A FUTURE WORTH BUILDING

BY ELLEN EGLEY

Taking a building from an idea to a design to a structure is a complex process that requires many professionals working together to ensure it is safe, functional, and appealing. That's something that Jera Schlotthauer learned earlier than most thanks to some incredible experiences in high school. STEM Jobs spoke with Jera to learn about her passion, path, and profession.

STEM JOBS: What sparked your interest in a career in architecture?
JERA SCHLOTTHAUER: I have always had a love for drawing and planning. As a kid, I often drew 3-D drawings and plans of homes and cities always thinking about the people that lived there, how they got around in the spaces they were in, and what impact a certain layout may have on them. I would even take my drawings home and build entire cities on the dining table out of whatever I could get my hands on. Little did I know at the time, but I was playing with different forms of architecture. It was in college that I finally discovered architectural/structural engineering, a field that brought my love for architecture, engineering, the environment, and solving mathematical problems with the science of materials together. From that point on, I was hooked and decided to focus on structural engineering, a component of architecture.

SJ: What is your current role, and what all does that encompass?
JS: I currently work as a professional structural engineer but am often in the role of a project manager. A great deal of what I do involves working alongside architects and contractors to design the structure of buildings. I like to think the design of a building structure is much like the skeleton of a human body in which the bones are what support the weight of the body and must be strong enough to resist the forces that act on it. Architects generally focus on the building layout or the 'skin', its form, and its function. It is my responsibility as the structural engineer to analyze that building layout and calculate the loads the building must resist. The loads I analyze that generally have the most impact on the design include snow, wind, earthquake, water, soil, and other heavy loads such as large equipment, assembly groups of people, storage, and more.

I must decide which structural systems are most suitable for the building and the materials that are most economical to construct in that region. The different types of building systems I work with often include steel, masonry, concrete, wood, or a combination of these materials. Using the loads and the appropriate building materials, I design the columns, floor beams, roof system, and walls to fit the structure to the shape of the building layout. On most projects, I see the building through construction and work directly with the contractor and builders to ensure it is constructed according to the plans so it is safe for the people inside it to use.

SJ: What type of education is needed to be qualified for your position?
JS: First, you should decide if architecture, design, or structural engineering is the right career for you. You must possess strong skills in math, science, decision making, writing, communication, and problem solving. You can start to practice these skills while you are still in high school by focusing on classes in math, science, and English. To become a structural engineer, you must attend and graduate from an ABET (Accreditation Board for Engineering and Technology) accredited university in either a civil or architectural engineering program with a structural option. Many choose to continue to get their master’s degree in a specific topic, but that is
not always required. After graduation and depending on your state’s requirements, you must acquire three to five years of experience as an engineer-in-training (EIT) under a professional engineer, pass the fundamentals of engineering exam (FE exam), and finally take and pass either the eight-hour PE exam or 16-hour SE licensing exam. However, education does not stop there as technology continues to change and there are new findings in research daily. Therefore, each state requires engineers to take and report their continuing education hours every year to maintain their license.

SJ: What experiences did you have that were the most valuable on your path to your current career?
JS: When I was a student in high school, my advisor encouraged me to join an organization called SkillsUSA. SkillsUSA is the largest organization for students in high school and college who are preparing for careers in the trades, technical, and skilled occupations. As a member, I trained and competed in architectural drafting both at the state and national levels. My experiences as a competitor, chapter member, and leader in this organization did more than enhance the skills I needed to become a structural engineer. SkillsUSA taught me how to think for myself and work with a team of students with different interests, and that it takes more than just good grades to stand out in the world of work. It challenged me to learn how to effectively speak in public, teach others, and advocate to business and industry partners. Most importantly, the organization taught me that success is only achieved through hard work, dedication, and enthusiasm for my career. I credit much of my success and where I am today to this organization and to my education in STEM-related programs. Therefore, I continue to give back to the organization that was instrumental in setting the foundation for my success and encourage young students to stay focused on their STEM courses.

SJ: What advice would you give to high school students who are interested in a career in architecture?
JS: Explore the many fields of architecture that are out there. If you are interested in construction, green building, technology, interior design, history, material sciences, engineering, travel, the environment, drafting, working in teams, or planning there is a place for you with a career in architecture. There are so many opportunities out there!
5-E CLASSROOM STEM ACTIVITY: REDESIGNING THE SCHOOL

Here are some ideas for how high school teachers could use this story as a launching point for integrated STEM learning. Our activities follow the 5-E Learning Cycle Model.

Part 1: Engage

1. Have an open discussion with students to address the following questions:
   a. What does an architect do?
   b. What does it mean to be an architect?
   c. Is this a career that appeals to them?
   d. What type of training do they think is required to become an architect?

2. Show students the video “How to Design Like an Architect” that can be found at edu.STEMjobs.com/teacher-resources.

3. Have the students read “A Future Worth Building” in STEM Jobs magazine.

Have any of their answers from the initial class discussion changed?

