Berkner STEM Exploration Center

ASSOCIATION FOR LEARNING ENVIRONMENTS

2020 SUBMISSION JAMES D. MACCONNELL AWARD

Project Details

Project Name: Berkner High School STEM Exploration Center

Location: Richardson, Texas

Client: Richardson Independent School District

Occupancy: 150 students

Capacity: 150 students

Available to: 12,000 students within District

Area: 7,350 square feet

Budget: $3,100,000

Client Reference: Sandra Hayes, Assistant Superintendent, District Operations, Richardson ISD, sandra.hayes@risd.org

Consultant Team: Reed, Wells, Benson & Company, MEP; Polly Allen Studios, Exhibit Design Services

Executive Summary and Project Scope

“First of its kind STEM Center in Richardson ISD.”

–JENNIFER KITE-POWELL, SENIOR CONTRIBUTOR AT FORBES MAGAZINE

In 2018, Texas Instruments awarded Richardson ISD a grant to create a “STEM for ALL” concept that instigated a symbiotic relationship between the school and the industry.

With industry partner support and 2016 bond reserves, the District converted an existing space into a STEM Exploration Center for ALL students in the high school feeder pattern. This STEM center now enriches 12,000 students each year through a culture of making, hands on learning, and exploration, and provides professional development for teachers to develop competency and confidence in STEM teaching.

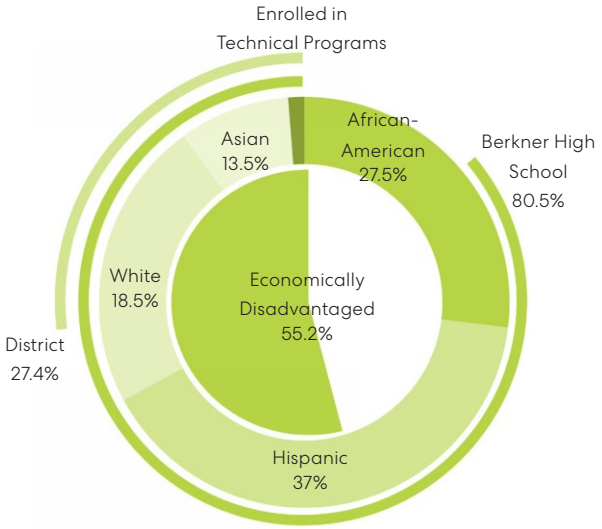
To effectively create a space that could accommodate and stimulate curiosity in students from kindergarten through high school, we hosted **inclusive visioning sessions with key stakeholders to determine the qualifications the students will need to be successful in their future careers.** The space needed to support a variety of activities and programs and be flexible for future changes in the industry. In response to current industry demands in the region, the pathways identified were: Aviation, Biotechnology, Cyber Security, Global Arts Communications, Engineering/ Robotics, and STEM Management.

To provide flexibility of use and to be agile for future change, the spaces were designed to accommodate first level uses: **Messy Lab, Clean Lab, Immersion Studio, Collaboration, and Present/Lecture/Train spaces**. The facility layout was finalized with direct feedback from the very educators who will be utilizing it.

Equally important was to provide professional development to teachers so they can incorporate STEM teaching and learning in their classrooms. The space will host partnerships with local public and private universities and other industry partners that will enhance curriculum, provide training and a pathway to a master’s degree for teachers, and also provide internship, mentorship, and scholarship opportunities for students.

ONLY 20% OF THE CURRENT WORKFORCE POSSESSES THE SKILLS REQUIRED BY 60% OF THE NEW JOBS THAT WILL OPEN IN THE 21ST CENTURY.

RESEARCH SUGGESTS THAT MOST STUDENTS LOSE INTEREST IN SCIENCE BETWEEN 12–13 YEARS OF AGE.



STEM Statistics and STEM Grant

According to the TIMSS 1 survey, STEM education in the United States ranks 8th out of the 37 participating countries. By increasing the quality of US STEM pedagogy, the STEM Center aims to close these gaps.

More than 97 percent of the funding will support efforts to strengthen STEM competencies and boost principal effectiveness and the number and quality of STEM educators—teacher effectiveness being one of the critical factors in students' academic success.

Berkner HS Demographics and Education Model

The Center initiates introduction to immersive experiences and introducing the world of STEM. Students tend to develop an interest in STEM throughout their early years and by year 5 or 6 have developed their attitude towards the industry as an education and career path.

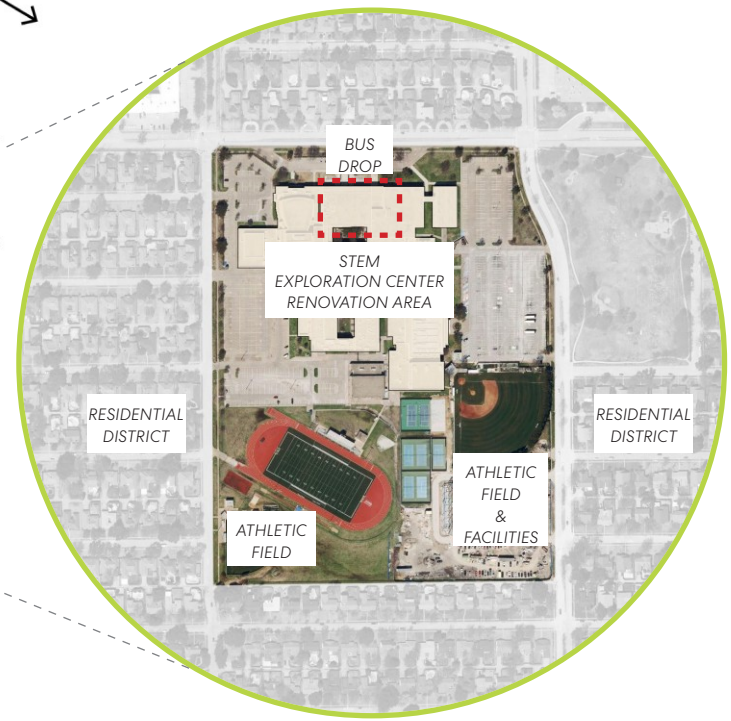
As a first step the district realigned the offerings at Berkner High School to make it a STEM High School. They recognized that the pipeline starts from elementary and middle school education.

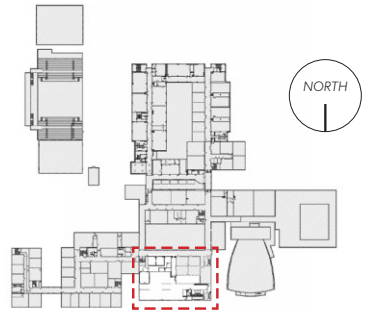
Fortune 500 Companies and Local Businesses

A suburb of Dallas, Richardson boasts a vibrant and diversified business community home to leading technology companies, such as Texas Instruments, is one of the brightest economic regions in the world and in close proximity to Berkner High School. The business community's investments support educational initiatives that develop a workforce pipeline, enabling local residents to increase tech skills and take advantage of opportunities in their local economy.

Berkner District School Feeders

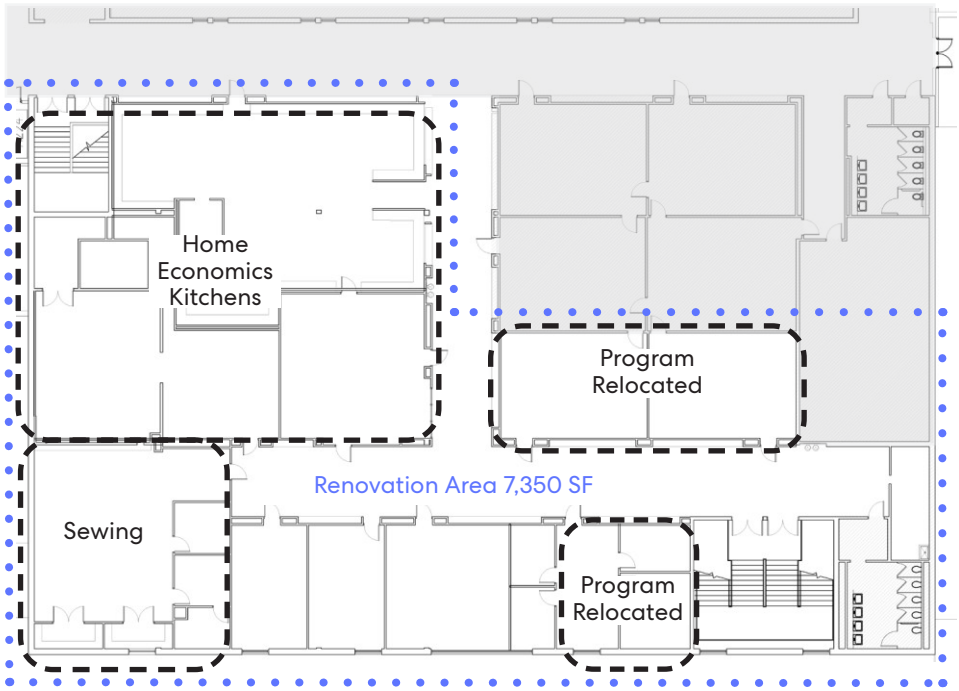
- Elementary Schools (11)
- Middle Schools (2)
- STEM Exploration Center / High School
- Other District High Schools
- Public University / Private University / .COM
- Major Industries Corridor
- Major Roadway



