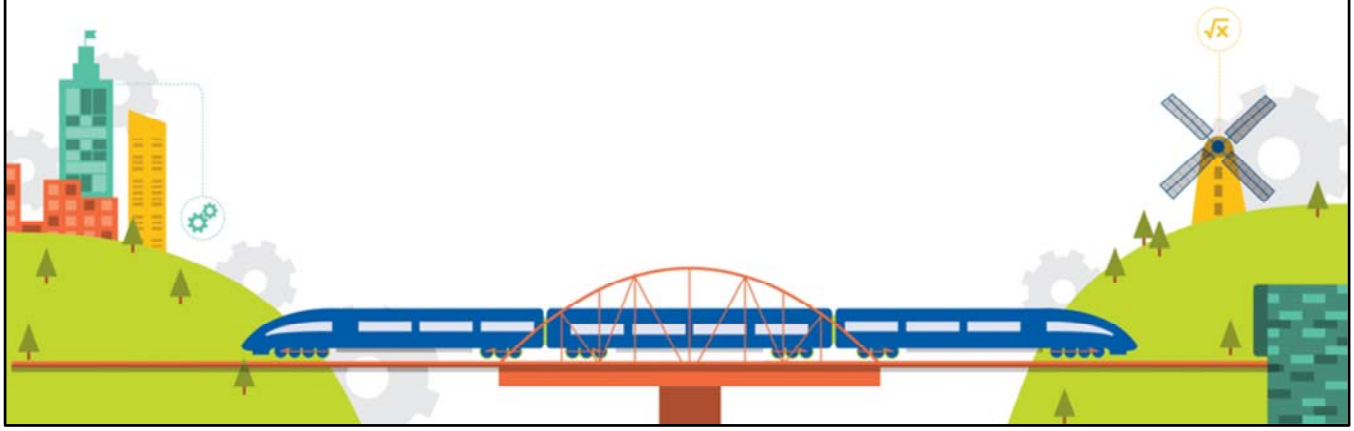
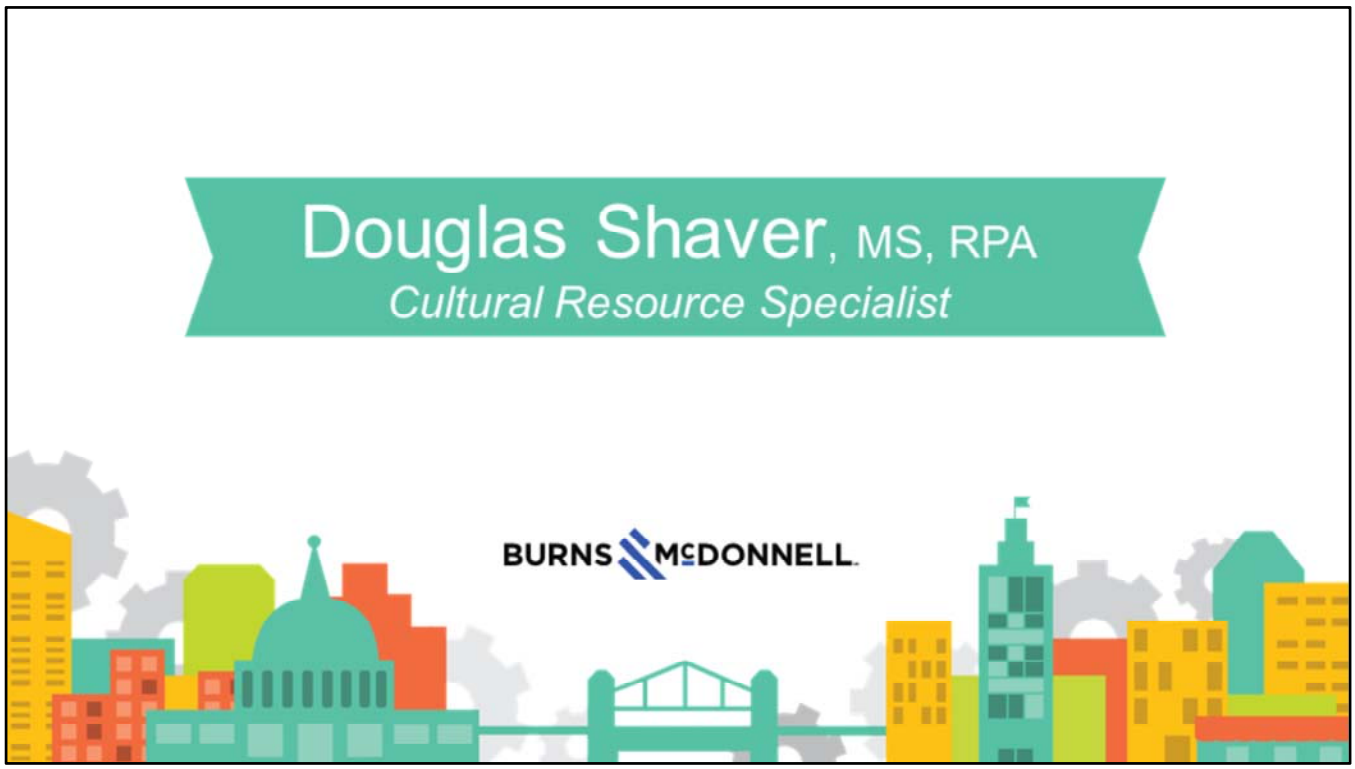
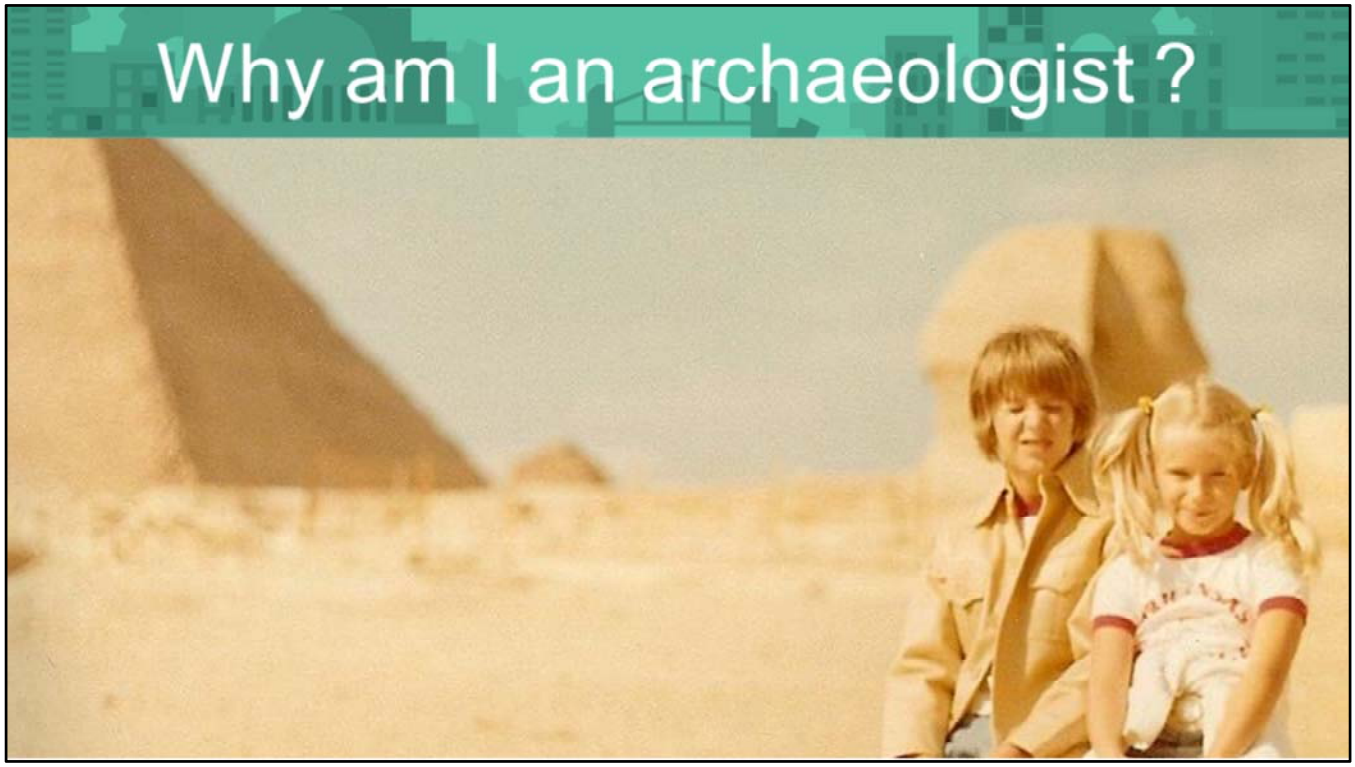
STEM Stories




Douglas Shaver, MS, RPA
Cultural Resource Specialist
BURNS McDONNELL



Why am I an archaeologist?
As a kid I lived in the Middle East where my father worked for the airlines. One thing that living in a foreign country showed me was the difference in cultures and peoples of the earth. It also showed me the vast amount of cultural history throughout the world and how cultural history is unique to each individual person.

