photo: Chicago Botanic Garden

Creating flexibility

Booth Hansen created a flexible and safe design on the inside of the building. Since the laboratories in the Center range from dry labs with no fume hoods, to hood-intensive chemistry and biology laboratories, two laboratory blocks are arranged based on the requirements of the research. The west lab block houses dry labs with fume hoods limited to specific support rooms, and the east block houses biology and chemistry laboratories. Each block is served by dedicated mechanical rooms, air handling units, and utilities.

The initial planning principle for the labs were "open" by rule, and "enclosed" only where required by function or safety. The basic planning module for the center is 32 feet x 32 feet with a 10-foot, 8-inch centerline between benches, and was designed to accommodate plug-and-play flexibility anywhere within the lab block. Walls can be located anywhere to combine labs or enclose areas as necessary.

Organizing the lab from low hazard to high hazard areas aid integration of the mechanical systems; plus, more interesting scientific instruments can be placed closer to the public viewing

View through fume hood zone to laboratory beyond. Photo: Michelle Litvin

areas. Microscopes, environmental chambers, automated analyzers, drying rooms, a DNA sequencer, and centrifuges are some of the available lab tools.

Every laboratory entry has a handwashing sink, lab coat/safety glasses storage, safety shower/eyewash, and a prominently-marked emergency station with first-aid and fire extinguishers.

Connecting with science

Public outreach is now being requested, and sometimes, demanded as a program feature," says Rietz. "Until this building, planners and designers only gave lip service to public outreach features in lab buildings."

The Plant Conservation Science Center puts science on display with its central atrium, full transparency to the labs, and openness with full daylighting. Visitors and scientists can experience science first hand.

"Buildings are really part of a larger community of human use and this project recognizes that it must be in concert and part of this bigger picture—and not just the picture itself," says David.

—Lindsay Hock

VITAL STATS

Project: The Daniel F. and Ada L. Rice Plant Conservation Science Center, Chicago Botanic Garden, Glencoe, Ill.
Size: 37,700 ft^2 **Cost:** $20.6 million

Owner:
Chicago Horticultural Society,Glencoe, Ill.

Architect and lab planner:
Booth Hansen Ltd., Chicago

MP and fire protection engineer, energy modeling:
Grumman/Butkus Engineering Inc., Evanston, Ill.

Structural engineer:
GFGR Architects/Engineers, Chicago

Environmental consultant:
Rocky Mountain Institute, Boulder, Colo.

Electrical engineer:
Dickerson Engineering Inc., Niles, Ill.

Civil engineer:
Gary Wiss Inc.,Northbrook, Ill.

Commissioning:
E Cube Inc.,Chicago

Landscape architect: Oehme, van Sweden & Associates, Washington, D.C.

Interiors: Perkins+Will, Chicago

Project manager, cost estimator:
Brown + Associates Inc., Lincolnwood, Ill.

Construction manager:
Featherstone Inc., Downers Grove, Ill.

Lighting Design:
David Nelson & Associates, Littleton, Colo.