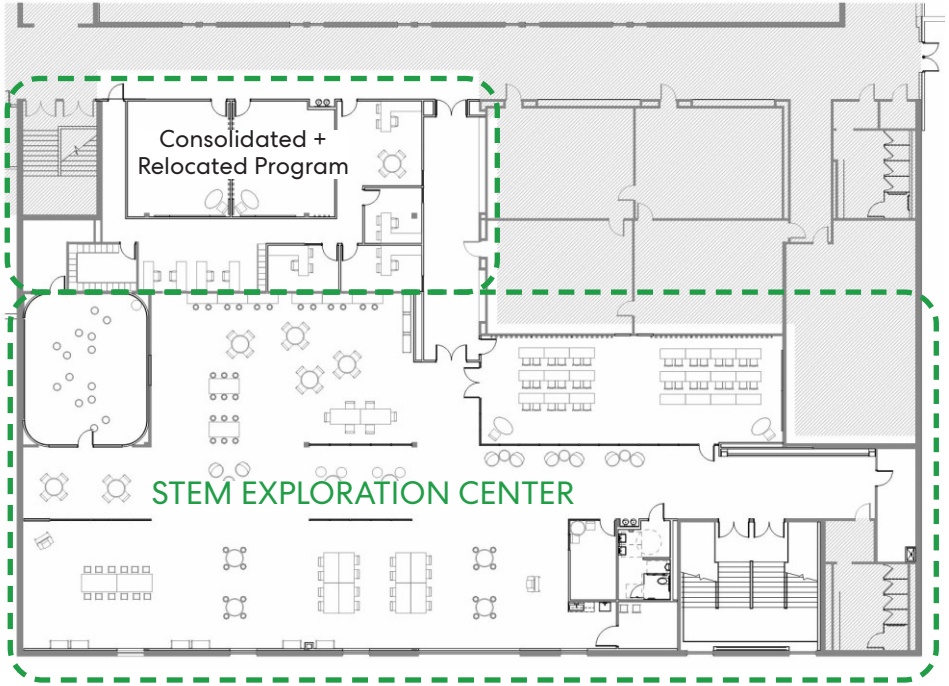


KEY PLAN

Before



After








BUDGET: 3.1 MILLION
(TOTAL GRANT: $288,000)
GROSS AREA: 7,350 SF

Completing the space within a year was no small feat, especially considering the renovation of a space in an occupied high school. Work on campus was carefully planned around the school calendar, maximizing holiday breaks and respecting the occupied hours of the campus. Demolition began over winter break, construction began over spring break, and was completed during summer break.

Jan 2018
RISD Receives Grant

Jan 2018 - July 2018
Independent Research Conducted

From January to July of 2018, district leaders used grant money to tour STEM centers throughout the region and meet with thought leaders and local peers to explore the current trends in programming and educational environments implemented in STEM Centers. The Visioning Workshop and Night at the Perot was the concluding event to this 6-month journey.

August 2018
Visioning Workshop and Night at the Perot

Workshop Sessions
Programming | Design | Refinement | Final Review

October 2018
Schematic Design

December 2018
50% CD's

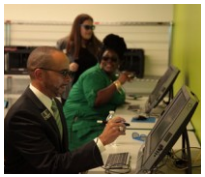
December 2018
Demolition Begins

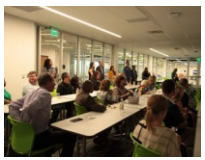
February 2019
Furniture Package and Graphics Package

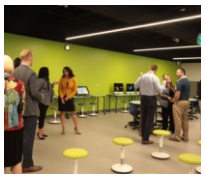
April 2019
Construction Begins

August 2019
Final Punchlist

September 2019
Soft Opening







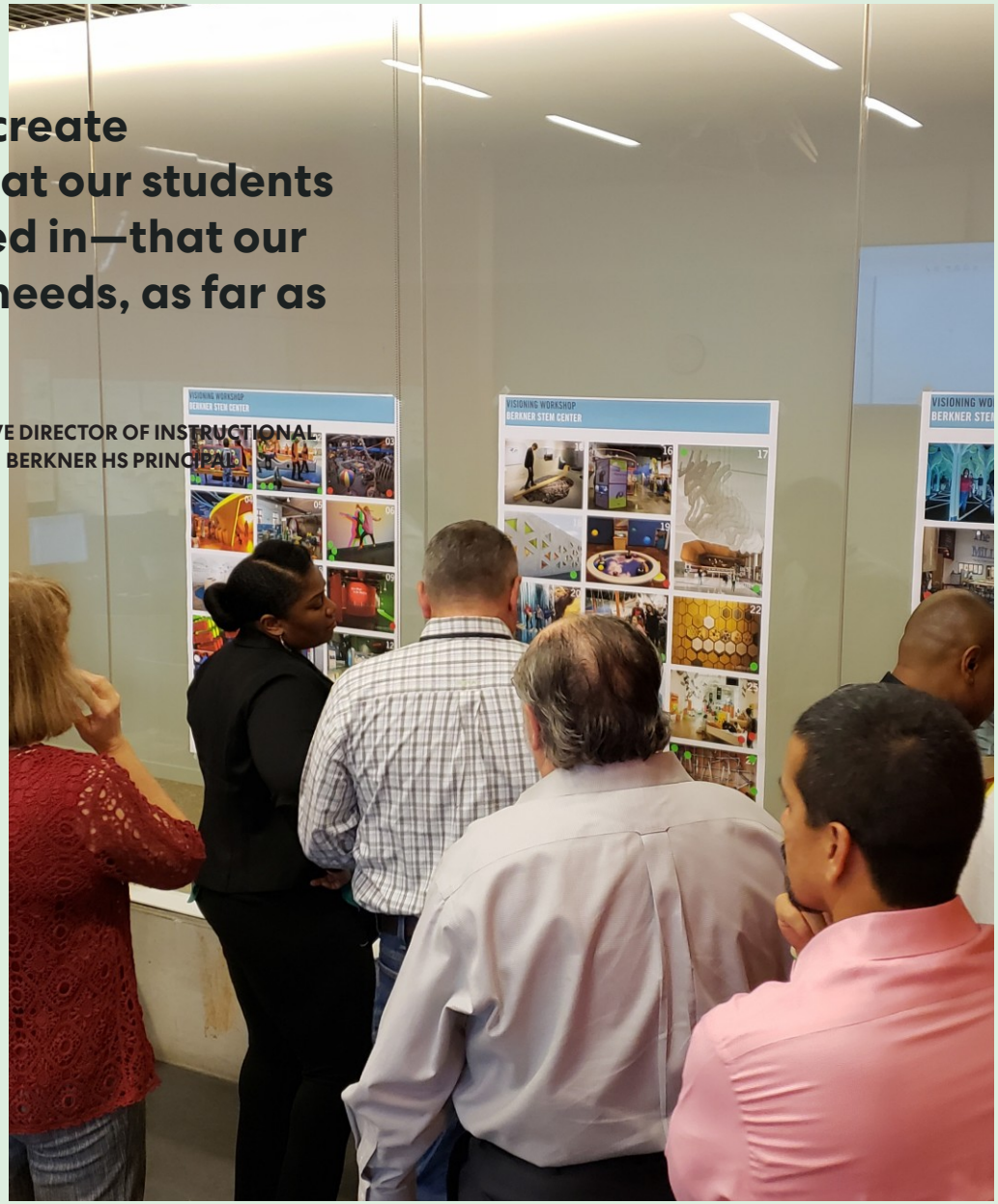
The ribbon cutting event at the STEM Exploration Center was a major community event where members of the school board, PTA, and corporate partnership committees could meet.

Ongoing Research Prototyping and Post-Occ. Surveys

School & Community Engagement

“We need to create programs that our students are interested in—that our community needs, as far as workforce.”

