SLAM

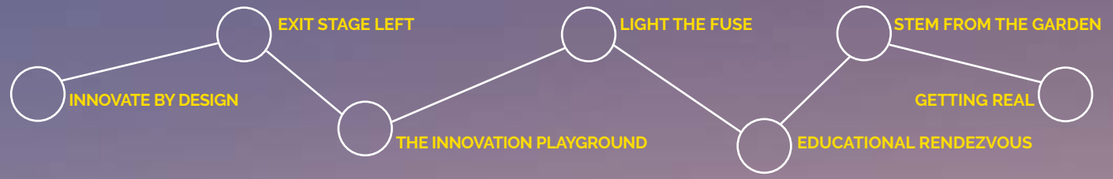
STEM Education

RUTGERS UNIVERSITY | RICHARD WEEKS HALL OF ENGINEERING

STEM

STEM degrees are no longer the final step in an education, but are often the basis for a more focused avenue of learning, practice, and discovery. Obtaining skills can be done in various paths that do not happen at the same time and place. The ultimate goal is to graduate with real-life experiences that provoke creative thinking with actual tools and with real people. Since every student has the world of information in their pocket, STEM learning is shifting away from lecture-based instruction to provide a foundation for a life-time of learning.

When passionate minds from many backgrounds come together, they bring unique insights and expertise that can lead to breakthroughs and paradigm shifts. What follows are SLAM's design ideas for STEM institutions that are influencing multi-model teaching, learning, collaboration and innovation.



CLAYTON STATE UNIVERSITY | LAKEVIEW DISCOVERY AND SCIENCE CENTER

INNOVATE BY DESIGN

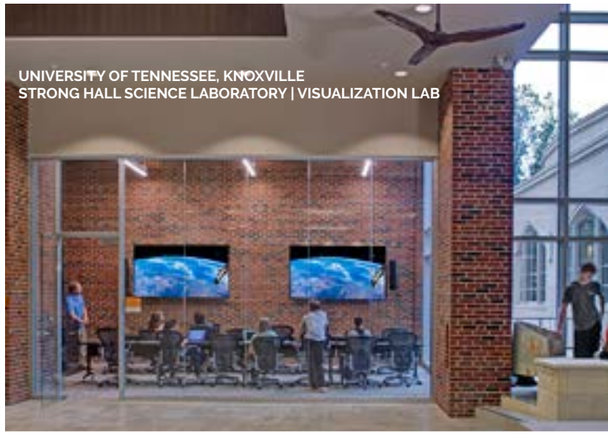
Traditionally scientists, often seen as impractical dreamers, made discoveries and engineers used those discoveries to inform inventions to solve actual problems. This traditional distinction between scientists and engineers, along with the linear connection between discovery and application, are fading away. Enabled and emboldened by today's technological advancements, transdisciplinary teams, often including members outside of the STEM disciplines, are accelerating the pace of innovation in science and industry. With demonstrated impact on learning outcomes and research productivity, creating environments that promote transdisciplinary collaboration and innovation is a driving force behind the modern academic building.

A distinctive feature of the future classroom could be the latest generation of visual technology providing images of unprecedented clarity and resolution for students enveloped in a 360-degree visual experience. The visualization/simulation/collaboration theater provides a cutting-edge approach to bringing data to multi-disciplinary teams ranging from visualizing objects from the galaxy to a DNA strand or math concepts.

> "Many ideas grow better when transplanted into another mind than the one where they sprang up."
>
> — Oliver Wendell Holmes

RUTGERS UNIVERSITY | RICHARD WEEKS HALL OF ENGINEERING

UNIVERSITY OF NOTRE DAME
JORDAN HALL OF SCIENCE



UNIVERSITY OF TENNESSEE, KNOXVILLE
STRONG HALL SCIENCE LABORATORY | VISUALIZATION LAB

SACRED HEART UNIVERSITY
AUGMENTED_REALITY / VIRTUAL REALITY CLASSROOM CORRIDOR

EXIT STAGE LEFT

Traditional didactic learning spaces are not aligned with how the brain works. Most people, on average, retain less than 10 percent of what they are told, so how do we actively engage students so they don't just remember but learn?

Seat location affects attention, so classrooms and laboratories can be configured with "multiple stages" for instruction and no fixed instructor position. Thus, every seat is the best seat in the house.

Laboratories can be convertible from lecture-style, to lab-style to workshop-style spaces with movable tables. Think of the learning environment as a "black box theater".

The instructor is not the only star of the show. A student, or group of students, can address the class, lead a discussion, share content, and engage other learners from anywhere in the space. Classrooms and teaching labs should be designed to work as theater or stage.