Part 2: Explore

Place students into architecture teams of two. They will work to put together a new design for a room in their school. Each team should work on a design for a different room. For example, one team may design a regular classroom while other teams design a new layout for the cafeteria, gymnasium, computer lab, or science lab. One member of the team will focus on the sketch and blueprint of the room and one member will focus on the construction of a 3-D model of the room.

- The sketch should be 3-dimensional and can be hand sketched or designed using CAD. The blueprint of the room will be the floor layout. Where is the door? What direction does the door open? Where are the windows, if they exist? How many desks or tables fit in the room? How much space is left between desks or tables?
- The 3-dimensional model should be exactly that, a model. The model will be built, using any household items, to match the floor plan design.
- Measurements are important to both the sketch and the model. The floor plan should be drawn to scale. Specify how many inches on paper represent how many feet for the actual design. What is the scale of the model compared to the actual room? Should a different material be used to differentiate between an interior and an exterior wall? What type of flooring will be used? Calculate capacity of the room. How many people fit comfortably and safely into the space?

Part 3: Explain

Students will present their designs to the class. They will need to present both the drawing and the model. They will explain why they used the dimensions they did, how the model relates to the drawing, and how it would translate to an actual classroom.
Part 4: Elaborate

Students can elaborate on their exploration of the architectural design of one classroom by expanding and considering the architectural design of the entire school. Students will reimagine the actual layout of their school building and think about ways to rearrange or repurpose the space. Consider the existing layout. What areas are problematic for students? Where do traffic jams occur? What issues do they encounter with the layout on a daily basis? Now think about how those problems could be solved by rearranging things within the existing layout. How many classrooms are there? Are the classrooms all the same? Do all the doors open the same way? Do all the classrooms have windows? How many hallways are there? Sketch the floorplan of the school, to scale. Why has the building been designed that way? Could there be a better option? Groups will present their building redesigns to the rest of the class, discussing the problems they identified with the existing layout along with the solutions they developed.

Part 5: Evaluate

Students will be evaluated for their presentation using the following rubric. Provide the rubric at the beginning of the lesson to clarify expectations and objectives. Each group will be graded, therefore all students in the group will receive the same score.

<table>
<thead>
<tr>
<th>Scoring Rubric</th>
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<tbody>
<tr>
<td>_____/10 Research</td>
</tr>
<tr>
<td>Was significant research completed? Is there sufficient data to show that research was completed?</td>
</tr>
<tr>
<td>_____/20 Sketch and Blueprint</td>
</tr>
<tr>
<td>Are both a 3-D sketch and blueprint drawing included? Are the drawings to scale and is the scale given/explained? Are calculations included and correct?</td>
</tr>
<tr>
<td>_____/20 Model</td>
</tr>
<tr>
<td>Is the model properly built to scale with the scale provided?</td>
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<tr>
<td>Does the model accurately translate the sketch and blueprint?</td>
</tr>
<tr>
<td>_____/10 Presentation</td>
</tr>
<tr>
<td>Did the presentation cover all areas of the process?</td>
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<tr>
<td>Was the presentation clear and easy to understand?</td>
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<tr>
<td>_____/60 Total</td>
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Individual students will also submit a brief essay reflecting on their own contributions to the project. The reflection essay can be graded for completion or as a formal writing assignment toward each student’s overall total.
Standards Addressed:

Common Core State Standards - Math
CCSS.MATH.CONTENT.HSA.CED.A. Create equations that describe numbers or relationships.
CCSS.MATH.CONTENT.HSG.SRT.A. Understand similarity in terms of similarity transformations
CCSS.MATH.CONTENT.HSN.Q.A.1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

Next Generation Science Standards
HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Science and Engineering Practices
Constructing Explanations and Designing Solutions. Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Disciplinary Core Ideas
Optimizing the Design Solution. Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.

Common Core State Standards - ELA
CCSS.ELA-LITERACY.RST.11-12.7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
CCSS.ELA-LITERACY.SL.9-10/11-12.1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9-10/11-12 topics, texts, and issues, building on others’ ideas and expressing their own clearly and persuasively.

Texas Essential Knowledge and Skills – Math
MMA.1.A apply mathematics to problems arising in everyday life, society, and the workplace
MMA.1.D communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate
MMA.6 Mathematical modeling in science and engineering. The student applies mathematical processes with algebra and geometry to study patterns and analyze data as it applies to architecture and engineering. The student is expected to:
MMA.6.A use similarity, geometric transformations, symmetry, and perspective drawings to describe mathematical patterns and structure in architecture;
MMA.6.B use scale factors with two-dimensional and three-dimensional objects to demonstrate proportional and non-proportional changes in surface area and volume as applied to fields;
MMA.6.C use the Pythagorean Theorem and special right-triangle relationships to calculate distances; and
MMA.6.D use trigonometric ratios to calculate distances and angle measures as applied to fields.

Texas Essential Knowledge and Skills – Science
P.2.E design and implement investigative procedures, including making observations, asking well-defined questions, formulating testable hypotheses, identifying variables, selecting appropriate equipment and technology, and evaluating numerical answers for reasonableness