fhi360 THE SCIENCE OF IMPROVING LIVES | Johnson & Johnson | JA Worldwide® | Smithsonian Science Education Center

IT STARTS WITH YOU!

A key piece of our new Johnson & Johnson's WiSTEM²D—Women in Science, Technology, Engineering, Math, Manufacturing, and Design—initiative is aimed at engaging girls between the ages of 5 and 18 in experiences that spark their interest in these subjects at a young age, encouraging college-aged women to pursue careers in these fields, and inspiring professional women to commit to these career paths for the long-term. To succeed, our efforts require a cadre of diverse and engaged employees who are willing to help.

I commend and thank you for choosing to be part of the **WiSTEM²D** Youth Programs pillar. You exemplify Our Credo and offer further proof as to why our employees are our most valuable assets. As a volunteer, you are sending a powerful message to young women and girls. Through your active involvement, young people will be more engaged and willing to try new things. They will remain curious and interested. They will better understand the relationship between what they learn in school and their successful participation in a global economy. Most important, with your help, these girls will dream big and accomplish great things!

I encourage you to review and use the information, tips, resources, and supplemental materials presented in this document. It is essential reading for all volunteers interested in working with girls and young women and provides you with important knowledge and background for engaging in the STEM²D arena.

It is exciting to envision young people the world over engaged with Johnson & Johnson employees in activities that will broaden their knowledge of STEM²D and open opportunities for their future education and careers. Thank you for taking the time to inspire and mentor young women of all ages. I know that, with your guidance and support, the next generation of women will view STEM²D as the exciting and viable career path that it is.

Sincerely,

Meri Stevens

Meri Stevens is Vice President, Strategy & Deployment, for the Johnson & Johnson Supply Chain organization. She also serves as the Executive Sponsor for Johnson & Johnson's WiSTEM²D Youth Programs pillar.

Revised design: JA Worldwide, April 2018.

SPARK WiSTEM²D

A Resource for WiSTEM²D Volunteers

INTRODUCTION

THE WiSTEM²D INITIATIVE

In 2015, Johnson & Johnson launched WiSTEM²D: Women in Science, Technology, Engineering, Mathematics, Manufacturing, and Design (STEM²D). Led by a network of volunteers from across Johnson & Johnson and its local operating companies, this ambitious initiative involves:

1. **Youth Programs:** Sparking enchantment with STEM²D subjects in young women and girls through creative problem solving and play.
2. **University Programs:** Inspiring career paths, by partnering with select academic institutions to develop high-impact strategies for recruiting, retaining, and engaging women leaders.
3. **Professional Programs:** Tapping into the power of diversity through reimagined recruitment and retention of the world's best technical female talent.

Johnson & Johnson seeks to cultivate females' STEM²D interests at an early age and help them continue to grow and develop in these areas, preparing and positioning them to pursue higher education and careers in STEM²D. With this foundation, they are primed to make valuable contributions to their communities, companies, and the world in the decades ahead.

To advance youth connections, Johnson & Johnson partnered with three leading nonprofit organizations:

- **FHI 360:** FHI 360 is a nonprofit human development organization dedicated to improving lives in lasting ways by advancing integrated, locally driven solutions. FHI 360 programs combine evidence with on-the-ground experience to deliver maximum efficiency and impact. FHI 360's impact is amplified through the synergy of partnerships. The "360" symbolizes our inclusive approach to sustainable success, attained only when we partner with community-based organizations, secondary schools, and higher education institutions, the private sector, and the communities we serve. FHI 360 serves more than 70 countries and all U.S. states and territories. FHI 360's National Institute for Work and Learning (NIWL) partnered with Johnson & Johnson on the WiSTEM²D initiative. *For more information, visit: fhi360.org.*

- **JA Worldwide.** As one of the world's largest youth-serving NGOs, JA Worldwide activates youth for the future of jobs. Through the delivery of hands-on, blended learning in financial literacy, work readiness, and entrepreneurship, we empower young people to grow their entrepreneurial ideas, hone their work skills, manage their earnings, and secure better lives for themselves, their families, and their communities. With more than 100 member countries, the JA Worldwide network is powered by over 470,000 volunteers and mentors, who serve more than 10 million young people around the world each year. *For more information, visit: jaworldwide.org.*

- **Smithsonian Science Education Center.** The Smithsonian Science Education Center—the only unit at the Smithsonian Institution that is solely dedicated to formal science education reform—transforms and improves the teaching and learning of science in schools in the United States and throughout the world. The Smithsonian Science Education Center builds awareness for preK-12 science education reform among state and district leaders, conducts programs that support the professional growth of teachers and school leaders, and engages in research and curriculum development (including its comprehensive K-8, research-based science curriculum programs). *For more information, visit: ScienceEducation.si.edu.*

Creating more opportunities for girls to build STEM²D skills and confidence and encouraging more girls to pursue STEM²D careers will be an increasingly important driver of economic growth in the future. These partnerships will enable Johnson & Johnson to reach one million girls by 2020.

ABOUT SPARK WiSTEM²D

Spark WiSTEM²D promotes the valuable involvement of volunteers to inspire young people in the STEM²D subjects and 21st-century careers around the world.

Designed as an essential resource for volunteers, **Spark WiSTEM²D**:

- Defines STEM²D principles and philosophy
- Provides information and statistics on the STEM²D labor market and diversity of career options
- Conveys that STEM²D is exciting and is a dynamic pathway that can open options for a variety of future careers
- Highlights research-based strategies and tips for engaging and interacting with girls and young women
- Offers tips and practical information to help you talk about yourself, your education, and your career path
- Empowers you to engage in the WiSTEM²D initiative through multiple approaches across in-school and out-of-school activities, as well as community-based events

Supplemental materials, such as the **Tell My Story Form,** offer both first-time volunteers and those who would like a refresher assistance in developing their own STEM²D story and showcasing their accomplishments in a relevant and personal way. The **Volunteer Tips** offer practical advice for working with educators, communicating effectively with young people, and facilitating groups of students.