> "Tell me and I forget. Teach me and I remember. Involve me and I learn."
>
> — Benjamin Franklin

UNIVERSITY OF CINCINNATI | ALUMNI ENGINEERING LEARNING CENTER

As students acquire more content online outside the classroom, passive lecture-style learning has given way to active learning pedagogies. Today's classroom offers seating in collaborative groups, where an instructor can be center stage or move throughout the room to groups at individual tables. Each table also supports its own intimate experience: low walls or tiered floors might separate groups while dedicated writing surfaces and embedded technology become the focal point. Although functioning independently, all tables contribute to the "buzz" of the space. This room works for multiple small groups or as a single team-based learning (TBL) studio where groups engage each other in peer-to-peer learning.

GEORGIA SOUTHERN UNIVERSITY
BIOLOGICAL SCIENCES BUILDING

UNIVERSITY OF MICHIGAN
RUTHVEN MUSEUMS BUILDING

THE INNOVATION PLAYGROUND

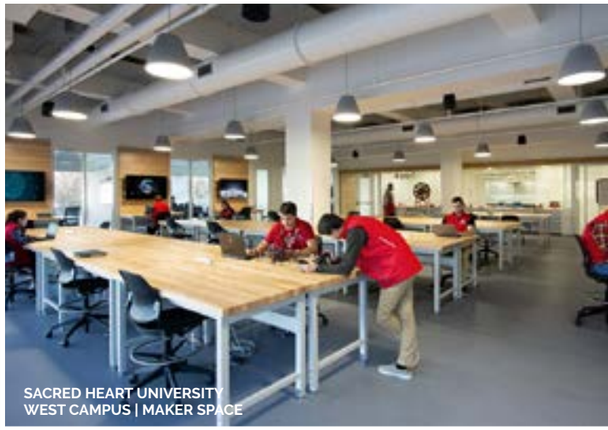
The innovation "playground" is a place to think, feel, and learn in different ways. More than a maker space, the playground is a teaching space where STEM learners discover how to use principles of "design thinking" to create new ideas, inventions, concepts, and designs. Stackable blocks can form the walls of a private learning space that can easily be disassembled to make way for brainstorming and think-tank discussions. Writable surfaces on wheels and mobile units where students store their projects can be assembled to create a gallery for poster and crit sessions. The informal environment, with cement floor, exposed ceilings, and moveable walls, can host formal classes as well as give students the unstructured time to tinker, explore, invent, and learn from failures. In some cases, high bay project spaces on grade with access to outdoor work areas support super-sized projects and imaginations. High-powered computer docking stations with specialized software, teleconferencing, and 3-D printers all enhance active learning and provide the perfect tools for creators and disruptors with new ideas awaiting real-world application.

"I'll play it first and tell you what it is later."

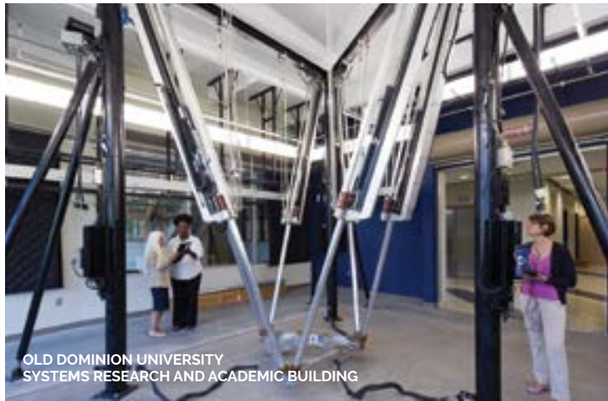
— Miles Davis

MASSACHUSETTS INSTITUTE OF TECHNOLOGY | MIT INSTITUTE FOR DATA, SYSTEMS AND SOCIETY

SUNY | BUFFALO STATE
TECHNOLOGY BUILDING



SACRED HEART UNIVERSITY
WEST CAMPUS | MAKER SPACE



OLD DOMINION UNIVERSITY
SYSTEMS RESEARCH AND ACADEMIC BUILDING

LIGHT THE FUSE

Fluid connections between STEM disciplines encourage students to connect with each other and increase the chance for faculty/student interactions inside and outside of the classroom. Hybrid labs fuse the lecture and lab environment taking team-based active learning curriculums to the next level. The open-plan lab promotes multi-team research. Fixed casework, fume hoods, sinks, and utilities around the perimeter leave the center of the room, equipped with overhead power and moveable furniture, easy to reconfigure to meet specific needs. Adjoining support spaces provide access to shared lab equipment and materials. With the open-plan, natural daylight can fill the labs creating humanistic environments that encourage chance meetings and provide an attractive place for people to learn and discover.

