National Inventors Hall of Fame®

WHAT DO CHILDREN WANT TO BE WHEN THEY GROW UP?

Children are dreamers. When left alone, they'll create imaginary worlds and need little convincing when it comes to trying new things. It's no surprise when adults ask children what they want to be when they grow up, the responses are myriad. Answers range from professional athlete to movie star to doctor. Theirs is an age where the only limitations are the ones they place on themselves.

Of course, not everyone can become a famous basketball player or star in the next Avengers® movie. However, this does not mean children must stop dreaming for the sake of practicality. A career in science, technology, engineering and mathematics (STEM), for instance, embraces creativity and gives working professionals the freedom to innovate. Even at a young age, children are drawn to these sorts of jobs. **According to a 2017 nationwide survey that asked more than 1,000 boys and girls under the age of 12 what they wanted to be when they grew up, five of the top 10 jobs were STEM related.[1]**

Campers observe their Optibot™ tracks in action at a Camp Invention™ program

Yet, despite this high level of interest in STEM careers at a young age, it is estimated that by the end of 2018, 2.4 million STEM jobs will go unfilled.[2] Girls especially are losing interest in these fields as they age, and in 2015, they comprised only 25 percent of the STEM workforce.[3] We must do a better job of supporting children's interest in STEM from a young age, and it begins with encouragement and exposure to innovation.

BATTLING A LACK OF EXPOSURE TO INNOVATION

Developing an inventive mindset at an early age is crucial to both pursuing and succeeding in a STEM career field. However, according to a 2017 study from the Equality of Opportunity Project, there exist large disparities in innovation rates by socioeconomic class, race and gender.[4]

The primary variable that determines whether a child will grow up to be an inventor is if they are exposed to innovation at a young age. Low-income and minority families are much less likely to experience this exposure than white and or affluent families. Because of this, students who fall under these demographics are much less interested in STEM fields compared to their counterparts as they grow up.[5]

- **Children from high-income families are 10 times more likely to become inventors than children from low-income families.**
- **White children are three times more likely to become inventors than African-American children.**
- **18 percent of patented inventors are female.**

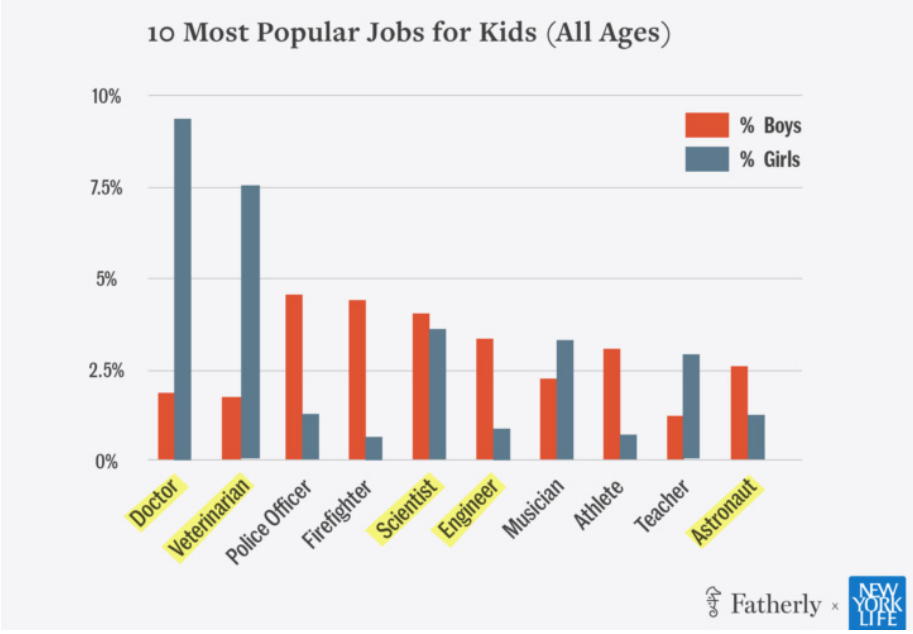

Image retrieved from https://www.fatherly.com/love-money/work-money/the-2017-imagination-report-what-kids-want-to-be-when-they-grow-up/[1]

1. Fatherly, & New York Life. (2017, December 22). The 2017 imagination report: What kids want to be when they grow up. Retrieved from https://www.fatherly.com/love-money/work-money/the-2017-imagination-report-what-kids-want-to-be-when-they-grow-up/
2. Smithsonian Science Education Center. (2018). The STEM imperative. Retrieved from https://ssec.si.edu/stem-imperative
3. Noonan, R. (2017, November 13). Women in STEM: 2017 update. Retrieved from https://www.commerce.gov/news/fact-sheets/2017/11/women-stem-2017-update
4. Bell, A., Chetty, R., Jaravel, X., Petkova, N., & Van Reenen, J. (2017). Who becomes an inventor in America? The importance of exposure to innovation. DOI: 10.3386/w24062
5. Ibid.

