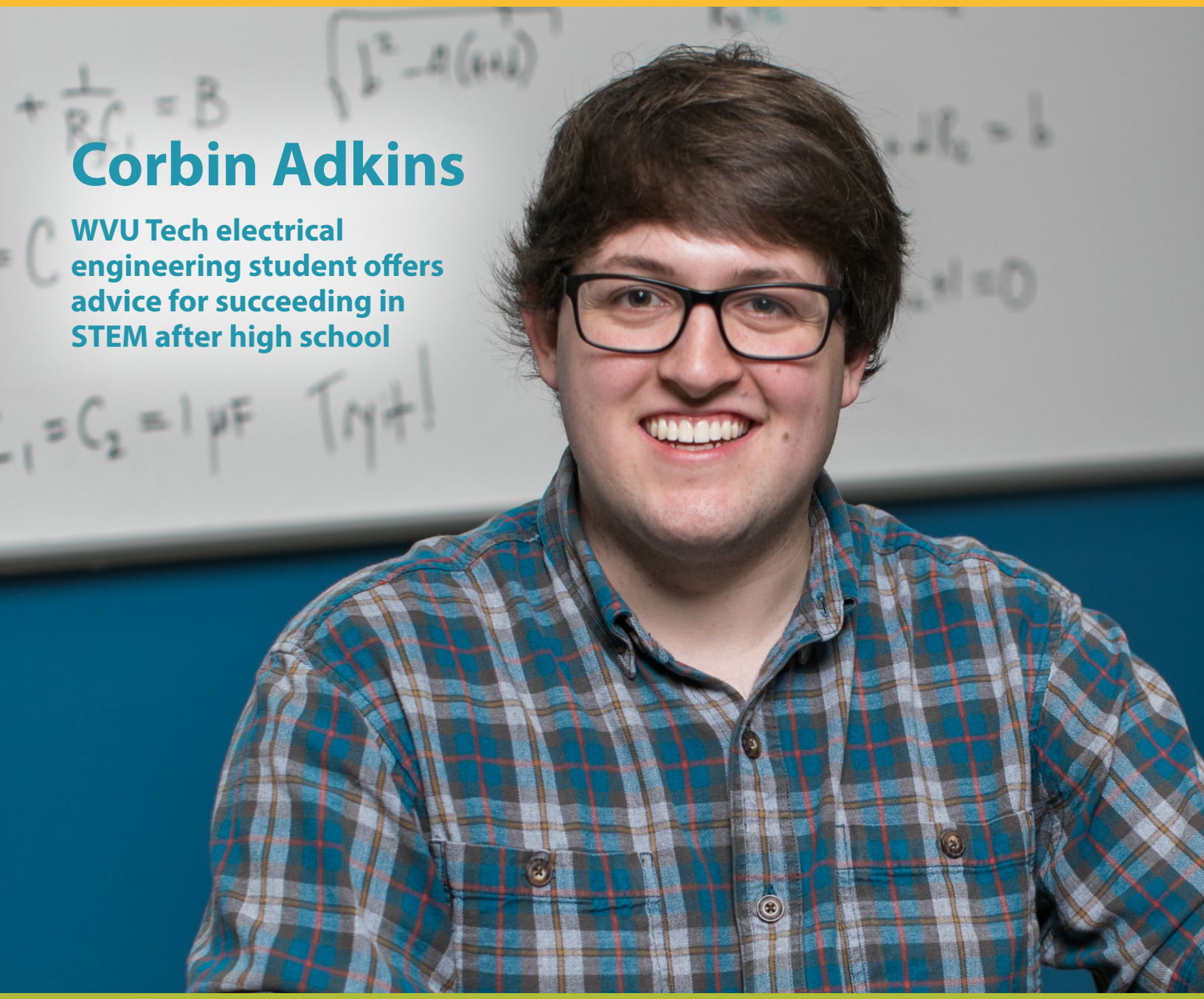
WEST VIRGINIA SCIENCE & RESEARCH FALL 2018

NEURITE

ENGINEERING

West Virginia's STEM Magazine for Students



Corbin Adkins

WVU Tech electrical engineering student offers advice for succeeding in STEM after high school

Notable Engineers Throughout History

West Virginia's Young Engineer Professionals

Engineering at National Youth Science Camp

Letter from the Editor

Let me introduce myself: I am the Neurite's new editor. This space is where I will highlight the features within each issue and provide a little insight into why I have chosen to curate the magazine in the way you'll find it in the following pages.

