URBAN LEARNING GREENHOUSE

Oklahoma City, OK

ACSA 2026

DESIGN BUILD AWARD

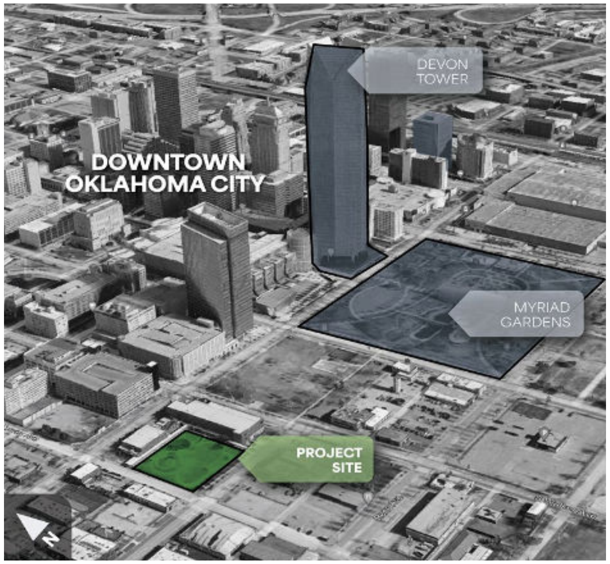
How can design seed ecological literacy in children while addressing urban food security?

At the center of Oklahoma City, the Urban Learning Greenhouse at John Rex Charter School demonstrates how food security, urban farming, and ecological literacy can be advanced through elementary STEAM education. Through a shared two-semester design-build curriculum, architecture and construction science students transformed an unused corner of a schoolyard into a modular greenhouse and outdoor classroom that supports hands-on learning in biology, botany, sustainability, and pollination, while strengthening community engagement and ecological awareness.

The project emphasized experiential learning, requiring students to progress from client engagement, site analysis, and prototyping to documentation, digital fabrication, logistics, and full-scale assembly. Architecture and construction science students and faculty worked in close coordination across all phases, creating a comprehensive design-build collaboration that reinforced interdisciplinary learning and teaching while mirroring the realities of professional practice. The greenhouse now anchors agricultural education within the school's curriculum, demonstrating how design-build work can deliver both infrastructure for food cultivation and a platform for STEAM learning.

Design-build students achieved a wide range of outcomes. They linked technical design methods with full-scale construction, moving fluidly between digital models, fabrication processes, and assemblies. They advanced community and cultural responsiveness by translating stakeholder input into spatial strategies reflecting social and educational values. They deepened systems thinking by examining how structure, modularity, fabrication, and assembly interconnect. They developed leadership and collaboration through collective decision-making and interdisciplinary coordination. Working within material and budgetary constraints reinforced economic efficiency and resourcefulness, while construction itself cultivated reflective practice, requiring adaptation to challenges while maintaining design intent.

Ultimately, the project demonstrates how agro-ecological architecture can advance cultural relevance, social equity, economic resilience, and environmental stewardship, serving as a replicable model for food security and ecological literacy in elementary STEAM education.



Project Data

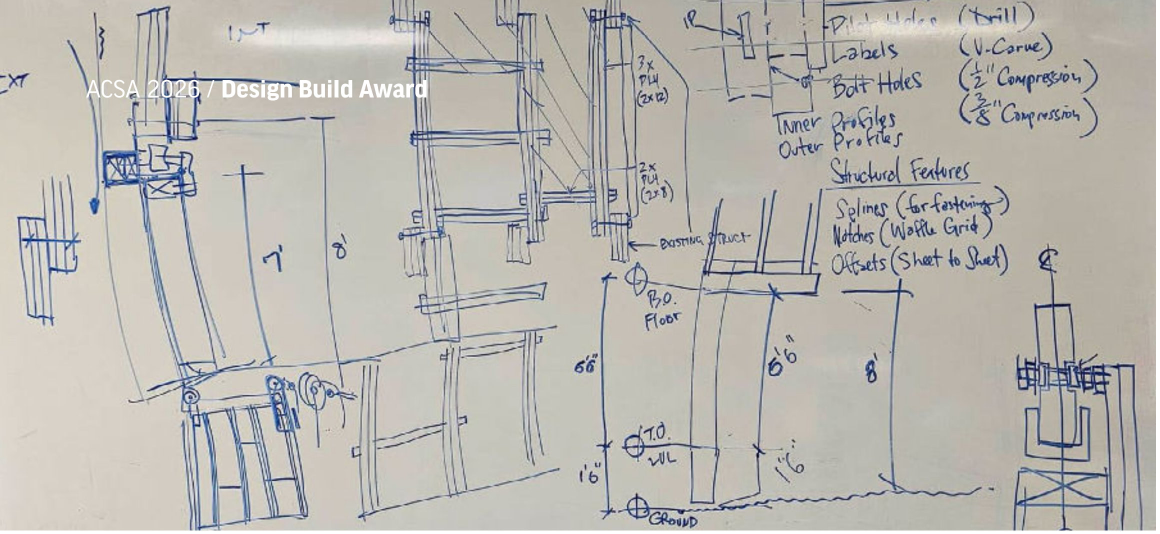
Month/Year Completed: June 2024
Project Size: 1,020 sf (705 sf greenhouse + 315 sf outdoor classroom).
Collaborators & Funding: $60,000 primary sponsor; $5,000 secondary sponsor; $5,000 internal stipend. Collaborators included John Rex Charter School faculty, administrators, and elementary students.

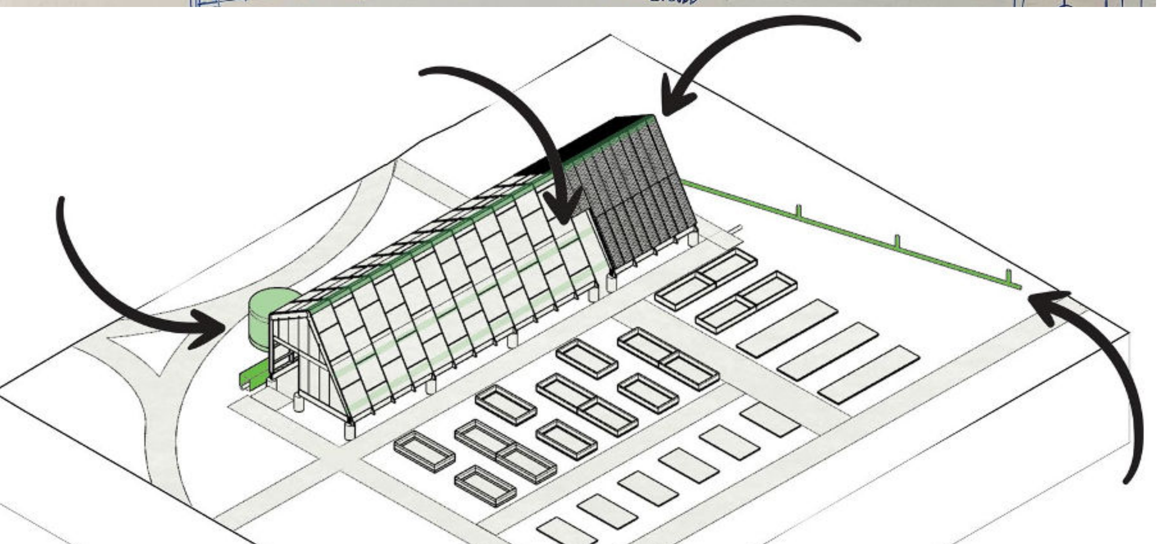
Location: John Rex Charter School, Oklahoma City, OK