–HENRY HALL, RISD EXECUTIVE DIRECTOR OF INSTRUCTIONAL TECHNOLOGY AND FORMER BERKNER HS PRINCIPAL



Where It All Began

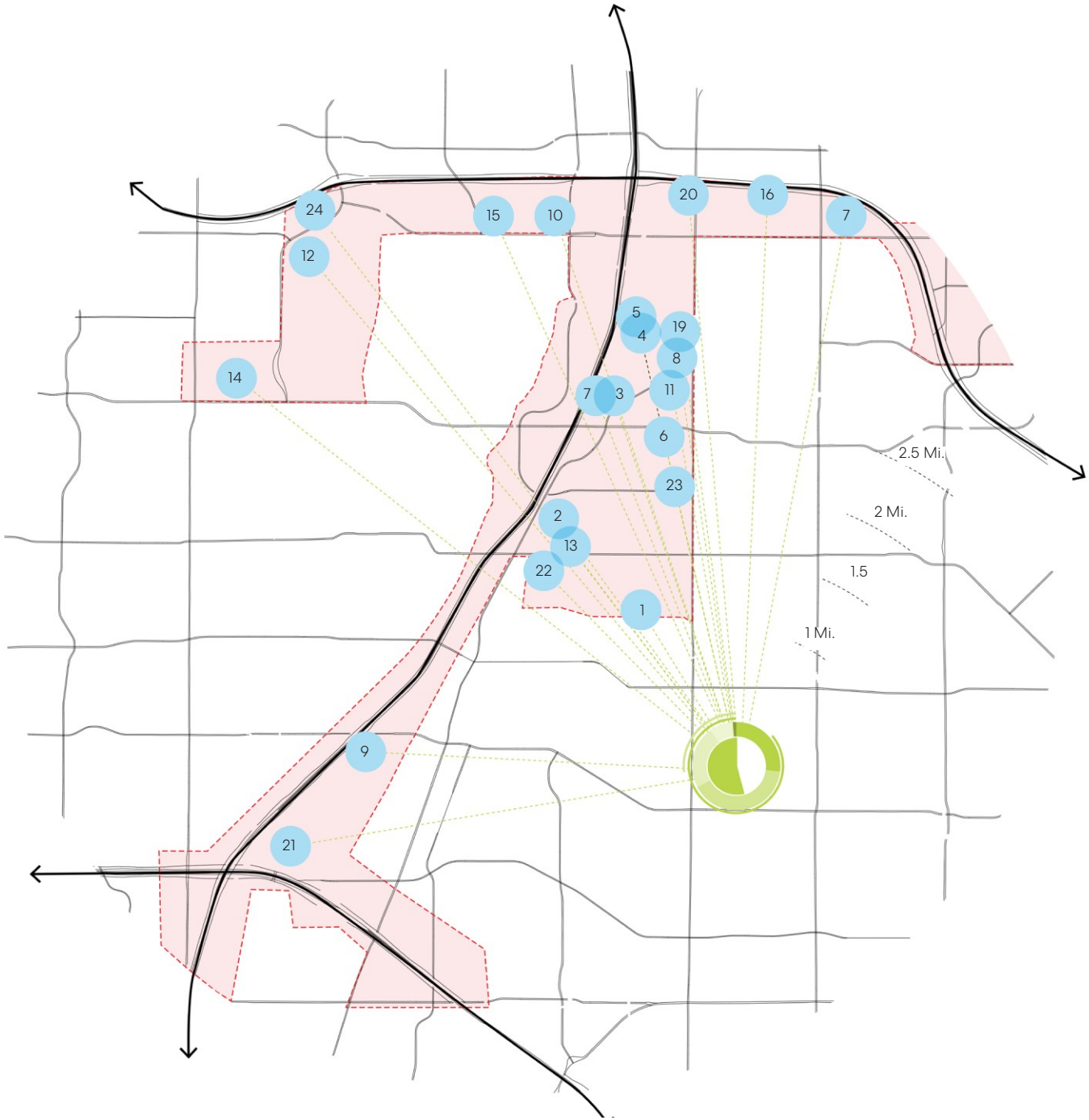
The community was engaged immediately after the award of the Texas Instruments grant. Planning began with a visioning session at a local museum to break traditional thinking patterns. Stakeholders revealed aspirations to **inspire** in the younger years, **encourage** exploration in the middle years, and **cultivate** STEM thinking in the older years, requiring a space nimble enough for students to learn during each visit throughout their education. We examined the macro and micro commonalities across STEM fields to provide complex and agile spaces that can be quickly converted from supporting one STEM strand to another as industries and technologies change.

Visioning Workshop

Our community engagement and design process began with a visioning session at the Perot Museum of Natural Science to step away from a traditional education setting, create an immersive experience, and break the habit of thinking inside the box. **For so long, educators have been locked into the mindset of making do with that they have** and the thought of something different can be both challenging and intimidating.

This event established a theme to anchor both the curriculum and design. After determining our theme and vision, we explored high level student outcomes, behaviors, and space implications to cultivate the educational environment that the STEM Center fills today.

To build upon this high-altitude vision, a program was developed that would meet the challenges of an ever-changing workforce and provide spaces conducive to current and future activities, but not so specific that it could become restrictive.



Providing a Pipline of Opportunity

Investments infused into the education system created a symbiotic relationship between the District and the Telecom Corridor. Local tech firms connect faculty and students to the latest technology while increasing STEM interest in future tech industry leaders. The Center will be home to partnerships with local and private universities and other industry partners that will enhance curriculum and provide internship opportunities for students.

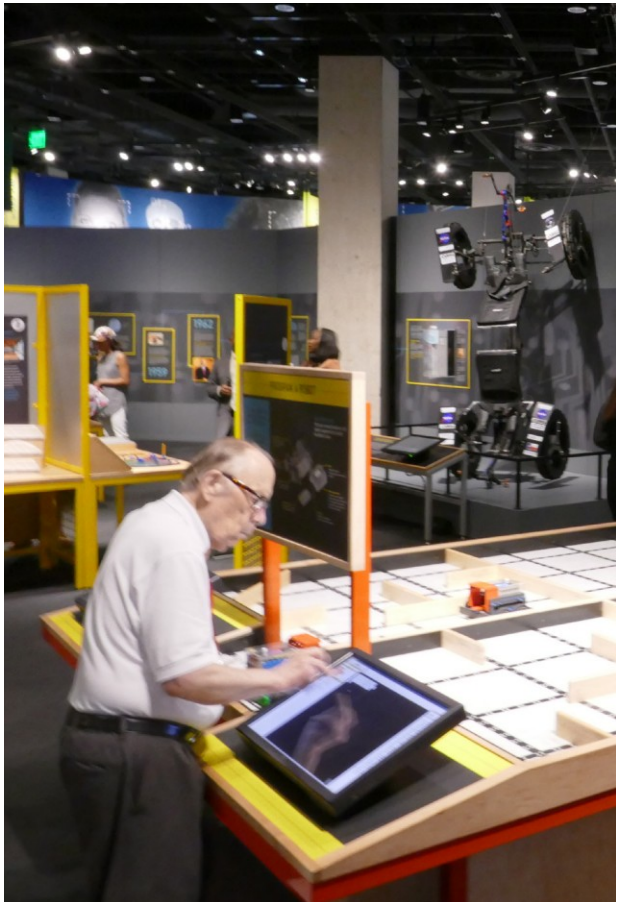
Telecom Corridor

- STEM Exploration Center / High School
- Regional Fortune 500 Companies
- Major Industries Corridor
- Major Roadway

Local Telecom and Technology Businesses

01 Amdocs
02 Associa
03 AT&T*
04 Bank Of America
05 Blue Cross Blue Shield Of Tx
06 Cvs Caremark*
07 Cisco Systems
08 Commscope
09 Fossil
10 Fujitsu
11 Geico
12 Hbs Systems
13 Iqor
14 Lennox International
15 Qorvo
16 Raytheon
17 Realpage
18 Rockwell Collins
19 Samsung Telecommunications America
20 State Farm Insurance
21 Texas Instruments Rfab
22 Towers Watson*
23 Travelers Insurance
24 United Healthcare*
25 Verizon Business*
*Multiple Locations

66% of jobs available to our elementary students in the future are unknown to us at this time. To create a center equipped to prepare students for the unknown, our engagement process maximized the creative thinking of community members, stakeholders, and students. →



Along with exploring the museum for inspiration, we provided attendees this range of prompts:

- How might we grow STEM thinking beyond the walls of the given space?
- Deep dive into portions of STEM; how do they teach, how do they use the space, what are the commonalities across? How can we apply to more subjects?
- How might we engage kids under the age of 10?
- How might we create an emotional connection with the learning experience?
- How might we design for today's strands and future strands?
- How might we design for gender equity?