Before I began working with STEM disciplines, my education and training were rooted in the humanities and higher education. Why does this matter? Having exposure to various fields has helped me see myriad ways in which the arts and sciences work together, and I hope to bring attention to that in each edition of this magazine. Take even a quick look at Leonardo da Vinci's body of work and you can see this idea illuminated. We will actually do just that in this issue, and you will see how much art influenced his brilliant STEM-based ideas.

Beginning with this issue, we have reimagined and redesigned the look and content of the Neurite. What can you expect to find? Each edition begins by profiling a West Virginia college student who is majoring in a STEM field, typically one who's working on an interesting research project. Looking closely at what others are doing is inspiring, and the accompanying interviews allow us to have a little peek into what these students find challenging and rewarding, and sometimes they gift us with helpful advice. In this issue, you will get to know Corbin Adkins, an electrical engineering major from WVU Tech who recently embarked on an exciting new career.

The Neurite also presents useful information about STEM majors and careers, gives you a look at individuals working in the field, shares recent activities taking place throughout West Virginia, and provides educational activities that work for those reading in the classroom and at home. Ultimately, our goal is to provide content that is both entertaining and informative, and is accessible for middle and high school students.

I'm excited to share this issue with you. I hope you enjoy it, and please let us know if there are topics you would like to see covered in future editions. We really want to hear your feedback. Having this information will help us shape the content of future issues and ensure that the information we provide to our readers is as useful as possible.

Brandi

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West Virginia Science & Research

FALL 2018

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ABOUT
West Virginia Science & Research, a division of the West Virginia Higher Education Policy Commission, provides strategic leadership for the development of competitive academic research opportunities in science, technology, engineering and mathematics. The office directs the National Science Foundation's Established Program to Stimulate Competitive Research (EPSCoR) in West Virginia, coordinates scientific research grants to academic institutions from federal and state agencies, and conducts outreach activities to broaden the public's understanding of science.

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Photo: Chris Jackson Photography

Adkins working on an engineering project

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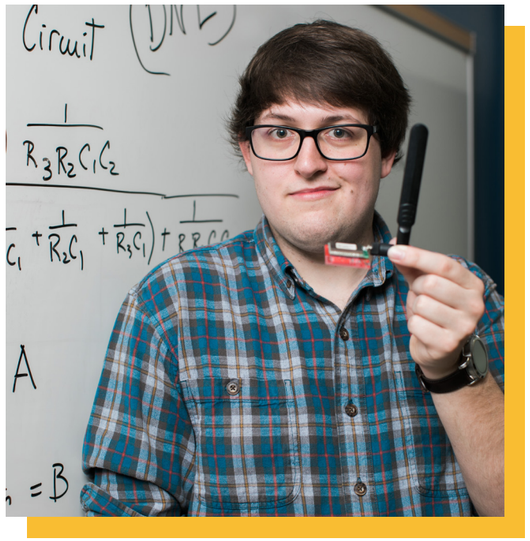


Corbin Adkins
Lewisburg, W.Va.

Electrical Engineering Student
West Virginia University Institute of Technology

Q: What inspired you to study engineering?

A: I've done electronics as a hobby since I was a little kid. Around seven or eight years old, I started building circuits. I learned how to program when I was ten - I wasn't very good at it, but I knew how to make things work, and that was enough for me. I asked my dad to type things for me because I couldn't type very well at the time, and it took me forever to write code. So, I enlisted his help to get it done faster. I hadn't really used a computer much until then.

I have always liked to build and take things apart, try to figure out how stuff works. I originally found a little toy kit that came with two resistors and an LED, really basic components, and I thought, "This is awesome! I can make this do all of these different things. Soon after, I was asking my parents, 'Hey, can I have some more of these?'"

Q: When did you decide to go into engineering?

A: I've known I wanted to be in this field forever. Before college, I was mostly self-taught, but I knew the practical stuff; I didn't know the theoretical at all. For example, I couldn't make a voltage divider, which is the simplest of circuits. I was able to estimate how a circuit would work, put it together to test it, and change it to make it work, but being at Tech has taught me so much and filled in all of the knowledge gaps.

Q: How did you choose WVU Tech?