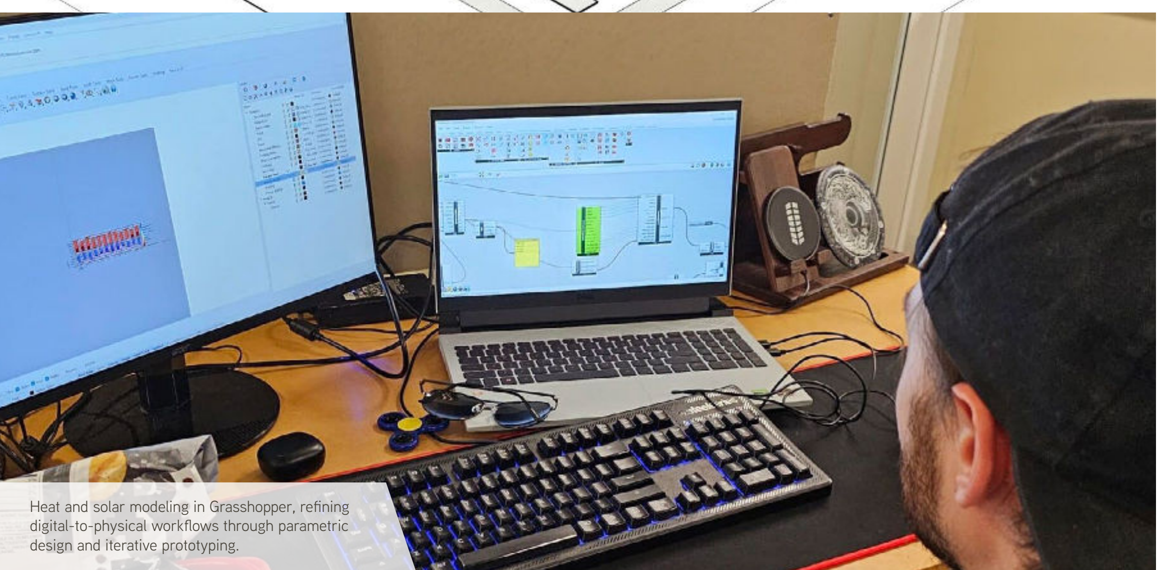
Faculty: Ken Marold (Architecture) & Bryan Bloom (Construction Science)

Architecture Students: Audrey Owen, Cole Newport, Emily Finis, Henry Shaver, Jackson Bruesch, Krys Ramdass, Matt Mullin, Ryan Bogie, Tray Nelson, Zach Van Laere,

Construction Science Students: Ashley Ibuado, Cesar Arellano, Diego Trevino, Ethan Watson, Jake Louthan, Jordan Mullican, Kade Berryman, Kalen McCarthy, Lee Broughton, London Hannah, Ramtin MSadeghi, Rebekah Spann, Tony Lemcke, Zane Reeves, Zoe Walker







Heat and solar modeling in Grasshopper, refining digital-to-physical workflows through parametric design and iterative prototyping.

Learning Outcomes

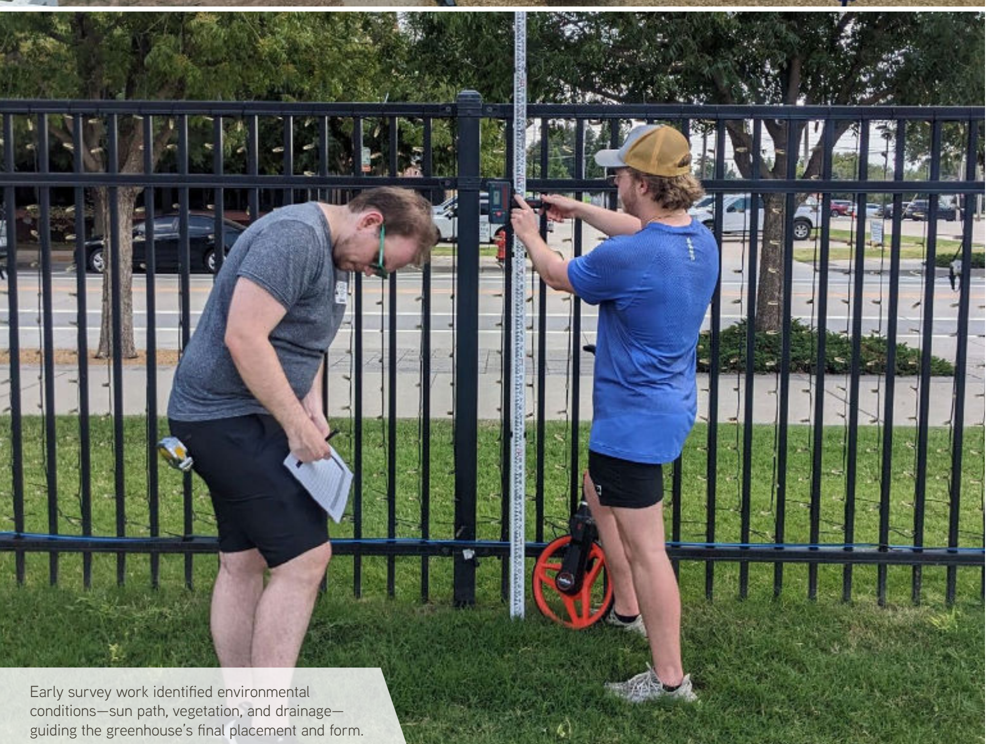
Students achieved outcomes across multiple domains of design-build pedagogy, demonstrating growth in technical, collaborative, and ecological literacy through the following:

- **Integration of Digital and Physical Workflows**: Moved fluidly between parametric design, CNC fabrication, and on-site assembly to connect representation and realization.
- **Interdisciplinary Collaboration**: Coordinated between architecture and construction science to develop shared workflows and deliver a unified project.
- **Systems Thinking**: Applied modular efficiency, sequencing, and assembly strategies to understand how structure, fabrication, and ecology interconnect.
- **Ecological Literacy**: Linked design to studies of prairie and urban agricultural systems, integrating solar orientation, pollinator support, and sustainable water and ventilation systems.
- **Leadership and Project Management**: Strengthened communication, scheduling, and accountability through real-world construction experience.
- **Community Engagement**: Connected academic learning with civic responsibility, ensuring design responded to community needs.
- **Reflective Practice**: Adapted design and construction strategies in response to field challenges and material constraints.