Key Action Items Taken from Visioning Workshop:

Space Should Support
- Creating
- Collaborating
- Experimenting
- Constructing
- Hacking
- Dissecting

Space Should Be
- Inclusive
- Inviting
- Flexible

Space Should Feel
- Inviting
- Inspiring
- Open
- Fun
- Unique
- Safe
- Transparent

Needs
- Flexibility
- the "Right" Tech.
- Storage

Students Should Engage In
- Exploration
- Self-directed Learning
- Group Learning
- Interdisciplinary Learning

Students Should Walk Away With
- Critical Thinking Skills
- Design thinking skills
- Global Awareness
- Future Ready Skills
- Communication Skills
- Presentation Skills

Students Should Walk Away Feeling
- Confident
- Inspired
- Creative

Teachers Will Learn
- Power of Self-directed Learning
- Loosen Control of the Classroom
- STEM Thinking in Non-STEM Subjects
- Interdisciplinary Pedagogy
- Build STEM Culture

Activity Map

Programs - independent research recognized five workforce-oriented stem strand programs, but these programs are subject to change

Grade Levels - the District worked to identify different functions and activations by age group

Where does the activity take place?

- Messy Lab
- Immersion Studio
- Clean Lab
- Equipment-based Projects

	Aviation	Biotechnology	STEM Management	Robotics	Cyber Security
Elementary School	• FAA activities • Carving out foam plane • Streaming + virtual interaction w/ Smithsonian STEM in 30 • Wind tunnel	• Giant prosthetic hand	• Local solutions (i.e. glow bottle lanterns, limited resources, food desert, impairment) • Lemonade Day	• Motors • Music • Makey Makey • NASA Robotics • STEMWorks	• KANO computer building • Hour of Code extension • Scratch coding
Middle School	• FAA activities • Mega Pockets • Streaming + virtual interaction w/ Smithsonian STEM in 30	• Digital dissection • MedTech in 20 years	• Global Challenges/PBL (i.e. drought)	• Vex IQ • Robot obstacle course • NASA Robotics • STEMWorks • Bare Conductive	• Escape Room • Hacking into other team's secure room
High School	• FAA activities • Streaming + virtual interaction w/ Smithsonian STEM in 30 • Airport design project			• Corporate led challenge • Virtual field trip • Job exposure • NASA Robotics • STEMWorks	

Education Specifications

Developed in collaboration between the design team and the faculty, the District developed specifications from the brainstorming that took place during the visioning workshops and the walk through of the Perot Science Museum with the independent design research provided by the our team. The specifications document also grew out of the response narrative to the STEM grant from Texas Instruments.

Major Themes:

- Understanding and connecting to a challenge
- Navigate information and ideas
- Invent or Innovate; test the process
- Evaluate, reflect, adjust, improve, and demonstrate new skills

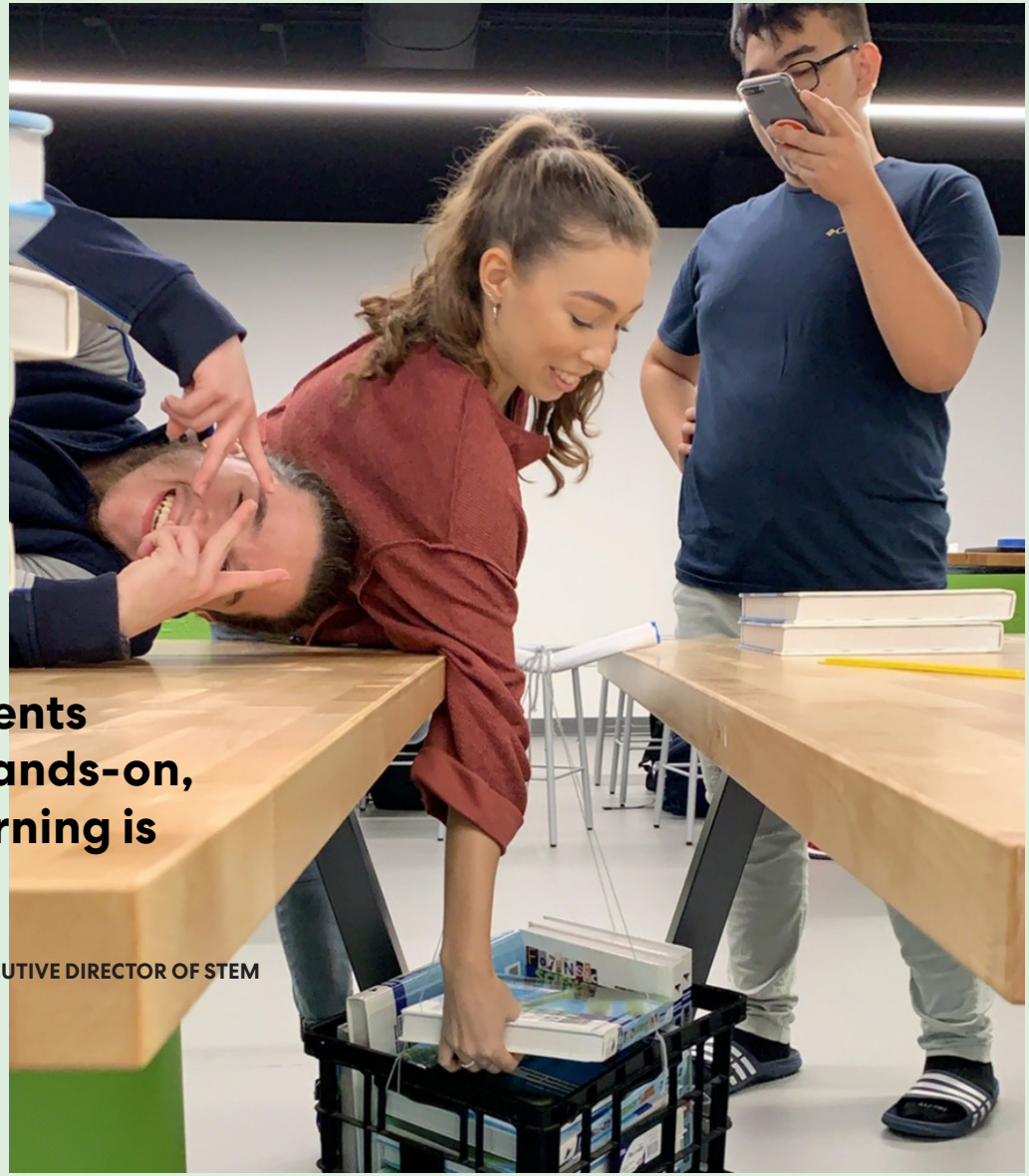
Vision to meet learning requirements of each age by:

- Inspiring curiosity in younger years
- Inviting exploration in middle years
- Cultivating STEM thinking in older years

Must haves:

- Visually appealing
- Flexibility in utilities, storage, modular furniture and sinks
- Faculty and student input
- Technology focused
- Openness

Educational Environment



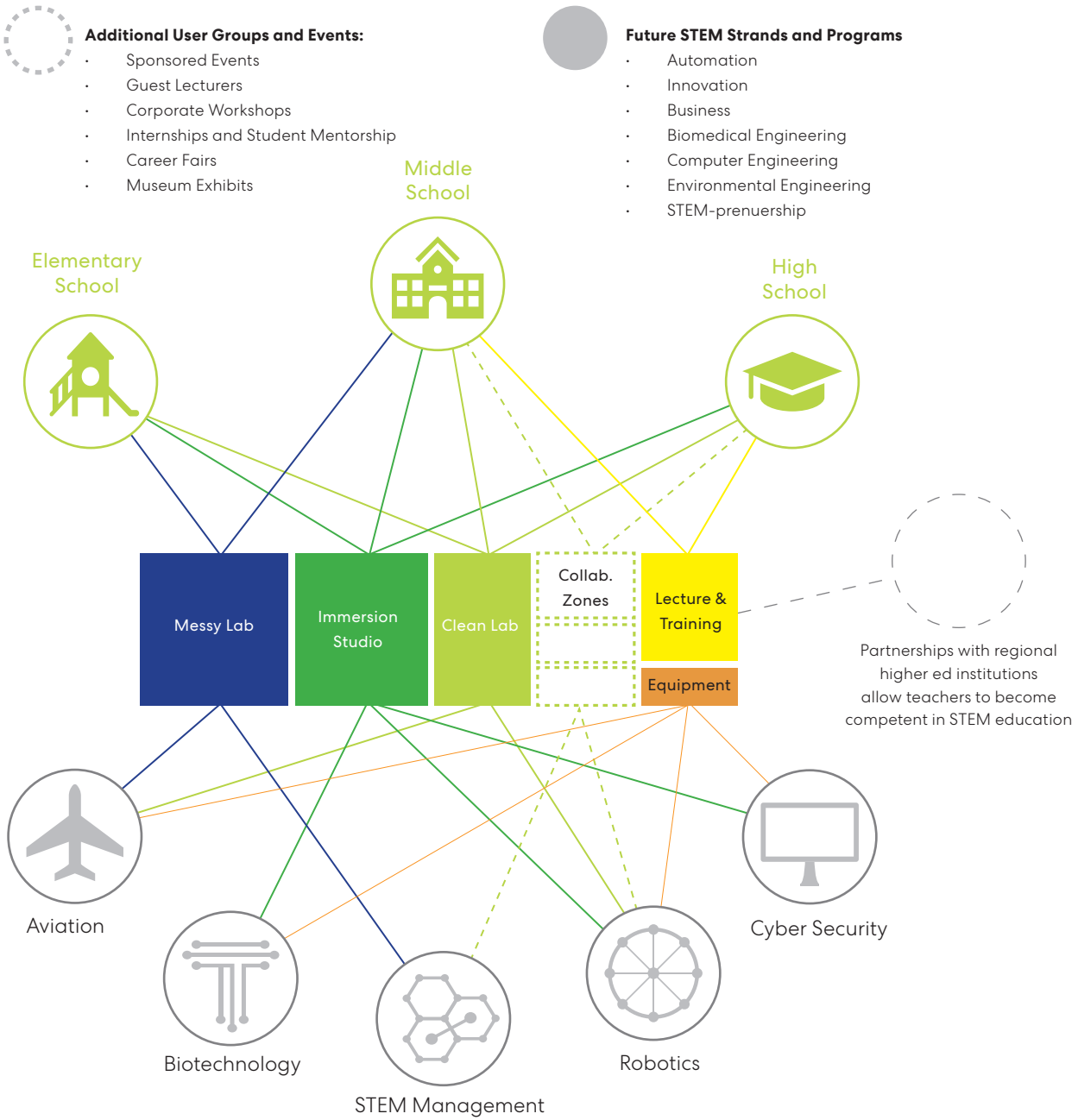
“Keeping students engaged in hands-on, minds-on learning is crucial...”

