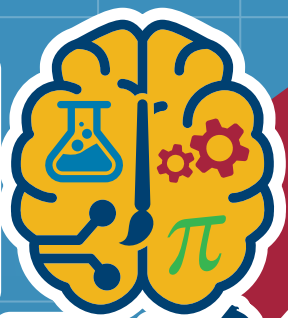
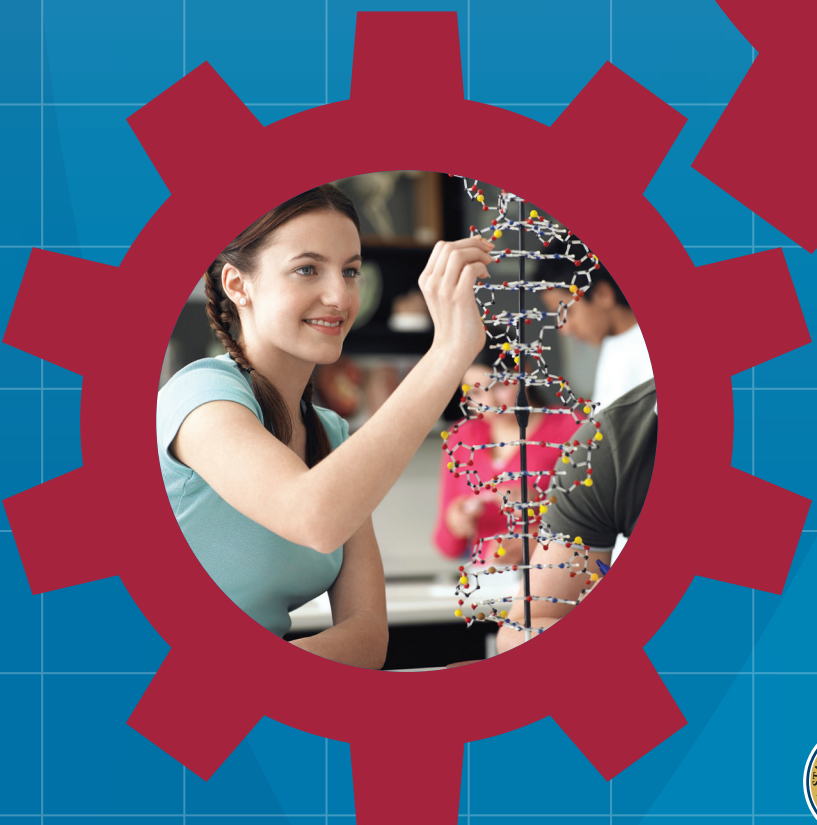


STEAM MIND^{ED} WV



STEM & STEAM COMPANION BOOK FOR FAMILIES:
Your Questions Answered



West Virginia DEPARTMENT OF
EDUCATION

WELCOME

The Companion Book is for all families who believe that children and teens deserve the best future. You want to guide them through educational decisions, and this companion will support you. This companion answers the questions parents often ask regarding STEM and STEAM in WV, and the best ways to support students in STEM and STEAM. STEM, by design, is intended to be a transdisciplinary endeavor, including the traditional STEM disciplines (Science, Technology, Engineering, and Math), as well as the arts (A) and the humanities. Throughout this companion, the acronyms STEM and STEAM are used interchangeably, unless they are specifically referenced.

The answers in this companion are designed to be brief and user friendly with a focus on regional information, national statistics, and meaningful research. Links are provided to online resources if you want more information. There is a lot of information in this companion, so skip to the questions that interest you, listed in the table of contents. Please use this as a resource - do not feel you have to read it all at once.

STEM and STEAM have the power to grow children into problem solvers and critical thinkers and grab their interest with the joy of being hands-on. If you are a big STEM or STEAM fan already, great! If not, we hope this guide sparks your interest.

As the greatest influence on your child, you can open the world to your child with these simple steps:

1. Talk to your child about STEM and STEAM;
2. Encourage your child in STEM and STEAM classes at school; and
3. Expose your child to STEM and STEAM activities outside of school.

If you have additional questions or feedback, please visit us at wvde.us/steammindedwv.

We thank you for your interest,

West Virginia Department of Education

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WELCOME

Hello, my name is Tommy Mastracci, and I am the mother of five children. One of my children is currently an eighth grader in a STEM program. Being in a STEM program throughout middle school has helped my daughter with her thinking skills, problem solving, and her leadership abilities. As someone who also enjoys arts, being in STEM has helped my daughter see that the fields of science, technology, engineering, and math are certainly not boring. These fields require creative and flexible thinking to solve any problem she is presented. STEM has also encouraged her to become reflective in her thinking. She no longer accepts failure but examines why and how the failure occurred and ultimately how to solve the problem next time.



Being part of a STEM team has helped my daughter express herself in a new outlet while taking into consideration the ideas of her teammates. Experimenting with ideas from her teammates, even when she thought they might not work, taught her to collaborate better with others.

She has learned to deal with compromise and experimenting with ideas from her teammates she did not always think would work. Some of the best ideas from her team were a result of a compromise.

STEM education has been worth the time and effort my daughter has put into the program. Even if she ultimately does not choose a STEM field for a career, she has learned so much as a result of being in STEM education during her middle school years. Through taking STEM, my daughter has gained skills and made connections in her thinking that I don't believe she would have learned elsewhere.

Regards,

Tommy Mastracci

PARENT TIPS

1 START with your child's teacher first, then your county school district, to uncover all the STEM enrichment to interest your child. Use the wvde.us/stemindedwv website.

2 SUPPORT your child's natural exploration. Parents have to be willing learners to have a conversation. It doesn't have to be high level; point out a bug you see, ask where they think the bug lives, and count its legs and wings.

3 FIND a tutor if your child is overwhelmed, don't wait.

4 ENCOURAGE them to play an instrument. By counting whole, half, quarter, eighth and sixteenth notes, they learn fractions and how to add different denominators. Music provides several math applications.

5 FOCUS on developing a growth mindset in your child. Let them know that challenges and mistakes are valuable parts of this process.

6 ENCOURAGE them to believe in themselves. Depth is more important than speed. Faster is not smarter. Mathematicians often think very slowly, yet deeply.



MAPPING MATH Before High School

> Grades **K-2**

Develop Foundations of Learning Basic Facts;
Build Fluency in Addition and Subtraction.

> Grades **3-5**

Extend Number Sense to Fractions; Build Understanding
in Operations of Whole Numbers, Decimals and Fractions.