Although the research presented is specific to girls, and the content was created with girls as the focus, girls *and* boys can benefit from STEM²D exposure and learning. STEM²D is for everyone.

DGLimages/Shutterstock

ABOUT STEM²D

WHAT IS STEM²D?

STEM²D is an acronym that refers to Science, Technology, Engineering, Mathematics, Manufacturing, and Design. The STEM²D subjects are:

Science: Observing, studying, and experimenting to better understand the natural world and how it works.

Technology: Putting science and other knowledge to practical use to solve problems, invent useful tools, envision new possibilities, and establish meaningful connections between people and the world that surrounds them.

Engineering: Applying science and math principles to design and develop products, structures, machines, tools, or systems that improve everyday life.

Mathematics: Using a quantitative framework (numbers, quantities, shapes, abstract principles, and problem solving) to describe the world.

Manufacturing: Creating something from raw materials by hand or by machinery.

Design: Creating, constructing, or inventing an object, plan, product, or system; it is also a human-centered mindset and collaborative approach that results in better experiences by uncovering unmet needs and championing meaningful relationships through user-friendly products, environments, and systems.

Currently, there is significant research on and programs aimed at improving the science, technology, engineering, and math (STEM) subjects, and "STEM" is referenced in this document when citing the research. Johnson & Johnson added "²D" to its initiative to recognize and elevate the manufacturing and design disciplines, which are directly aligned with the other STEM subjects. As a result, WiSTEM²D advances the vast array of careers and career paths that are available in these interdisciplinary subjects throughout the world.

THE STEM²D PHILOSOPHY

STEM²D subjects cannot be considered in siloes. Rather, the STEM²D philosophy relies on a student-centered, integrated approach to understanding, exploring, and engaging with the world.

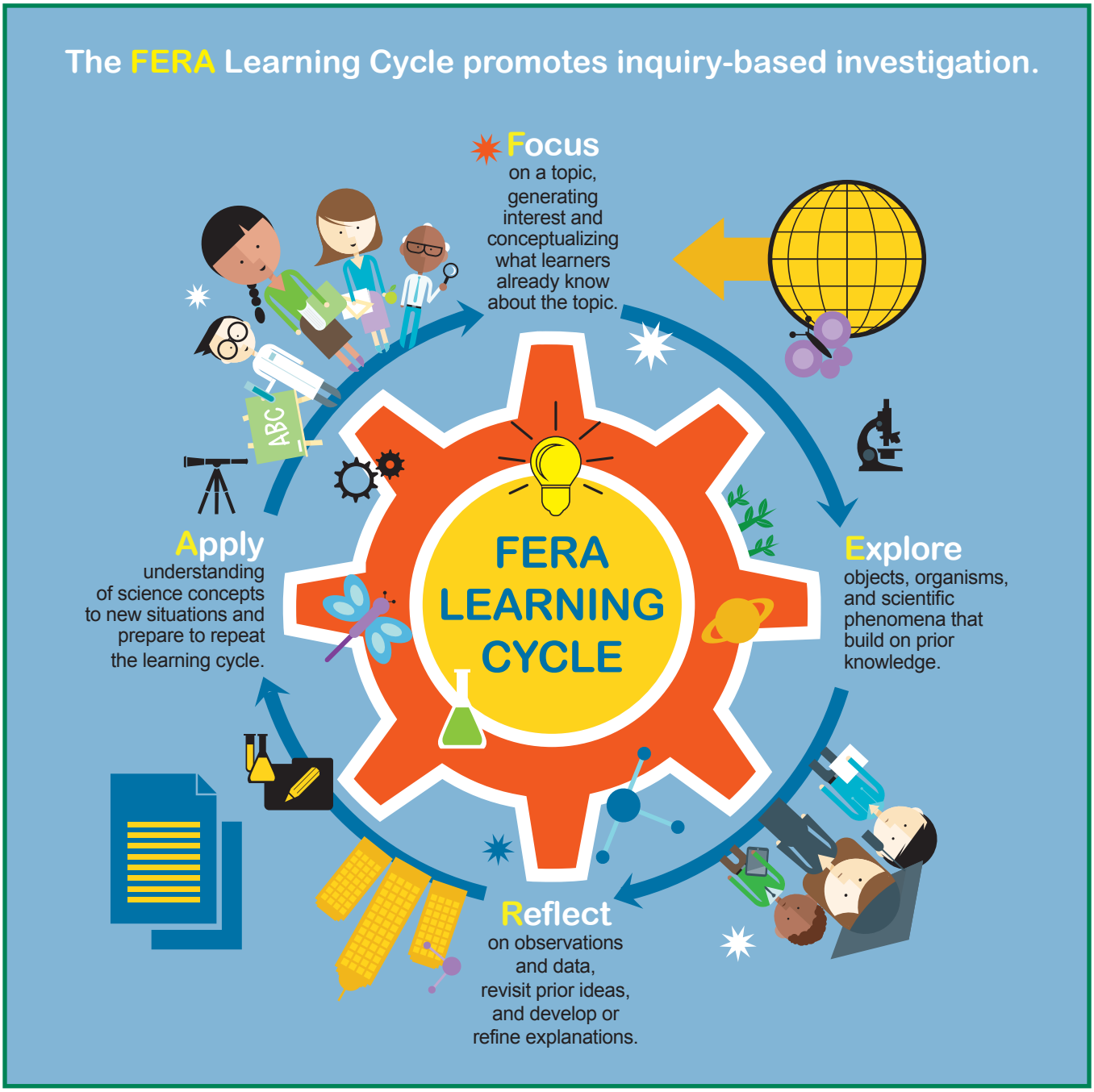
This comprehensive approach involves:

Collaboration and teamwork: Collaboration and teamwork give young people the opportunity to work with others to design, produce, or create something.

