

MOTIVATING CHILDREN TO BECOME ENGINEERS:
THE TEAM GOAL OF FOUR OREGON AND NATIONAL GROUPS, INCLUDING IEEE

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One would have to make a concerted effort NOT to recognize that bright students are progressively less interested in technical careers. Engineering, in particular, has become associated with being "uncool" and nerdy, bordering on something of a fallback position for those who can't make it into more "desirable" professions.

This is both sad and scary. If today's children are not to become tomorrow's engineers, our future is in serious jeopardy, as we will not be able to maintain a continuously improving standard of living we have come to take for granted. The average age of practicing engineers is increasingly graying, retiring faster than they can be replaced by new graduates.

There are several reasons for this engineering drop-off. For one, due to a shortage in funding, our space program has been significantly reduced, a field that used to inspire young minds with passion, dedication, and the pursuit of a lofty goal. Today's children are not motivated in the same way, and by the same objectives, as they were 30 years ago. Repeated studies have shown that our bright, middle class youth feel virtually no fear of poverty. Instead, and perhaps rightfully so, their belief is that no matter what happens, someone will step in to ensure they are provided for. The result is that the former appeal of engineering, as a stable, financially secure profession, has lost much of its lure. Shifting the onus of cradle-to-grave security onto others has reduced incentive, motivation, and work ethic, replacing them with "image" professions where it's more important to look and feel good and be admired than challenged and accomplished.

While the majority of today's children have the same energy, ambition and intelligence as children 30 years ago, they lack the patience of their parents to wait for rewards. This is especially relevant today, which may further explain the drop-off in engineering enthusiasm. Traditionally, engineers were first taught the tools of the trade—math, science, physics, and chemistry. Once these tools were mastered, and students graduated from engineering school, only then were they assigned exciting projects. This technique does not work on today's youngsters, raised on the internet and MTV, used to getting solutions before the next commercial. New motivational approaches are called for, especially in the recruitment of girls and minorities, who traditionally shun engineering.

In contrast to that pessimistic note, wouldn't it be wonderful if middle school students actually enjoyed engineering? That's what happened to 500 Hillsboro middle school students, April 12th, at Intel's Jones Farm Campus. Intel introduced the new PBS series, [Design Squad](#), which it sponsored in part by Intel and airs on OPB Sundays at 12:30 pm. "Design Squad" features two teams of high school student contestants, solving a myriad of problems, such as the construction of dragsters and musical instruments. The intent is to introduce grade school and middle school students to engineering by challenging competing teams to think "out of the box." Enabling kids to wrap their brain around an engineering project, formulate a problem-solving plan, build from scratch, then test using non-conventional materials, taps into their innately curious minds, forcing them to think for themselves and as part of a team.

The Design Squad concept was pioneered and produced by Ellen Robinson at Station WGBH in Boston, Massachusetts. While others, perhaps more qualified than these authors, may have other opinions of what is happening with this program, in our view this form of training is turning traditional engineering education and motivation on its head. We feel this model involves assigning non-technically trained students projects that are traditionally solved by engineers. Two student teams are assigned these projects. Thinking their way through the best way to "engineer," then build these projects, becomes a contest between two teams—the Blue and the Red.

The rules of engagement impose strict limits on time, money, and outside resources, just as in real engineering projects. Now all the excitement of sports, competition, results and the unfolding of a project right before their eyes becomes irresistible, a challenge to motivate these students to consider

and embrace engineering as a valuable and fulfilling career. As soon as they learn standard engineering tools, they quickly realize how valuable these tools would have been had they been available during the "Design Squad" competition. That is how we see it, and we like it a lot.

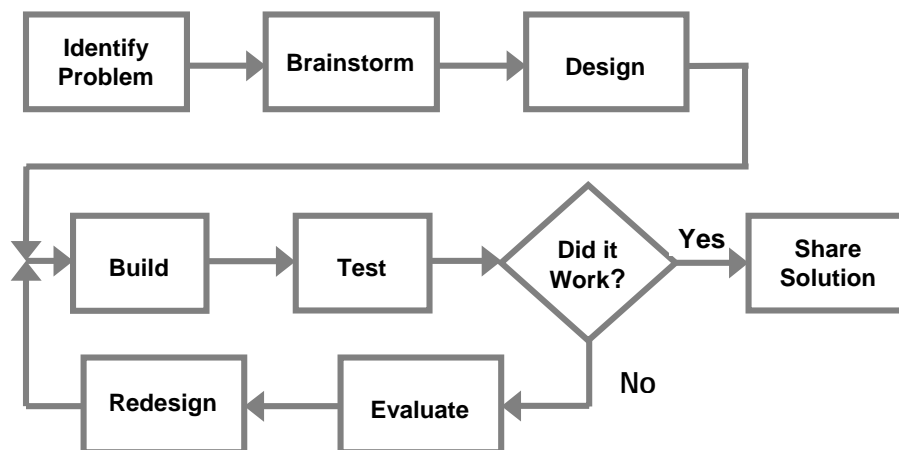
Each episode makes the essential engineering activities of brainstorming, designing, building and testing come alive by demonstrating their use. Often, what they first try, based on instinct alone, does not work. They have to evaluate why it failed and move forward—just as in real life. When they finally get it right, it's the result of using valid engineering techniques. Their respect for how "cool" engineering can be, the methods that actually worked and their joy in applying those techniques becomes absolutely obvious from the first moment. It's a "high" that's difficult to shake off!