> Grades **6-12**

Apply Proportional and Algebraic Reasoning;
Build Fluency in Operations with Rational Numbers

01 MASTERING STEM BASICS



JENNIFER'S STORY

*Jennifer Schwertfeger
2020 West Virginia Teacher of the Year*

As you step into her classroom, curious, wide eyes stare at beakers filled with water and bright green leaves. A sense of amazement flows over the novice scientists as bubbles start to rise shortly after bright lights are turned on. Comments and questions are shouted out and resonate through the lab. The sense of wonder comes alive. “I believe all students, regardless of academic ability level, background knowledge, or learning challenges deserve to experience science as discovery. STEM curriculum makes science and math content relatable, especially those who struggle with processing ideas, following instructions, and maintaining focus”, states Jennifer Schwertfeger, STEM educator and West Virginia 2020 Teacher of the Year. “This is what teaching science is all about!”

Schwertfeger began her career in education at the age of forty following years of experience as a medical assistant in the field of Ophthalmology. Teaching was definitely not in her plans, but as her children reached their busy teen years, she was looking for a career change that would offer enough flexibility to continue active parent involvement in their school events, but would also make good use of her education and work experience. “Working in a medical practice requiring face to face patient interaction is very similar to teaching. Relationships are built as a sense of trust and familiarity develops over the years.” A close teacher friend had the insight to recognize she had the potential to become a good educator. Following some research and a few phone calls, Schwertfeger enrolled in the Master’s in Secondary Education program at West Virginia University. She has been employed by Marshall County Schools since her graduation in 2007.

Schwertfeger related she had serious doubts about her ability to stand before a group of teenagers and get them excited about science. After many failed lessons, it became evident traditional methods of science content delivery led to superficial student understanding. “My lessons were not engaging or exciting, just a repeated cycle of note taking, complex vocabulary terms to study, followed by a summative test. “Good” students were the best memorizers,

but when I would ask a question about a previously covered topic; no response, no retention. There had to be a better way.”

She started developing lessons where the experience came first incorporating research on whole brain teaching and learning with emphasis on physical movement, artwork, music, and creative writing. “I realized not all methods work well for all students. Differentiated instruction and formative assessments became natural practices within my lesson planning. With some creativity and practice, I was able to offer challenging, problem-based learning experiences to all students by providing multiple pathways to learning and comprehension sparking interest and inquiry.” She discovered that encouraging students to use their talents to design and engineer experiments empowers them to seek new problems to solve and questions to answer. This links science lessons in the classroom to the nature of science in the outside world. The meaningful lessons and experiences that take place in modern science classrooms can inspire students to consider their personal contributions by becoming proactive citizen scientists. She testified, “In my classroom on any given day, if students can describe a problem they are trying to solve, then I know my lesson is on the right track.”

By providing limited guidance and assistance with materials, her time is primarily focused on asking probing questions to challenge students to consider misconceptions, think

through possible errors, and correlate their data results to expectations. This type of lesson design reinforces deep teacher content knowledge which can be passed onto students in creative ways. “I like to have students complete formative tasks that are totally new to them; activities they have not performed in any other class. I love to watch students

create products or models from a pile of scrap craft supplies. I encourage them to use technology available on their cell phones to creatively express mastery of content.”

Schwertfeger believes STEM is the keystone to building a bridge into our future. This curriculum at all grade levels can be one workable solution to the many issues our youth face. By providing STEM curriculum to our West Virginia students, we can equip them with skills and qualifications needed to fulfill future workforce demands. It is a pathway to provide jobs, improve our economy, and give students a sense of hope for their future with a chance to live and prosper in our state as new technology-based employment opportunities arise.

Finally, Mrs. Schwertfeger shared her mother’s favorite phrase, “Always do a little bit more than what is expected of you.” As a successful teacher, she has applied this practice to all aspects of her professional life. “I have discovered the best teachers seem to instinctively follow these words, even if they have not heard them directly. I feel that drive within myself as I keep pushing forward,



keep learning, and keep improving to do the best job possible for my students.” She credits dedicated mentor teachers and administrators who shared good advice, constructive criticism, and positive feedback along the way. Of all her accomplishments, she is most proud to hear from former students. “It feels good when they share their successes. They recognize how well prepared they were as current classmates or coworkers turn to them for assistance. They thank me for giving them a challenging experience, building their confidence, and having high expectations for their success.”

Q WHAT IS STEM ANYWAY?

STEM is an acronym for the transdisciplinary integration of the four disciplines of Science, Technology, Engineering, and Mathematics. STEM education places a priority on the study of science and math with purposeful integration of technology and the engineering design process. STEM education is an opportunity for students to collaboratively solve engaging and relevant problems using innovation and creativity. The engineering design process allows students to identify problems, design possible solutions, and test and evaluate those solutions until the best solution is discovered. STEM in the classroom engages students in real-world situations and allows students to experience solution finding for problems that are relevant to the world in which they live.

STEM challenges students with projects, concrete knowledge and experience. STEM is hands-on, mind-on and feeds natural student curiosity when they are most ready to learn. STEM is also known as STEMM (STEM + Medicine) or STEAM (STEM +Arts). Medicine is a science combining technology, bio-engineering and math. The arts include design, which is how STEM interacts with the world, so we often group arts as a family member too. STEM appears here as the most commonly used acronym.

Q WHY IS STEM IMPORTANT, WHAT’S THE FUSS?

STEM is everywhere, shaping our daily lives. Walk outside into nature (science), pick up technology in your cell phone, drive a car designed by engineers or bake brownies using math to measure, select the correct oven temperature and timing. We are a technology-driven society and those with STEM skills better meet challenges, enjoy a higher quality of life and earn a greater income. STEM careers are also “helping” professions that solve the problems facing our communities with rewarding work.

Promoting STEM does not necessarily mean every child will become an engineer or a scientist. However, STEM is for everyone and grows children in these ways:

- 1 STEM prepares children for an ever increasing technological world. From the Internet to inventions we can't yet imagine, those comfortable with technology hold an advantage.**
- 2 STEM teaches kids how to analyze and problem-solve, developing critical thinkers. The thought patterns math and science develop also apply to the many challenges of work, career and life.**
- 3 STEM builds creativity. Brainstorming, designing, tinkering, collaborating, contributing & communicating opens our children to more possibilities in the lab or architecture studio, 3-D printing, industrial, gaming and web-design fields.**
- 4 STEM education develops "soft 21stCentury skills"* to increase emotional intelligence and build stronger relationships. STEM education uses group activities, where students learn to listen, empathize, express and promote themselves and draw parallels between learning and the larger world.**
- 5 STEM builds grit. STEM and math, in particular, are challenging. As children struggle, they increase their skills and learn not to give up. Intelligence is created through effort.**
- 6 STEM creates confidence when students overcome the challenges of difficult tasks or subjects. As a result, they become lifelong learners able to tackle new demands.**
- 7 STEM offers growing and higher paying work and careers. The U.S. Department of Labor projects that by 2018, 9 of the 10 fastest-growing jobs with a bachelor's degree will require greater science or math training.**
- 8 STEM inspires innovators & inventors. Entrepreneurs who create products and services that improve our lives are the single, largest source of new jobs for our economy.**
- 9 STEM will improve our world standing. In the latest tests of 15-year-olds from around the world, American kids ranked #31 in math and #23 in science - far behind many other industrialized nations.**
- 10 STEM solves the world's problems with research that cures diseases, engineering that modernizes decaying transportation systems and technologies that produce new jobs. STEM talent will fix global problems and improve our lives.**

Let's not forget that STEM is just plain fun, tapping our natural curiosity, the joy of discovery and learning about the world.