Hands-on, minds-on learning: The hands-on part of learning means that young people are engaged, trying things out, and physically manipulation objects and ideas so that they stay interested. Minds-on learning requires an active involvement with learning in which young people are curious and keep their brains active with challenging ideas.

Inquiry-based investigation: Young people learn best through inquiry. Inquiry-based investigation is a method of instruction that starts by posing questions, problems, or scenarios rather than simply presenting established facts. Successful inquiry-based investigation activities encourage students to use the FERA learning cycle: Focus, Explore, Reflect, and Apply (FERA). This four-stage learning cycle is grounded in educational research and practice. This process is similar to the ones that scientists employ (such as the 5E model).

The FERA Learning Cycle promotes inquiry-based investigation.



Source: Smithsonian Science Education Center

Project-based work that has real-life applications: Project-based work is a teaching method in which young people gain knowledge and skills by working for an extended period to investigate and respond to real-life engaging and complex questions, problems, or challenges.

The opportunity to build confidence: Confidence, or a feeling of self-assurance, arises from the appreciation of one's own abilities or qualities and the receipt of positive feedback for her or his efforts.

Exposure to diverse role models: Diverse role models—people whose behavior, example, or success can be emulated by others—are critically important and a powerful message for young women and girls..

As a volunteer, strive to provide opportunities and experiences that include all aspects of the STEM²D philosophy.

WHY STEM²D?

The STEM²D philosophy makes learning more exciting, interesting, meaningful, and relevant. It also fosters inquiring minds, logical reasoning, creative thinking, problem solving, and collaboration. To succeed in this new information-based and highly technical society, all students need to develop these cross-cutting skills and capabilities at levels beyond what was considered acceptable in the past.[1] These are the capabilities and skills that prepare students to become the future innovators, educators, researchers, and community leaders. STEM²D builds strong:[2]

- **Thinking skills:** Critical and creative thinking helps young people solve problems, detect mistakes, gather relevant information, and understand how different parts or systems interact with each other.
- **Communication skills:** Communication skills are important for working well with others, listening, and conveying information clearly, both orally and in writing. Communication skills include technical writing, public speaking, interpersonal communication, and the ability to explain difficult concepts simply.

Senior HR (human resources) professionals rate problem solving (that is, thinking skills) and communication as the most important STEM skills employees will need in the next five years.[3,4]

In addition, the STEM²D approach results in smarter, more competitive, more productive, and more engaged global citizens who:[5]

- Make informed decisions about health and safety
- Are better able to participate in public policy decisions and debates
- Manage daily lives that increasingly rely on technology
- Find solutions for challenges that face our global population

Finally, the global demand for STEM talent is growing. Experts indicated that almost all of the 30 fastest-growing occupations in the next decade will require at least some background in STEM.[6] Between 2014 and 2024, the number of STEM jobs will grow 17 percent, compared with 12 percent for non-STEM jobs.[7] This represents an increase of about 1 million new jobs.[8] Demand for design professionals is also high and growing. For example, between 2010 and 2014 design employment grew by 21.7% compared to 6.1% for the UK economy as a whole.[9]

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1 National Science Board (2007). *National Action Plan for Addressing the Critical Needs of the U.S. Science, Technology, Engineering, and Mathematics Education System* (NSB-07-114). Arlington, VA: National Science Foundation.

2 Vilorio, D. (2014, March 22). STEM 101: Intro to Tomorrow's Jobs. *Occupational Outlook Quarterly*. Washington, DC: Bureau of Labor Statistics, U.S. Department of Labor.

3 Rothwell, J. (2014, July 1). *Still Searching for Job Vacancies and STEM Skills* (Rep.). Washington, DC: Brookings Metropolitan Policy Program.

4 Dishman, L. (2016, May 17). These are the Biggest Skills that New Graduates Lack. *Fast Company*.

5 Smithsonian Science Education Center. (n.d.). *Transforming Science Education* [Infographic].

6 Harmon, H., & Wilborn, S. (2016). The Math Learning Gap: Preparing STEM Technicians for the New Rural Economy. *The Rural Educator, 37*(3).

7 Change the Equation. (2015, February). Solving the Diversity Dilemma: Changing the Face of the STEM Workforce. *Vital Signs*.

8 Vilorio, D.

9 The Design Council. (2015). *Design Economy. The value of design to the UK Design Council.* London: The Design Council.

Despite this persistent labor market demand, not enough students are graduating with STEM backgrounds to fill the open positions in the marketplace.[10] STEM disciplines suffer from high attrition: fewer than four out of ten students who plan to get a degree in a STEM major will actually get one.[11]

WHY WOMEN IN STEM²D?

There is a lack of gender diversity in STEM²D fields. For example, although women in the United States made up 57.2 percent of all professional workers in 2015, they comprised only 46.6 percent of science professionals, 24.7 percent of computer and math professionals, and 15.1 percent of engineering and architecture professionals. The scarcity of women in STEM²D fields is a long-standing and persistent problem. And, in advanced manufacturing, women made up only 10 percent of the workforce in 2001 and 2014.[12] Other countries across the globe see similar statistics.

For many girls who start out strong in mathematics and science, interest wanes along the way. Clear evidence supports that girls and young women receive social cues—regularly reinforced in conscious and subconscious ways by parents, teachers, university professors, and even managers on the job—that they cannot compete with male counterparts and, therefore, should not pursue their goals in STEM fields. The result is what is often referred to as a leaky pipeline, in which talented girls eventually steer away from careers in STEM and pursue work in fields where they will receive more positive reinforcement and do not have to fight as hard to carve out their place in the world. It is our belief that STEM²D awareness, exposure, and understanding will serve girls and young women well.