–KYNDRA JOHNSON, RISD EXECUTIVE DIRECTOR OF STEM AND INNOVATION

Educational Vision and Goals of School

The foundation of the project vision was to create a place beyond science and STEM. The District aimed to ignite creative thinking across all subjects starting with the youngest of students. By developing critical thinking skills before they leave elementary school, students move forward into their educational career able to apply these skills to challenges in each subject and beyond the classroom. Knowing that 66% of jobs available to our elementary students in the future are unknown to us at this time and because students form their attitudes about STEM by seven and eight years of age, the goal of this center was to foster and sustain a healthy curiosity in STEM fields and STEM thinking before and beyond this age group. The career strands Richardson ISD has identified today will not be the career strands of tomorrow, necessitating a space to be functional, yet agile to sustain multiple strand changes as our world grows and evolves. Additionally, the space will needs to support a wide range of ages to learn by doing. Finally, the space will need to be flexible enough to hold three classes working holistically or independently at the same time.

While many top tech firms thrive in the region, the varying socio-economic levels in the community create disparities in access to these jobs. This districtwide STEM resource creates opportunities for all students to develop the skills needed. Public exhibit spaces are inspired by a culture of making, allowing the space to host different theme displays, class project displays, or even museum displays so content is always fresh, changing, and interesting to students.

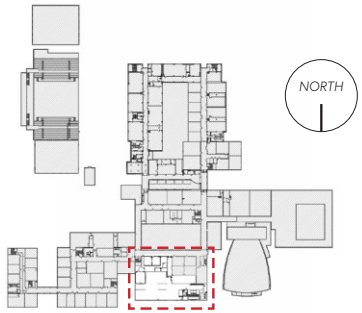


A Variety of Learning and Teaching Styles

A variety of furnishings provide both formal and informal options for natural interactions, similar to a contemporary workspace. Because most careers today require working in a team, there are no individual desks in the space, allowing classmates to assist one another or work side-by-side. For more critical thinking, both independently and in small groups, mobile marker boards can be used as spatial dividers. Beyond furnishings, we focused on technology navigation as an essential skill for future success. Students are exposed to new technologies in the lab that they are unlikely to see elsewhere, building digital literacy and preparing them for the future workplace.

Designed Adaptability and Flexibility

The STEM Center gives students a choice of work areas—seated or standing—and empowers them to take ownership of their learning. When students feel trusted, they are more likely to show a stronger work ethic and level of professionalism. The furniture provided is mobile and has trays, hangers, totes and writable surfaces, encouraging students to develop planning, organization, and prioritization skills important in professional settings. Beyond workstation flexibility, the space remains adaptable through storage solutions that are impermanent, quickly changeable storage solutions. Walls and permanent structures are minimized throughout the space. Ultimate flexibility is provided through the ability to remove all equipment and bring in temporary exhibits, student created or museum hosted, allowing teachers to connect a variety of subjects through themed weeks; e.g. Sustainability, history, etc.



KEY PLAN

CONNECTION FROM HIGH SCHOOL

COMMUNITY ENTRANCE

STEM Exploration Center

- 01 Welcome Zone / Entrance
- 02 Messy Lab
- 03 Collaboration Zone
- 04 Clean Lab
- 05 Immersion Studio
- 06 Training Room
- 07 Stem Coordinator
- 08 Restroom
- 09 Experiential Stair + Main Entry
- 10 Storage
- 11 Relocated Program

← **STEM for ALL**

Space flexibility and modular furniture accommodate curriculum for students at 5 years of age through 17 years of age.

↓ **Training Room**

- Projectors
- Flexible Furniture
- Writable Surfaces
- Tackable Surfaces

Collaboration Spaces

Positioned through the center of the space, the collaboration spaces create a flexible barrier between the Messy Labs, Clean Labs, and Immersion Studio. The space features modular furniture and can be used for groups of all sizes.

Immersion Studio

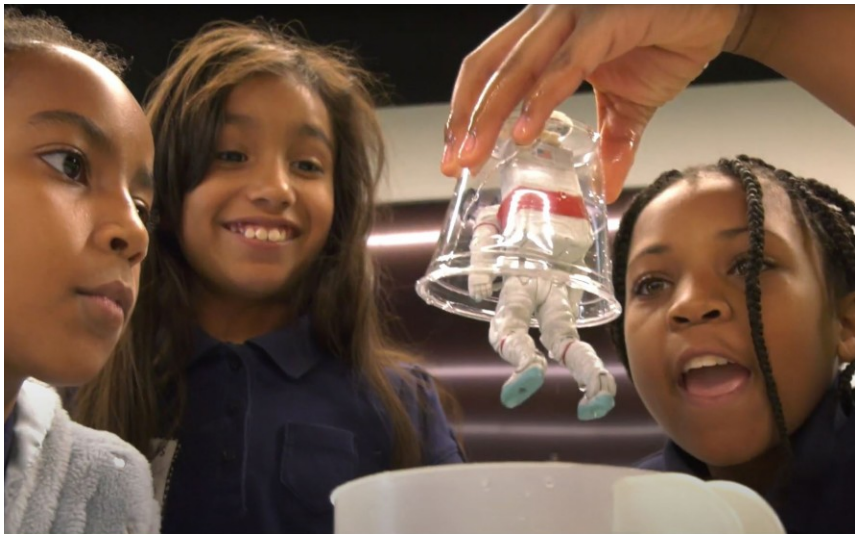
The Immersion Studio creates an encompassing environment, providing experiences for students beyond the classroom and redefining research.

Training and Lecture Room

The Training and Lecture Room is designed for pre and post lab discussions. It can also be utilized as an exhibit or event space.