** Defined by The Partnership for 21st Century Skills, these are a set of abilities that students need to develop in order to succeed in the information age and include:*

- Learning Skills: critical thinking, creative thinking, collaborating and communicating.*
- Literacy Skills: information, media and technology literacy.*
- Life Skills: flexibility, initiative, social skills, productivity and leadership.*

More information: <https://k12.thoughtfullearning.com/FAQ/what-are-21st-century-skills>

Q WHY SHOULD PARENTS BE INVOLVED IN STEM?

Your focus on STEM shows that you care about your child. You are their first teacher, a role that doesn't end when school starts. You have the most influence with them.

When parents play an active role, their children are better learners, regardless of income, race or the parents' education, according to research. Teachers also encourage participation. The National Science Teachers Association believes parent or caregiver involvement increases children's interest in and ability to learn science. Children of engaged parents are more confident, do better in math and are more likely to choose and stay in STEM careers.

Not surprisingly, your children value your opinions and attitudes. In a national survey of students in STEM fields, 32 percent said a parent had the most influence on the decision to study STEM and 73 percent said that a parent had some influence on their decision.

Q HOW DO I TALK TO MY CHILDREN ABOUT STEM?

A strong strategy includes a discussion of STEM and future careers. Please do not feel overwhelmed if your child dislikes STEM classes or can't yet look ahead. The earlier you talk about it, from elementary to high school, the more easily your child will choose STEM. These tips, along with those in our resource section, will equip you for these conversations:

UNPACK THE MEANING OF STEM.

Start with the simple definition (science, technology, engineering, and math) and share examples they know. Tell your story or the story of someone who works in a STEM field, what they do and why it matters. Using one of your child's interests, like watching TV, talk about how STEM makes it work.* Explain STEM is a helping choice that improves lives around the world with safe drinking water, devices for better hearing and vision and communication to distant places.

PUSH YOUR CHILD'S NATURAL CURIOSITY.

Remember their early why-why-why questions? Children are born curious; discover their interests and strengths by exploring their questions as they respond to the world around them. You encourage their natural curiosity with your own why-does-this-happen and how-does-that-work questions. Share and support your child even if you don't know the answers. Google, libraries and people you know are good resources.

HOLD UP A STEM MIRROR, SO THEY SEE THEMSELVES.

Point out how their natural interests relate to STEM. A nature and outdoor lover could become an environmentalist, maybe the young artist is a promising digital designer. Identify your child's strengths that relate to STEM. Kids are naturally drawn to STEM when they build forts, collect bugs and play computer games; point this out. Reinforce that the world depends on their minds, skills and talent to fix big problems for people everywhere. Next time your child is asked what they want to be when they grow up, steer them toward STEM, part of almost any career they can imagine. Children see themselves as STEM learners in STEM fields when we show them how STEM involves those choices. We move them closer to their dream and a fulfilling life.



WHAT TIPS DO YOU HAVE FOR ENGAGING MY CHILD IN STEM?

The possibilities are almost endless at home, school and with local STEM resources. There are many STEM activities occurring in West Virginia over the summer. Visit wvde.us/STEMmindedWV for a list of STEM events.



AT HOME



- » Do experiments and simply explore
- » Ask “Why did that happen?”
- » Ask “How does that work?”
- » Provide STEM-oriented toys & games
- » Watch STEM movies or shows

AT SCHOOL



- » Enroll them in STEM clubs or after-school activities
- » Encourage teachers to provide hands-on activities in the classroom
- » Suggest taking STEM classes in middle, junior and high school



IN THE COMMUNITY



- » Get into nature and the outdoors
- » Visit a museum
- » Experiment in maker space
- » Suggest taking STEM classes in middle, junior and high school



Q WHEN DO I ENGAGE MY CHILD IN STEM?

You can never begin too early or too young to tap that natural attraction to rocks, dirt and questions. Sixty-five percent of scientists and STEM-graduate students say they developed their interest in elementary school, according to a study in the March 2010 International Journal of Science Education. Another study shows that students decide as early as second grade whether they like and are good at math. Without early support, many narrow their work choices well before middle school, missing promising and rewarding professions.

There are also late bloomers who discover their STEM interest in high school and college. No matter your child's age or range of interests, simply plug them into STEM information and activities. It is never too late.



INTERVIEW WITH SARAH STARGOVIC

First Generation College Student, Fairmont State University, WV

Did you always want to go into a STEM career?

Not always, I have always been interested in science, but not until I took AP Biology did I consider Biology as a major. I just loved the way I could learn about the things I hold so dear. I am fascinated by the natural world and I wanted so bad just to discover more about it. Before I made this decision, I considered elementary education as a major until my senior year of high school.

How did you make a choice for a STEM major in college?

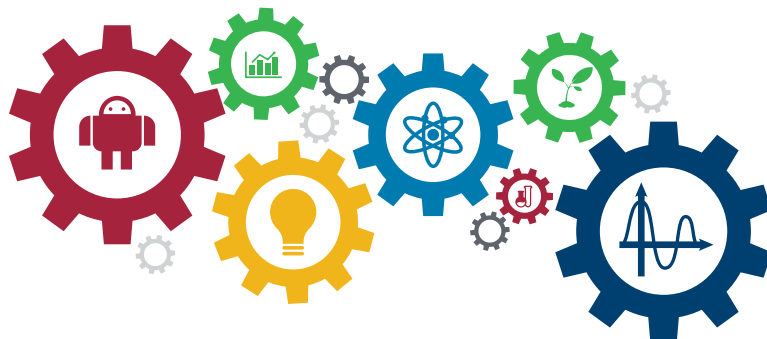
When I registered for classes at Fairmont University, I chose Biology as my major because of the many great experiences in my high school AP Biology course with Mrs. Schwertfeger. I just wanted to learn more. I absolutely loved the content, inquiry style learning, lab experiences, and it sparked my interest to pursue a related career. However, as I began my first college chemistry class, I thought it was the most academically challenging thing I had ever done. After speaking with my advisor, I found I could double major and include chemistry as well. This has been challenging, but I feel I have gained a tremendous amount of knowledge and skills, including time management! I am very happy with my decision to major in both.

What interested you in high school?