My Story
In high school, I was not an academic student and was unable to stay focused on the curriculum. In my senior year I ended up dropping out of high school, got a GED, and joined the military. Once out of the military I still did not know what I wanted to do. I tried a couple of years of college and ended up working in the construction and building trades industry for nearly seventeen years. During this time I maintained a passion for history.

Wherever I worked, I always looked at the physical history of my surroundings. In my mid-30s I pursued a job posting for Youth Build where there was an opening as an assistant director of construction. After three interviews, myself and another person were shortlisted. I didn't get the job because I didn't have a degree. So, I got angry and told my wife I was going to go back to school. At the time we had a toddler at home. I enrolled for the very next semester.

In less than four years I completed my undergraduate degree and completed my masters degrees in Cultural and Urban Geosciences. I also earned certifications in GIS and Native American Studies and during that time, my wife and I had another child.

Eventually I landed atBurns & McDonnell as a cultural resources specialist.

What is archaeology?

The Society for American Archaeology defines it is “the study of the ancient and recent human past through material remains. It is one of the four subfields of anthropology, the study of all human cultures.”

An archaeological site is a location in which the physical remains of human activity can be found. This can include artifacts, buildings and structures, modifications to the landscape and spiritual places (cemeteries, burials, Traditional Cultural Properties).

So, why does Burns & McDonnell need archeologists or a cultural resource management department? Well, Section 106 of the National Historic Preservation Act of 1966 created the first legal requirements for the archaeological investigation and site mitigation of federally funded projects.

Now there are federal, state, tribal, and municipal governments that have laws in place requiring developers to survey, record, and possibly excavated or avoid archaeological remains, depending on their significance. Another aspect of our job is to evaluate archaeological sites, historic buildings and structures, and traditional cultural properties for its eligibility for listing on the National Register of Historic Places (NRHP). A site or property must meet at least one of the four criteria for listing on the NRHP.

Criterion A: Event-the property must make a contribution to the major pattern of American

history.

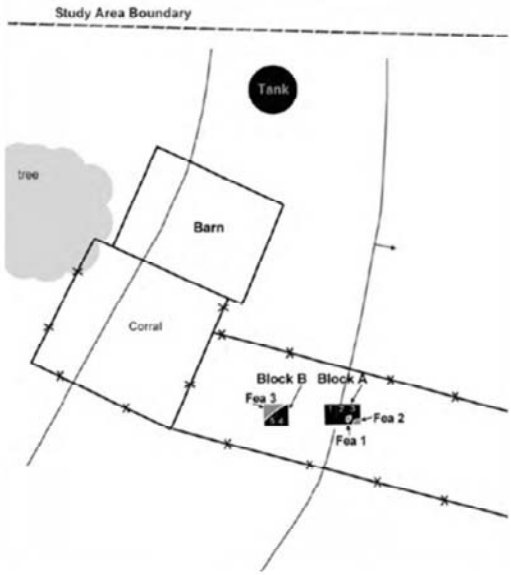
Criterion B: It must be associated with a significant person or people of the American past.

Criterion C: It must have distinctive design or construction characteristics, great artistic value or being the work of a master.

Criterion D: If the site or property can yield significant information important to pre-history of history.

There are different ways and methods that can be used to survey a site. The traditional is pedestrian survey and systematic shovel testing. In the photos above I am using a gradiometer to record and map subsurface features at the pre-Civil War era John Wornall House.

Project Example



Project Example
For a Department of Transportation (DOT) highway realignment project, our team established a National Environmental Policy Act (NEPA) boundary around sections of the project corridor.

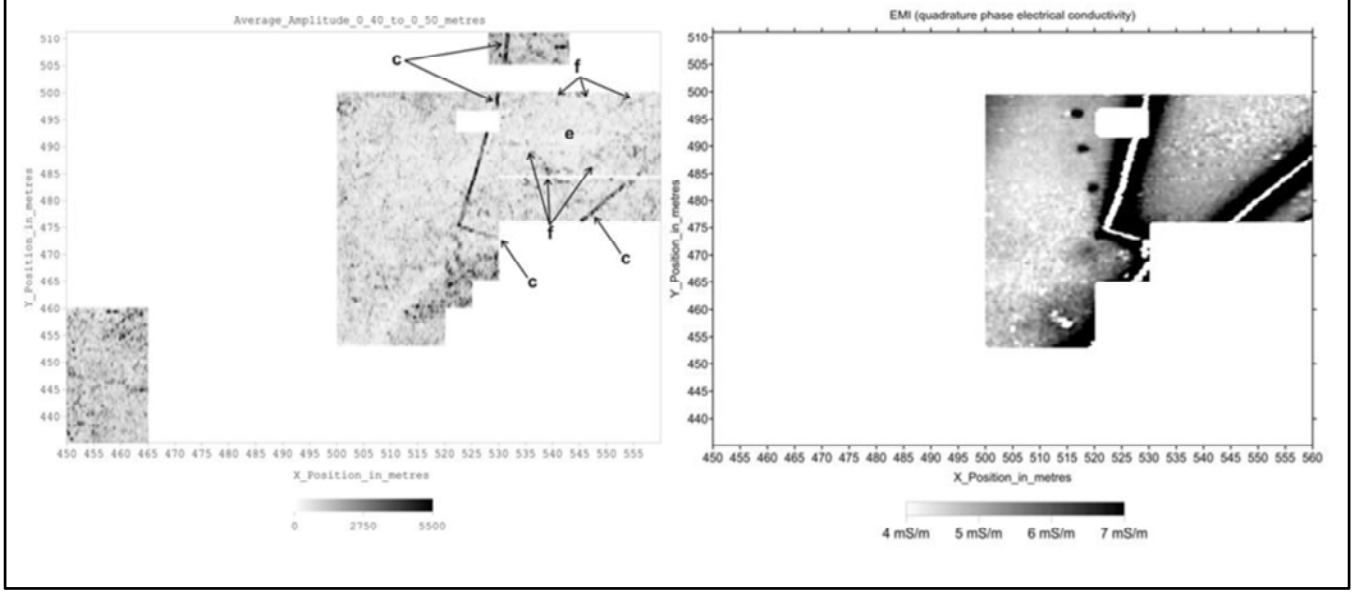
Within the corridor a previously recorded archaeological site, 34SM87, had been recorded. The site required testing to establish its eligibility for listing on the NRHP. Initially, we performed systematically shovel testing and back hoe trenching. Deep testing revealed indications of a buried burned rock feature. Through geophysical exploration, we determined the locations of other possible features.

Geophysical Survey

A geophysical survey can be any systematic collection of geophysical data of spatial studies and mapping. Data that is collected using geophysical instruments can be used for mapping subsurface archaeological feature.

Keep in mind that archaeological excavation, by its very nature, is both destructive and costly. Instruments that can be used include magnetometers and gradiometers, electrical resistivity meters, ground penetrating radar, and electromagnetic conductivity. Often more then one of these instruments is used in unison with another. Each instrument will give different results.