National Inventors Hall of Fame® Inductee Radia Perlman with a Camp Invention participant

CHANNELING CREATIVITY

In addition to exposing students to innovation, studies have also shown that those who participate in arts activities beginning at a young age are more likely to become innovators in adulthood. According to research from Michigan State University, there exists a strong correlation between arts and crafts knowledge and producing patentable inventions or founding new companies. Furthermore, the majority of STEM graduate students surveyed believe this early arts influence stimulated their innovation and entrepreneurship qualities.[6] Early arts exposure, combined with interactive STEM education, can attract students normally drawn to less technical subjects. This becomes increasingly important as legislators around the nation attempt to balance public school budgets by cutting art and music programs. Education in these subjects contributes to a well-rounded student who is successful in both innovation and STEM fields.

ENCOURAGING GIRLS IN STEM

One of the main contributors to the low number of women working in STEM fields is the fact that there exist comparatively few female role models and mentors. A study of out-of-school programs like camps, outreach programs and internships found that this lack of mentorship for young girls may contribute to girls' perceptions of who does science and to their own views of themselves as science insiders or outsiders.[7] A 2017 study from Microsoft supports these findings and found that one of the main reasons girls chose not to follow a career in STEM was because they lacked a female role model.[8]

This effect can be mitigated by encouraging girls to participate in authentic science activities like simple experimentation, especially when led by female educators. Challenging stereotypes of who can conduct science experiments allows girls to better identify with the field and reinvigorates their childhood interest in STEM subjects.[9] The Equality of Opportunity Project estimates the gender gap in innovation would "fall by half" if girls were exposed to female inventors as often as boys are to male inventors.[10]

INTRODUCING CHILDREN TO INNOVATION

Introducing children to innovation as they mature is a leading factor in determining whether they will become inventors in adulthood. Those who grow up in families who embrace creative thinking are far more likely to pursue careers that allow them to use this skill set. In fact, those whose parents hold patents in a certain technology class are more likely to innovate and hold patents in this same area.[11] For example, if a parent holds a patent in nuclear technology, their child is more likely to also hold a patent in nuclear technology than in a different field.

Additional exposure to STEM fields cannot be limited to formal education, as science in the classroom is sometimes overlooked until students reach middle school. Only 4 percent of teachers for kindergarten through second grade earned undergraduate degrees in science or science education. This makes sense, as teachers for this age range are typically expected to be generalists, and not specialize in particular areas or subjects.[12]

EMBRACING OUT-OF-CLASSROOM EXPERIENCES

Out-of-school programs and summer camps can make a significant impact on students' futures in innovation, especially when these exposure programs target children from underrepresented groups in the STEM industries.[13] These programs can help make up for the lack of exposure to innovation that minorities and low-income children receive due to the neighborhoods they grow up in. Outside exposure to STEM careers from experts and educators can guide children's futures by inspiring them to follow their passions.

It's not enough to tell kids they can become anything they want when they grow up. Instead, they must be exposed to a wide array of skill sets at an early age to make informed decisions about what career field they'd most like to pursue. According to Alaina Rutledge, vice president of education research and development at NIHF, outside programming that allows students to explore STEM topics on their own is essential to sustaining interest over the long term.

"It's important that instructors give students permission to take ownership of their own learning," Rutledge said. "Only through exploration can children discover what STEM topics are most interesting to them and what they might consider learning more about as they age."

6. LaMore, R., Root-Bernstein, R., Root-Bernstein, M., Schweitzer, J. H., Lawton, J. L., Roraback, E., & Fernandez, L. (2013). Arts and crafts: Critical to economic innovation. *Economic Development Quarterly, 27*(3), 221-229.
7. Riedinger, K., & Taylor, A. (2016). I could see myself as a scientist. *Afterschool Matters, 23*, 1-7.
8. Trotman, A. (2017, March 1). Why don't European girls like science or technology? Retrieved from https://news.microsoft.com/europe/features/dont-european-girls-like-science-technology/
9. Riedinger & Taylor (2016).
10. Bell et al. (2017).
11. Ibid.
12. Falk, J., & Dierking, L. (2010). The 95 percent solution. American Scientist.
13. Ibid.