Art was my first love. I took all five art classes offered at Cameron High School. I also shared my love of art with elementary students during my volunteer time at the Blue and Gold Christian Center which serves our small community with afterschool care. I discovered I had a knack for teaching, and this is why I thought I wanted to be a teacher. I also was very interested in nature and environmental conservation which eventually inspired me to enroll in AP Biology. Mrs. Schwertfeger assigned a summer project prior to the start of the course where we had to locate, research, and document multiple organisms and natural phenomenon from a list. I made it my goal that summer to teach myself what all the things were on the list and locate them. I ended up being one of the only students in the class who finished the project. That research process made me think more about STEM as an option.

What about in elementary school?

During my years in elementary school, I found pleasure in the design process of making and creating things. It didn't matter if they were even functional. I especially loved making jewelry. At home, my mom, who was a stay at home mother, kept a craft box for me and my siblings. She let us make whatever we wanted, so we constructed all kinds of crafts and objects our minds came up with. We also played outside, a lot. We live on a large farm with many acres of wooded areas and open spaces to run around and explore. We would go on nature scavenger hunts and had contests to see which member of the family could recognize and name the most organisms most accurately.



How would you describe your path in STEM?

I believe I was always destined to be in a STEM area of study and career. I feel my talents and interests have steered me here. I am so happy that this path has led me to where I am today. When I was younger and not thinking about college, the thought of being a STEM major never crossed my mind. It wasn't until I realized STEM offered me everything I was looking for. Now that I have nearly completed both my STEM degrees at Fairmont University, I can't imagine myself not in STEM.

Was there an event or an experience in your childhood that demonstrated to you that a STEM career was for you?

Growing up I never had any thoughts of going to college or even what STEM was. My parents and most of the adult figures in my life had never been to college, so thinking about careers was not something I did when I was younger. Science and art classes were always my favorite class in school though. I always liked discovering how things worked together and why they did. I guess I was developing my engineering science skills before I even knew I had them!

What role did your teachers play in your choice of a STEM career?

In high school, my AP Biology teacher, Mrs. Jennifer Schwertfeger, helped me figure out that I wanted to be a STEM major. She was very supportive and encouraging. She recognized my skills, talents, and interests could be used together; combined to lead me into a successful academic college experience and career. She pointed me in the right direction, showed me the resources, and believed in me.

What about your family?

Since my parents did not attend college, it was hard for them to understand what the process requires, and honestly it was hard for me too because I was figuring it out all on my own. Also, I was the first of my siblings to go to college so they could not offer guidance, just support. My mom has been my biggest cheerleader and has made every effort to help me in the process. She went with me to all my college campus visits and made sure I had the opportunity to speak with all the science faculty members to make the most informed decision I could.

Even though she had never been to college, she made sure that my transition was as easy as she could make it for me.

To what do you credit your success in college in STEM?

I credit my success to all my teachers and my mother. My teachers in high school always pushed me to be the best I could be, STEM and otherwise. When began my course work at Fairmont University, it was no different. The STEM department is pretty small so students have the opportunity for extended one on one time with professors. In addition to my classes, I work as a research assistant. I have developed a close relationship with one of my chemistry professors and she has been a priceless resource and inspiration. I am grateful for all my parents have done for me and my siblings. I credit them for teaching me work ethic and a desire to never give up. My years on the farm taught me anything less than your best and hardest work was unacceptable. I use these traits every day and have worked so hard to get here and accomplish my goals. STEM is very hard work, but if you make up your mind that you are going to do it, amazing things happen. So many unexpected opportunities have come my way.

What do you do for fun?

I still love creating things, especially jewelry, and being in nature, so that passion has not changed since I was young. I still continue to do art, especially as a way to calm down and relax during times between all the STEM work because it can be difficult and overwhelming. Finally, I also enjoy rock climbing and spending time outdoors with my sister and roommate during our outings with FSU's outdoor club.

02 BUSTING STEM BARRIERS & MYTHS



BAILEY'S STORY

Bailey Baker has always been interested in science. She fell in love with Biology her sophomore year, which led her to take Anatomy and Physiology her senior year. Bailey remembers the hands-on activities from elementary school, “like testing pH levels and watching mold grow on bread that we passed around the class.” In high school, Bailey took classes that were outside the realm of science. “In my CTE (Career and Technical Education) course, I worked with the Engineering portion of STEM which I always was curious about.” Bailey’s curiosity has always been a driver for her. Bailey’s teachers and family played a major role in her choice of a STEM career. “All of my science teachers have been especially passionate in the subjects they teach, which is inspiring!”

A high school senior, Bailey was recently accepted into Marshall University’s BS/MD program. Why medicine? “I knew I wanted to be a doctor because growing up, I was frequently a patient. That, and my love of science, kind of pushed into me choosing medicine.” Bailey credits much of her success to her focus on her long term goals. A clear focus on her goals helped her to be a strong student throughout high school. Also, Bailey has always been supported by her school, her friends, and her family. “My family supports me in all of my interests, and they definitely helped me realize how much of a drive there is for women in STEM.”





WHAT ABOUT THE ARTS?

It's not a choice between STEM and the arts (STEAM). We need both as they work together to create new products and services, a healthy economy, job growth and, most importantly, a well-rounded person. Working both sides of the brain, logical and creative, STEM and STEAM ask the same, bold questions: What is true? Why does it matter? How can we move society forward? Both search deeply for meaningful answers.

Many famous inventors and scientists were also musicians, artists and writers: Galileo drafted poetry and Einstein plucked the violin. How can you encourage your child in opening to both sides of his/her brain?

STEM is not exclusive and blends easily with other subjects. For example, psychology heavily uses math and statistics; history teaches us the past and, when we apply those lessons, develops critical thinking. Spoken and written language unlock our understanding of STEM so we can relate it to our lives. Together, these subjects draw a more complete picture of the world, building a stronger base for solving problems.

Our primary STEM focus feeds a society hungry for more technology that has, until recently, left behind math and science. As a result, we almost all identify as readers, but rarely as good in math. We don't want to set STEM above other subjects, but it can't be less. STEM can drive our economy and solve big, worldwide problems.

Famous West Virginian STEM Professionals



KATHERINE JOHNSON

Mathematician



ADRIAN MELLOTT

Astrobiophysicist



HOMER HICKAM

NASA Engineer



WILLIAM MITSCH

Ecosystem Ecologist



CARL KEITH

Chemist



ELLEN MOSLEY-THOMPSON

Climatologist and Glaciologist



JOSEPH MAROON

Neurosurgeon



LONNIE THOMPSON

Paleoclimatologist



PAUL M. DOTY

Biochemist



KIM WEAVER

Astrophysics Astronomer

Inspiring West Virginians <https://pbslearningmedia.org/collection/wv-steam/>

Q WHAT IF I AM NOT A STEM PERSON?