Evaluation Methods

Assessment was integrated throughout all phases of the project using multiple methods to measure student learning, collaboration, and performance:

- **Design Reviews**: Faculty critiques evaluated clarity, constructability, and responsiveness to community input.
- **Fabrication and Assembly**: Accuracy of digital-to-physical translation, precision of assemblies, and adaptability to site conditions were assessed.
- **Peer Evaluation**: Students reviewed teamwork, communication, and leadership within interdisciplinary groups to ensure accountability.
- **Professional Practice Criteria**: Performance in permitting, procurement, budgeting, and scheduling was evaluated against real-world standards.
- **Post-Occupancy Feedback**: Teachers and students provided qualitative assessments confirming the greenhouse's daily utility, educational value, and replication potential.



Early survey work identified environmental conditions—sun path, vegetation, and drainage—guiding the greenhouse's final placement and form.

Vacant Corner to Ecological Classroom

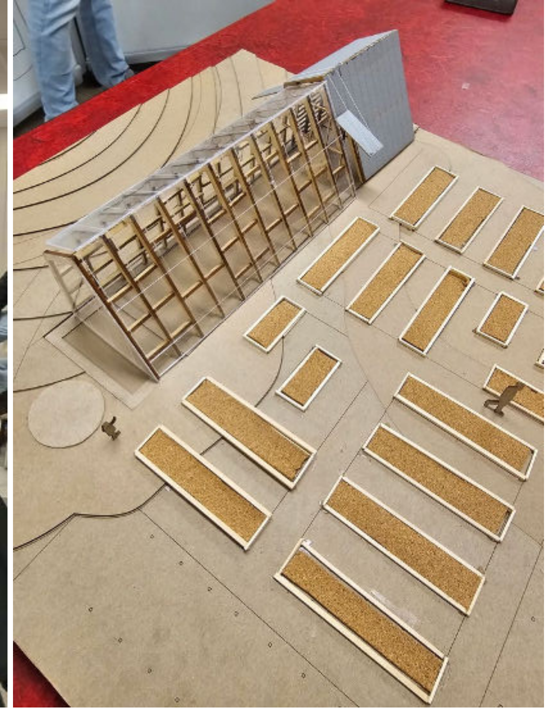
The Urban Learning Greenhouse transformed an underutilized downtown schoolyard corner into an active site for elementary education, food security, and STEAM learning. University students conducted ecological research and site analysis, examining topography, vegetation patterns, drainage, and solar orientation to inform design decisions. Studies of regional prairie ecology, layered with urban and agricultural systems, helped students situate the project within Oklahoma's broader environmental context.

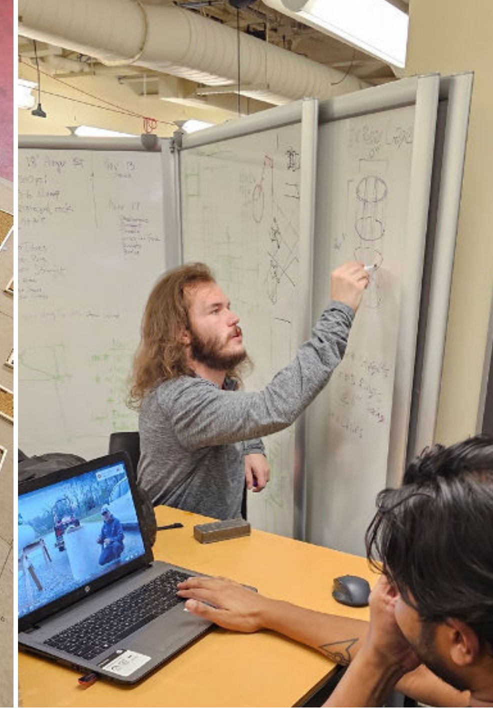
This analysis linked agricultural renewal and pollinator support to place-based learning, grounding design decisions in ecological performance and environmental literacy. By translating site research into spatial and material strategies, students reframed a vacant condition as a productive educational landscape embedded within the city.

Design development combined pollinator-friendly planting research with classroom engagement to align ecological goals with educational programming.

Community Collaboration and Curricular Alignment

Engagement with teachers and elementary students shaped the design agenda through ongoing dialogue rather than a single consultation phase. Students practiced community responsiveness by aligning design decisions with classroom curriculum goals while iteratively testing interactive elements such as pollinator-friendly planting, irrigation strategies, and passive ventilation systems developed in response to teacher feedback. This process reinforced design as a reciprocal exchange between educational needs, environmental performance, and spatial experience. Evaluation focused on how effectively stakeholder insights were translated into built strategies, strengthening empathy, collaboration, and civic responsibility while demonstrating how design-build pedagogy can operate as an active partner within K–12 learning environments.