A: I actually didn't begin here. After high school, I went to the University of Illinois Urbana-Champaign for two years. Honestly, it was an incredibly brutal experience. Being ranked as the 6th best engineering program in the country creates an entirely different dynamic. Participating in groups was difficult. For example, their Institute of Electrical and Electronics Engineers (IEEE) group had close to 500 students. It was hard to have access to professors because of the large class sizes, and I would also have to go through multiple teaching assistants to gather information. Ultimately, it was really hard to get help and get involved there.

I knew about WVU Tech's reputable engineering program from a family member and other people who had gone here. Eventually, I transferred. I really value the smaller class sizes, and the ability to talk directly with my professors and get great feedback. I'm not just a number here. I also learned to study better here. I didn't have to study too much in high school to do well, so I wasn't prepared for what the demands that college would bring.

Photo: Chris Jackson Photography

"I think people sell STEM wrong... I still don't like the pure math classes, but once I was learning how to apply it to engineering, that's when it became interesting."

I've been really successful here at Tech, and I've managed to be involved in student groups and was even hand selected to work on the Connected Vehicle Project. It's been great!

Q: Can you tell us more about the Connected Vehicle Project?

A: The general idea is to create a network of vehicles that share their GPS location data with each other. This self-sustaining mesh network is capable of providing information about the location and speed of nearby vehicles for navigation assistance and collision avoidance in self-driving and assisted-driving vehicles. For example, if this technology is used in a smart car or assisted-driving vehicle, it can easily spot a blind turn, or determine that there's a car speeding through an intersection where a building is obstructing the visibility. This system can then radio those GPS coordinates and also determine speeds to decide if the vehicle needs to slow down. This gives a little more specific advancement than the technology that already exists.

Although it is intended to work in vehicles, I have made it so it can be put in any circuit and have a node that can determine the location of all other nodes. Ideally, I think it would be great for drone networks.

Q: What do you enjoy most as an engineering major?

A: I love research! Working on the Connected Vehicle Project was great, and I was able to see other ways in which the technology could be useful. For example, I used the same premise for my senior design project. I created a smart home system that logs the current draw of a home so the owner can shut things off that use too much power while they're sitting still. For example, at night, you can shut down the power to your cable box - something that just sits there and gets hot without doing anything.

Q: What do you plan on doing with your degree?

A: Actually, I recently accepted a position with the Lincoln Electric Company in Euclid, Ohio (a Cleveland suburb). I will be working through their engineering development program, slated to work in the Research and Development department after training is complete. The R&D department was most interested in my embedded design work.

Q: Do you think we need to do a better job prepping kids for STEM fields at younger ages, say middle school and earlier?

A: I think having those opportunities available would be great. I, personally, lacked those types of resources. If I had those resources as a kid, things would have gone smoother.

For example, now high schools are putting in fab labs. If more middle school students had access to those types of spaces, they could explore so many things. I think middle school is probably prime for generating more interest in STEM because students have the ability to actually do and understand things at that age.

Also, I think people sell STEM wrong, particularly to high school students. They often sell it via math, which is intimidating. I didn't like math - well, hard math - and I still don't like the pure math classes, but once I was learning how to apply it to engineering, that's when it became interesting. My minor is actually math.

Q: What advice do you have for Neurite readers?

A: Once you begin college, definitely utilize the resources available to you on campus, and get to know your professors. If you're having difficulties, seek help. Don't struggle silently while assuming the curriculum is above your comprehension.

Get involved in student groups. If you're in electrical or computer engineering, I highly recommend the IEEE. That is THE place to be. You learn things in these types of groups, meet like-minded people, and participate in many resume-building activities. It's also an opportunity for community service and outreach.

Engineering Majors

AEROSPACE: Design aircraft, spacecraft, satellites, missiles, and systems for national defense; Aerospace Engineers also test prototypes to make sure they function according to design.

COMPUTER: Embed computers in other machines and systems, build networks to transfer data, and make computers faster, smaller, and more capable.