Everyone has some STEM skills. You may not be an engineer, but you can fix things around the house. You may not be a chemist, but you can cook. Even if you only know some things about STEM, you can always learn with your child. When you guide your child toward finding the answer, you model that we continue to learn at every age

Q MY CHILD HAS A POOR ATTITUDE TOWARDS MATH, NOW WHAT?

As mentioned earlier, your child will see a STEM future when they feel strong in math. This is key. If they struggle with math or other schoolwork, remind them that they don't need to do it perfectly, especially not ALL at once. However, if you sense there's a deeper problem, maybe a lack of interest, check with your child's teacher, who can offer tutoring or more challenge.

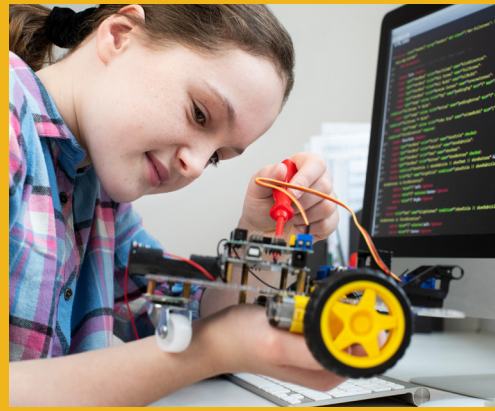
The "math brain" does not exist. The genes that set academic talent control ALL subjects. Math is a challenge at some point for everyone! Struggling a bit, even getting the wrong answer, is how we truly learn. We gain more from our mistakes than being perfect. The challenges feed determination, sticking to it and grit that predict educational success. With steady effort, a child can find mathematics motivationally challenging.

Share with your child that math includes abstract thinking. Looking at ideas instead of facts or what is right in front of them may be a new skill, mastered with practice. Drive their enthusiasm by making meaningful connections between math, their interests and what they care about. Younger students may not realize they are doing math when counting money and telling time. Point that out. Ask older students to explore how math may be part of a college, work or occupation goals.



Math Challenge

To demonstrate that math is relevant to everyday life, challenge your family to go a whole day without using math. You'll become away of the numerous (pun intended) ways we automatically incorporate math into daily life.



Q WHAT ABOUT OPPORTUNITIES FOR GIRLS IN STEM?

STEM is wide open for girls, who share big dreams for making the world better, IF we shift false stereotypes, negative messages and their own views. While women make up over half the U.S. workforce and hold the majority of college degrees, there are very few in STEM education (20 percent in engineering, computer science and physics) and careers (25 percent). The truth is girls and boys are equally smart in STEM, and high-school girls earn even more math and science credits and have higher GPAs (grade point average).

Girls draw their attitudes from how they view themselves instead of their real ability. When they believe in themselves and that hard work and effort increase intelligence, girls improve their math and science scores. They do less well when they believe boys are better at math, research says. However, when told they are equal in talent, they score equally. Girls may have these incorrect assumptions, blocking their full potential in math and science.

Girls with the same abilities as boys are more likely to give up on difficult material and lose interest in STEM by middle school when they believe these subjects are too hard. As STEM parents, we must reinforce the message that struggling is often how we learn, especially in math, and that girls can do well in STEM subjects. Some parents and teachers unknowingly discourage girls with lower expectations. Research studies show that:

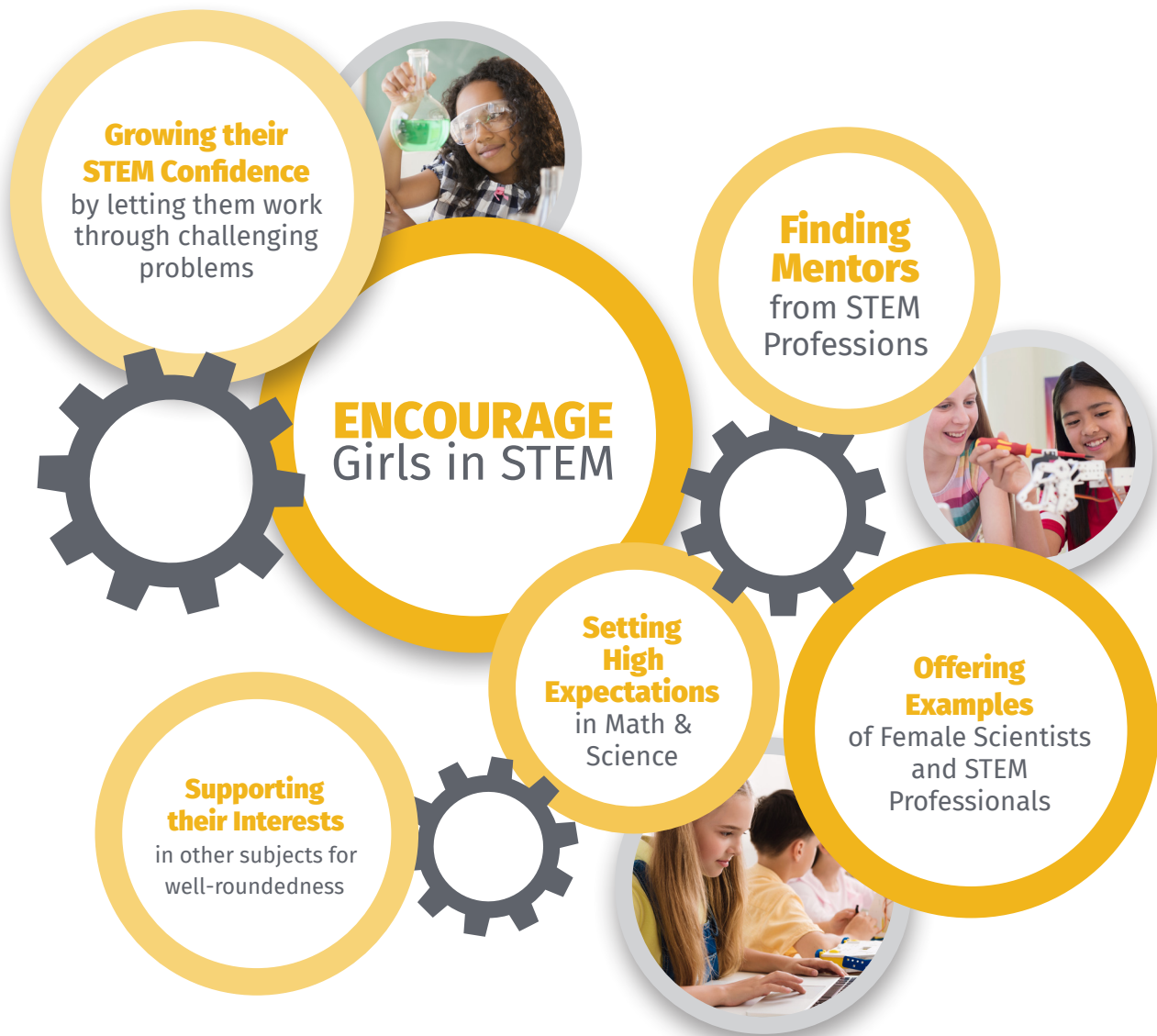
Teachers expect more in math and science from boys guiding them to find solutions, than from girls, to whom they give answers.

