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Top 5 STEM Activities for Gifted Youth

Charlton Wolfgang, Ph.D., Central Pennsylvania Mensa, USA

Gifted learners may possess many key characteristics necessary for success in STEM fields, including high levels of curiosity, strong problem-solving skills, creativity, capacity for abstract thinking and reasoning, and high levels of persistence and a willingness to tackle challenging problems (Ulger & Çepni, 2021; Watters & Diezmann, 2003). These characteristics can be further nurtured and developed through participation in STEM activities. By providing opportunities for gifted learners to engage with STEM concepts, participate in authentic research projects, and develop their skills in these areas, we can help them unlock their full potential and prepare them for successful careers and further education in STEM fields. In the next section, we will highlight five free or low-cost STEM activities that are well-suited for gifted learners of all ages.

Key Points

- Gifted traits such as curiosity, creativity, problem-solving skills, abstract thinking, and persistence can be nurtured through STEM activities.
- Projects are an effective way to get students involved in authentic STEM practices.
- Engagement in authentic projects helps gifted students develop their STEM skills and prepares them for future education and careers in these high-needs fields.

Citizen Science

Citizen science involves large groups of people collecting and analyzing data on various scientific topics. For instance, students can participate in citizen science projects that collect data on bird populations in their backyard or air quality in their neighborhood. The data collected by these projects can be analyzed using big data and AI techniques to identify patterns and trends that would be difficult to detect otherwise. By participating in these projects, students can learn about scientific processes and contribute to authentic scientific research. Examples of citizen science opportunities include SciStarter, Zooniverse, citizenscience.gov, and NASA's Citizen Science projects.

MakeyMakey

This is a low-cost microcontroller that is plugged into a laptop via the USB or USB-C port that functions as an alternative input. It allows the user to turn everyday objects such as food, strips of aluminum foil, or any other conductive material into touchpads and keyboards. One of the advantages of MakeyMakey is that gifted learners of all experience levels can use it. No coding experience is needed to begin using it; however, even advanced coders can develop and create their own programs to interact with the MakeyMakey. There is an active maker community that posts videos and tutorials, sharing examples of the creativity involved in the MakeyMakey community.

Coding Software for Students

The emergence of generative Artificial Intelligence (AI) and the rapid uptake of this nascent technology has cast a spotlight on coding. Despite some contention that AI will replace the need for programmers and any knowledge of coding, it actually highlights the need for a basic understanding of coding. Having a basic understanding of coding helps gifted learners in a variety of ways, including demystifying what is happening behind the cell phone screen, increasing creativity by empowering them to express themselves, increasing problem-solving skills and persistence, and fostering the development of executive functioning skills such as planning and mathematical thinking (Hebda, 2023). Examples of coding software include code.org (which is an entire coding ecosystem and learning system), Blockly, and Scratch and Scratch Jr. (which interface well with the MakeyMakey).

Engineering Design Challenges

A more general category of activities well-aligned with the characteristics of gifted learners is the use of engineering design challenges. Engineering design is a key component of STEM education that emphasizes open-ended problem-solving and encourages gifted learners to learn from failure. Embracing the lessons learned from failure teaches students that real learning often takes place in the struggle and helps them to develop resilience, which is a characteristic that gifted learners won't develop and refine if learning is always easy. Engineering design challenges focus on the iterative design process, encouraging students to reflect on the process through a series of feedback loops by uncovering new design possibilities to arrive at innovative solutions. A quick internet search will reveal many different ready-made design challenges. Recommended resources include Science Buddies, Teach Engineering, The Tech Interactive, and the STEM Activity Clearinghouse.

Reverse Engineering Activities

The last activity that we highlight here is the use of reverse engineering. Many gifted learners have an innate desire to know how things work. Reverse engineering of an object involves taking a finished product and deconstructing or disassembling the object into its component parts. Students can use this process to see how an object is designed and can figure out what steps an engineer might take to design and integrate the separate components into producing the finished product and its desired outputs. Reverse engineering can also be used to focus on creative and critical thinking by having students make suggestions for improvements to the design of an object, resulting in improvements in an object's function or improved cost efficiency. Repurposing an object or its components can be an additional outcome of reverse engineering.

Helpful Resources

Blockly
blockly.games

Citizen Science
citizenscience.gov

Code.org
code.org

MakeyMakey
makeymakey.com

MakeyMakey YouTube
youtube.com/c/makeymakey

NASA's Citizen Science
science.nasa.gov/citizenscience

Science Buddies
sciencebuddies.org

SciStarter
scistarter.org

ScratchJr
scratchjr.org

STEM Activity Clearinghouse
clearinghouse.starnetlibraries.org

Zooniverse
zooniverse.org

References

Hebda, M. R. (2023). Technology talent development: Beyond an hour of code. *Gifted Child Today, 46*(2), 108-118.

Ulger, B. B., & Çepni, S., (2021). Gifted education and STEM: A thematic review. *Journal of Turkish Science Education, 17*(3), 43-466.

Watters, J.J. & Diezmann, C. M. (2003) The gifted student in science: Fulfilling potential. *Australian Science Teachers Journal,49*(3), 46-53.