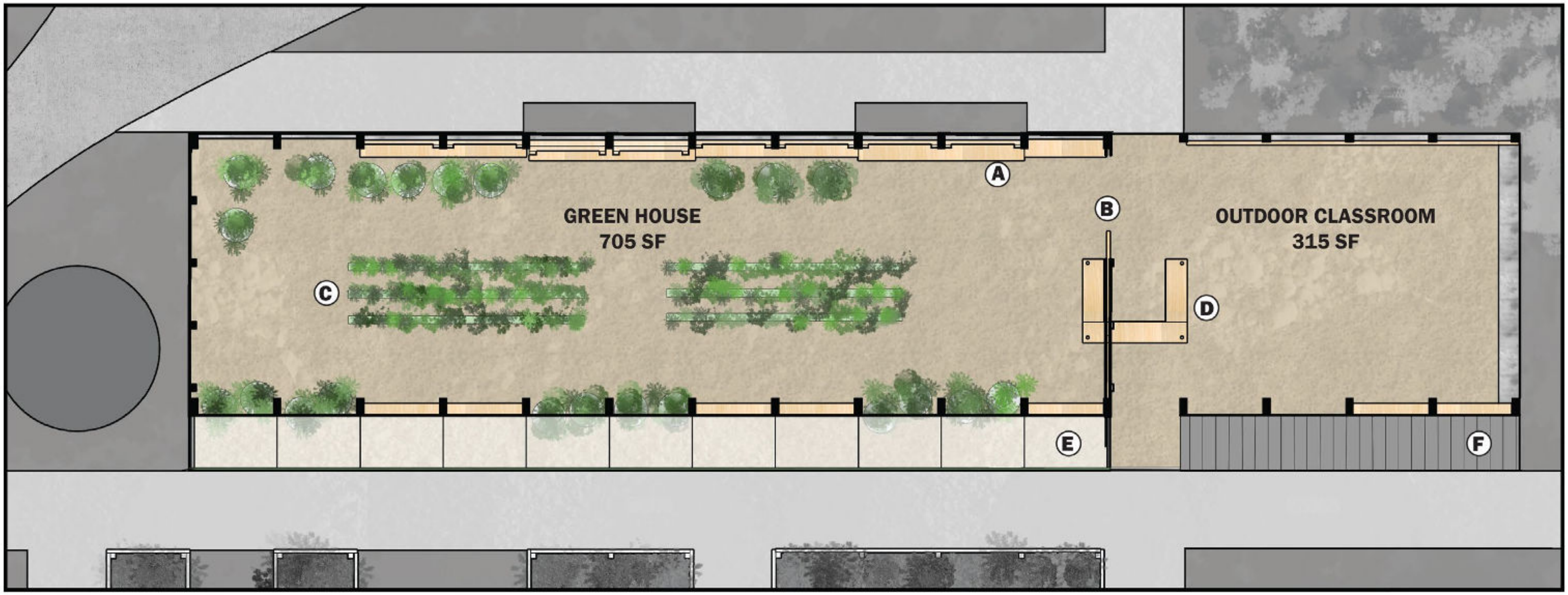


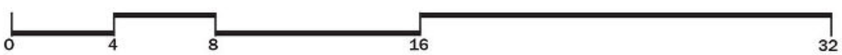
Architecture and construction science students collaborate across all phases of design and construction, linking classroom research to real-world construction processes.

Professional Practice as Pedagogy

The studio unfolded over two semesters. Fall emphasized research, site analysis, design development, assembly simulation, and site preparation, with students producing digital models, physical prototypes, and on-site foundations. Spring shifted to procurement, fabrication, and construction, mirroring professional practice and requiring coordination across drawings, stakeholder meetings, and logistics, where decisions carried material, budgetary, and schedule consequences.

Progress was guided through critiques, phased deliverables, and construction milestones. Students advanced technical proficiency while developing leadership and collaborative capacity. Pedagogy emphasized that professional competence emerges not only from technical mastery, but from the ability to make informed decisions under constraint, work across disciplines, and remain accountable to community partners and the realities of a built outcome.





FLOOR PLAN

A. MOUNTED SHELVING
B. SLIDING BARN DOOR
C. HYDROPONICS SYSTEMS
D. STORAGE
E. POLYCARBONATE SHEETS
F. CORRUGATED SKIN SYSTEM

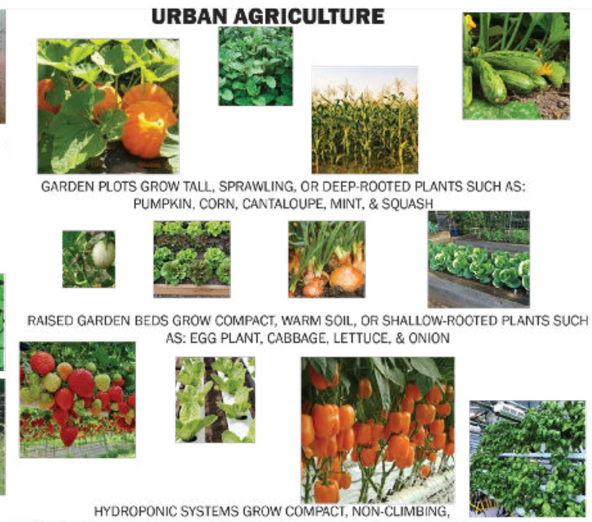
URBAN PRAIRIE

TALL GRASS LIKE BLUESTEM, INDIAN GRASS, & SWITCHGRASS ARE HOST PLANTS FOR INSECTS & BIRDS

WILD FLOWERS LIKE MILKWEED, INDIGO, & CONEFLOWER ARE POLLINATOR & HOST PLANTS AS WELL AS NECTAR PROVIDERS

BIOSWALE PLANTS LIKE CAROLINA ROSE, BUTTERFLY WEED, & PRAIRIE BLAZING STAR ABSORB EXCESS RAINWATER WHILE PROVIDING NECTAR, POLLEN, & ACTING AS HOST PLANTS