Immersion Studio →

- Screens
- Interactive Projectors
- Acoustical Separation
- Local Sound



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Clean Lab

- 3D Printers
- Computer Stations
- Cord Reels
- Flexible Furniture

←

Messy Lab

- Shop Vac
- Small Compressor
- Cable Reels
- Flexible Furniture

Clean Lab

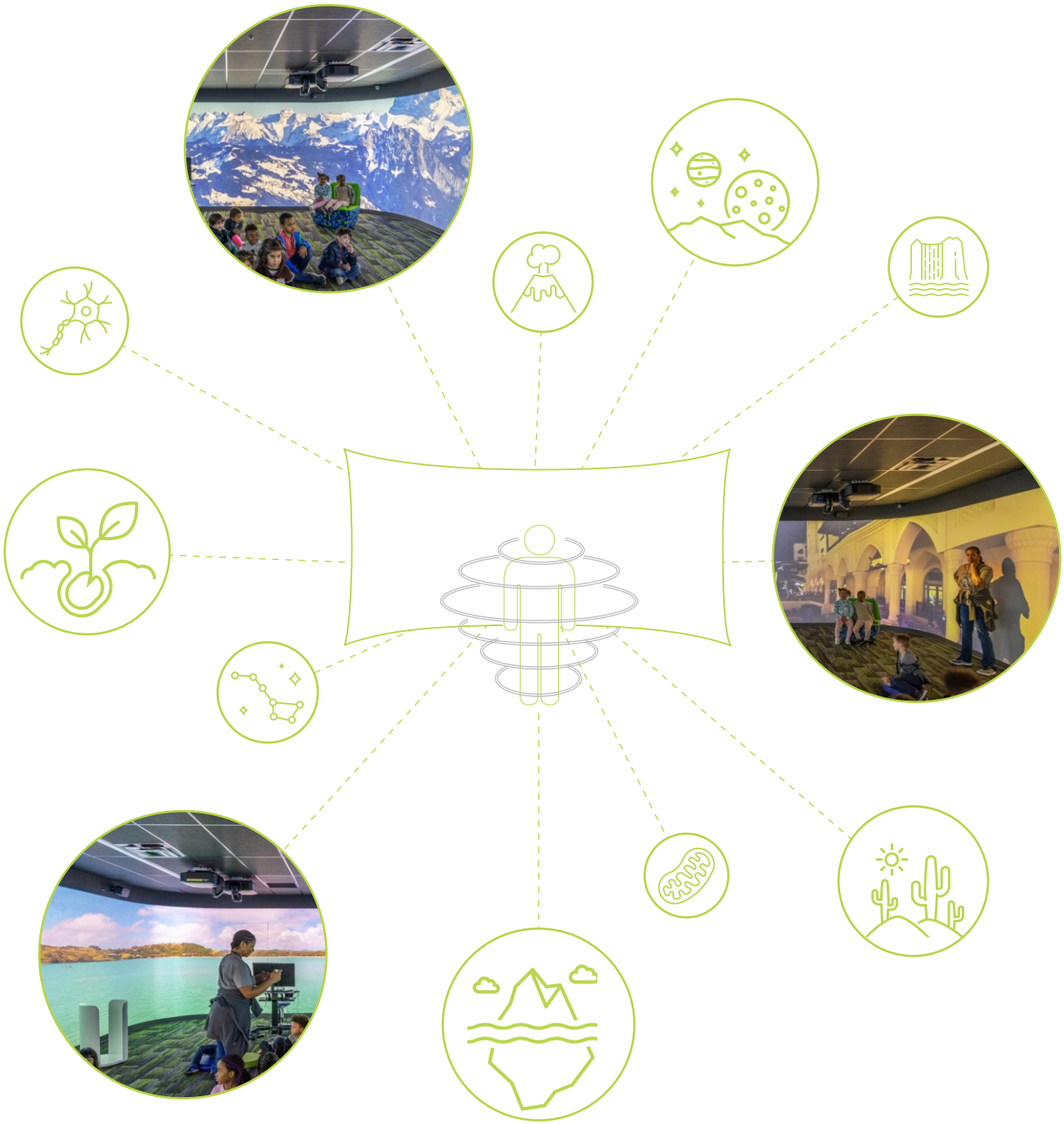
The Clean Lab is a high technology lab for students to develop coding and 3D modeling skills. It is adaptable to accommodate changing programs as new skill requirements emerge.

Messy Lab

The Messy Lab is a space for students to get down and dirty in science experiments. There is ample availability of power, exhaust, and water in this area.

“In an immersive environment, the students can virtually travel to any of these spaces and learn.”

–JENNIFER KITE-POWELL, SENIOR CONTRIBUTOR AT FORBES MAGAZINE



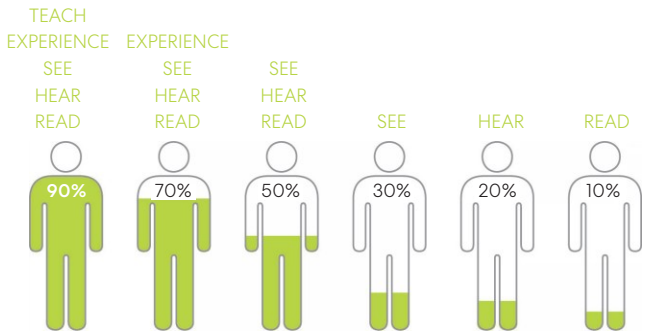
The Virtual Field Trip

Instead of hosting a STEM Center at each campus, the District decided to create a centralized space available to all. The decision led to cost savings that the District invested into higher levels of engagement and technology, leading to the creation of this Immersion Studio.

The Studio expands the depth of students' understanding of content by learning though simulation, leading to improved data retention and understanding. Beyond experiencing 4-D content, students are also taught how to create these immersive experiences.

The studio also provides an opportunity for economically disadvantaged students to travel the world and experience new cultures in ways Internet research does not allow, and creates the immersive experience of traveling abroad at a time when international travel is unsafe or inaccessible.

We all learn in different ways...



Physical Environment

“The Berkner STEM Exploration Center was designed to respond to a variety of learning activities and ever-changing technology.”

–KYNDRA JOHNSON, RISD EXECUTIVE DIRECTOR OF STEM AND INNOVATION

As students move through the stairs, the smallest gear senses the motion and the fan in the display begins to rotate, which in turn moves the entire exhibit of gears. This creates movement and captures visitor interest.

Physical Attributes of the Environment

This adaptive reuse increases daylighting and revitalizes the space from a closed floor plan to an open concept multi-lab STEM Center, making a large impact through minimal disruption.

The STEM center achieves the goals of the District, faculty, and students with its multifaceted ability to adapt as workforce strands ebb and flow. The Messy Lab and Immersion Studio inspires curiosity in younger years, the Messy Lab, Clean Lab, and Immersion Studio inspire exploration in the middle years, and accelerated curriculum cultivates STEM thinking in the older years. It is a space for students to present their research, projects, and creations, creating opportunities for peer interaction and feedback that enable students to grow. This allows for peer interaction and feedback enabling students to build off other findings. Thinking outside of the box has become more important as technological innovations are changing the world faster than ever before.

To highlight the STEM Center’s role as **a diverse community hub** that encourages positive connections and inspires possibilities, we positioned an exhibit space at the end of the collaboration spine. Exhibits can be rotated out as needed to expand and refresh the experience.

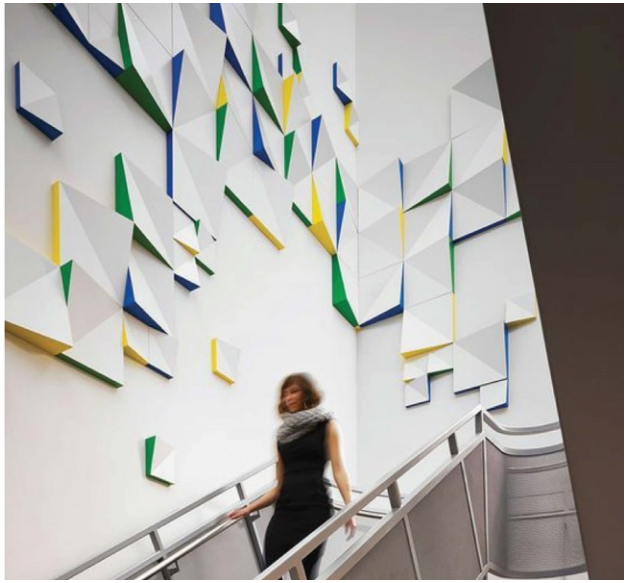
Biophilic Design was infused into the physical space through biomorphic forms and patterns, highlighting complexity and order through visual and material connections with nature.

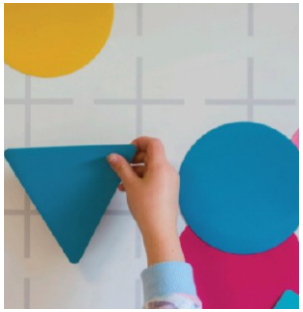
The Center maintains its physical value by being nimble enough to adapt to changing workforce strands. It is flexible enough to accommodate hands-on learning and exploration at each level of curriculum throughout a student’s educational career.