AGRICULTURAL: Develop and design new procedures, tools, and systems for agricultural products and environments; Agricultural Engineers often work to solve environmental issues pertaining to agriculture, or they may specialize in bioprocess technology

ELECTRICAL: Design, develop, test, and supervise the manufacturing of electrical equipment, such as electric motors, radar and navigation systems, communications systems, and power generation equipment

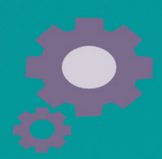
ARCHITECTURAL: Apply engineering principles and technology to building design and construction; Architectural engineers work together with architects and civil engineers, but are unique in both their skills and role as part of the building design team

ENVIRONMENTAL: Design, develop, test, and supervise the manufacturing of electrical equipment, such as electric motors, radar and navigation systems, communications systems, and power generation equipment

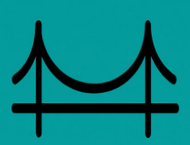
BIO/BIOMEDICAL: Work with doctors, therapists, and researchers to develop systems, equipment, and devices in order to solve clinical problems

INDUSTRIAL: Improve systematic processes through the use of statistical analysis, interpersonal communication, design, planning, quality control, operations management, computer simulation, and problem solving

CHEMICAL: Apply the principles of chemistry, biology, physics, and math to solve problems that involve the production or use of chemicals, fuel, drugs, food, and many other products



MECHANICAL: Design, develop, build, and test mechanical and thermal sensors and devices, including tools, engines, and machines



CIVIL ENGINEERING: Design and supervise the construction of building projects, such as roads, bridges, canals, or dams

SOFTWARE: Design, develop, test, and evaluate the software and systems that enable computers to perform their many applications

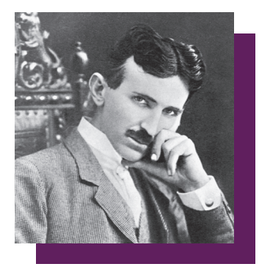
Notable engineers throughout history

Archimedes *(c. 287 – c. 212 BC)* While many of the details of his life are unknown, Archimedes is regarded as one of the leading scientists of classical antiquity. His ideas have influenced math, physics, engineering, and astronomy, among other fields. Much of his engineering work derived from his desire to create various defense mechanisms for the island of Syracuse where he lived, including: the Archimedes' Screw (which was originally used for irrigation and for pumping out ships, but is still used today to propel bulk materials), the heat ray (which used mirrors to create a parabolic reflector to burn ships attacking the island), and the Claw of Archimedes (a weapon with a crane-like arm and hook that dropped onto attacking ships in order to immobilize or sink them).

Isambard Kingdom Brunel *(1806 – 1859)* An English mechanical and civil engineer, Brunel was responsible for the design of tunnels, bridges, ships, and railway lines, and is considered one of the greatest British engineers of the 19th century and the Industrial Revolution. Brunel's designs revolutionized public transport and modern engineering. He worked with his father in planning the Thames tunnel, created the designs for the Clifton Suspension Bridge across the River Avon, and constructed a network of tunnels, bridges, and viaducts for the Great Western Railway.

Lillian Gilbreth *(1878 – 1972)* Originally interested in English Literature, and receiving two degrees in the field, Gilbreth earned a Ph.D. in applied psychology, which made her the first pioneer of industrial management to have a doctorate. Eventually labeled the "Mother of Modern Management," Gilbreth became the first female professor at Purdue University's engineering school, the first woman elected to the National Academy of Engineering, and the second woman to join the American Society of Mechanical Engineers. She also worked to improve the design of kitchens and household appliances, all while raising her 12 children. The book *Cheaper by the Dozen* is the story of Gilbreth and her family.

Mary G. Ross *(1908 – 2008)* Born in Park Hill, Oklahoma, Mary G. Ross was the first-known Native American female engineer and the great-great granddaughter of renowned Cherokee Chief John Ross. She earned a bachelor's degree in mathematics, and later received her master's degree from the University of Northern Colorado. Ross taught math and science in rural Oklahoma schools for nearly a decade before moving to California and working as a mathematician for Lockheed in 1942. Here, she worked with engineers conducting pioneering research that launched the space race, and became one of the 40 engineers who made up the secret Lockheed Skunk Works.



Nikola Tesla *(1856 – 1943)* Nikola Tesla was a Serbian-American inventor, electrical engineer, mechanical engineer, and physicist. Tesla received an advanced education in engineering and physics in the 1870s and gained practical experience in the early 1880s working in the new electric power industry before immigrating to New York City. Tesla spoke eight languages, produced the first motor that ran on AC current, held over 300 patents, and developed wireless communication technology.

West Virginia's young engineers

Amy Haddix

Where is your hometown? Elkins, W.Va.