Geophysical Results



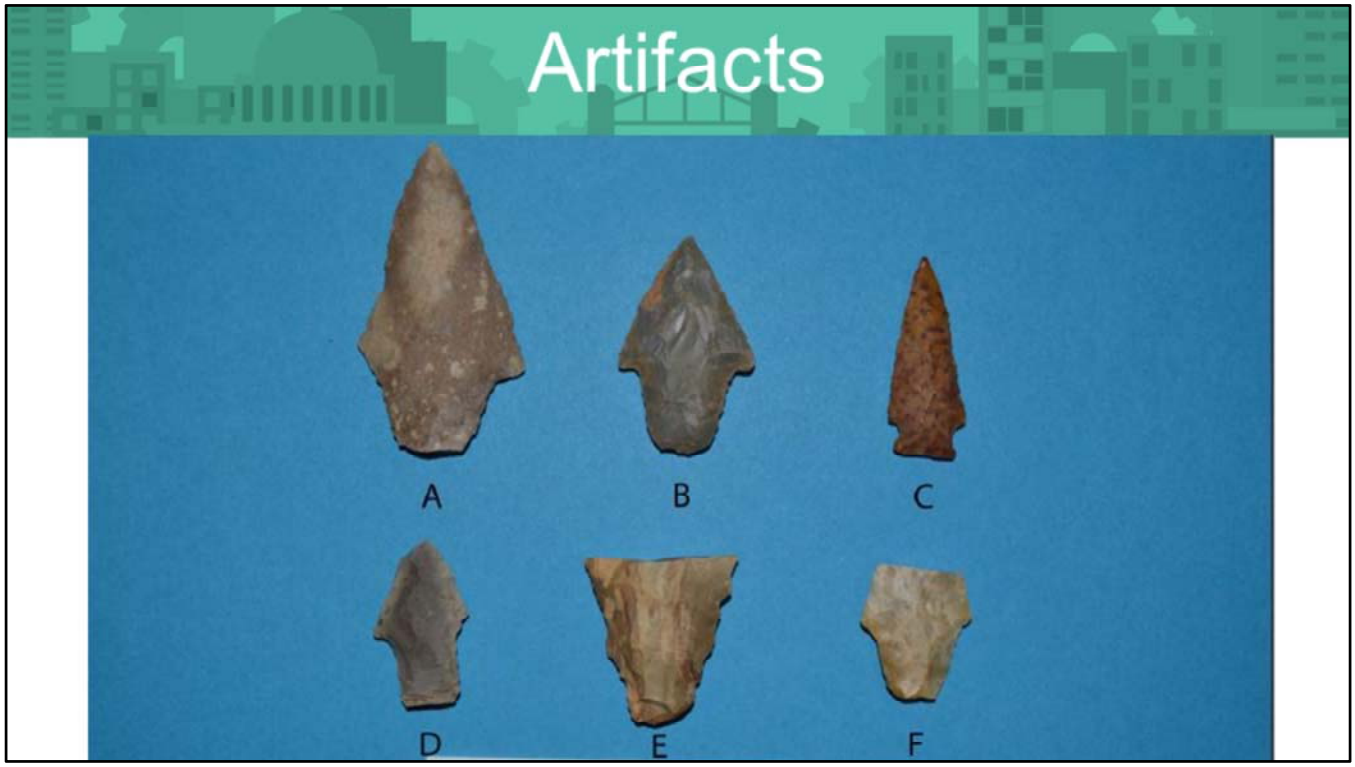
Here are the results for the same location of the site where a geophysical survey took place. The image on the left is the result of the magnetometer survey and the results on the right are from the electromagnetic conductivity survey. Both surveys pinpointed locations where excavations should take place due to the appearance of subsurface features.

Excavations

The next step was to open test units at these locations.

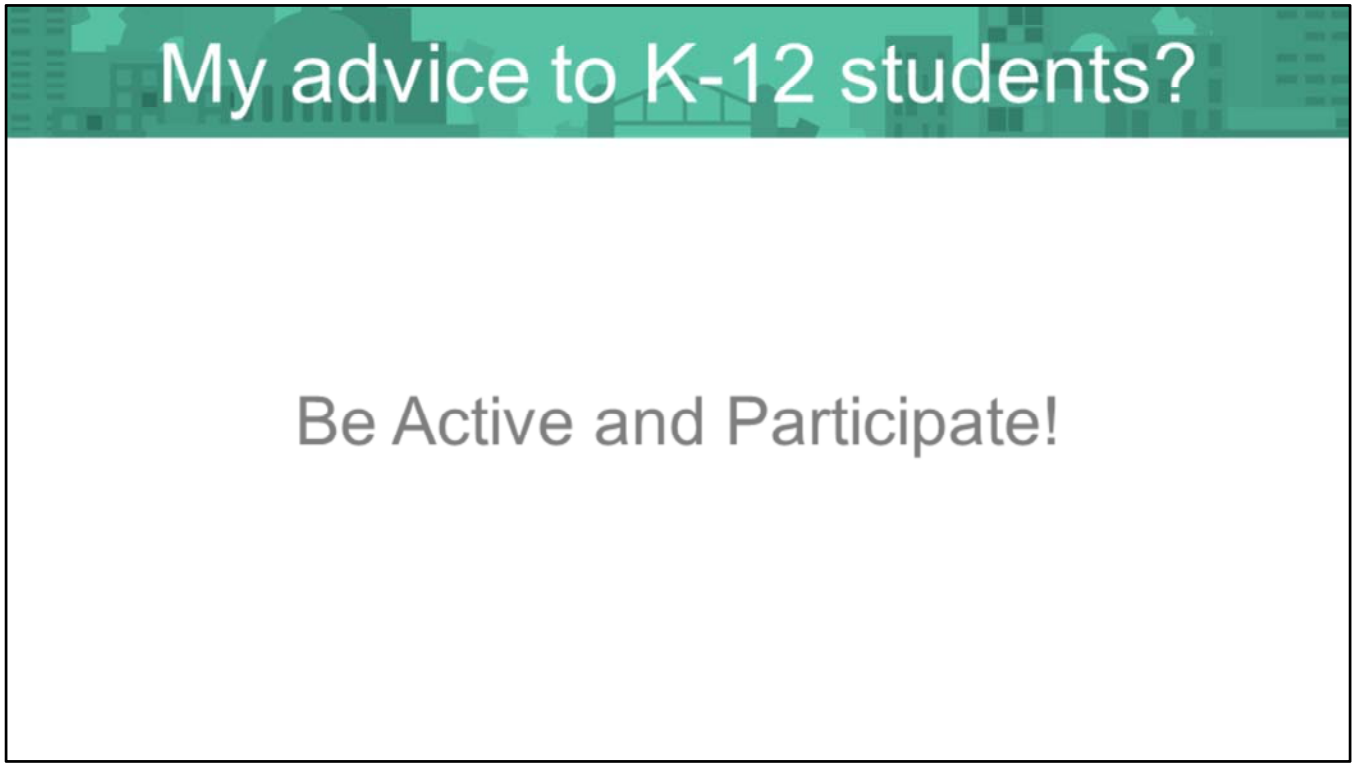
Features

And the results, once accessed, were that the Middle and Late Archaic components of the site make it eligible, under Criterion D, for listing on the National Register of Historic Places.



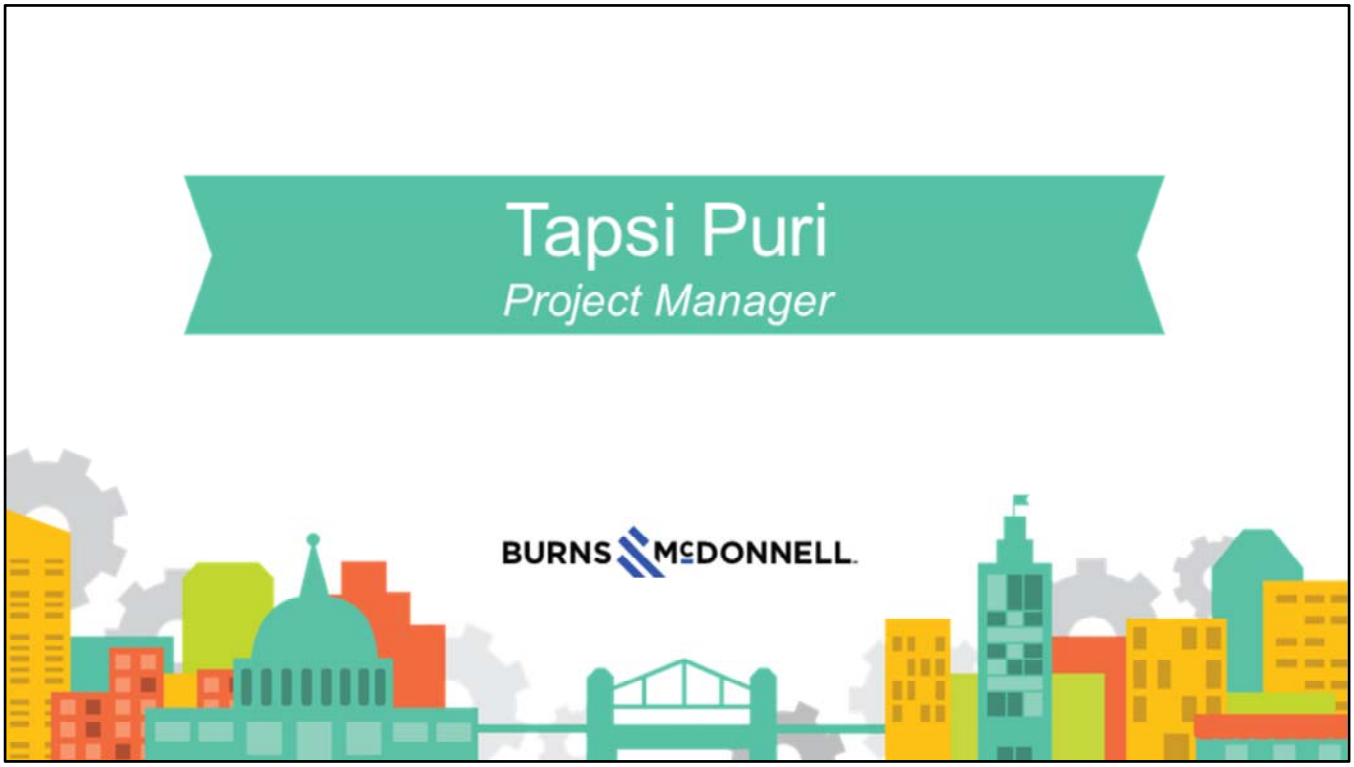
Artifacts from the site

A) Gary Point: Unit 3, 80-90 cm
B) Gary Point: Unit 3, 100-110 cm
C) Ensor Point: Unit 3, 1120-120 cm
D) Bulverde-like Point: Unit 1, 80-90 cm
E) Gary Point: 110-120 cm
F) Gary Point: Unit 1, 90-100 cm



There are many avenues for kids to take if they are interested in archaeology. Many states, including Missouri and Kansas, have summer archaeological training programs that kids, educators and the general public can participate in. Explore historic sites and museums. Take courses in history, culture, mapping, and science. Become a good writer. Learn how to do research. As an archaeologist you will spend all of your career studying, researching, and learning.