Mothers encourage their sons more than their daughters in hands-on activities in science museums.

Teacher call on boys more than girls in science and math classes.

Once we become more aware, we can be sure to provide proper and equal encouragement.

WE ALL MUST BECOME MORE AWARE AND MORE ACTIVE IN ENCOURAGING GIRLS IN STEM BY:



More than anything else, supportive families can move girls toward STEM. ALL children benefit from exposure to STEM activities, STEM role models and mentoring. When we stress STEM for girls, boys respond positively too and understand that STEM is for everyone.



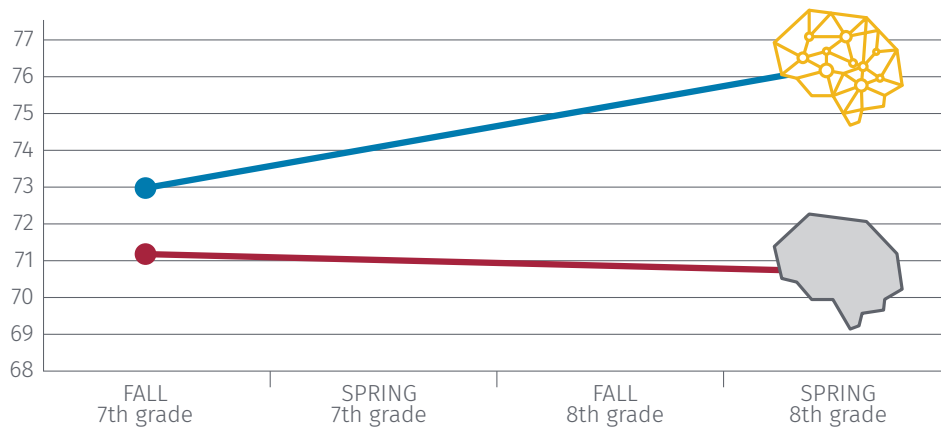
I HEAR A LOT ABOUT “MINDSET,” HOW DOES THAT RELATE TO STEM?

When students believe hard work and practice increase their basic talent, they shine. Researchers Carol Dweck and Jo Boaler call this a growth mindset that covers all learning as well as STEM subjects. Intelligence and talent are starting points. Students with growth mindsets learn more and improve from challenges and failures. This is also a life lesson. Amazingly, the brain grows just as any other part of the body when exercised.

You can easily practice growth mindset by praising your children for their effort over abilities, guiding them to work through difficult problems. Children with teachers and parents who understand the growth mindset benefit most. Teachers with a classroom growth mindset report greater student progress.

Growth Mindset Example

In one study, seventh grade math students were given a survey to measure their mindset, then researchers followed the students over two years to monitor their mathematics achievement. The results were dramatic, as the success of the students with a fixed mindset stayed constant, but rose for those with a growth mindset (Blackwell et al., 2007).



HOMEWORK, HELP!



We’ve ALL been here: overwhelmed by our children’s math and science homework. Don’t panic, their classes are more advanced than ours were at the same grade. Fortunately, there are resources.

1. Quantile Site www.quantiles.com
2. Math@Home hub.lexile.com/math-at-home
3. Math Skills Database hub.lexile.com/math-skills-database
4. Summer Math Challenge www.quantiles.com/parents-students/find-mathresources-to-support-classroom-learning/summer-math-challenge
5. Khan Academy www.khanacademy.org
6. Desmos www.desmos.com

MORGAN'S STORY

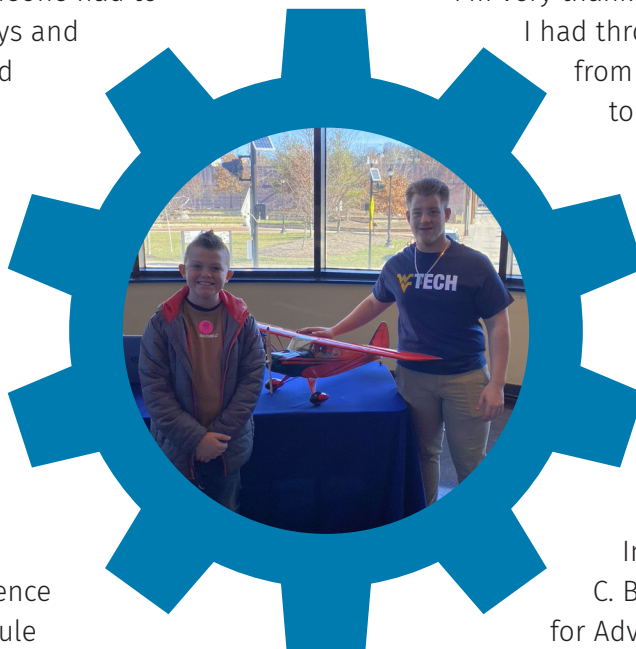
Morgan Smith always demonstrated an obvious passion for STEM. As a young boy, he would take his toys apart just to see how they worked and operated. In elementary school, he developed a hobby of launching model rockets and proclaimed his favorite subject in school to be science. Eventually, he had the realization that someone had to design the tools and toys and use every day; little did he know that he was already on the path to a future in mechanical engineering.

As he got older, his love for science did not waiver. In high school, he was heavily involved in robotics and participated in a successful Vex robotics team and took extra science courses when his schedule would allow it. He spent his summer breaks volunteering for a middle school STEM robotics camp.

Morgan's early experiences helped to shape his STEM career path. For example, his successful Vex robotics team was a direct fit for mechanical engineering, the career he ultimately would choose. He also attributes his success in STEM to his family and his teachers throughout PreK-12 schooling. "My mother and father had a huge impact on my choice of going in the STEM field," Smith

stated. "My Father and I flew remote control airplanes together which sparked my interest in aerodynamics. We also built furniture together which taught me the importance of Mathematics. Most of all they supported me in all aspects of life." Morgan also has his teachers to thank for guiding him toward STEM.

"I'm very thankful for all of my teachers I had throughout my education from preschool all the way to college. Looking back, I notice myself using something that each one had taught me."



Morgan is a graduate of West Virginia University Institute of Technology. Today, he works as a Design Engineering Intern at the Robert C. Byrd Institute (RCBI) for Advanced Flexible

Manufacturing. Smith is proud of the work he gets to accomplish in mechanical engineering and says he uses "all subjects of STEM very often" to do his job. When he's not working as an engineer for RCBI, he still enjoys STEM-related hobbies such as flying and building model airplanes. Morgan credits his family, friends and previous educators in preparing him for his career and for pushing him to always strive for success.