What was your college major? B.S. Chemical Engineering from WVU Institute of Technology

Where do you work? Dow Chemical Company

What is your job title, and what do you do? Production Engineer. I am responsible for producing quality products on time to meet customer demands and specifications.

Where do you live now? St. Albans, W.Va.

What inspired you to choose your major? I was interested in math and fell in love with chemistry thanks to my high school teacher. In college, I received a summer internship at Dow Chemical. This motivated me to continue my education so I could do this full time.

What do you love about your career? Making a positive impact. The work is ever-changing.

Is there anything else you would like readers to know about you? I have one dog and two cats. I enjoy spending time with my fiancé, sightseeing, and experiencing West Virginia's many wonders.

Katie Smith

Where is your hometown? Ottawa, W.Va. in Boone County

What was your college major? I had a dual major: Electrical and Computer Engineering from WVU Institute of Technology

Where do you work? American Electric Power

What is your job title, and what do you do? I am a Distribution Engineer, which means I design local power systems.

Where do you live now? Hurricane, W.Va.

What inspired you to choose your major? My love for learning and science.

What do you love about your career? I love being able to improve the reliability for customers in the area where I grew up.

Is there anything else you would like readers to know about you? I have one rescue dog named Ellie. I also love to bake, garden, and travel with my friends and family.

Meet the graduates building careers

Keisha Burns

Where is your hometown? Morgantown, W.Va.

What was your college major? Computer Information Technology from Shepherd University

Where do you work? BES Technology Inc.

What is your job title, and what do you do? Junior Systems Engineer. I am responsible for environment and infrastructure for two mobile apps, one of which goes live in the next year.

Where do you live now? Hedgesville, W.Va.

What inspired you to choose your major? I have been interested in science and technology since I was a little girl. I wanted to get into a field that would allow me to pursue my passions both analytically and creatively.

What do you love about your career? Facing new challenges and learning from them. It's like constantly solving a puzzle. I also love working with a diverse team.

Is there anything else you would like readers to know about you? I also have a degree in art. I truly believe engineers are artists at their core. We both create and push boundaries to advance our fields. There isn't just one type of person that can get into STEM.

Lucas Gardner

Where is your hometown? Oak Hill, W.Va.

What was your college major? Civil Engineering Technology from Fairmont State University

Where do you work? Civil & Environmental Consultants, Inc. (CEC)

What is your job title, and what do you do? Project Consultant. I'm a designer in the civil/site practice, creating construction plans for site development.

Where do you live now? Fairmont, W.Va.

What inspired you to choose your major? Two of my favorite things as a kid were drawing and LEGOs. I chose civil engineering because of the range of design disciplines and jobs in West Virginia.

What you love about your career? I love coming up with ideas for things that currently do not exist, knowing they will be built based on decisions I make.

Is there anything else you would like readers to know about you? I've been married for about two and a half years. I think God is the most valuable thing in the world. I also enjoy sports, biking, and board games.

National Youth Science Camp 2018
A look at the engineering project outcomes

The National Youth Science Foundation (NYSF) - a Charleston, West Virginia-based nonprofit that recently celebrated its 55th anniversary - selects two recent high school graduates as delegates from each state, as well as several international delegates, to attend its National Youth Science Camp (NYSC) that is held each summer in Pocahontas County, West Virginia free of cost.

NYSC offers three and half weeks of outdoor adventures and advanced science education to promising young people interested in careers in science, technology, engineering, and mathematics. At the NYSC this summer, recent high school graduates learned how engineers design solutions to problems. In directed studies, they learned how motor vehicle companies make vehicles based on user driving habits and about solar energy systems, which can decrease reliance on environmentally-harmful fossil fuels.

Check out the photographs below for a look at engineering activities from the 2018 NYSC.

NYSC delegates participate in a directed study on solar energy where they bake cookies in a solar oven. Shantanu Kadam, a delegate from Alabama, said it was eye-opening to learn how to install a solar panel. "A lot of times in class, you're taught this is a theory, but you never see it applied," said Kadam. "I think I could actually do that now. It made the idea so much more tangible, which is really valuable."