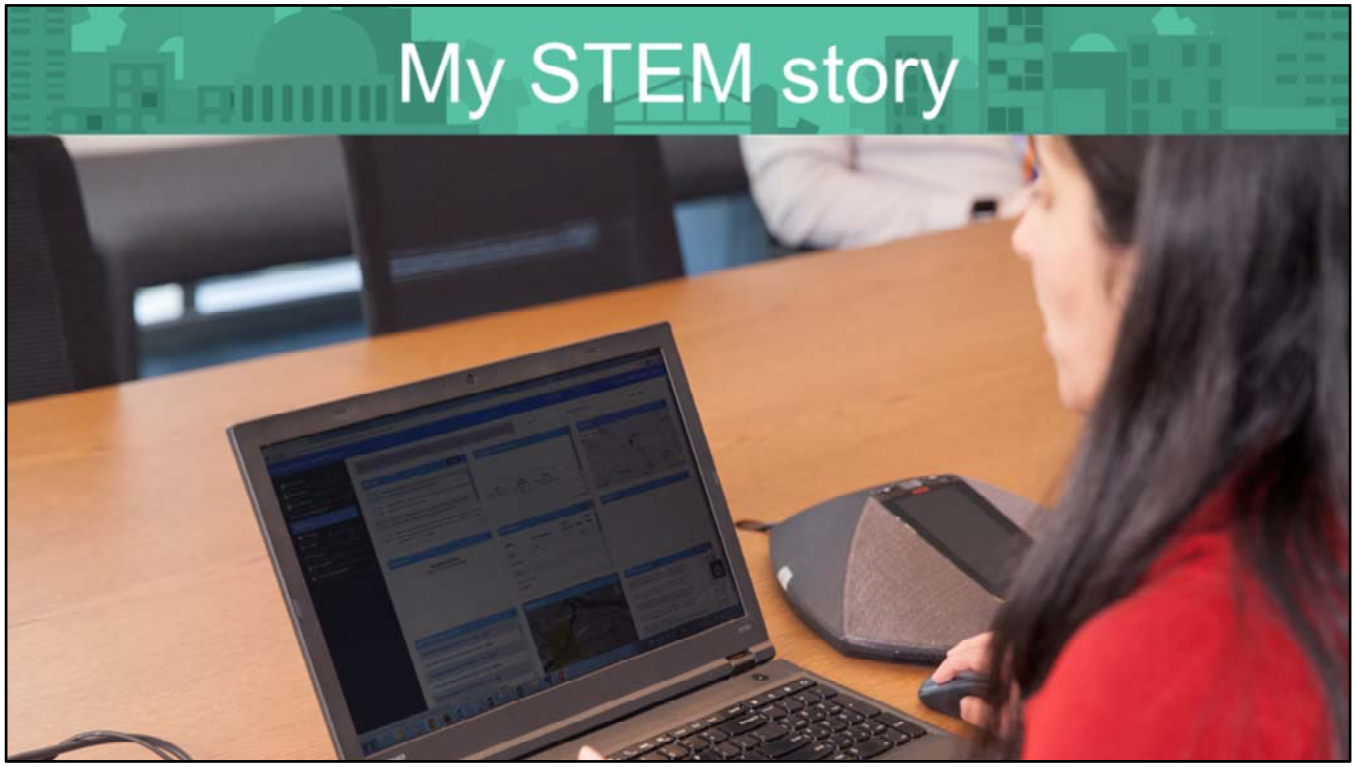
Here are some helpful links:
Kansas Archaeological Training Program
Missouri Archaeological Society Survey Training Program
Kansas City Archaeological Society Facebook page
American Archaeology website (The main page contains information for educators K-12.)
Project Archeology is geared towards teaching educators on how to bring archaeology into their curriculum and into the classroom.


Tapsi Puri
Project Manager
BURNS McDONNELL

Why I'm a Technical Project Manager?
As you can see in this photo of me, life is an adventure! I enjoy traveling, cooking and obviously, engineering.

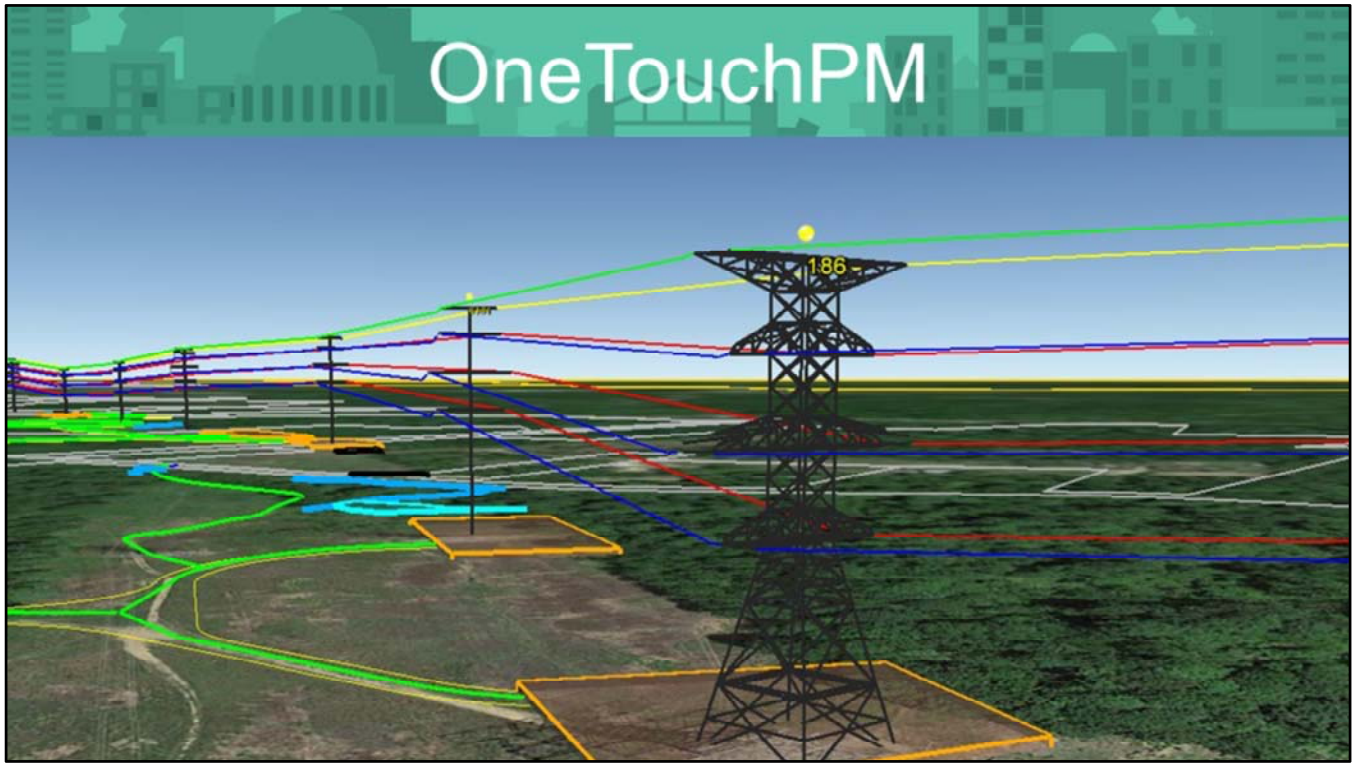
I completed my Bachelor and Master of Science degrees in Computer Science. During the second semester of my master's degree studies, I accidentally stumbled upon project management.

I realized very quickly that I've found my career path. Project management was challenging; a lot of work. But allowed me to look at projects from inception through completion. It also allowed me to understand how and why end-users use the software solutions. My goal as a project manager is to develop high-quality innovative software systems, delivering solutions in a timely and cost effective manner to our clients.