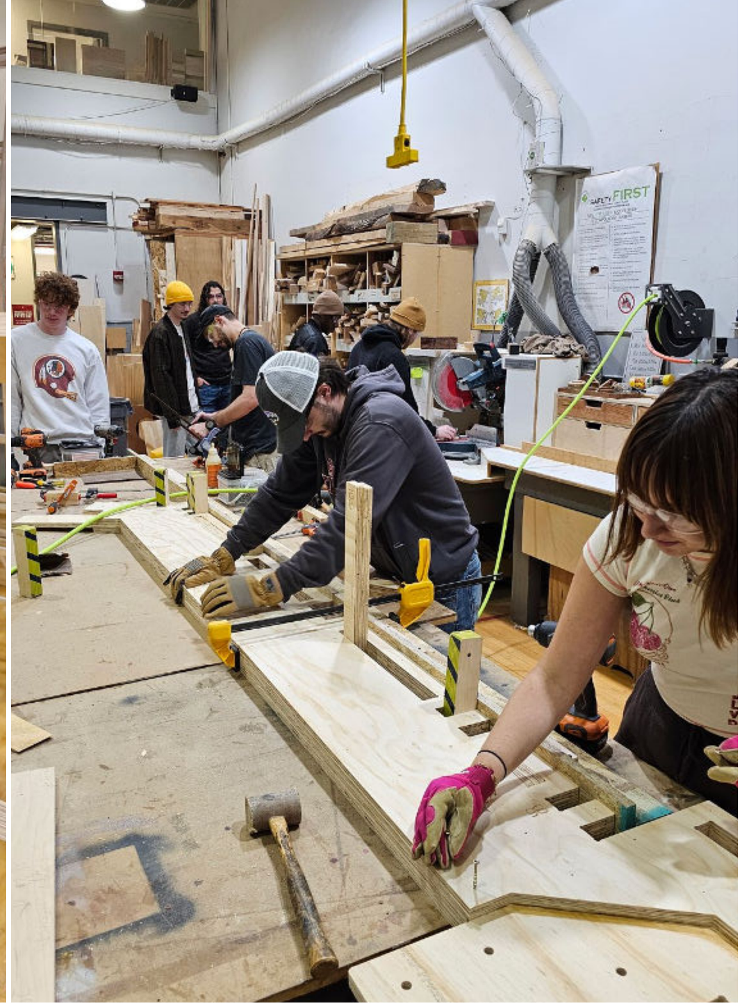
URBAN AGRICULTURE



GARDEN PLOTS GROW TALL, SPRAWLING, OR DEEP-ROOTED PLANTS SUCH AS: PUMPKIN, CORN, CANTALOUPE, MINT, & SQUASH

RAISED GARDEN BEDS GROW COMPACT, WARM SOIL, OR SHALLOW-ROOTED PLANTS SUCH AS: EGG PLANT, CABBAGE, LETTUCE, & ONION

HYDROPONIC SYSTEMS GROW COMPACT, NON-CLIMBING, NON-ROOT CROP PLANTS SUCH AS: STRAWBERRY, BASIL, BELL PEPPER, & SPINACH

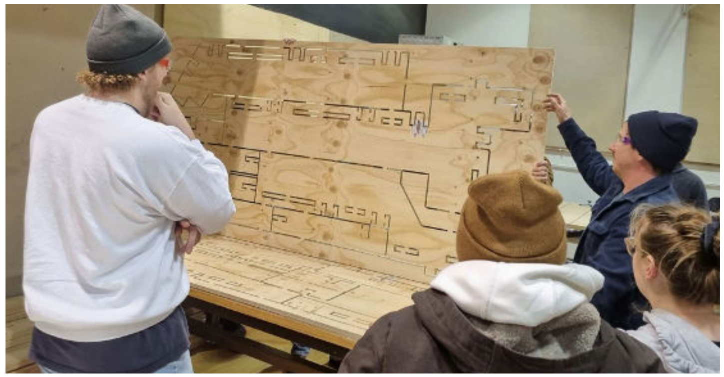


Students translate parametric models into CNC-milled plywood and modular polycarbonate components, aligning computational precision with material craft.

Digital Fabrication and Interlocking Structural Systems

Students used Rhino, Grasshopper, RhinoCAM, and Revit to generate parametric models, toolpaths, and construction documents that translated directly into fabrication and assembly. CNC-milled plywood, CNC-plasma-cut steel, and modular polycarbonate components were produced and constructed by the team as a coordinated system rather than isolated elements.

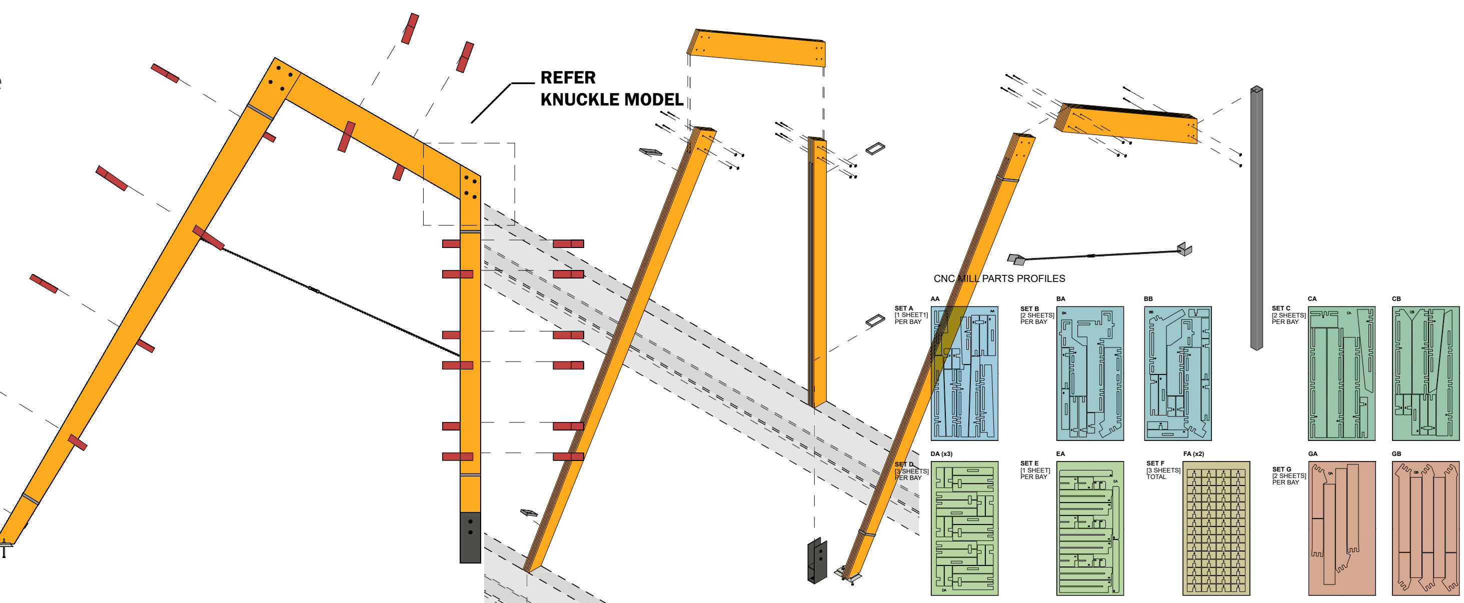
The greenhouse's modular framework relied on integral interlocking structural components, requiring dimensional precision and sequencing discipline. CNC fabrication enabled sub-millimeter tolerances, giving students direct experience with how digital accuracy informs craftsmanship, material logic, and structural performance. Because components were designed to assemble cleanly with minimal field adjustment, students confronted the consequences of modeling decisions early, clarifying how design intent, fabrication control, and deployable construction systems are directly linked.



Iterative Design and Collaborative Problem-Solving

Connection details, fabrication workflows, and full-scale prototyping required students to iteratively refine modular assemblies and structural details as conditions and constraints emerged. Digital models were tested against material behavior, fabrication limits, and on-site realities, prompting adjustments to tolerances, connections, and sequencing. Iteration functioned as a method for validating decisions through making rather than refinement alone.