A Closer Look at the Leaky Pipeline:[13]

- Girls and boys take math and science courses in roughly equal numbers.
- About as many girls as boys leave secondary (high) school prepared to pursue science and engineering majors in college.
- Fewer women than men pursue these majors.
- Among first-year, post-secondary students, women are much less likely than men to say that they intend to major in STEM.
- By graduation, men outnumber women in nearly every science and engineering field, and in some, such as physics, engineering, and computer science, the difference is dramatic, with women earning only 20 percent of bachelor's degrees.

THE DIVERSITY OF STEM²D CAREERS

STEM²D careers, as well as those in the associated health and healthcare fields, cover a broad spectrum of occupations. All require workers to use their knowledge of science, technology, engineering, or math to understand how the world works and to solve problems.

A STEM²D career isn't only for people who have post-secondary degrees. Rather, STEM²D entry-level educational and training requirements vary greatly. Of the fastest-growing STEM²D occupations, nearly half require a

[10] STEM Fast Facts. (n.d.). Retrieved April 19, 2017, from http://stemcareer.com/stem-fast-facts/

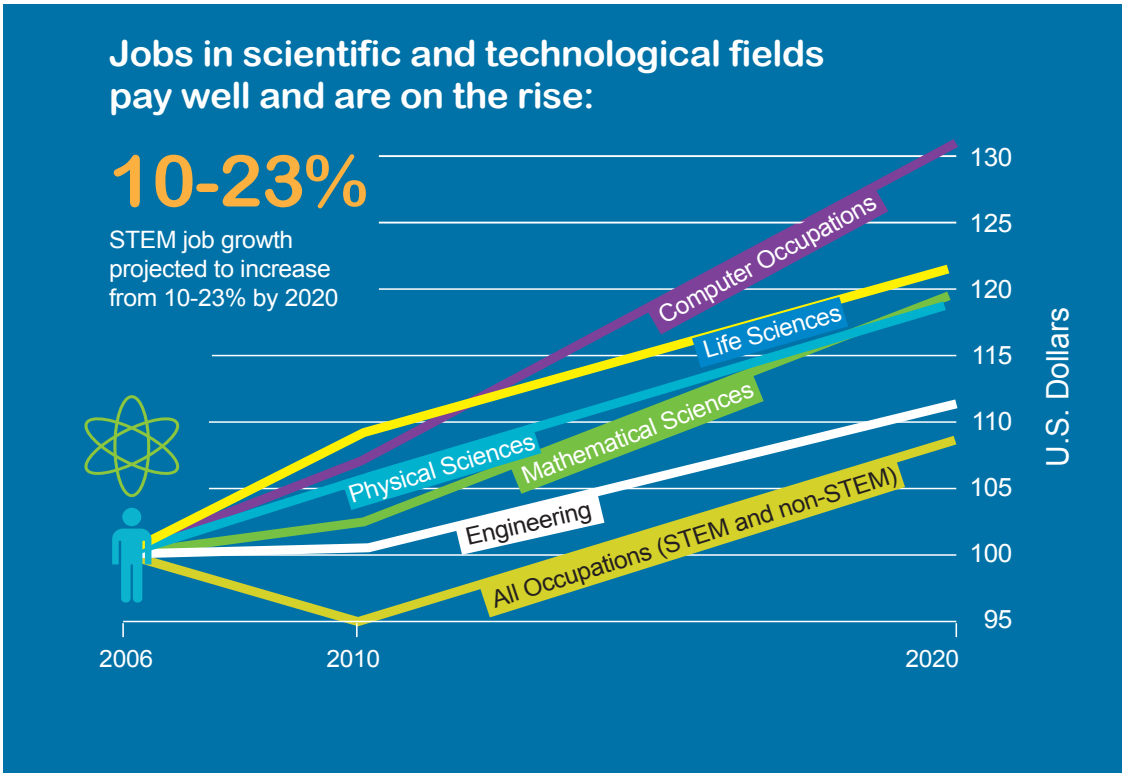
[11] Dolan, E. (2016, June 13). We Should Inspire Students in Science Now for Future STEM Jobs. *The Monitor*.

[12] Change the Equation. (2015, February). Solving the Diversity Dilemma: Changing the Face of the STEM Workforce. *Vital Signs*.

[13] Hill, C., Cobett, C., & St. Rose, A. (2010). *Why So Few? Women in Science, Technology, Engineering, and Mathematics.* (Publication). Washington, DC: American Association of University Women.

two-year Associate's degree, certificate, or the completion of an apprenticeship and pay an average of 10 percent higher than non-STEM²D jobs with similar education requirements.[14] A very small number require either some college but no degree, or a secondary-school diploma or equivalent. The remainder of STEM²D occupations require a three- to four-year Bachelor's degree. More technical and advanced jobs, including those in medicine or research, usually require additional education and training, as well as a professional or advanced degree.

Professionals in STEM occupations generally enjoy higher average salaries than those employed in non-STEM jobs. In 1970, STEM workers earned 12 percent more than non-STEM workers. By 2012, STEM workers earned 21 percent more.[15] Mean annual earnings remain higher for STEM jobs than non-STEM professional or related occupations; however, within each STEM field, there is wide variation.[16]



Source: Bureau of Labor Statistics. U.S. Department of Labor. Occupational Outlook Handbook, 2016.
Design: Smithsonian Science Education Center.

Higher wages for STEM workers can be seen across all occupations and at every education level, a trend that remains consistent across time.[17] In addition, growing demand for STEM professionals results in a tight labor market and typically low unemployment levels. For example, in September 2016, the unemployment rate for all occupations was 4.8%, while the rate for architecture and engineering occupations was 1.9%.[18]

[14] Rothwell, J. (2013, February 10). *The Hidden STEM Economy* (Rep.). Washington, DC: Brookings Metropolitan Policy Program.