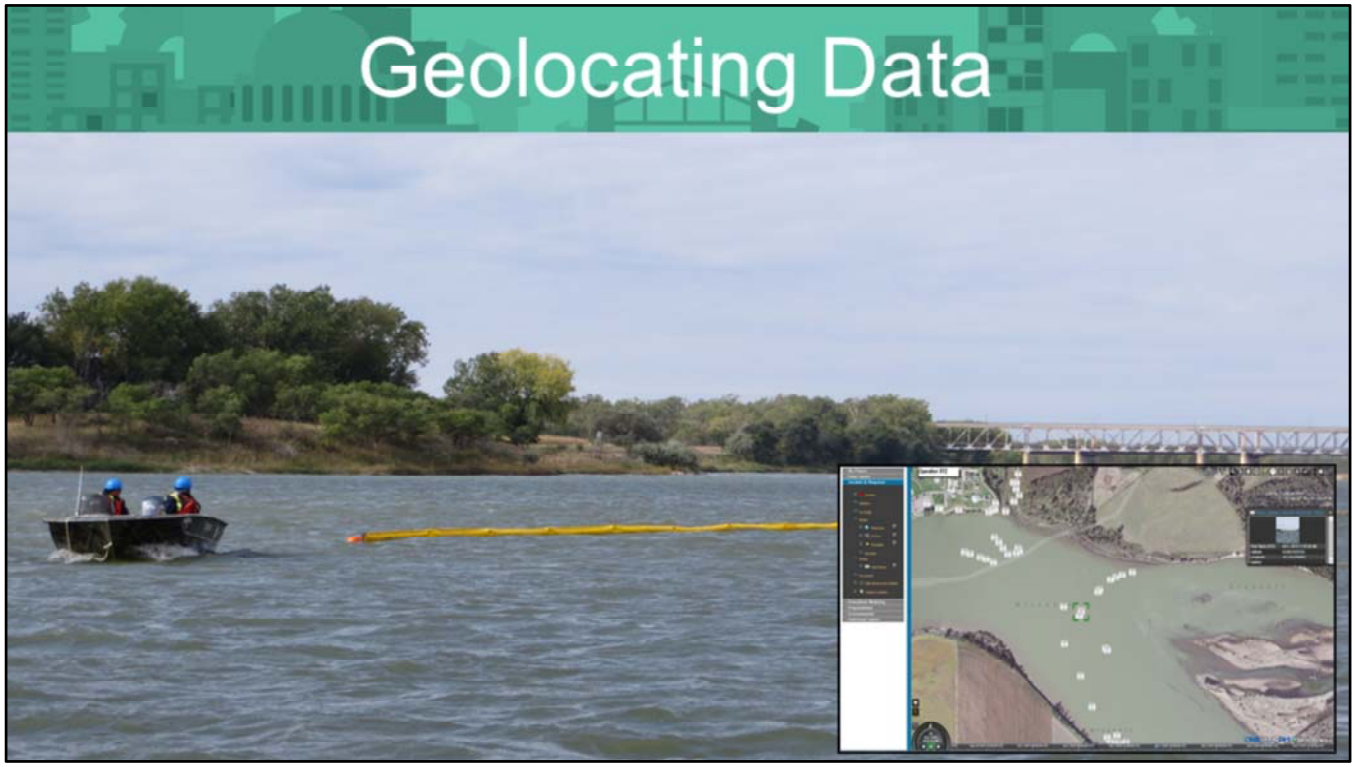


My STEM story?
At Burns & McDonnell, I work with my team to deliver software solutions that address a client's challenge. We start with prototypes of the tool, constantly checking in with the client to make sure we've understood their needs and answered a particular question before scaling up. I work with all types of clients on a variety of problems.

One example of a software solution we've designed is OneTouchPM, a web-based application developed by Burns & McDonnell that pulls data from any source system and geospatially displays it in a single, user-friendly, three-dimensional world. For one of our clients, we used this application to create an emergency preparedness and response tool that can track developments in real time. The map represents hundreds of emergency plan documents available based on location. Instead of searching through all those files in a typical file hierarchy, the client can quickly access the document closest to their incident's location and link to other pertinent emergency preparedness data based on that record.



We also use OneTouchPM for clients in transmission and distribution market vertical. Often these clients want a visual representation of an transmission line's location relative to property lines (to address property owners' concerns), geographic features (to determine the best route alignment, perhaps avoiding certain soil types, bodies of water or densely forested areas) or physical barriers (to ensure lines don't interfere with other major structures like cell phone towers or existing transmission and distribution lines, and the structure heights are in accordance with Federal Aviation Administration guidelines).



Looking again at the emergency preparedness and response tool, in an emergency OneTouchPM can illustrate the response in real-time using GPS. In the photo, the client is conducting an emergency exercise to respond to an oil spill. The screen inset shows how data provided by the emergency response team is linked to a specific location so that the client can track the response over time. Adding that fourth dimension (time) to the tool gives the client even more information to assess how the exercise is going and adapt their response as the situation unfolds.

The emergency response team can use mobile devices to send information to the OneTouchPM tool as they're collecting data in the field. The client can view this information to see where their team is at and what areas they may need direct them to.

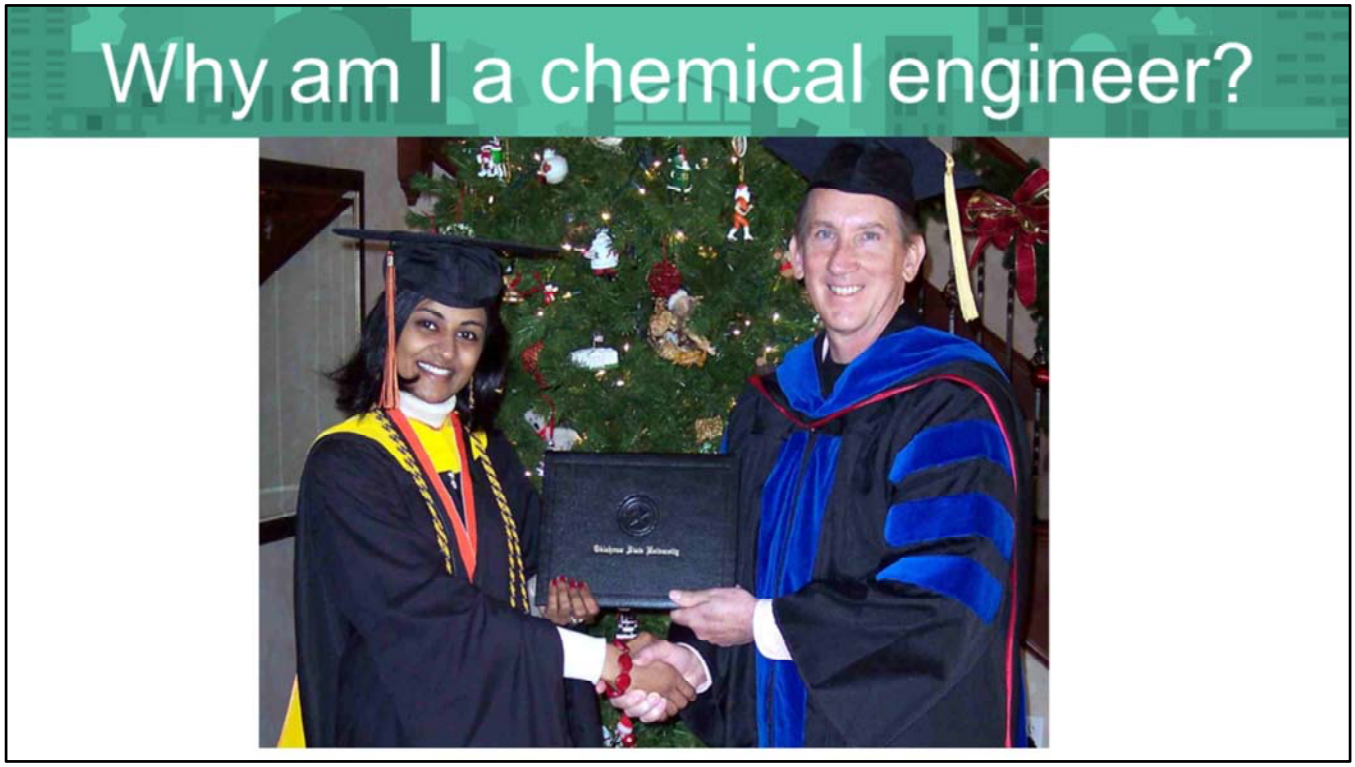
My advice to K-12 students?

"It is very important to have a feedback loop where you're constantly thinking about what you've done and how you could be doing it better."

-- *Elon Musk*

My advice to students is to be open to change. Solving problems for clients requires that we're always asking if the solution we proposed could be improved or taken one step further.