This process fostered problem-solving, adaptability, and collaboration by requiring teams to diagnose failures, reconcile discrepancies between digital intent and physical outcome, and arrive at shared solutions under time and material constraints. Peer critique emphasized collaborative responsibility, evaluating how effectively teams communicated, negotiated trade-offs, and aligned technical resolution with design intent.



Exploded diagrams evolved into parametric models embedding constructibility and connectivity, guiding CNC-milled components and modular assemblies optimized for precision and on-site efficiency.

Systems Thinking and Material Integration

Material strategies were developed within a systems-thinking framework that prioritized modularity, efficiency, and adaptability. Students coordinated structure, fabrication, and assembly as interdependent systems, recognizing that decisions at one scale directly influenced performance and constructability at another. Digital modeling, material selection, and fabrication logic were aligned with assembly sequencing and site conditions, reinforcing architecture as an integrated process rather than a collection of discrete components.

Evaluation emphasized how effectively modeling informed construction outcomes, the reduction of material waste through precise fabrication and modular sizing, and the performance of assemblies as adaptive ecological infrastructure. By linking structural behavior and environmental response, students learned to design systems capable of supporting ecological learning and changing educational needs over time.

Students test modular assemblies and connection details, reinforcing systems thinking as structure, material, and assembly inform one another.

"I had the most fun during fabrication — making the components — bringing ideas to life in real time really gave me a sense that I can make work that creates real change."

— American School Design Build, 5th-Year Student

Construction Management and Field Leadership

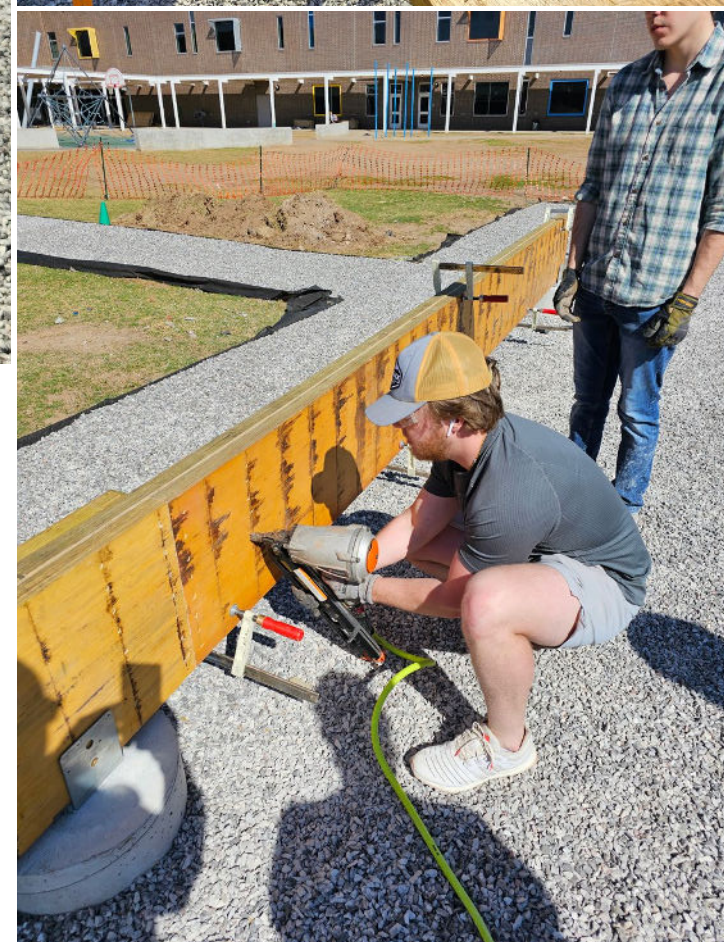
Students assumed responsibility for scheduling, budgeting, and coordination, managing the project's daily progress while responding to evolving site conditions. Weekly field logs, budget tracking, and partner feedback structured accountability, requiring students to document decisions, track impacts, and communicate clearly across disciplines. Field work demanded adaptability and situational leadership, as teams balanced safety, sequencing, and material constraints while maintaining momentum on site.

Through this process, students learned to approach challenges not as setbacks but as opportunities for evaluation and adjustment. Construction became a framework for reflection, reinforcing that architectural intent gains clarity and meaning when tested through full-scale execution, shared responsibility, and real-world consequence.

Students managed scheduling, budgeting, and field coordination, translating classroom planning into real-time construction leadership.

“So much design takes place in the field. You realize drawings aren’t the end of design — they’re just the beginning.” — *American School Design Build, 5th-Year Student*

Teams pour concrete piers, set beams, and layout structural grids, establishing the foundation system that anchors the greenhouse to its site.