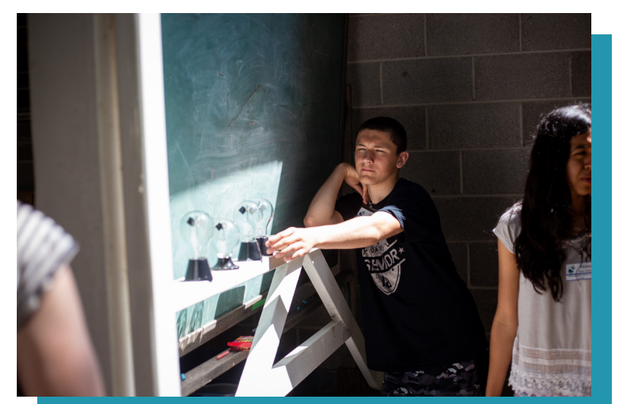
Jeff Gilbert (standing in white and khaki at right) leads the directed study on solar energy. He has over 23 years of experience in the renewable energy industry and is currently owner and president of Azimuth Solar, LLC.

Will Dickson (not pictured) of General Motors taught delegates steps to guide design and innovation when engineering products, including identifying problems and designing solutions.

Reeny Botros (far left), a delegate from Kansas who plans to study computer science, said several delegates noted they fell asleep during long car rides, so they pitched an idea to make vehicle seating more easily converted into sleeping areas. "It was eye-opening to learn about how much goes into the car-building process," she said. "I thought it was just a bunch of geniuses in suits."

Paula Pérez Bianchi (pictured writing on the chalkboard) also participated in the General Motors directed study. "It was inspiring for us," she said. "It was useful for me because right now I'm developing a robot and I don't have any help."

Bianchi, a delegate from Argentina, had no electronic or coding experience, but had been watching tutorials and working on the project since September. She was watching her father water plants one day, and it occurred to her that her country, which is heavily reliant on agriculture, could benefit from the assistance of robots.

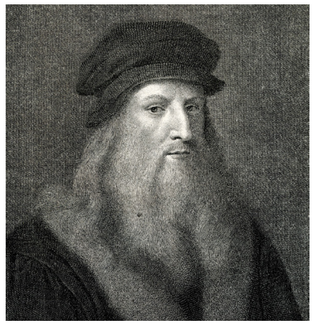


Paul Allmendinger (pictured), a delegate from Alaska, contemplates the physics behind the rotation of radiometer vanes in sunlight.

As a child, Allmendinger wanted to become a police officer. "I just liked the idea of being able to help people," he said. Later, he decided a career in engineering could offer more security to his family. At camp, Allmendinger saw engineering principles used in topics ranging from robotics to cybersecurity. He realized engineering could help people, too. "It brought back that feeling," he said. "It could help people on a bigger scale. It reminded me that I'm still able to help people."

For more information about the National Youth Science Foundation or the annual camp, visit nysf.com.

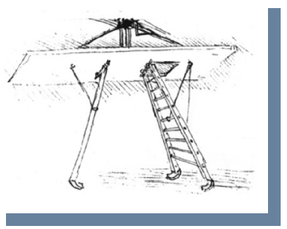
Putting the 'A' in STEAM
Leonardo da Vinci



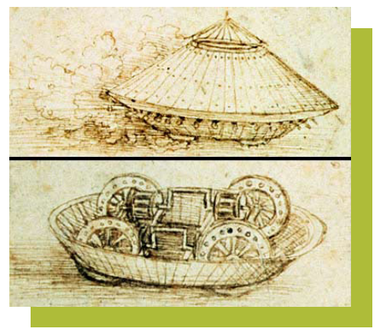
Of course you recognize the name Leonardo da Vinci *(1452 – 1519)* as the artist who created "The Last Supper" and "Mona Lisa," but what you may not realize is that he was a self-taught engineer. He was also an inventor, architect, and anatomist. Da Vinci's work was groundbreaking for its time and inspired many modern inventions, including the helicopter, parachute, tank, simple ball bearing, portable bridges, the spring drive, and double hull for ships. Da Vinci also diagramed the human body's internal organs, muscles, and bones more thoroughly than his predecessors. He applied the scientific method to many aspects of life, including art and music.

Take a look at the following da Vinci drawings to determine the invention[i]:

A. fan B. umbrella C. teepee D. helicopter



A. slide B. escape hatch C. landing gear D. tree house



A. carousel B. tank C. tent D. car

Answers on back cover

While living in Milan, Italy, da Vinci worked for Ludovico Sforza (Duke of Milan) and developed an interest in anatomy. In 1489, da Vinci began working on anatomical drawings, starting with the skull, but realized he lacked access to the medical corpses he would need in order to create more. Around 1527, physician and historian Paolo Giovio wrote a short biography of da Vinci, and noted that "he dissected the corpses of criminals in the medical schools, indifferent to this inhuman and disgusting work. He then tabulated all the different parts down to the smallest veins and the composition of the bones with extreme accuracy."[ii] Da Vinci later returned to the notebook where he first produced the skull drawing, and eventually created what is now known as *Anatomical Manuscript B*, which is kept at the Royal Library at Windsor Castle in England.