Preetica Kumar
Business Development Manager
BURNS McDONNELL

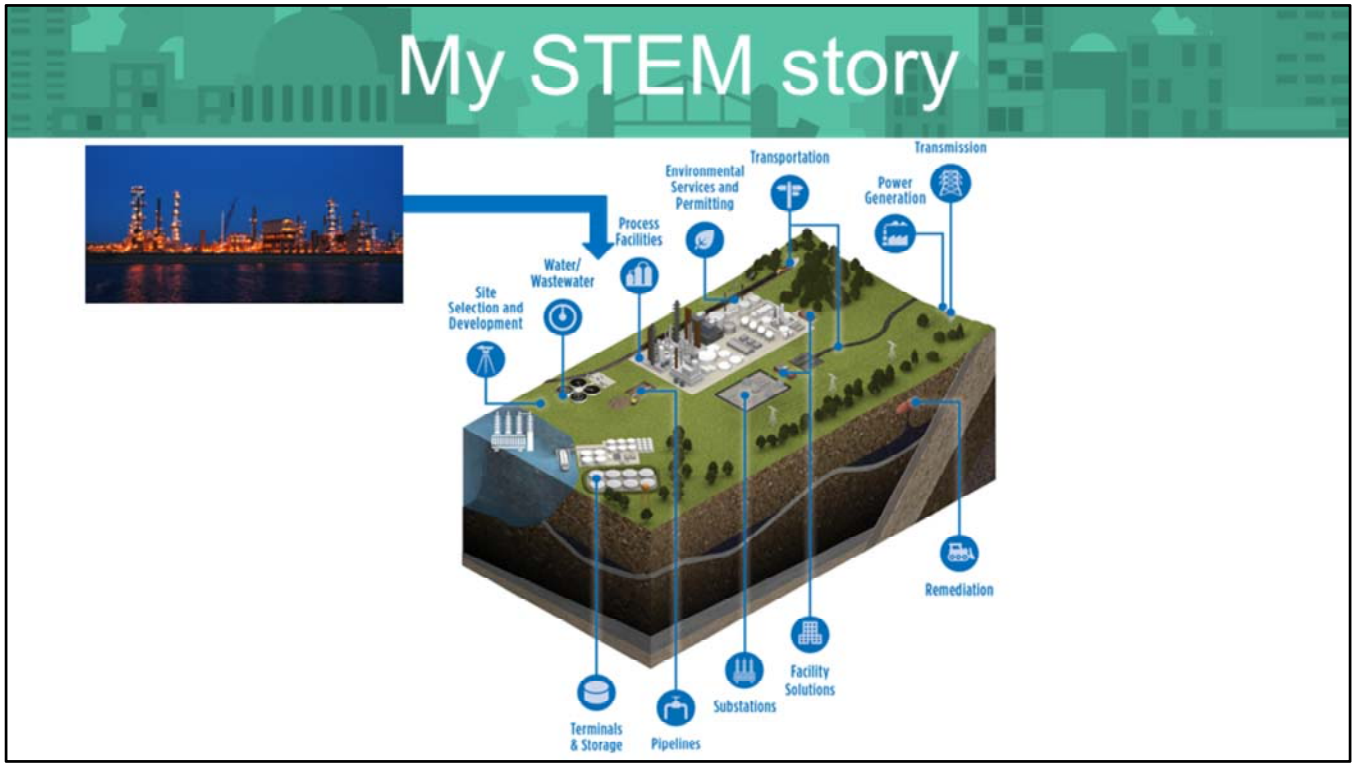


Why am I a chemical engineer?

Courtesy of my dad, he was the first mechanical engineer I knew. I was curious and asked the question: "Where does fuel at a gas station come from?" He gave me a very detailed, passionate response and while I didn't admit it then, I was fascinated. Once I got to college, I knew I was good at math, analytical/logical thinking, and I enjoyed chemistry. I decided on chemical engineering (as a small act of rebellion – I didn't want to be just like my dad) and after completing my four-year undergraduate degree, pursued a Master of Science in Chemical Engineering. "Chemistry in test tubes in the lab" is just once facet of chemical engineering. You can use chemistry to create life size scaled up applications like oil refineries, that impact the world everyday with their products..

My STEM story:
Throughout my 10 year career, I've held several roles at Burns & McDonnell. "Process Engineer" is an industry term for chemical engineer in the oil/gas field. My experience as a process and field engineer early on helped hone my technical skills and led to more responsibility as a project engineer, which involves overseeing all engineering disciplines. As a field engineer, seeing visions/designs on paper come to reality is very fulfilling. Remember, it doesn't matter how good your design looks on paper, if it can't be built! Eventually, I transitioned to managing projects –looking at the budget, timeline, workforce – and now work in business development. In a business development role, we work hard to retain clients and gain new ones, which requires a combination of technical expertise (the client must have confidence in us to solve their problem) and great communication skills (the client needs to know we understand their unique challenges and can help them arrive at the best solution). Students can either choose technical expertise in a certain field of engineering or choose a general career path that involves basics of all types of engineering.

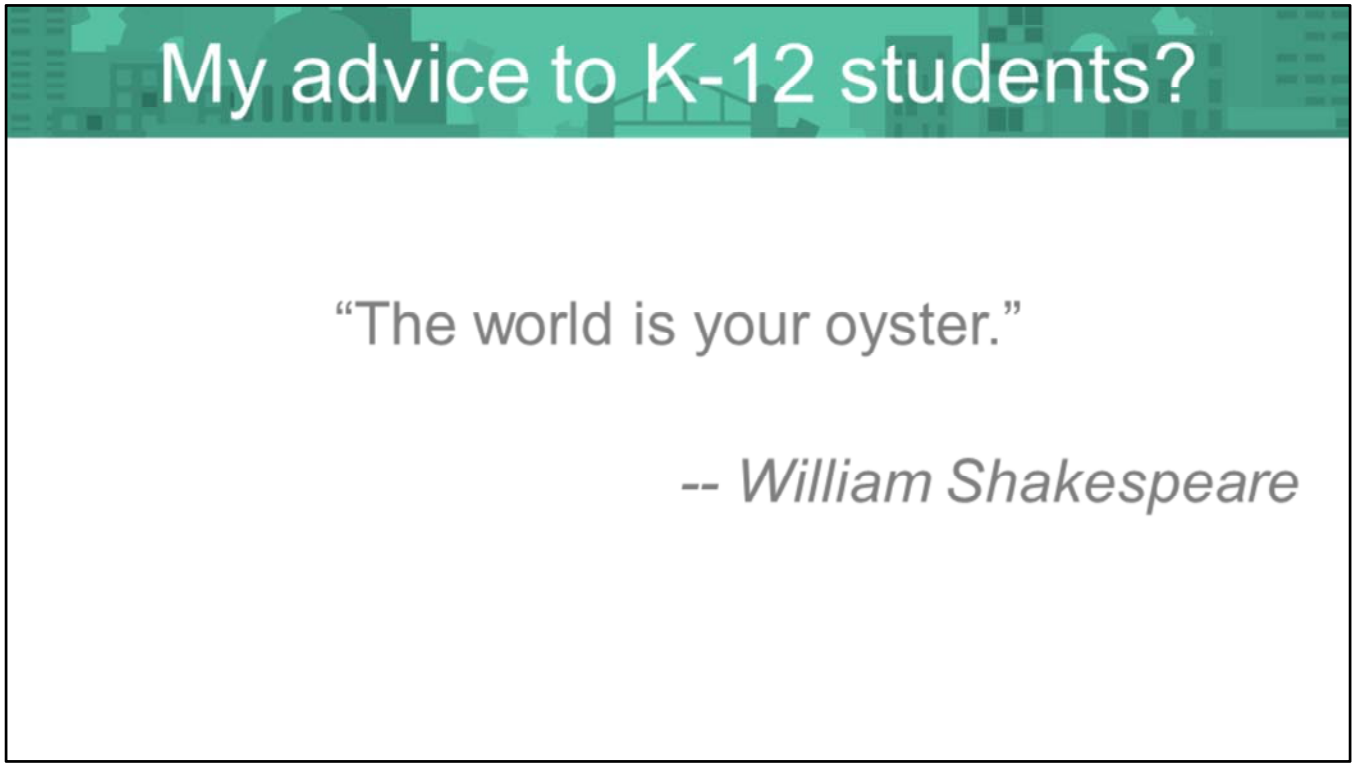
Looking at the oil and gas industry and thinking back to my father's explanation of where fuel comes from, there are three main sectors. "Upstream" refers to oil exploration and production. Drilling operations deep into the earth tap into reserves of crude oil. You can't put this in your car yet, though. "Midstream" refers to the transportation of crude oil and other petroleum products to a refinery. "Downstream" refers to the refining of the crude oil, turning it into gasoline, jet fuel, diesel and hundreds of other petrochemicals. The refineries that you see fall into this category. After downstream refining, gasoline/diesel is delivered to your local gas station, where you can finally fill your tank.



