



News & Highlights

Engineering Stars at Google Science Fair

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Most of the young winners of this year's Google Science Fair (GSF) revealed themselves to be imaginative engineers-in-the-making [1]. At the July 2019 final winner selection event held at the Google headquarters in Mountain View, California, the schoolchildren, from all over the world, showcased their novel solutions to pressing environmental and health challenges, such as plastic pollution, diabetes, and deafness.

Entrants to the annual competition, begun in 2011 and open to children aged 13–18 (in two age groups, 13–15 and 16–18) first pick a topic from a defined list of 13, such as earth and environmental sciences, inventions and innovation, biology, and physics. The budding scientists and engineers are required to complete an eight-section entry, including their research question/proposal, research methods, results, and conclusions [2]. Slides or a video presentation are also permitted, and projects are scored on a 50-point scale. Thousands of submissions were made from mid-September to mid-December 2018.

From an initial short list of 100 entries selected in May 2019 through a judging process linked to score, global region, age group, and category, 20 global finalists, drawn from 14 countries, were chosen. These finalists (Fig. 1)—several of which were teams of two children—presented their work at the July 2019 final event to a panel of high-profile judges, including Google vice-president and Chief Internet Evangelist, Vinton Cerf. Hosting the event was science communicator Dianna Cowern, known to the 1.4 million subscribers to her YouTube channel as “Physics Girl.”

The winner of the Google Grand Prize, a \$50 000 USD educational scholarship, was Fionn Ferreira from County Cork, Ireland (Fig. 2). Aged 18, Ferreira was already a veteran of national and international science fairs: In 2018, his prizewinning efforts at the Intel International Science and Engineering Fair resulted in a minor planet being named after him. Ferreira's entry in the GSF was the scientific exploration of a technique to remove microplastics from solution. Microplastic particles, which range from 5 mm in diameter down to microscopic size, are a growing problem in the ocean. They are typically the breakdown products of the enormous amount of plastic pollution already in the ocean, synthetic microfibers washed from clothing or microbeads from cosmetic products. The particles are consumed by small organisms and accumulate up the marine food chain, causing a wide range of potential harms [3,4]. Using a range of home-built equipment, Ferreira explored a potentially sustainable process to remove



Fig. 1. The 24 global finalists of the GSF 2019 presented their work at the final winner selection event at Google headquarters in Mountain View, California, in July. Credit: Google (public domain).

microplastics from solution. It involved adding oil and magnetite powder to the solution and shaking it vigorously. The oil, magnetite, and plastic particles clumped together and more than 85% of plastic particles could then be removed by a magnet.

Four other major-prize winners scooped awards worth tens of thousands of dollars, each including a \$15 000 USD educational scholarship. Three of these entries were engineering-focused solutions to health or environmental challenges. Of those, Tuan Dolmen of Turkey, in the 16–18 age group, won the Scientific American Innovator Award for a low-cost module he designed to harvest mechanical energy from wind-caused tree vibrations. The sustainable generation of energy in rural areas is a key aspect of “precision agriculture,” which often relies on low-power wireless sensor networks in farm fields [5]. Dolmen developed a cantilever-beam-based piezoelectric generator device that attaches to a tree trunk and can be used to power a range of agricultural sensors and transmit their data wirelessly.

Celestine Wenardy from Indonesia, in the 13–15 age group, won the Virgin Galactic Pioneer Award for her work on a low-cost glucose monitor for people with diabetes that does not rely on drawing blood. With the fourth largest population in the world (after China, India, and the United States), Indonesia has a growing problem with type II diabetes that is compounded by inconsistent



Fig. 2. The winner of GSF 2019, Fionn Ferreira from Ireland, shows off his winner's trophy with Vinton Cerf, competition judge and Chief Internet Evangelist at Google. Credit: Google (public domain).

access to healthcare across the archipelago [6,7]. Wenardy's device calculates blood glucose levels non-invasively using a combination of thermal technology and optical coherence tomography.

The Lego Education Award went to finalist Daniel Kazantsev of Russia, in the 16–18 age group. His aim was to develop discreet technology to facilitate communication between deaf people who use sign language and hearing people. The World Health Organization estimates that 466 million people worldwide have “disabling hearing loss” [8]. Kazantsev engineered a sensor-laden forearm cuff that used electromyography to detect electromechanical activity in forearm muscles. He then used neural network-based computing to convert the sensor data from his prototype to interpret the sign-language gestures made by the wearer's hand and arm, finally outputting the meaning of the gestures aloud, in words.

Of the 24 children among the global finalists, the gender mix was 13 girls and 11 boys. “It's important for everyone to see this kind of diversity in capable young innovators,” said Cowern. “These very motivated girls and boys are role models to other young scientists.”

Norman Fortenberry, the executive director of the American Society for Engineering Education, was also encouraged by the gender balance of the finalists. “This is an important accomplishment. I think the open-ended nature of the problems to be addressed, with their greater connection to the human side of engineering challenges, is what allows competitions such as GSF to attract more girls, and members of other populations underrepresented in engineering.” Fortenberry also noted that many American universities are now seeing increased gender

parity in their science and engineering classes. In 2018, for example, Cornell University's College of Engineering enrolled equal numbers of men and women for the first time in its history [9]. And in the United Kingdom this year, the female students taking A-level exams in sciences outnumbered the males, also for the first time in history [10].

But whether competitions like the GSF fuel interest among students in science, technology, engineering, and mathematics (STEM) subjects more broadly is debatable, said physicist Jess Wade of Imperial College London, a high-profile advocate for women and minorities in STEM, and one of Nature's “ten people who mattered this year” in 2018 [11]. “The students who have the confidence to enter this competition were pretty lucky even before they entered, because you need a really switched-on science teacher or fully engaged parents to do this,” Wade said.

While competitions like the GSF provide an important way for corporations to promote interest in STEM, more is needed, Wade said. “In countries such as China and South Korea, whose children always do exceptionally well in these sorts of competitions, teachers are valued and respected in society, and properly paid. Globally, we need to collectively celebrate and support science teachers, to help more of them produce more of these fantastic children.”

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