Clean Lab Collaboration Zone Immersion Studio

Wall Graphic

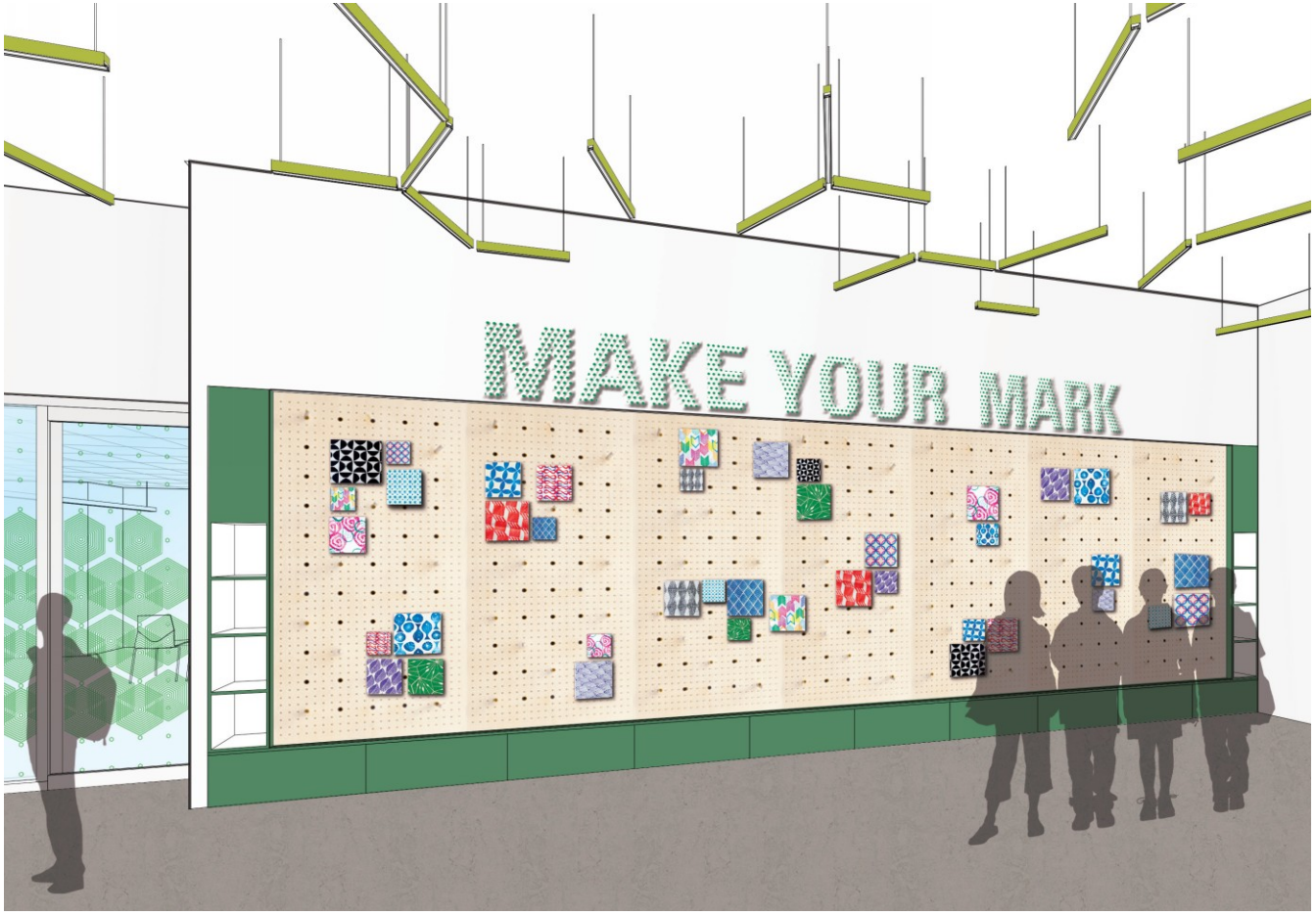
The wall graphic in the collaboration zone showcases the diversity in the STEM field. The idea that "All Belong in STEM" was integral to the teaching pedagogy. The content in the hexagon frames are removable and allow students to replace images with leaders in STEM fields with whom they identify.





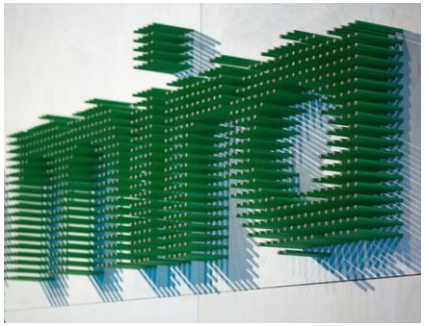
Lecture and Training Spaces

Entry and Exhibit Space



Make Your Mark Wall

Upon entering the STEM Center, the students encounter an impactful display of their peers' work, creating engagement as they move into the center full of expectations and opportunities. This wall expresses the individual creations of students and encourages creativity, self-discovery, and cross-disciplinary thinking.



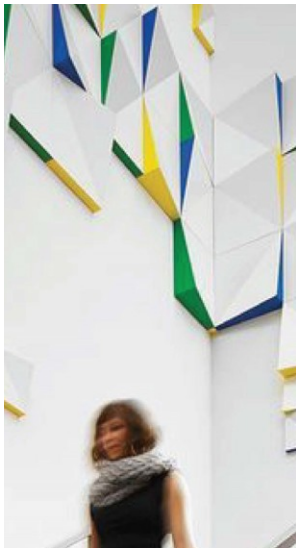
EMERGENT SYSTEMS

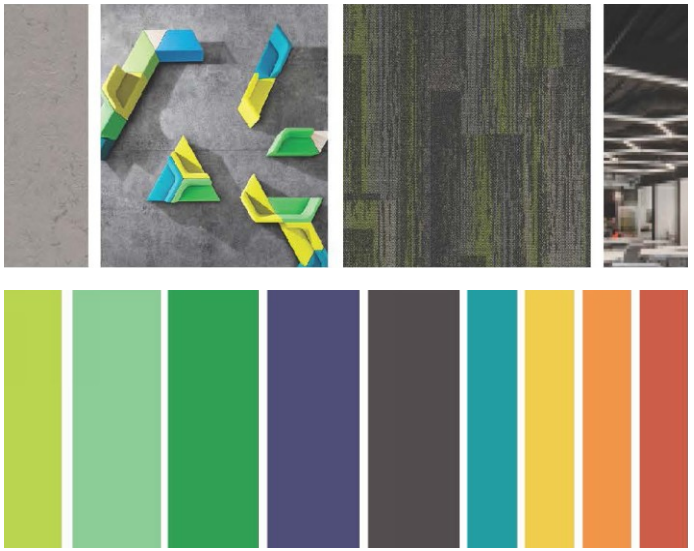
Elements of biophilic design and systems thinking are largely responsible for the design team's palette. These ideas informed not just color and pattern choices but the articulation of the building systems themselves.

BIOPHILIC SYSTEMS

The influence of natural systems can be found in STEM activities such as math and engineering; similarly, the design pedagogies of the school's STEM program can be found in connected, overlapping, and loose-fitting systems.

Systems of the built environment are articulated with pops of color from nature.
Bold, geometric patterns integrate various molecular elements into the atmosphere.





Key Design Elements

A Feeling of Openness

Visually Appealing
Incorporating the influence of natural systems like the connected pedagogies in STEM.

Current Trends in Technology
Adaptable to accommodate changing programs as new skill requirements emerge.

Modular Furniture
Allow for speedy swaps between furniture sized for students at 5 years of age through students at 17 years of age.

Results of the Project and Process

"[It is] a wonderful, innovative, exciting space that allows for our students here, not only at Berkner, but the entire feeder pattern, to experience STEM for all."

–DR. JEANNIE STONE, RISD SUPERINTENDENT

Achieving Educational Goals

The open layout and transparency of the design allow the space to expand into a large lab, reducing overall square footage.