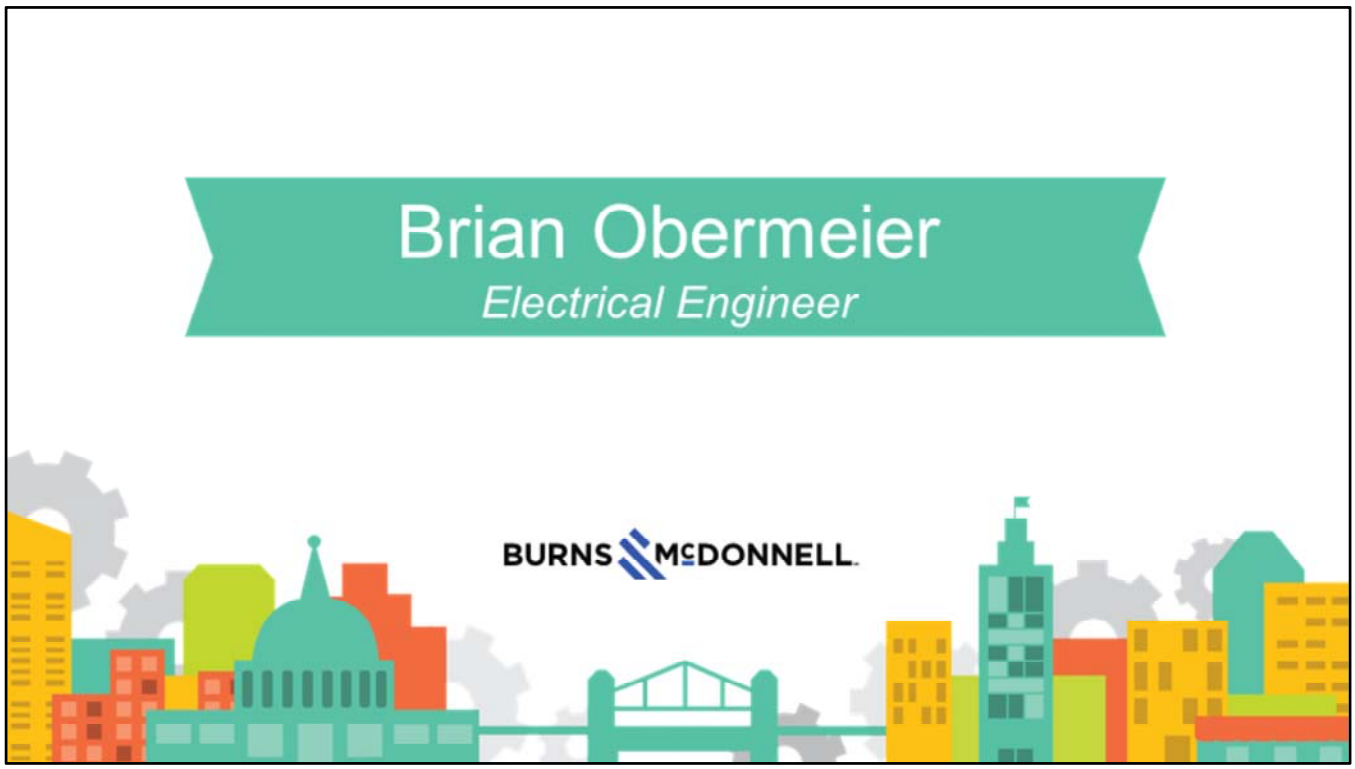
The downstream processes at a refinery require all types of STEM careers.

A small sampling:
Environmental scientists help determine an appropriate site for the refinery.
Transportation engineers design access to the site – by pipeline, barge, train or tanker truck.
Environmental engineers design water and wastewater treatment strategies.
Process, civil/structural, piping, mechanical and facilities engineers design the refinery to ensure the crude oil is processed into the appropriate components.
Electrical engineers provide power to the site. Instrument engineers provide instrumentation and control systems to read and control variables like pressure, temperature, flow.
There are lots of STEM career opportunities in just looking at a refinery site. The variety of jobs in the oil and natural gas industry is limitless.

Engineering is adding art to science. There are always design constraints in any project and a refinery is an excellent example of how those constraints lead to imaginative solutions. Different raw material-product combinations and business objectives demand different chemical processes. You need to know more than just theory; refinery sites might be limited to a certain footprint or the design is a retrofit so that much of the existing facilities need to remain in place and operational. Engineers need to think creatively to make all the pieces fit. No two projects are ever the same, which makes careers in oil/gas fun!



My advice to students is something my mother always told me: "The world is your oyster." Experiment! Internships are a low-risk way to do that. Your college degree is only the beginning. The most successful people continually learn and explore their strengths throughout their careers. There are so many opportunities if you keep your eye out for them and work hard.

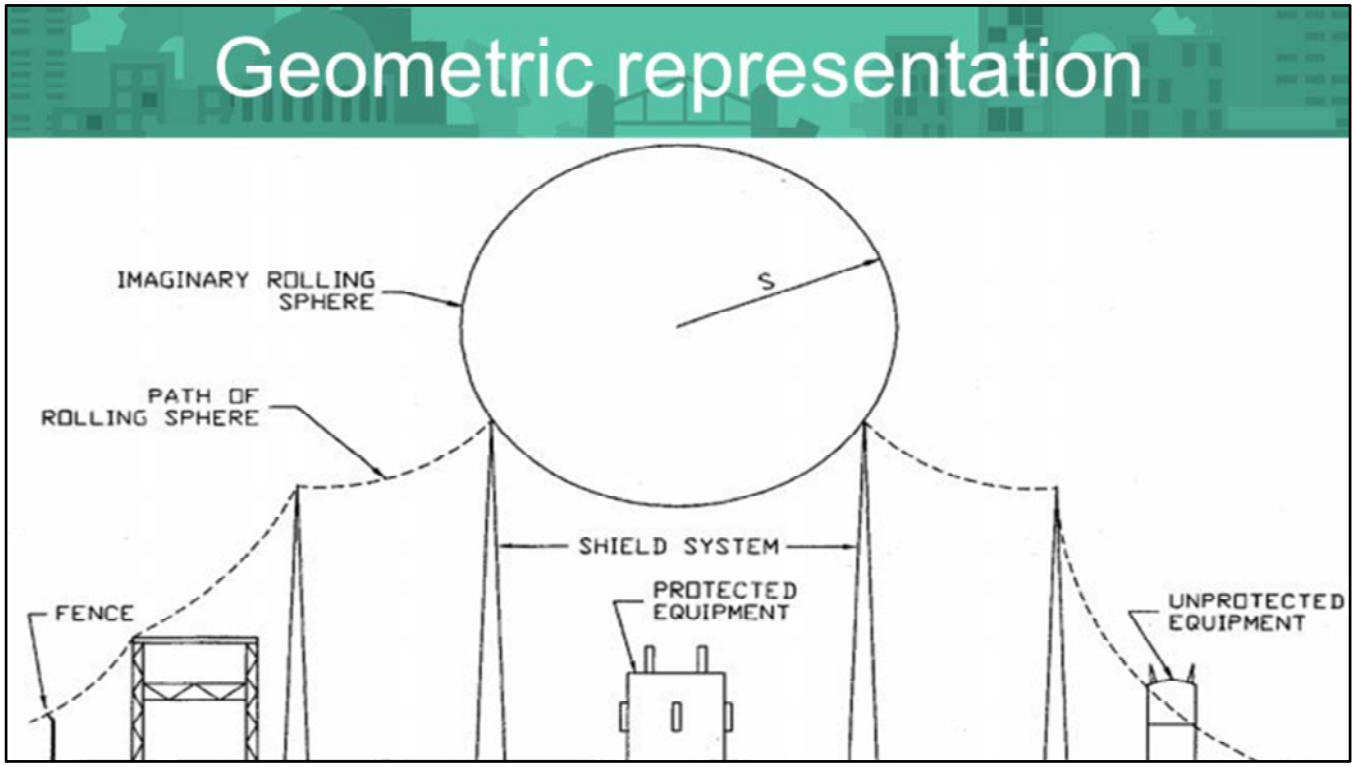

Brian Obermeier
Electrical Engineer
BURNS McDONNELL

Electrical engineering appeals to me more than any other engineering path because it is the most flexible in how it can be used. There is such a wide range of what people do with an electrical engineering degree compared to other STEM degrees and other engineering degrees in particular. The day to day workings of a computer programmer, a circuit board designer and a transmission/substation designer are vastly different but all stem from the same base of knowledge.

My name is Brian Obermeier and I like to solve problems. Not necessarily math problems or science problems, although I do like those as well. But I like find answers to questions we don't have the answers to. Overcoming adversity and the feeling of accomplishment is what drives me forward. As an engineer I get to stretch those muscles and practice my problem solving skills.