[15] Rothwell, J. (2014, July 1). *Still Searching for Job Vacancies and STEM Skills* (Rep.). Washington, DC: Brookings Metropolitan Policy Program.

[16] Bureau of Labor Statistics (2016). Table 39: Median weekly earnings of full-time wage and salary workers by detailed occupation and sex. *Labor Force Statistics from the Current Population Survey.* Washington, DC: U.S. Department of Labor.

[17] Carnevale, A. P., Smith, N., Stone, J. R. III, Kotamraju, P., Steuernagel, B., & Green, K. (2011, November). *Career clusters: Forecasting demand for high school through college jobs, 2008-2018.* Washington, DC: Georgetown University Center on Education and the Workforce.

[18] Bureau of Labor Statistics (2016). Table 39: Median weekly earnings of full-time wage and salary workers by detailed occupation and sex. *Labor Force Statistics from the Current Population Survey.* Washington, DC: U.S. Department of Labor.

Depending on where their interests lie, girls can opt for one of hundreds of different careers. The 2014–2024 outlook is especially promising (with faster-than-average job-growth projections) for the following STEM²D fields:

Secondary School Diploma *(No formal post-secondary credential)*	**Non-Degree Certificate, Apprenticeship, or 2-year Degree** *(Associates)*	**3- or 4- Year Degree** *(Bachelor's)*	**Professional Degree** *(Master's or higher)*
Computer User Support Specialist	Chemical Technician	Biomedical Engineer	Audiologist
Dental Laboratory Technician	Dental Hygienist	Cartographer	Design Strategist
Derrick Operator	Diagnostic Medical Sonographer	Computer Systems Analyst	Genetic Counselor
Dispensing Optician	Environmental Engineering Technician	Industrial Designer	Nurse Practitioner
Home Health Aide	Junior Designer	Medical Sales Representative	Optometrist
Pharmacy Aide	Phlebotomists	Operations Research Analyst	Physical Therapist
Solar Photovoltaic Installer	Veterinary Technician	Personal Financial Planner	Statistician
Wind Turbine Technician	Web Developer	Registered Nurse	Supply Chain Operations Director

Source: Bureau of Labor Statistics. U.S. Department of Labor. Occupational Outlook Handbook, 2016.

For more information on the global demand for STEM²D-related occupations and various educational pathways, visit STEM²D.org.

Design: Smithsonian Science Education Center.

SPARKING INTEREST IN STEM²D

NURTURING STEM²D IDENTITY

STEM²D identity refers to a person's beliefs, attitudes, emotions, and dispositions about STEM²D and her resulting motivation and approach to learning and using knowledge. It involves the ways students think about themselves in relation to STEM²D and the extent to which they have developed a commitment to, are engaged in, and see value in STEM²D. Girls in particular have a conflict between their self-identity ("people like me") and their perception of who does STEM²D ("not people like me"). They struggle to identify with STEM²D culture and professionals.

It is important for you to understand how and under what circumstances STEM²D identity develops. Try to nurture a positive STEM²D identity as it is crucial to increasing girls' interest, engagement, and performance in STEM²D. Lack of a STEM²D identity is often cited as one of the main reasons that girls do not pursue STEM²D education and careers.[19] [20]

The existing literature on the development of girls' STEM²D identity points out the importance of the learning environment as a community of girls and young women and the need to create learning environments that foster self-efficacy.

You can nurture a positive STEM²D identity by cultivating:[21] [22]

- **Interest:** Young people who are interested in STEM²D like to do STEM²D. They are excited about it, express curiosity in STEM²D subjects, and want to try more activities. In fact, elementary school students who show this kind of interest report taking further STEM²D classes in middle or high school.
- **Confidence:** Young people who have confidence in their abilities can do STEM²D. They will persist in the face of initial failures. This is an essential feature of a growth mindset—the idea that ability and competence grow with effort. Research points out that with a growth mindset (as opposed to a fixed mindset), you believe that the harder you work, the smarter you grow. People with a growth mindset are more persistent, are encouraged by failure, and choose challenging work and subjects to study, like STEM²D.
- **Relevance:** Young people who understand the relevance and value of STEM²D want to do STEM²D. They understand STEM²D's relevance in contributing to society and solving global and local problems, and they see how STEM²D intimately connects to their everyday lives.

Identity is not static; it is developed through social processes and shared experiences. It has been documented that girls create identity in practice by combining knowledge from their in-school and out-of- school worlds. The ability

[19] ASPIRES Project. (2014). *ASPIRES: Young people's science and career aspirations, age 10-14.* London: King's College London.

[20] Leary, M., & Tangney, J.P. (2011). *Handbook of Self and Identity.* New York: The Guilford Press.

[21] Krishnamurthi, A., Ballard, M., & Noam, G. (2014). *Examining the impact of afterschool STEM programs: A paper commissioned by the Noyce Foundation in collaboration with the Afterschool Alliance & Harvard University's*
Program in Education, Afterschool and Resiliency (PEAR). Washington, DC: The Afterschool Alliance.

[22] Jolly, E.J., Campbell, P.B., and Perlman, L. (2004). *Engagement, capacity, and continuity: A trilogy for student success.* Boston: GE Foundation.

to see oneself as proficient in STEM²D is formed through a community of practice created by a teacher or any role model who provides space for children and youth to bring knowledge from their social worlds to their study of math and science.

IMPROVING STEM²D AWARENESS

Despite living in the information age, young people today are only slightly more informed than their predecessors about their career options. They often don't have a clear grasp of the diverse options and the array of career choices available to them.