WHAT ARE MINDSETS AND SKILLSETS?

Mindsets are attitudes held by an individual that play a major role in motivation and achievement. Mindsets determine how individuals make decisions, approach opportunities, and handle adversity. Skillsets are specific abilities that allow individuals to accomplish tasks. The STEAM mindsets and skillsets are those necessary for student success in a STEAM-rich future.



CURIOSITY & IMAGINATION

Students value originality, generate new ideas, investigate life with curiosity, and ask questions.



GROWTH MINDSET

Students think about their thinking and reflect upon their actions and ideas.



COURAGE & RISK-TAKING

Students work outside their comfort zones, embrace adventure, stay open to new ideas, and strive to achieve their goals.



PERSISTENCE & GRIT

Students see a task through to completion, push through obstacles, and work to create solutions to problems. Students see challenges as a learning opportunity.



OPPORTUNITY-SEEKING

Students identify community issues and act to find solutions.



PROBLEM-SOLVING

Students generate alternative solutions to problems, think critically, recognize solutions, and proactively develop creative solutions.



OPTIMISM

Students feel confident and hopeful in their ability to innovate solutions.



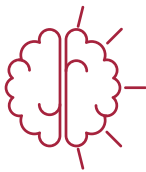
RESOURCEFULNESS & ADAPTABILITY

Students explore quick and clever ways to overcome challenges, with the understanding that they can always make adjustments.



EMPATHY & ALTRUISM

Students think about other people's needs and feelings and keep these in mind when solving problems.



CREATIVITY

Students are bold and imaginative.



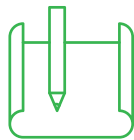
TEAMWORK

Students learn from new people and work with people with diverse perspectives, skills, and talents.



DESIGN THINKING

Students learn processes for problem solving that originate with empathy and compassion.



PROTOTYPING

Students create simple models to explain their ideas, get feedback, and learn how their solutions can be improved.



PUBLIC SPEAKING

Students create and deliver short, clean, persuasive arguments to rally people around their ideas.

03 DIVING INTO STEM

JENNIFER'S STORY

Originally from Canton, Ohio, Jennifer always had an interest in the sciences. During high school, life sciences appealed to her and she considered pursuing a degree and career in biology. She enrolled in Hiram College, near Canton, OH where she found a passion for chemistry and political science. After she enlisted in the Army in 1996 where she specialized as a vehicle mechanic stationed in Ft. Lewis, Washington where her engineering skills were developed.

After her honorable discharge from military service and starting a family, she decided to finish her college career at the University of Akron where she graduated with a degree in Chemical Engineering. "I wish I knew sooner what engineering was all about. It is a great career, one in which women are needed. Women bring a sense of empathy and compassion to the engineer's world of dry problem solving. Women contribute a different perspective". She believes the stereotyped image is changing and would like to see more females enter the field.

"After spending 12 years in the industry, I was ready for a change. I started teaching Sunday school after moving to West Virginia and discovered I had a talent for teaching, so I decided to pursue a new career in science education putting my skills, interests, experience, and content knowledge to use." Like most teachers, especially second career teachers, she had a desire to have more positive impact on society by serving youth.

Jennifer commented on the fact corporate America is very different from public education, however, she has carried over her "develop the team" approach to the classroom. She admits classroom management will be a constant work in progress. "It is not a fast process because we need to give time for compassion first, leading and motivating our students through discovery and problem solving."

During this time of virtual learning experiences, Jennifer has found she had an edge as educators entered the virtual transition due to her extensive experience with technology communication tools. She has her science classes involved in daily, live, interactive lessons to continue her students on a STEM discovery journey. In addition to her busy life as a mom and teacher, she started a business, Native Roots, Inc., which specializes in the sale of native WV plants for landscape and restoration projects. This passion project continues to fuel her love of everything STEM.

She hopes to be a source of inspiration to her students as they consider their own career pathways. Through her story, she demonstrates the value of STEM education and its applications in all walks of life.

Jennifer Johnson exemplifies what a true STEM professional is; driven, creative, community minded, and dedicated with a passion for all things science. We are fortunate to have her as a citizen of our state and inspiring teacher to WV students.

Our West Virginia youth are facing a future where experience in STEM education will be a necessity. Our state leadership has been working toward bringing technology-based industry into our state and those businesses will be in need of a prepared workforce. Jennifer's story is one of inspiration and hope for our WV students.

Q HOW DOES STEM RELATE TO STATE AND NATIONAL EDUCATIONAL STANDARDS?

West Virginia standards list what students in kindergarten through 12th grade (K-12) should know in all the content areas (English language arts, math, social studies, science, computer science, wellness, the arts, etc.) by the end of each grade. While STEM doesn't have its own set of standards, it is meant to draw topics from many different content areas as educators work with students to solve real-world problems.



TIP

Consider recommendations from other parents and exploring this website:
www.noodle.com/articles/what-to-look-for-in-stem-education-at-every-grade-level

Q HOW DO I EVALUATE A STEM CLUB OR PROGRAM?

The best STEM program interests your child and fits your lifestyle. When choosing, consider one that:

Great!

- › Includes a hands-on activity(s)
- › Ties activities to real-world
- › Teaches a key science or technology point
- › Encourages students to try challenging activities
- › Celebrates failures (that's learning!) as well as successes

Even Better!

- › Is supported by mentors who are professionals in their field, who can be role models
- › Involves parents in some way
- › Shares how it connects to STEM careers

04 STEM BEYOND HIGH SCHOOL: COLLEGE, JOBS AND CAREERS

SKYE'S STORY

As early as elementary school, Skye Reymond can remember math always being her favorite class. Fortunately for Skye, she had a family that realized her gift for mathematics at a young age and encouraged her to participate in events like Math Field Day and any advanced math classes available to her throughout her schooling. By the time she got to high school, she knew she wanted to have a career that involved mathematics.

Skye credits her Advanced Placement (AP) Statistics teacher, Mrs. Goode, as her biggest influence on her interest in math and ultimately a career in STEM. In that class, Skye read a book titled *How to Lie with Statistics* and it opened her eyes to the power of using data in storytelling. Mrs. Goode showed her class how math could be used in the real world to minimize risk and make smarter business decisions, and ultimately that is what sparked Skye's interest in pursuing math as a career.