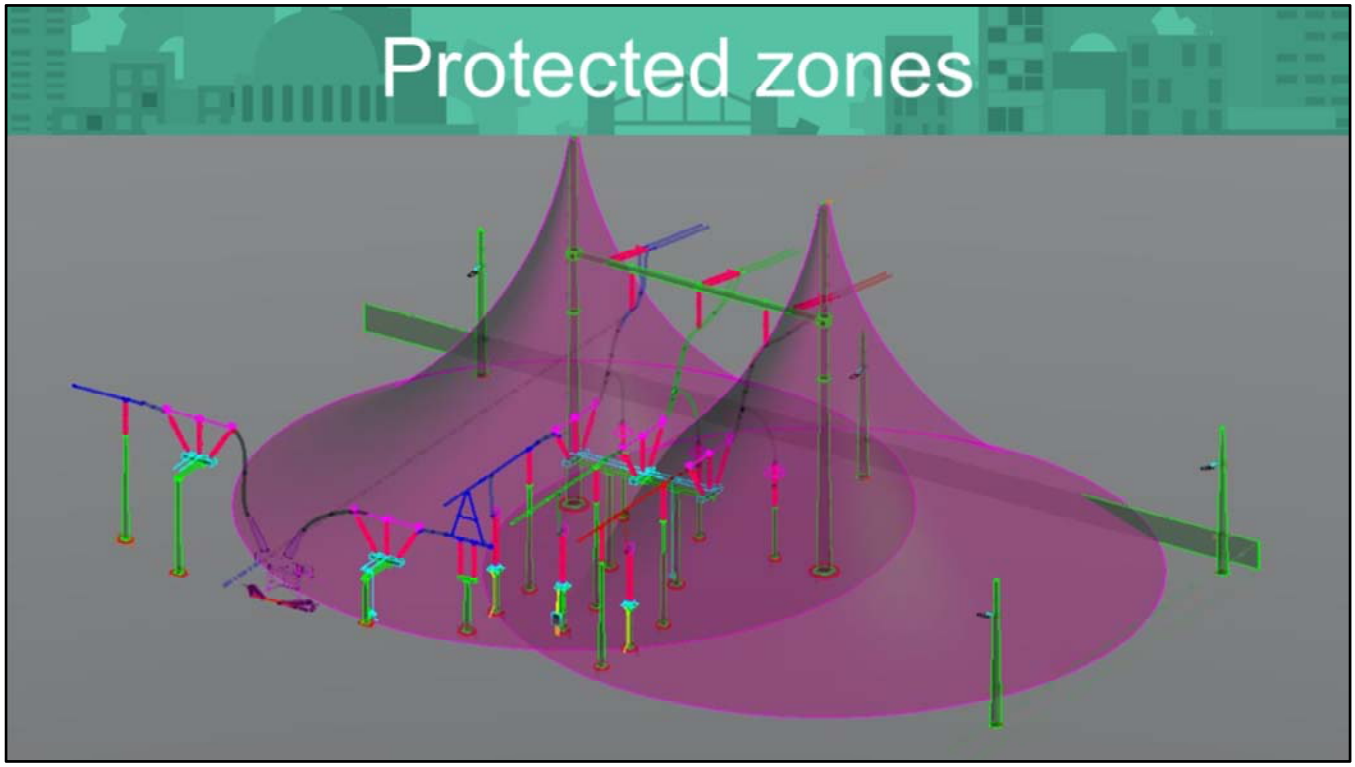
My STEM story:
The Dangers of Lightning: Substation equipment
One of the problems I continually need to solve is the protection against lightning for the substations I design. This photo is of a typical transmission level substation. The transformers in this substation are about two million dollars each and breakers are about three hundred thousand dollars each. The lightning masts outside of the normal box structures and dead ends are about ten thousand each. Far less in value for the protection they provide. It is important to protect this equipment but we still want to use as few resources as possible.

The Dangers of Lightning: Lightning Destroys
In this picture we see a lightning strike hit a live substation. This will surely damage equipment and cause power outages and decreased reliability to the system if not protected against correctly.

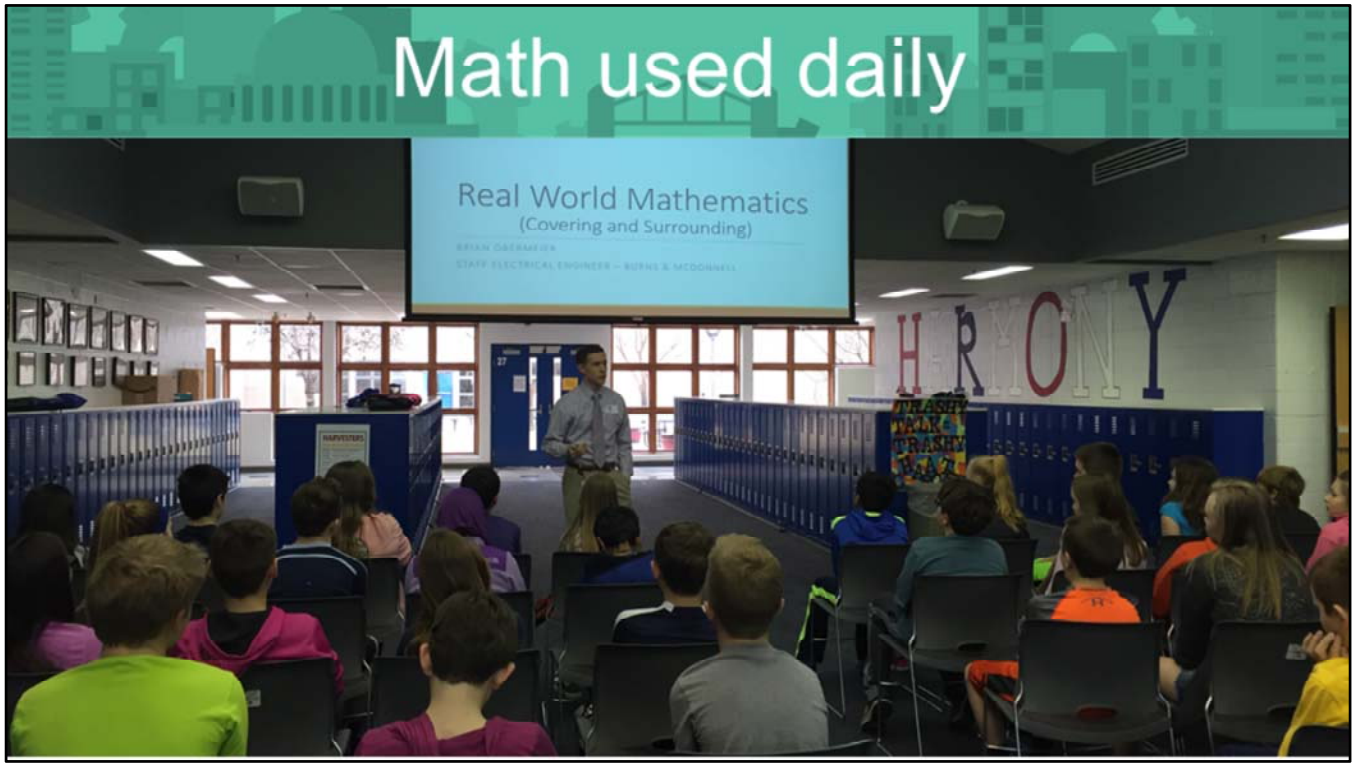


The Dangers of Lightning: Protecting Substations

The most basic way to protect against lightning is to use shield masts or "lightning masts" around the equipment needing protection. The first step we take is to represent the lightning as a sphere. The sphere is a geometric representation of how far the lightning can reach based on the voltage and basic impulse level of the substation needing protection. We will "roll" this sphere around the substation and what it cannot reach is protected.



The Dangers of Lightning: Protected Zones
Shown here is the area of the substation protected by the lightning masts. The cone represents the area the sphere cannot reach and thus the area of protection. Based on the height of the equipment we are trying to protect we can slice the cone and determine a circle or area of protection from each lightning mast.



It can be easily explained why we need basic math skills to an elementary student because everyone no matter what your job or situation is needs to have these skills to function efficiently in society. This would include addition, multiplication, basic problem solving and so on. It is also easy to explain the need for high school level classes for use in STEM careers. But sometimes it can be hard to explain the need for middle school math classes or at least some of the topics learned in middle school such as geometry. My seventh grade math teacher told me I was learning the topics in her class so I would be able to understand the topics in high school and to further my problem solving skills. While this wasn't false it wasn't the whole story. Today I used the math learned by sixth through eighth grade students on a weekly basis.

My advice to young students is to follow opportunities. There are so many jobs and opportunities within STEM that lead to real opportunities. Even within the STEM skill set of degrees or jobs follow opportunities not what you think is the "best path" Many times people pick one thing they want to do and get stuck trying to do that one thing and they miss a similar or even very different opportunity that can be a successful path. I want to be clear in saying you should still have passion but don't let it control the decisions you decide to make. During 2008 there was a high unemployment rate but many jobs available. Don't let learning a new skill or going down a different path scare you or hold you back. Mike Rowe visited a company that had twelve job openings for heavy machine operator starting at $50,000 and moving to $120,000 within a few years. The PR campaign for "Work smart not hard" is telling kids to go for college and not skilled STEM labor. There are about 8 million unemployed people in the United States and logic says this means there is a lack of 8 million jobs. But in reality there are 3 million jobs that people just don't want.

These following links show the interviews Mike Rowe has had about skilled labor and job opportunities:

Interview
Clip from interview
Discussion on Bill Maher
Ted Talk
Talking to Senate

STEM Stories Q&A

- **S**cience: Douglas Shaver
- **T**echnology: Tapsi Puri
- **E**ngineering: Preetica Kumar
- **M**ath: Brian Obermeier