Therefore, it is critical in your interactions with young people to introduce and make girls aware of the broad spectrum of STEM²D careers. You can:

- **Be a role model.** It is important to remember that during the time—even minimal amounts—spent with young people, you can serve as a role model. Exposure to female role models has been shown to improve performance on tests and to invalidate stereotypes.[23] No matter which STEM²D category, a female role model can be found. It is important to show and teach the stories of women.
- **Offer personal stories.** All volunteers—regardless of gender—can greatly enrich their time with young people by drawing on and sharing their own experiences. The **Tell My Story Form** at the end of this document supports and encourages volunteers to develop their STEM²D story and share their accomplishments in a relevant and personal way. Sample colleagues' stories are available at STEM2D.org/mystory. These shared experiences provide an opportunity for you to have an impact and help girls establish a positive STEM²D
- **Relate to the young person.** Young people have unique social, personal, and academic needs. Approach them with sincerity and respect. Learn their names and encourage their participation.
- **Provide meaningful advice.** No two people or communities are alike, and no single activity or talk will meet the needs of all young people. Connect the activities to young people's current and future needs. Personalize everything.

ENCOURAGING AND ENGAGING GIRLS

Several proven strategies can be used to encourage and engage girls in STEM:

- **Teach girls that academic abilities are expandable and improvable.**[24] If you have ever learned to play a musical instrument or participated in a team sport, you know that it takes time, effort, and practice to succeed. The same is true of STEM²D subject abilities: They improve through consistent effort and learning. Knowing the right answer may make students feel smart, but what happens when there is no right answer? Then students need to problem solve, which takes a lot of time and effort. Such problem solving can be very intriguing to girls. It is important for girls to know that cognitive abilities are not fixed or determined by gender. All it takes to close the gender gap is girls having curiosity, interest, questions, and an environment that fosters those aspects of learning.
  - ➢ **Key Strategy:** *Teach girls that working hard to gain knowledge improves performance.*
- **Provide prescriptive, informational feedback.**[25] Everyone likes to hear, "good job" in terms of their performance. However, try to amend their feedback when it comes to encouraging girls' abilities. A simple "good job" doesn't tell girls *why* they are doing well, which is important in building girls' confidence. Furthermore,

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[23] Halpern, D., Aronson, J., Reiner, N., Simpkins, S., Star, J., and Wentzel, K. (2007). *Encouraging Girls in Math and Science* (NCER 2007-2003.) Washington, DC: National Center for Education Research, Institute of Education Sciences, U.S. Department of Education.

[24] Halpern.

[25] Halpern.

stating that an answer is incorrect with no explanation can lead girls to believe they lack the ability to get it right and cannot do math and science. Informational feedback on effort and content—such as, "You worked really hard to solve that problem," or "Review your calculations in Step 3; there is a minor multiplication error,"—positively influences girls' beliefs about their abilities. This is an important strategy to keep girls interested in solving challenging problems.

➢ **Key Strategy:** *Provide girls with positive feedback about why they are doing well and specific information about how to make corrections.*

- **Create an environment that sparks initial curiosity and fosters long-term interest.**[26] Some students are naturally interested in tinkering and technology. Others have more artistic or humanitarian interests. To cultivate a long-term interest in STEM²D, exercise creativity by embedding STEM²D into fantasy scenarios, real-world problems, popular culture, and even day-to-day life. Literacy also plays a large part in this recommendation. Girls also respond well to strategies that integrate literacy with science. Reading informational text is important in the context of science because reading is something scientists do. Informational text can generate interest and further curiosity, provide data and evidence to explain phenomena, and provide the context for defining problems.

  ➢ **Key Strategy:** *Embed tinkering, creativity, and literacy into science activities in contexts that are interesting to girls.*

- **Provide spatial reasoning skills training.** Girls perform well on tests closely related to school-taught curriculum. However, questions on standardized tests do not closely match day-to-day learning. Researchers have found that spatial skills (the capacity to understand, reason, and remember the spatial relations among objects or space) are associated with performance on math tests and that spatial skills can be improved with practice.[27] To improve spatial skills, encourage girls to design and build things. Emphasize skills like mental visualization of what objects look like when they are rotated in space.[28] Even at the earliest ages, increasing spatial skills is shown to improve girls' standardized test scores later in their primary and secondary education.

  ➢ **Key Strategy:** *Have girls answer math and science problems using both verbal responses and spatial displays.*

GET INVOLVED!

To spark girls' and young women's interest with STEM²D subjects, we need to reach them where they are—in urban centers, small towns, villages, and rural communities. STEM²D must be accessible and available in a broad variety of places or settings: in schools, afterschool programs, community-based events, museums, libraries, business conference rooms, and village squares.

There are many ways to engage with this initiative, whether you want to help plan an event, share your career journey, present material in a school setting, organize a learning experience at your company for girls, or become part of a strategy team. With more than 400 volunteers to date, we are excited to grow this movement with your support and participation.

Read on for more tools, tips, and strategies to support you in WiSTEM²D volunteer experiences.

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[26] Halpern.

[27] Doolittle, A. E. (1989). Gender differences in performance on mathematics achievement items. *Applied Measurement in Education, 2*, 161–178.
Newcombe, N. (2002). "Maximization of spatial competence: More important than finding the case of sex differences." In A. McGillicuddy-De Lisi and R. De Lisi (Eds.), *Biology, society, and behavior: The development of sex differences in cognition. Advances in applied developmental psychology*, *Vol. 21*. (pp. 183–206). New York: Ablex Publishing.
McGraw, R., Lubienski, S., & Strutchens, M. (2006). A Closer Look at Gender in NAEP Mathematics Achievement and Affect Data: Intersections with Achievement, Race/Ethnicity, and Socioeconomic Status. *Journal for Research in Mathematics Education, 37*(2), 129-150.

[28] Halpern.

Tell My Story Form

This form will help volunteers serving as activity leaders prepare to talk about their STEM²D interests, education, and career path.