Achieving the District's Goals

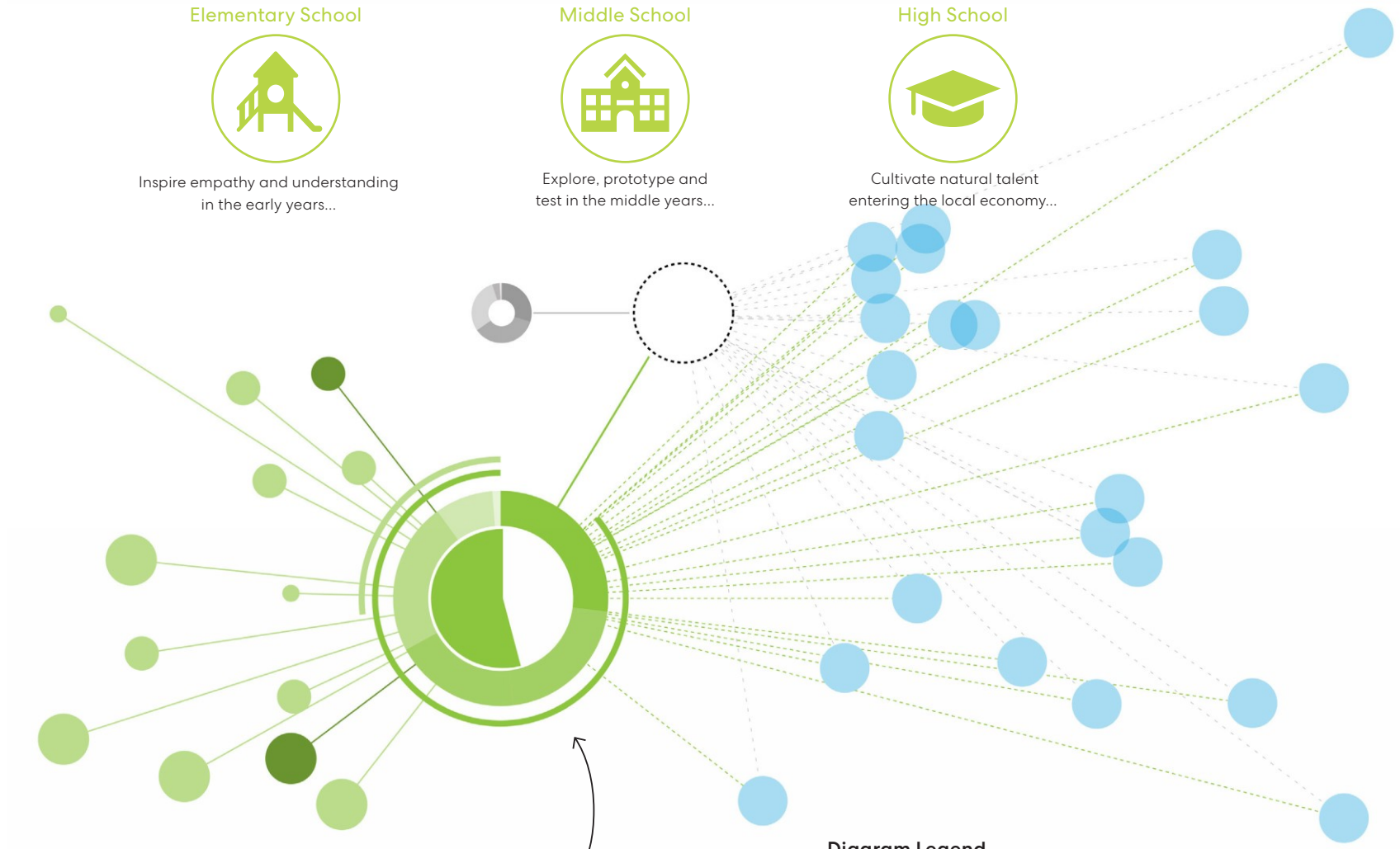
The STEM Immersion Center is utilized districtwide and reduces costs the District would otherwise spend on a STEM center on each campus. Various hands-on learning, making kits, and interactive technologies allow students to explore new ways of learning. The public exhibit spaces are inspired by a culture of making, allowing the space to host different theme displays, class project displays, or even museum displays so the content is always fresh, changing, and interesting to students.

Achieving the Community's Goals

While many of the top tech firms thrive in the region, the varying socio-economic levels in the community create disparities in access to these jobs for the students. This districtwide STEM resource creates opportunities for all students to develop the skills needed for the future. Local business investments developed a social contract with students by elevating their education quality and providing opportunities to directly translate those skills into jobs and participate in local economy confidence.

Unintended Results

A few unforeseen benefits of the Studio are providing an opportunity for economically disadvantaged students to travel the world and experience new cultures in ways Internet research does not allow, and providing the ability for the immersive experience of traveling abroad at a time when international travel is unsafe or inaccessible.



Regional Centralization

The centralized STEM Center offers attending students the opportunity to connect with their peers across the District, local high ed institutions, and a nexus of global corporations in the immediate region. Access to internships and direct employment becomes greatly increased.

Public Private Partnerships

Partnerships with regional higher ed institutions allow teachers to become competent in STEM education.

Before

- High lighting density levels
- Significant light reflection
- Hard contrasts between dark and light spots, uneven foot candle count
- Floors that need to be waxed to be maintained

After

- Low lighting power density levels
- Minimal reflection
- Ample diffuse light
- Low light gradient, even foot candles
- Direct view to exterior and natural light
- No wax floors

“A space for 12,000 students and 700 teachers experiencing STEM education and blended learning in a unique way.”

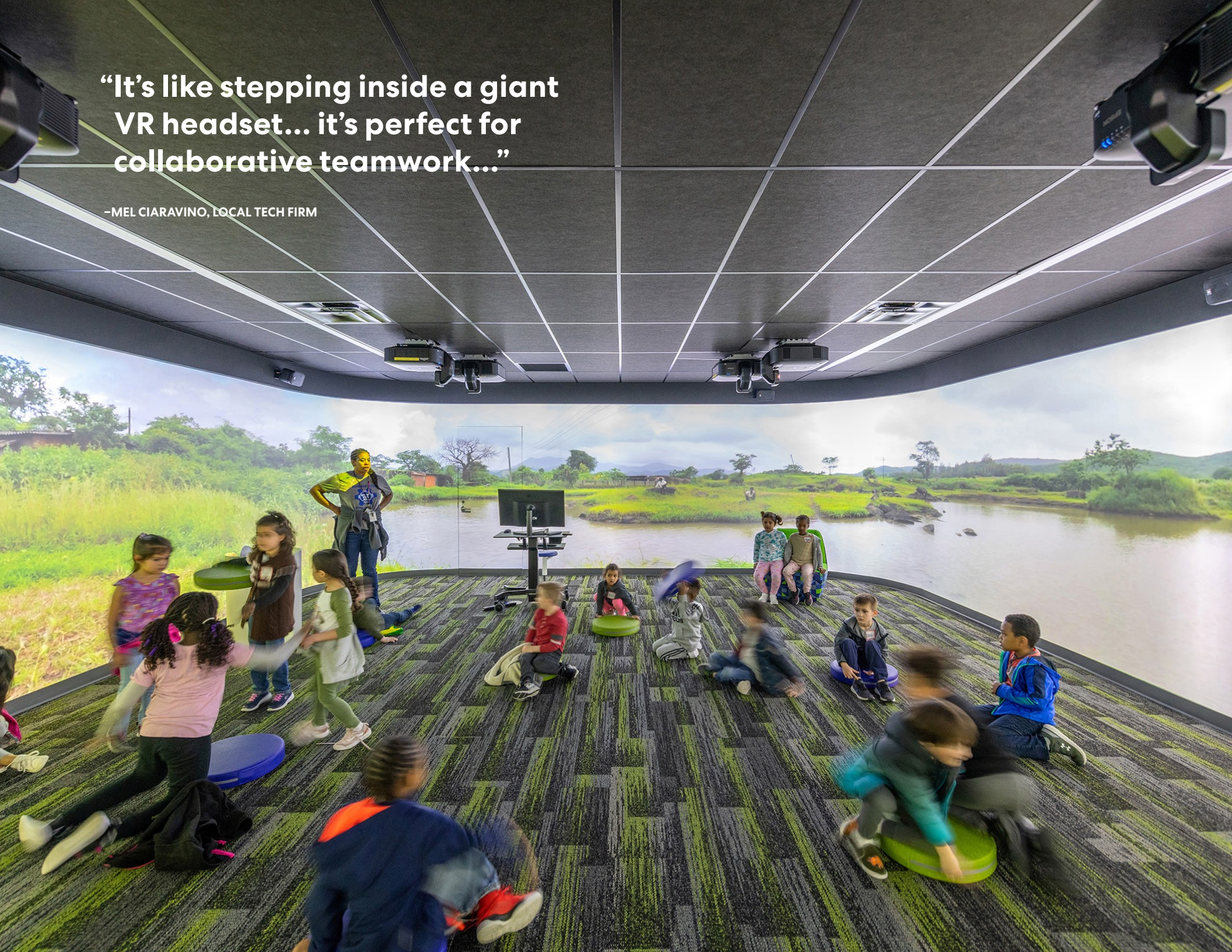
–KYNDRA SCOTT, RISD EXECUTIVE DIRECTOR OF STEM AND INNOVATION

The Immersion Studio is a direct feed to the world—it’s the new field trip. →

What Else is Possible?

- Teacher Learning
- Sponsored Events
- Guest Lecturers
- Corporate Workshops
- Internships
- Student Mentorship
- Career Fairs
- Museum Exhibits
- Art and Media Shows

STEM IS THE CONCENTRATED EFFORT TO INTEGRATE PROBLEM SOLVING SKILLS INTO THE CURRENT WESTERN EDUCATIONAL MODEL


“It’s like stepping inside a giant VR headset... it’s perfect for collaborative teamwork...”
–MEL CIARAVINO, LOCAL TECH FIRM

“They get to design an object to complete a real-world challenge.”

–EXECUTIVE DIRECTOR OF INSTRUCTIONAL TECHNOLOGY

“We need to create programs that our students are interested in and that our community needs...”

–EXECUTIVE DIRECTOR OF INSTRUCTIONAL TECHNOLOGY