He later compiled *Anatomical Manuscript A*, which features more than 240 individual medical drawings and is also held in the Royal Collection. Although we recognize da Vinci as a painter, the reality is that he likely produced no more than 20 paintings (only 15 of which have been authenticated). Da Vinci is an example of an incredibly skilled anatomist who could also draw, or a great artist who could dissect anatomical structures.

i. Museum of Science, Boston. (2018). Activity: Inventions Quiz. Retrieved from https://www.mos.org/leonardo/activities/inventions-quiz; ii. Richter, J.P. (1939). The Literary Works of Leonardo da Vinci. London: Oxford.

Featured College Major
Biomedical engineering

What is biomedical engineering?
Biomedical engineers combine engineering principles with biological knowledge to design and create equipment, devices, computer systems, and software used in healthcare. Biomedical engineers work to understand how these areas intersect and how they can be used together to improve quality of life.

How is biomedical engineering different from biomechanical engineering?
It's not just that the names look somewhat similar, biomechanical engineering is often considered a subset of biomedical engineering. Typically, biomedical engineering programs give students a broad background in areas of biomechanics, biomaterials, and biomedical imaging.

What classes do biomedical engineering students take?
Biomedical engineering curriculum is designed to provide a solid foundation in mathematics, life and physical sciences, and engineering. Sufficient flexibility in the upper division requirements encourages students to explore specializations within the field, through the thoughtful selection of engineering and science electives.

What can you do with a major in biomedical engineering?
A biomedical engineering degree can prepare you for work in a multitude of fields, including: software and hardware engineering, medical device industry, innovative design and development, research and development, manufacturing, equipment testing and field servicing, clinical patient evaluation, technical documentation, hospital equipment selection and support, undergraduate preparation for medicine, dentistry, or law.

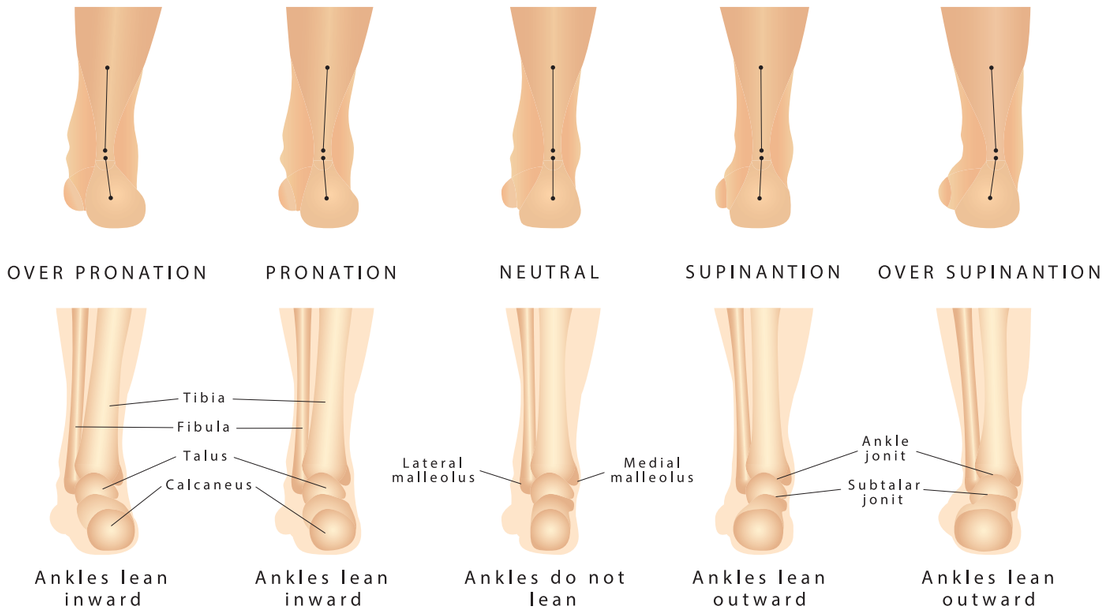
What's the work environment like?
Most biomedical engineers work in manufacturing, universities, hospitals, and research facilities of companies and educational and medical institutions.