ABOUT YOU

Name: _____

Job Title: _____

Company: _____

When/Why did you become interested in STEM²D? _____

_____

_____

What do you hope young people, especially females, will get out of this activity? _____

_____

FUN FACT

Share a little about your background. Ideas:

- Share a memory from childhood where you first had your spark or interest in STEM²D.
- Detail your journey; highlight what you have tried, what you learned, steps to success, etc.
- Failures or set backs are also great to talk about—difficulties, and/or challenges and how you overcame them.

EDUCATION AND CAREER PATH

What classes/courses did you take in secondary school and in college that helped or interested you most?

_____

_____

How did you know you wanted to pursue a STEM²D career?

_____

_____

What was your postsecondary path, including the institution you attended and your degree? *If you switched disciplines, make sure you explain why to the students.*

_____

_____

What your current position entails. *Be sure to include how you use STEM²D on a typical work day.*

_____

_____

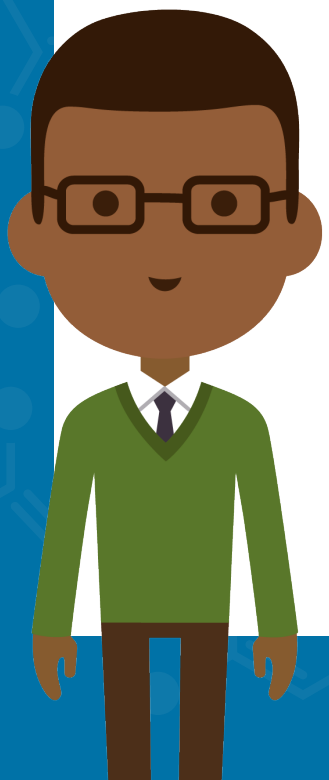
VOLUNTEER TIPS

The **WiSTEM²D** initiative relies on volunteers to engage with young people in activities that will broaden their knowledge of STEM²D and open opportunities for their future education and careers. The Volunteer Tips provide a variety of practical information to help first-time volunteers, as well as those who would like a refresher, prepare for, engage with, and inspire youth.

GET READY!

What It Means: Plan and organize.

TIPS	WHAT CAN I DO?
Engage in the WiSTEM²D initiative.	• Help plan an event, share your career journey, present material, conduct an experiment or lab, lead a team-based challenge, facilitate a STEM²D activity, or organize a learning experience at your company for girls. • Choose wisely! If implementing a hands-on, minds-on activity, lab, or experiment, chose a topic that aligns with your expertise or background. ➢ **TIP! Go to stem2d.org for ideas and activities.** • Make sure you are comfortable with the content you will be delivering. • Recruit a colleague to volunteer with you.
Visit the site where you will volunteer and observe the young people.	Note the following: • How many young people are there? • Assist with any accommodations required for young people with special needs, those who have limited language skills, or those who have difficulty reading. • How does the site encourage orderly participation? Do the young people raise their hands when responding to questions during discussions? How are interruptions handled? • What does the site do to make each student feel important and at ease? • How is the room arranged? Will you need to move desks or chairs for any part of the presentation? • How can you engage the site representative in your presentation?



VOLUNTEER TIPS

GET READY!

What It Means: Plan and organize.

TIPS	WHAT CAN I DO?
Work with and talk to the educator or representative at the site where you will volunteer.	Educators and site representatives are experts in working with youth. Ask them to: • Confirm the logistics, including date, time, and location. Be sure to exchange contact information to communicate any schedule changes. • Provide the number of students and verify their ages. • Confirm whether permission slips or photograph-consent forms are required. • Verify the site's policies regarding visitors. Most require checking in at the office or providing photo identification. Be advised that in most school settings, an educator must be present. • Offer suggestions for delivering your message to young people. • Recommend how to group or pair students. • Assist with any accommodations required for young people with special needs, those who have limited language skills, or those who have difficulty reading. • Help with acquiring any audiovisual or technological equipment or setting up the room. • Review or introduce key concepts prior to your presentation to prepare the young people. • Review and reflect on key concepts after you leave.

VOLUNTEER TIPS

GET SET!

What It Means: Prepare and practice.

TIPS	WHAT CAN I DO?
Practice! Practice! Practice!	• Prepare your remarks in advance. • If designing an activity for students, be sure it incorporates the STEM²D Philosophy. • Do a trial run. Complete all calculations, labs, experiments, and/or real-life scenarios prior to presenting to young people. • Secure materials and make photocopies of any student handouts, based on the total number of students attending.
Be student centered.	• Tailor your remarks to meet student needs. • Use language, examples, and analogies that connect with young people. • Provide the material in an attention-capturing manner. • Use PowerPoint slides or other visuals to support your presentation. • Use PowerPoint slides or other visuals to support your presentation.
Tell your story.	• Be yourself. • Talk about your early aspirations, your current job, and how you got it. • Use the **Tell My Story Form** (available at STEM2D.org/mystory and in this guide), which will prepare you to talk about your educational and career path.
Think about pairing students or using groups.	• Consider randomly assigning students. ➢ **TIP!** Diverse groups are better at solving problems because they expect all members to share their unique perspectives, experiences, and background information to solve the problem or complete a task. ➢ **TIP!** Ask the young people to number off, beginning with one, and to remember their numbers. Assign groups based on numbers. • Try assigning roles to each team members: timekeeper, reporter, recorder, leader, etc.

VOLUNTEER TIPS

GO!

What It Means: Implement! Start engaging with youth!