> **“The essence of teaching is to make learning contagious, to have one idea spark another.”**
>
> — Marva Collins

IOWA STATE UNIVERSITY | ADVANCED TEACHING AND RESEARCH BUILDING

RUTGERS UNIVERSITY
RICHARD WEEKS HALL OF ENGINEERING

CLAYTON STATE UNIVERSITY
LAKEVIEW DISCOVERY & SCIENCE CENTER

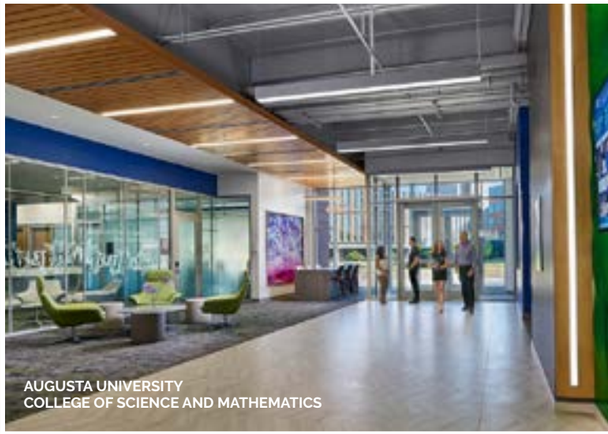
PROVIDENCE COLLEGE
ALBERTUS MAGNUS SCIENCE CENTER

EDUCATIONAL RENDEZVOUS

Learning doesn't only happen in the classroom. In the most successful STEM facilities, students rendezvous to study and socialize throughout the building, throughout the day. Relationship building is one of the greatest benefits of the university experience. These personal interactions are what set the physical campus environment apart from online degree programs. Building a strong learning community requires the opportunity of diverse spaces outside of classrooms for students to study independently, work in teams, or even grab a coffee. The goal is to create learning landscapes where touchdown, study, project and café spaces provide places for students to linger beyond class time. Places where STEM students can build the social relationships that are proven predictors of academic success in challenging STEM programs.

EMORY UNIVERSITY | R. RANDALL ROLLINS BUILDING - SCHOOL OF PUBLIC HEALTH

IOWA STATE UNIVERSITY
ADVANCED TEACHING AND RESEARCH BUILDING



AUGUSTA UNIVERSITY
COLLEGE OF SCIENCE AND MATHEMATICS

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
INSTITUTE FOR DATA, SYSTEMS AND SOCIETY

STEM FROM THE GARDEN

Outdoor learning spaces can be very effective in promoting hands-on active learning experiences. A courtyard can provide informal environments to chat with peers about schoolwork, or it can provide the solitude of peaceful space to focus on projects. It can also serve as an outside classroom to hold brainstorming discussions, work on projects in groups or individually. The outdoor environment also serves as a living laboratory. In a native plant meadow, science classes can observe the intricate interdependence of plants, insects, soil, sunlight, and water. A water-saving bio-swale can capture rainwater and use it in the bio-retention gardens, or a green roof terrace can provide an area for experiments and study space for students. Garden-grown herbs and plantings can provide sampling material for students to perform experimental tests, and conduct research.

> **Gardening is full of mistakes, almost all of them pleasant and some of them actually instructive.**
>
> — Henry Mitchell

STONEHILL COLLEGE | SCIENCE BUILDING

UNIVERSITY OF CALIFORNIA - IRVINE
NURSING AND HEALTH SCIENCES COMPLEX

EASTERN CONNECTICUT STATE UNIVERSITY
SCIENCE BUILDING

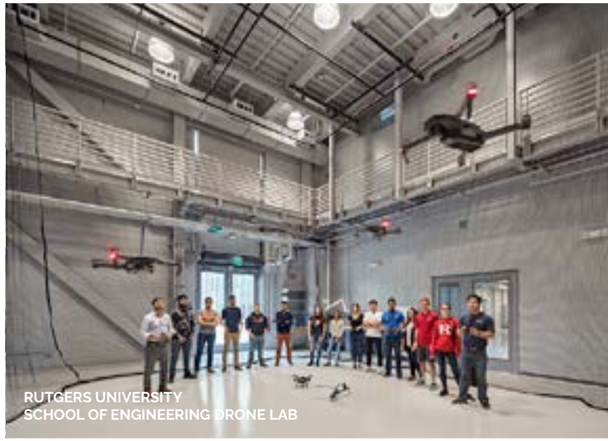
GETTING REAL

Partnerships between academic institutions and industry are an influential part of today's STEM landscape. Before students even depart from the academic experience, they may work side-by-side with a potential employer through research internships and externships. Universities are designating space specifically to nurture these relationships and help them grow.

> "Nothing ever becomes real till it is experienced."
>
> — John Keats

RUTGERS UNIVERSITY | STUDENT PROJECTS STUDIO

WESTERN MICHIGAN UNIVERSITY
HOMER STRYKER SCHOOL OF MEDICINE



RUTGERS UNIVERSITY
SCHOOL OF ENGINEERING DRONE LAB

UNIVERSITY OF TENNESSEE, KNOXVILLE
STRONG HALL SCIENCE LABORATORY

LOOKING FORWARD TO WHAT'S NEXT

UNIVERSITY OF MICHIGAN | CLASSROOM IN THE ROUND

EMORY UNIVERSITY
ROLLINS SCHOOL OF PUBLIC HEALTH (RRR)

MISERICORDIA UNIVERSITY
FRANK AND DOROTHEA HENRY SCIENCE CENTER

UNIVERSITY OF CINCINNATI
ALUMNI ENGINEERING LEARNING CENTER

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