How can one become a biomedical engineer?
Biomedical engineers typically need a bachelor's degree in biomedical engineering or bioengineering, or in a related engineering field. Some positions may require a graduate degree.

2017 Median Pay	$88,040 per year
Typical Entry-Level Education	Bachelor's
Work Experience	None
On-the-job Training	None
Number of jobs, 2016	21,300
Job outlook, 2016-2026	7 percent
Employment Change, 2016-2026	1,500

From Bureau of Labor Statistics. For more information, visit: www.bls.gov/.

Shoes and engineering activity



The activity for this edition of the Neurite is, of course, about engineering, too. Have you ever wondered what goes into the construction of the shoes we wear, particularly specialty shoes, like those for running or for individuals with foot and ankle conditions? Let's explore this idea before delving into our activity.

Visit any specialty running and walking store, and you will likely find a staff of shoe experts - people who have been trained to analyze your gait and provide a custom fit for your particular running or walking shoe needs. The staff will watch you walk or run to determine your foot and arch shape, along with other biomechanics.

What might you discover when looking for your new running or walking shoes at the specialty store? Likely, you will hear one of these three words related to how your foot strikes the ground when you step: pronation, supination, or neutral. But, what does that mean?

Pronation is a movement of the foot that happens when heel rotates away from the center of the foot and the interior ankle rolls toward the center. Often, people who regularly over-pronate appear "flat-footed."

Supination is when the ankle rolls way from the center of the foot and the heel simultaneously turns toward the center.

Neutral is when the foot strikes neutrally and neither pronates or supinates. This type of gate causes the least amount of injuries and is ideal because it leads to less wear and tear.

So, now you might be wondering what this has to do with engineering. Engineers - often mechanical, biomechanical, and biomedical engineers - play a vital role in the design mechanics behind running shoes. Engineers transfer knowledge into actionable ideas and products. Check out the activity below to do a basic assessment of your own gait using the information you just learned.

What you'll need:

- A pan/tray, one big enough to fit your foot
- Water pitcher or small bucket
- Water
- Dark *(not black)* paper, ideally, a brown paper bag or construction paper
- Pen or pencil
- Scissors *(optional)*

Directions *(read all directions before beginning)*:

1. Place your pan/tray on the floor
2. Use the pitcher to fill the pan or tray with water. Make sure you fill it with enough to cover the entire bottom of your foot with water when you step in.
3. Place the dark paper in front of the tray of water.
4. Stand with one foot on the side of the tray of water, and step your other foot into the water.
5. With your foot still in the water, step your opposite foot (the dry one) forward, parallel with the side of the paper.
6. Now, bring the foot that is in the water forward and step (as you normally would) onto the paper like you were walking. Then, step off of the paper.
7. You should see the outline of your step. Use a pen or pencil to carefully trace your foot shape before it dries.
8. *Optional:* You can cut the shape out of the paper. This is especially useful for comparison and display purposes if this activity is done in a classroom setting.
9. Assess your footprint. Compare it to the footprint of your classmates, friends, or family members.

Pronation. Most of the bottom of the foot is visible and looks like a flat foot.

Supination. Much of the foot appears to be missing, and mainly just outside edge

Neutral. Gait will appear well balanced. There isn't enough footprint to appear entirely flat, and there also isn't much footprint missing.

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DA VINCI ANSWERS: *1. D. helicopter* - Two people needed to run on the lower level, which would create a rotation forcing the upper "fans" to rotate, lifting the helicopter off the ground. *2. C. landing gear* – The landing gear was featured below the helicopter and consists of a prop and ladder, both of which were retractable. *3. B. tank* - The upper image depicts the tank firing. There were multiple cannons arranged around the tank. The lower image shows the bottom of the tank. Four people would work the wheels in order to move the tank.

The Chancellor's

STEM SPEAKER SERIES

at the Culture Center in Charleston

Emily Calandrelli
Engineer. West Virginia native.
Thursday, March 14

Hakeem Oluseyi
Astrophysicist. Science educator.
Thursday, June 27

For more information, visit **westvirginiaresearch.org**, email us at **info@wvresearch.org**, or call at **304-558-4128**.