TIPS	WHAT CAN I DO?
Be conscious of time.	• Arrive early! This will give you time to set up the room, review your plan, prepare visual aids, and test any electrical equipment, as well as relax. • Begin on time and end on time. • Provide a 10- to 15-minute break every 1.5 hours.
Get off to the right start.	• Wear business/appropriate attire; look like an "expert.". • Greet the students in a friendly and professional manner as they enter the room. • Introduce yourself to each student. Give your name, ask for the student's name, smile, shake hands (if appropriate), and maintain eye contact. This will make everyone more relaxed • Consider using name tags or table tents. • Determine what the young people already know about a concept or topic: ➢ **TIP!** Ask: What do you know about this topic? Do you have any experience working with this topic?
Set the stage.	• Share expectations. Explain to the young people that there are established expectations that ensure the success of a hands-on or interactive activity, project, lab, etc. ➢ **TIP!** Sample expectations: Everyone participates and shares her or his knowledge; participants must work together and help one another; and everyone listens with respect.
Give clear and logical directions.	• Ask if clarification is needed. • Frequently check for understanding by asking process questions. • Give directions before separating the large group into pairs or teams. • When particular skills are required, such as mathematical calculations, provide an example or demonstration of the process before asking young people to solve the problem. • Involve everyone. Let hesitant students know that you value their contributions, but that silence is also acceptable. • Avoid criticizing, placing value, or rejecting wrong answers. • Use non-verbal recognition, like nodding, smiling, and gestures.

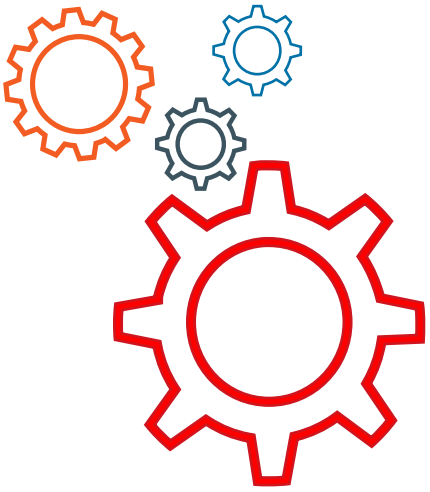
VOLUNTEER TIPS

GO!

What It Means: Implement! Start engaging with youth!

TIPS	WHAT CAN I DO?
Ask open questions.	• Encourage participants to view one another as resources. ➢ **TIP!** When a participant makes a comment or asks a question, ask the group, “What do you think?” or “Would anyone like to respond to what was just said?” • Avoid questions with yes-or-no answers. ➢ **TIP!** Sample open-ended questions are: What do you think? What ideas does this conversation spark for you? What would you recommend?
Listen actively.	• Ask one question at a time. • Wait at least five seconds for an answer. • Do not answer your own questions. ➢ **TIP!** Use the following active-listening strategies: ➢ Paraphrase: Repeat a question or comment made by the student. This helps all participants to hear what has been said, as well as validate that the student was heard. ➢ Mirror: Capture the student’s exact words. ➢ Encourage: Create an opening for the student to say more. Try: Can you give an example? What questions does this raise for you? ➢ Introduce intentional silence: Give a few seconds of extra time for students to determine what they want to say.
Encourage and engage female students.	• Give recognition for hard work. • Provide prescriptive, informational feedback. ➢ **TIP!** Instead of a simple “good job,” tell students why or describe how they are doing. • Encourage girls to take leadership roles. • Spark their interest! ➢ **TIP!** Use fantasy scenarios, real-world problems, popular culture, and even day-to-day life examples. • Encourage and promote spatial reasoning, critical thinking, and communication skills.

HAVE FUN!



VOLUNTEER TIPS

REFLECT!

What It Means: Consider and think.

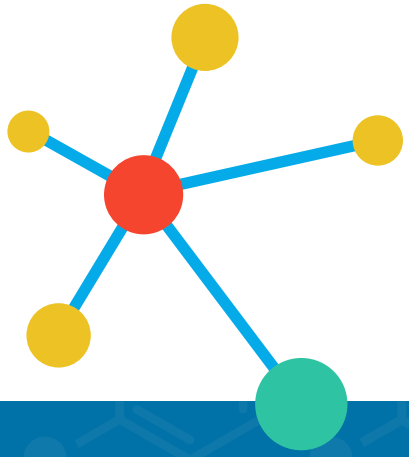
TIPS	WHAT CAN I DO?
Have students summarize what they learn.	• Provide time for students to reflect on what they learned and how it affected their STEM²D beliefs, attitudes, interests, and confidence.
	• Encourage students to reflect on how STEM2D can contribute to society, solve global and local problems, and connect to their everyday lives.
Set aside time for self-reflection.	• Reflect back on both the strengths and challenges of the experience, as well as your implementation techniques; make changes, if necessary, for future sessions.

VOLUNTEER TIPS

TIPS FOR DEALING WITH THE UNEXPECTED

What It Means: What to do when things don't go as planned.

CHALLENGE	HOW DO I RESPOND?
A student gets off the topic.	• That is very interesting. Let's get back to the original question we were addressing. • I appreciate your comment. Since our time is limited, let's stay focused on the topic at hand. • Let's stay focused so that we can keep moving.
One student wants to dominate the conversation.	• Can we hear from someone else who sees it differently? • Has anyone else here had a similar experience? • What do other people hear (insert name) saying? • You have made some good points. Let me recap what you have said. • Let's hear from this side of the room. Try not to call on participants by name. • This question is only for the (insert a characteristic, such as students wearing blue, girls wearing a necklace, students with blue eyes, etc.).
Students quiet	• Let's hear from some of you who have not shared yet. Do you agree with what you just heard?
Students are talking at the same time.	• We want to hear what everyone has to say, but we will not be able to hear anyone if we talk over one another. • Let's share "air time" so everyone gets a chance to speak. • We do not want to miss a great comment.
A student is disagreeable.	• Everyone has the right to his/her own thoughts and feelings on the subject. Perhaps what we talk about next will be more in alignment to your ideas. • It is important to listen to everyone's opinions. • It sounds like you have some strong feelings about this subject. I would be glad to discuss with you at a later time. • My experience (or the research) shows it can work. I would be happy to share my experience (or the research) with you after this session.



Leave discipline of students to the implementation site representative.

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