At Intel, middle school students were given the opportunity meet two show cast members, co-host Nate and high school contestant Natasha, and to design solutions to several challenging problems. Challenges included constructing a kinetic sculpture out of everyday printer paper and string. Another was a highrise tower supporting a tennis ball while withstanding the wind from a fan. In keeping with the space age, students fabricated a foot-powered ping-pong ball launcher, which projected the ball high enough to catch it. Also designed, and built, was a hidden pressure sensitive alarm and dance pad, which clicked each time the foot tapped it. These and other engineering design challenges for 9 to 12 year olds are described in the [Educator's Guide](#). "How to Organize a Design Squad Event" is in the [event guide](#). The challenges can be used by parents after-school leaders, and teachers, to provide a fun and extremely educational activity for kids.



The Design Squad TV show and student challenges emphasize the design process, using the same protocol as engineers:



The general Design Process concept is based on the practice of engineering, this process, with the theory to follow later. Without a real problem to solve, the theory will have far less meaning. Learning is from direct observation of their efforts. In each challenge, kids brainstorm, design, build and test. Demonstrated in the TV show, and emphasized in the objectives, are the time-honored engineering principles of understanding why something didn't work, then trying again.

Each show project has constraints—limitations on materials, components, tools and time—which provide excitement as well as innovative solutions. After we watched the video clips, we interviewed Nate, one of the show's hosts, and Natasha, a cast member. We asked Nate about his biggest

challenge, and he said letting the high school contestants struggle through the projects when it would have been so much easier to show them the standard engineering solution. Natasha was asked the hardest thing about being a contestant. She, along with most of the other kids, said she had trouble letting go of her own ideas and working to combine the best of everyone's. She added, "Knowing the team members really helped in working toward the pride of ownership idea."

When students finished working on the projects, they watched excerpts from the first episode, "The Need for Speed," in which one team built a dragster from a tricycle, and the other from a red wagon. To see who won the drag race, and pick up on all the action, watch the show on [OPB](#), or check out the [Design Squad web site](#).

Major funding for "Design Squad" is provided by the National Science Foundation and Intel. Significant other funding provided by IEEE, American Society of Civil Engineers, Tyco Electronics, National Council for Engineering Examiners, Harold and Esther Edgerton Family Foundation and the Noyce Foundation. The program is one of many efforts and activities that expose kids to the joy of engineering.

The Design Squad project got started in the Portland, OR area when Intel, one of the more educationally-minded companies, agreed whole-heartedly to be a local champion. In fact, Intel not only provided the location and supplies to make this all possible, but assigned one of their employees, Morgan Anderson, to be the very skillful event coordinator. Congratulations Morgan! The event came off without a hitch!



Another one of the many full time Intel employees who helped was Bill MacKenzie. When we asked Bill for his philosophy behind this event, he stated, "If you can show these young adults that math, science and engineering are truly related to their lives, they will be much more inclined to go into all the technical professions. That is our desired objective—to show the engineering profession to be both desirable and obtainable. We are also anxious to encourage the heavily under-represented females and minorities to become engineers and scientists." Just for the human-interest side, we asked the Intel staff if they noticed any difference between the approaches taken by the girls vs. the boys. They generally felt, "Boys jump on a project right away and get moving fast, but the girls will stick with it longer before asking for help or giving up."

We asked Bill if Intel wanted an exclusive on this pioneering concept, or whether the IEEE ran similar local programs. He said Intel was not looking to dominate this idea. To the contrary, Intel would welcome, and help, any credible group should run similar programs. Intel desires to encourage all those who want to improve education in general, and engineering and science in particular.

Locally, the Business Education Compact (BEC) has a deep interest in having youth pursue careers in technology. Beginning in kindergarten they expose kids to math, science and engineering through classroom visitations by volunteer engineers. They also support schools and teachers by providing grants as well as making student and teacher internships available. Their [Techno Science Supersite](#) offers a comprehensive list of camps, classes, clubs, contests, competitions, fairs, conferences and museums that expose K-12 students to math, science and engineering. It also has information on student internships, research resources for math, science and technology, as well as scholarships in math, science and technology.

Their slogan is "Make Learning Real." Another way of expressing "real learning" is that it should prepare students for the real world, which inherently, at least for most of us, means getting a job. The BEC has a highly effective internship program where businesses bring students to their site, and have students do "real" employable work. What surprises many business people is that kids doing work they believe in makes their work experience more enjoyable than what is traditionally thought of as play.

If you have an enterprise that can help, please contact the BEC. They are actively seeking and working with many different companies to provide students with this powerful jumpstart towards future gainful employment. The BEC has overcome many of the normal challenges of apprenticeship. Students will actually be employed by the BEC, which serves as a contractor to the business. This dramatically reduces paperwork and exposure. Very good thinking, BEC! The contact person at the BEC is Greg Kulander Ph.D. 503-646-0242 x 23 (gkulander@becpdx.org).

CONTACTS WHERE YOU CAN HELP:

The IEEE Oregon Section actively participates in and supports K-12 math, science and technology. For information on local IEEE activities, contact [John Vinson](#), Oregon Section Pre-College Education Chair.

For more information about Design Squad, go to www.pbskidsgo.org/designsquad or contact Design Squad's Outreach Coordinator at designsquad_outreach@wgbh.org

OTHER LINKS OF INTEREST:

Business Education Compact, www.becpdx.org

IEEE Oregon Section, www.ieee-or.org

Intel Robotics, www.ortop.org

Northwest Science Expo, www.nwse.pdx.edu

Oregon Public Broadcasting (OPB), www.opb.org

Techno Science Supersite, www.TechnoScienceSupersite.org