Nanoheroes assemble

Nanotechnology and superheroes can inspire high school students to explore science, as Lisa E. Friedersdorf and Quinn A. Spadola explain.

There are many aspects of a student's life that compete for their time: academics, sports, jobs, friends, family, and various other extracurricular interests. And while some high school students are naturally drawn to science and will take the initiative to learn more, many are not and do not see the connection to their everyday life or interests. Even the students that excel at maths and science may simply be going through the motions of solving problems without really grasping the power that comes with a scientific understanding of the world around them or developing the passion to make science a part of their life. When I (Lisa Friedersdorf) taught high school chemistry and physics at a small Quaker school in Charlottesville, Virginia, I found examples, stories, and hands-on activities that intersected student experiences could keep them engaged. The concept of centre of gravity is more real when you fall out of a canoe. Projectile motion is more fun illustrated as a class project with foam darts on a beautiful spring day. But where I really saw the passion develop was when a student's curiosity was piqued and they completely lost themselves digging into a concept to learn more.

Now, at the National Nanotechnology Coordination Office, our experience teaching at the high school and university levels (Lisa Friedersdorf) and in film and science communication (Quinn Spadola) informs all of our education and outreach efforts. Beyond the desire to increase the number of science, technology, engineering, and mathematics (STEM) students in the professional pipeline, the accelerating application of nanotechnology into products, from stain-resistant clothing to high-end electronics, intensifies the need for students, and the broader public, to have a basic familiarity of nanotechnology. We have developed image and video contests aimed primarily at university student researchers, partnered to produce educational videos for science classrooms, and collaborated with graphic design students to create nanotechnology-themed animations for the general public. We are also facilitating a nationwide network of undergraduate student groups and have assembled a vast array of resources for teachers. What we are

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most excited about, however, is a superhero contest for high school students.

Nanotechnology and superheroes are a natural combination. The extraordinary properties that exist at the nanoscale enable gecko-inspired climbing gloves, invisibility cloaks, and strong, lightweight materials ideal for costumes and vehicles. With the popularity of comics and superhero movies, we thought a contest had the potential to elicit the type of curiosity that would get high school students excited to dig in and learn more about nanotechnology. Furthermore, we hoped that the combination of super-materials and superheroes would reach students that might not normally explore science in their spare time. And a little competitive spirit never hurt.

We fashioned Generation Nano: Small Science, Superheroes to motivate students to use nanotechnology to design gear for their own original hero. Superhero abilities may often appear magical rather than being grounded in science and technology. But, nanotechnology is uniquely capable of both explaining many popular superheroes' abilities and inspiring students to dream of talents for their heroes. Students were encouraged to explore nanotechnology, both applications and current cutting-edge research, and to reasonably extrapolate what might be possible in the future. Once the students discovered that their superhero really could have an invisibility cloak; create energy with their movements; heal the sick using nanomedicine; or provide clean water using nanopore filters, they had to create a world for their hero and tell a story in the form of a comic or video. Science requires imagination, a fact that is often lost to high school students. This competition gives them the chance to learn about nanotechnology, use that knowledge to create gear for their own hero, and then build a story around how nanotechnology helps their hero. This process shows students how important their

voice and creativity is when thinking of ways to solve problems using science.

With the help of our colleague Mihail Roco, Senior Advisor for Science and Engineering at the National Science Foundation (NSF), we reached out to the public affairs office at the NSF to pitch the concept. Susan Mason and her team liked the idea and ran with it. With the infrastructure, experience, and contacts necessary to successfully run such a contest, the NSF launched Generation Nano: Small Science, Superheroes (<http://go.nature.com/47uX2K>) in November 2015. The competition closed 2 February 2016, and the finalists were invited to present their superheroes at the USA Science and Engineering Festival in Washington DC on 16–17 April. The USA Science and Engineering Festival (with over 300,000 visitors expected) was selected as the venue to further promote both nanotechnology and the contest to the broader public, and to provide the finalists with the opportunity to experience the many STEM-focused exhibits. Through their contacts, the NSF even got the attention of legendary comic creator Stan Lee, who helped promote the contest through his social media. In one tweet, he wrote "Nanotech is the real science of imagination." We expect this contest will inspire the next generation of nanoscientists and engineers, and who knows what revolutionary revelations await our resourceful heroes.

To be continued...

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