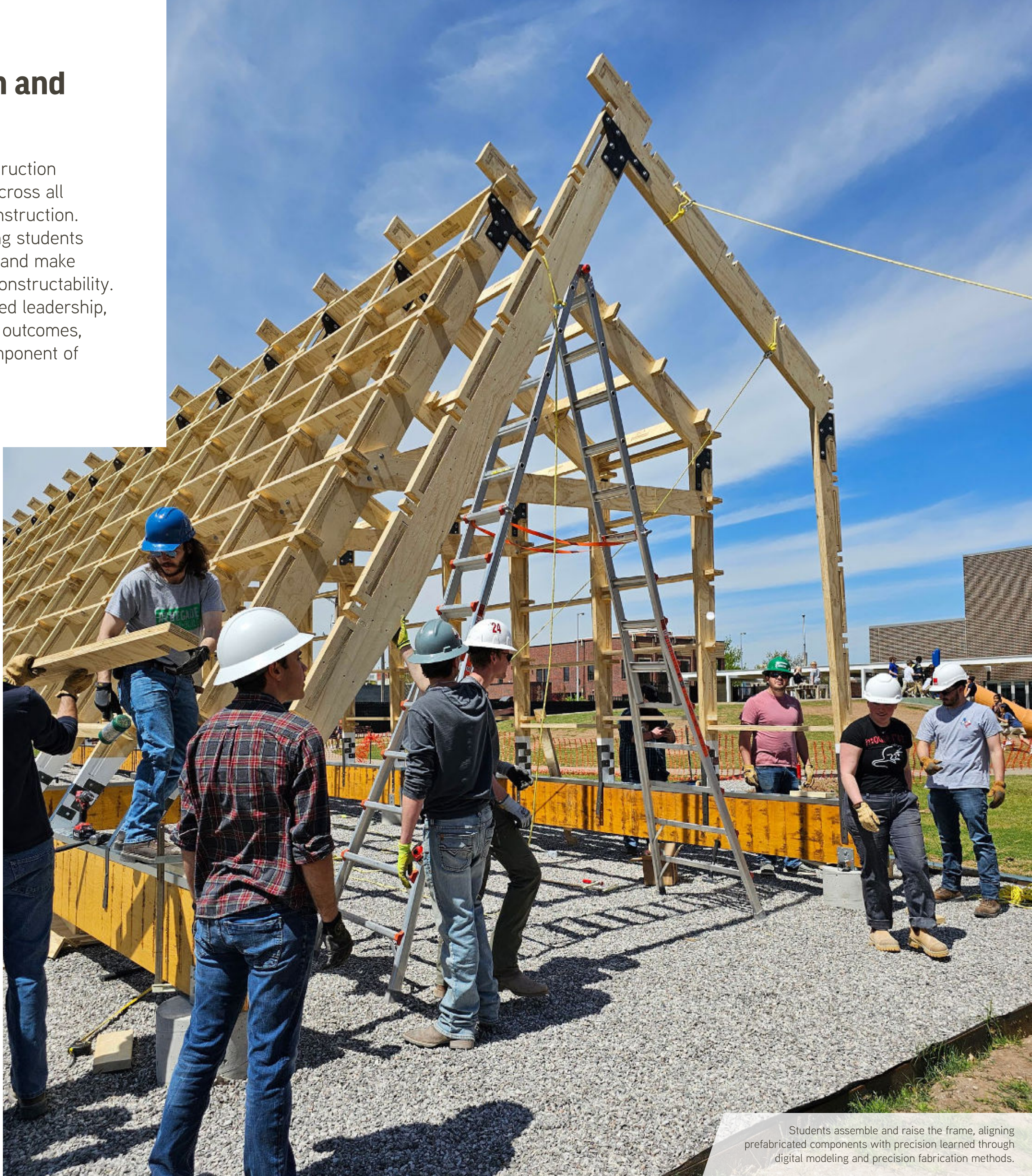
Learning Through Making: Design Meets Construction

Hands-on construction functioned as a primary instructional method, linking design intent to material and field conditions. Students were evaluated on their ability to translate digital models into buildable assemblies, adjust tolerances in response to site conditions, and maintain modular precision throughout construction. Making operated as a feedback mechanism, revealing gaps between intent and outcome and requiring informed adjustment.

Learning outcomes emphasized reflective practice, using construction activity to reinforce decision-making, adaptability, and technical judgment. By responding to evolving site conditions and material behavior, students demonstrated how design knowledge is developed and verified through direct engagement with construction.

Interdisciplinary Collaboration and Team Learning

Operating as a unified team of architecture and construction science students, participants shared responsibility across all project phases, from design development through construction. Instruction emphasized collective ownership, requiring students to coordinate roles, integrate disciplinary knowledge, and make decisions that accounted for both design intent and constructability. Peer evaluation and team-based assessment measured leadership, communication, and collaboration as explicit learning outcomes, strengthening interdisciplinary practice as a core component of professional competence.



Students assemble and raise the frame, aligning prefabricated components with precision learned through digital modeling and precision fabrication methods.

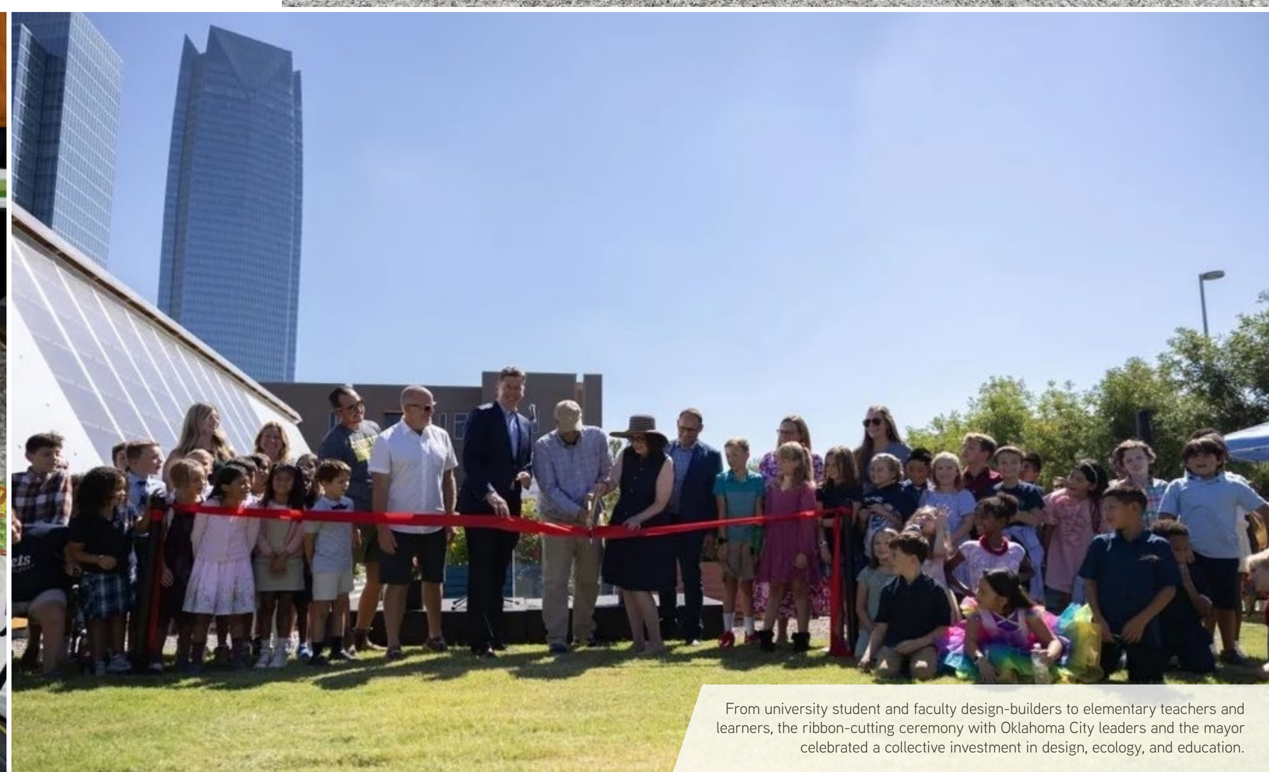
"The Urban Learning Greenhouse taught me how ideas become real, from sketch to fabrication to construction. Seeing it built gave me confidence that design can change a place for the better — and seeing my family walk through it was a dream realized." *– American School Design Build, 5th-Year Student*

Polycarbonate cladding is installed to balance daylight, durability, and energy performance while maintaining comfort and coverage for classroom learning.