After graduating from Hurricane High School, Skye graduated from Marshall University with a degree in applied mathematics and a minor in Economics, and later from Northwestern University with a master's degree in data science with a specialization in analytics and modeling. Now, she is a data scientist for Terbium Labs, a cyber-security start-up that specializes in dark web monitoring services. Skye is responsible for creating Natural Language Processing models to identify dark web content as various types of fraud. In her free time, however, she consults for various data science projects. Her latest project has her working in the National Prescription Opioid Litigation, a collection of lawsuits brought by cities and counties across the United States against major manufacturers and distributors in the drug industry. The case has been called the "biggest and most complicated civil case in U.S. history" by the Washington Post. Skye is responsible for producing data visualizations and creating anomaly detection models to identify suspicious orders filled by drug manufacturers.

Skye also uses her passion for data and STEM to sit on the advisory board for the Marshall University iCenter, to teach statistics classes, and to contribute to the podcast "Data in Depth," a series that explores advanced analytics, business intelligence, and machine learning within the context of the manufacturing industry. For fun, she coaches a U15 girls travel soccer team. Skye believes the next generation of workers can "change the economic landscape in West Virginia," and hopes to help "inspire women to contribute to the future of West Virginia's workforce."

When asked about the great success she has experienced this early in her career, Skye says “I think a lot of my success in STEM comes from the support system that always encouraged me to pursue the field I was most interested in and helped me figure out the best path forward. My parents taught me the value of being self-disciplined in my study habits and doing well in school and this helped me commit time and effort when learning complex mathematical concepts.”

Q WHAT ABOUT STEM JOBS?

STEM jobs are in demand, and growing around the globe, nation, state and region. Pure STEM accounts for 20 percent of U.S. jobs, while 80 percent of all work requires some STEM skills. The same is true for STEM jobs in West Virginia. Many positions remain open, however. Local employers blame fewer employees with technical skills - good news for the next generation. Ideally, we want our children to be happy, independent, with enough money and in steady jobs. Those in STEM enjoy higher pay, career growth and long-term employment over other fields.



Q WHAT DEGREES ARE REQUIRED FOR STEM JOBS?

Education is key to success in STEM professions. Ninety-five percent of jobs paying a livable salary will require some combination of education beyond high school, on-the-job training, and/or work experience over one year. A bachelor's degree or higher is necessary for over 30 percent of these higher-paying jobs. The bottom line is those with only a high-school education are likely to remain in low-paying jobs.

Healthcare, information technology, and architecture/engineering STEM jobs are in the most demand in West Virginia.

LARGEST AREAS OF PROJECTED JOB OPENINGS	Average Entry Salary	Projected Openings by 2026
Architecture and Engineering Occupations	\$50,890.05	494
Computer and Mathematical Occupations	\$44,712.24	961
Healthcare Practitioners, Technicians, and Support Occupations	\$39,617.83	11,329

If your child is interested in one of these high-demand professions, but not a four year degree, there are shorter, associate nursing programs and certifications in Information Technology (IT), construction, electrical and plumbing that lead to steady jobs with good pay. Even if STEM is not your child's career choice, sharpening their STEM skills can make them more competitive. These data are provided by Workforce West Virginia, <https://workforcewv.org/>.

Q HOW CAN I HELP MY CHILD DECIDE ON A CAREER?

Kids are always asked: "What do you want to be when you grow up?" They usually respond based on the books, TV and people they know. These early ideas are formed from limited information, not reality. Very few make the NFL draft to play pro football, or are cut out for the brutal road to becoming a medical doctor. As parents, we often expect school counselors to guide our children's work, college and occupation choices. Realistically, counselors are overwhelmed by large numbers of students. Remember, YOU know your child best, want the best for them and hold the greatest influence in their lives.

Career decisions are often mind-boggling, difficult and depend on interests, skill, desired income, location and job availability. Pulling this together takes effort, thought and your support. Information, role models and experiences create better decisions. USE every tool you have: school career-test results, exploring your job with your child and introducing them to STEM professions. Relationships and experiences are the most meaningful in creating your child's future.

Most students experiment before finding the right direction and, even then, may change and that is OK. Research shows almost everyone picks a pretty good fit in the end. The upshot: don't worry if your child is not yet in college and/or doesn't know what they want to do when they graduate.

Be mindful that early exposure to careers improves how well children do in school and how much they value education. A study of 15-year-olds with job-related experiences (internships, job shadowing, job fairs or school advising) showed positive attitudes about education. Career coaching, STEM studies and exploration build a solid future for your child.



TIP

Self-survey and information to match to various majors/areas of study
<http://www.bestcolleges.com/resources/choosing-a-major/>

SUMMARY

Whether you are a parent, caregiver or a concerned adult, we appreciate your interest in STEM. The West Virginia Department of Education believes that in working together we create a brighter future for our children, our families and our region. We support STEM to build critical thinking skills for ALL careers. We grow decision makers who use information to make informed decisions. We nurture citizens to embrace science and technology. We create new businesses, jobs and economic wealth for our region. All of this is possible ONLY with the support of parents and the example of role models for our children. You make STEM relevant, you make a difference and you WILL inspire our next generation.



COLLEGE PREP CHECKLIST

FRESHMAN YEAR

- Review your PEP to align with your career goals
- Continue career exploration

JUNIOR YEAR

- Consider taking the ACT
- Make campus visits; attend college fairs
- Be involved & round out your school experiences
- Gain work experiences
- Begin AP or dual credit classes
- Take the School Day SAT
- Review requirements for the college/university you are interested in
- Revise your PEP to align with your career goals

MIDDLE SCHOOL

- Begin exploring CFWV
- Take or plan to take Algebra 1/Math 1
- Map out classes for 9th & 10th grade on your PEP
- Engage in Career Exploration as part of the Middle School experience

SOPHOMORE YEAR

- Consider taking the PSAT
- Review your PEP to align with your career goals
- Explore dual credit/AP courses available in your school

SENIOR YEAR

- Retake ACT and/or SAT if you want to improve score
- Continue AP or dual credit classes
- Apply for college
- Apply for financial aid
- Apply for scholarships
- Apply for PROMISE

COLLEGE PREP GLOSSARY:

CFWV – College Foundation of West Virginia

PROMISE Scholarship – A state funded merit-based scholarship program available to all West Virginia students.

ACT – The ACT is an entrance exam administered by ACT, Inc used by most colleges and universities to make admissions decisions.

SAT – The SAT is an entrance exam administered by the College Board used by most colleges and universities to make admissions decisions.

Personalized Education Plan (PEP) – This plan, which begins in 8th grade, assists students and families as they work with school counselor(s) and/or teacher advisor(s) to personalize students' high school program of study and courses they plan to take.

Advanced Placement® (AP®) – These courses are college-level courses offered in high school. At the completion of the course, students have the option to take an exam administered by College Board for the purpose of gaining college credit; students who earn a three or higher on the exam receive college credit.

Dual Credit Courses – These courses are college courses aligned to meet requirements for college and high school courses. At the completion of the course, students with a C or higher receive college credit.

STEM MINDED *WV*



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