Curricular Impact, Replication, and Community Reach

For university students, the project provided rigorous preparation in parametric modeling, digital fabrication, budgeting, procurement, and field management through an integrated design-build curriculum. Parametric workflows enabled students to develop adaptable systems rather than fixed solutions, allowing design logic, fabrication constraints, and material efficiencies to be tested and refined in real time. Digital fabrication served as a bridge between design intent and construction, strengthening precision, repeatability, and accountability in making.

The greenhouse's modular system, adaptable footprint, and controlled cost structure positioned the project as a replicable model for future deployment. Students produced construction documents, fabrication files, and assembly strategies with reuse and variation in mind, reinforcing a creating–making philosophy in which design is understood as an active, iterative process rather than a static outcome. Collectively, the project framed design-build as a platform for scalable innovation, preparing students to extend parametric and fabrication-driven approaches into future practice, research, and entrepreneurial contexts.



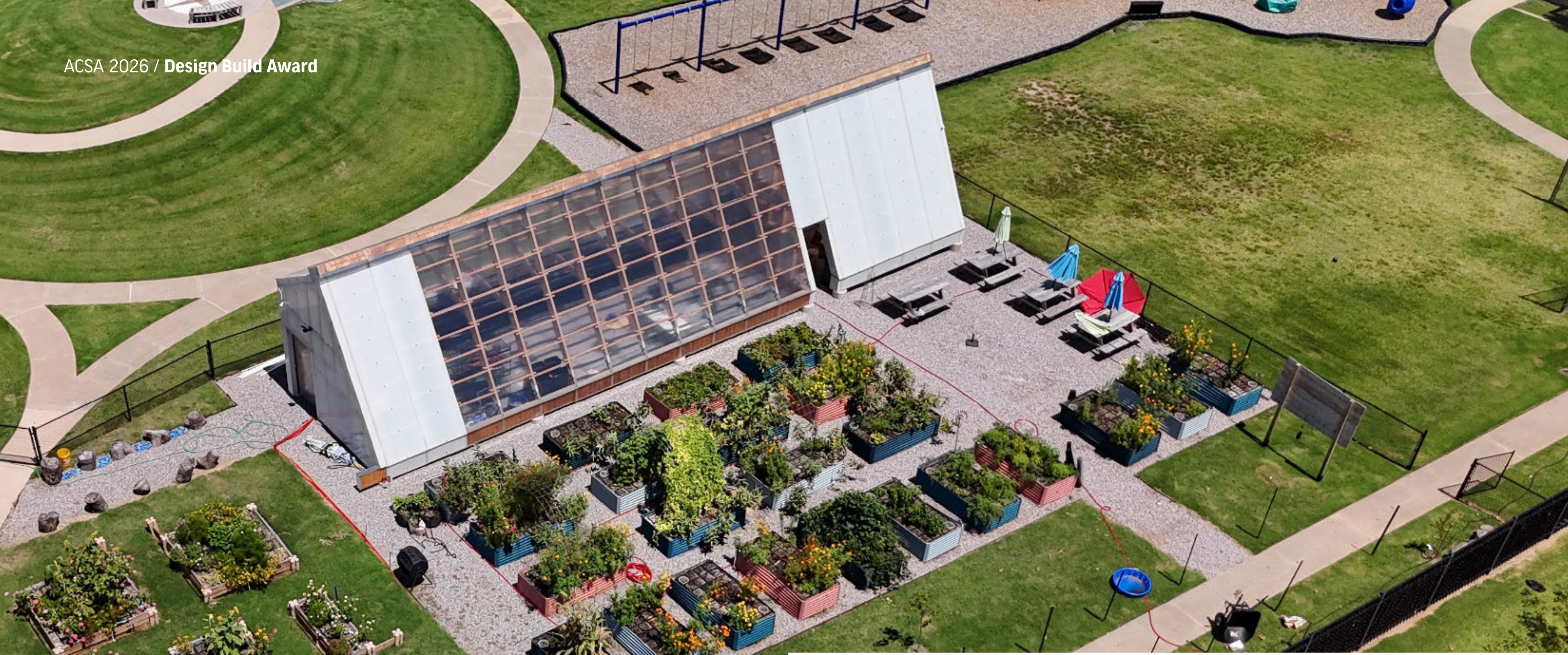
From university student and faculty design-builders to elementary teachers and learners, the ribbon-cutting ceremony with Oklahoma City leaders and the mayor celebrated a collective investment in design, ecology, and education.

Harvested produce from the greenhouse is used in the school kitchen, connecting cultivation, nutrition, and environmental literacy in practice.

From Classroom to Kitchen

The Urban Learning Greenhouse demonstrates how design-build pedagogy can generate lasting curricular and community connections. At the partnering elementary school, the greenhouse functions as a daily learning environment where children encounter food systems, pollinator cycles, and ecological processes through hands-on experience. Teachers report that the space supports STEAM objectives by linking science, sustainability, and applied learning within a living classroom.

Produce harvested from the greenhouse is used in the school's kitchen, creating direct connections between cultivation, education, and nutrition. Building on this foundation, the charter school is exploring collaborative opportunities with local businesses and restaurants, extending lessons around food systems, stewardship, and community engagement beyond the classroom. These emerging partnerships position the greenhouse as a platform for experiential learning that connects education, production, and local food networks.



Pollinator gardens and food cultivation plots extend ecological learning beyond the greenhouse, linking design and stewardship through daily observation.

Embedding Ecological Systems Through Design-Build

The Urban Learning Greenhouse integrates sustainability as both a design priority and a teaching tool, uniting ecological performance with educational purpose. Planting strategies combine food cultivation and pollinator habitats, allowing children to observe ecological cycles firsthand, while polycarbonate glazing, ventilation, and climate control systems reinforce lessons in daylighting, environmental performance, and resource efficiency.

More broadly, the greenhouse demonstrates how design-build pedagogy can translate environmental systems into lived experience. By embedding ecological processes directly into daily instruction, the project positions sustainability not as an abstract concept, but as a tangible, observable practice shaped through design, construction, and stewardship. In doing so, the Urban Learning Greenhouse serves as a model for how applied design education can support ecological literacy, food awareness, and long-term environmental responsibility across educational scales.