Want to make a difference in the future? Offer a program to tell students what engineers do. Better yet, SHOW them what we do.

At the Fayette campus of Penn State, we have been running programs to attract K-12 students to STEM careers (Science, Technology, Engineering and Math) for many years. Here is what we have learned that can help you develop a successful program where you live. I can break it down into three steps.

1. **Build an audience.** There are several ways to find students who might be interested in learning about engineering. I have had some of my best success by contacting the gifted coordinator at our local schools. In our region, there is usually one teacher for gifted students up through eighth grade, and a different contact for grades 9-12. They have direct contact with the brightest students, and those are the ones we would most like to attract toward STEM careers. And most of the gifted program teachers I have met have a non-technical background. They would like to offer a program for those students interested in math and science, but just don’t know who to contact locally. So you could be their angel by offering their students a STEM program.

If you have kids in school (especially grade school), perhaps their teacher would be willing to have you visit for a couple of hours. Just keep in mind that finding a good time for a special event is challenging for a teacher. They have a lot of logistics that must be worked out from their side, so try to be flexible and understanding.

If neither of the above paths work for you, contact the school guidance counselor. They should be able to connect you to a math or science class. One approach that I have used for a high school chemistry class was to ask the teacher which concept they were studying that week. Then I explained how I have used that concept as an engineer. Topics have ranged from partial pressure (psychrometric chart) to stoichiometric analysis (furnace combustion analysis). In fact he was so intrigued by the pitot tube and draft gauge that I brought for Show-N-Tell that he kept them for a couple of weeks!

Work with an age group that you feel comfortable with. If your kids are still in grade school, you have some guinea pigs living in your home to see what works for that age. If you want tougher questions, head for the high school. But I believe that the middle school is most important level to impact. When these students select their curriculum track for high school, they are basically defining the trajectory of their professional career. If they listen to their peers and take the “easy” math and science track in high school, they have already built road blocks to a STEM career. But if they challenge themselves academically through their high school years, they will be ready for any career path that they choose. At this age, these kids are beginning to think seriously about what they want to be when they grow up. If you plant the seed thoughts of a STEM career early, we will harvest lots of engineers later.

Several years ago, I was attending a “Women in Engineering” workshop at Penn State. They announced that one of the senior female undergraduates attending had just accepted a job offer as an Industrial Engineer with Revlon. When I found out she was from my hometown, I sat beside her at lunch to find out when and how she decided to become an engineer – was there a trigger event? She said that when she was in 6th grade, a speaker came to her class and talked to them about engineering. She remembered that I was that speaker ten years earlier. For most of these students, YOU will be the first person to suggest to them that they could become an engineer.

1. **Develop your program**. In cub scouts, we use the KISMIF principle and you can use it as well. KISMIF stands for “Keep It Simple, Make It Fun.” Remember that some of the kids you are talking to still think engineers just drive trains. So there is no reason to give them the ASHRAE handbook version of engineering – complete, technical correct, and boring as hell (*ed. Note=may want to edit the wording here a tad*). Start by asking them what they think engineers do. Or better yet, have them point out things in the room that an engineer helped make. (Probably just about everything!) Kids today are very interested in energy and environmental issues (BP oil spill, Japan’s nuclear problems, global warming), a topic that all ASHRAE members should be familiar with. By explaining that as engineers, we are working to find solutions to those kinds of problems, you will appeal to those with problem solving skills – they would make great engineers.

The second half of KISMIF is just as important. When students are having fun, they learn in spite of our best efforts. But to have fun, they have to become engaged and active. Sitting still and just listening for the whole time is not as productive. So plan an activity. There are lots of age-appropriate suggestions on the ASHRAE website (*add URL here*). Just be sure to give the activity or experiment a “dry run” before your presentation so you know what to expect.

One word of caution about doing activities. It is very easy to lose control of the classroom if students are not given simple and specific instructions on what they are to do. “Draw a horizontal line across your paper one inch up from the bottom” earned me a room full of blank stares from a room full of 9th grade students a few years ago. Turns out some of them did not know the meaning of “horizontal” and most of them could not use a ruler to measure an inch. (Guess that is a skill not required by No-Child-Left-Behind.)

 One new twist that the National Engineers Week Committee recommends this year is to begin to dispel the image that all engineers must be good in math. Tell students that to become an engineer, they must be able to DO the math. But it doesn’t have to be their best subject. Point out that our job is much broader than just doing math. Stress the teamwork that engineers use – the jocks will be able to identify with that. Point out that most engineering projects are designed to help MNOP (Meet the Needs Of People) – that will resonate with the female students in the audience. In fact I make a specific point to mention that females are encouraged to become engineers. Unless a female has a father, uncle, brother or neighbor who is an engineer, you might be the first person to ever tell these young ladies, “You can become an engineer.”

1. **Have fun**. You know the date, time and place and the name of your contact teacher. Now all you have to do is gather your materials together, practice a couple of times, and make it happen. The key thing to keep in mind is that you do NOT have to be perfect. The students have no idea what you thought you were going to cover. So if you forgot to say something, no big deal. They just know if they had fun while you were there. But if you talk too much, it could be a bad thing. Plan to leave something as a “take-away”. This could be a simple handout about engineering downloaded from www.JETS.org , trinkets from your sales staff, or bookmarks ordered from ASHRAE or JETS or E-Week.

**PHASE TWO – KICKING IT UP A NOTCH**

So you have already done a program similar to the one outline above. But you know from your sales background that just hearing a message once does not work because people need to hear the same message repeated several times before they actually process it. Want to take your chapter’s program to the next level? Here are some low-cost activities that we do that might work for you.

 Plan a series of local technical site visits for the students. I pick a theme each year and set up 4 to 6 sites in a row. For our high school program, we run 3 program in the fall and 3 or 4 more in the spring. For our middle school program, we typically offer technical visits for five consecutive weeks wrapped around National Engineers Week in February. Both programs come together during National Engineers Week, and I bring in an ASHRAE speaker to talk to the students. Any topic related to energy or the environment (sustainability, green design, high tech buildings) will hold their interest. . We alternate between Wednesday and Thursday evenings for the meetings to avoid constant conflicts with sports and other school activities. We usually start about 6:30 PM, which gives them enough time to eat supper before they arrive, and gets them back home early enough to finish their homework for the next day.

For our high school group, we have partnered with the Boy Scouts of America to create a co-ed Engineering Explorer Post. The theme this year was “Digging into Engineering” and we visited sites related to the utilities that attach to their homes – natural gas, electric, water, sewer, sanitary landfill, telephone. Sometimes you have to get creative – without a power plant to visit, we made arrangements to tour the nearest electric utility maintenance shed. Students got up close to electric insulators, guy wires, and safety issues with boom trucks – all new concepts for them, so they learned something definitely NOT taught in their regular classroom.

For my middle school program, I focus on recruiting girls only, because, at that age, the hormones can get in the way of learning. Girls don’t want to appear smarter than the boys, so they clam up and won’t ask questions – or answer them – with boys around. And boys want to show their dominance, so they push the girls into a spectator role. Since females prefer careers where they help others (teachers, nurses, doctors), this year our theme was “Engineering the Human Body” and we looked at the technology that the medical profession uses to make us better and to keep us healthy. We have visited the “back room” of a dentist’s office (How do they make the suction? How do they sterilize the instruments? Where do they go to develop the X-rays of my teeth?) For most of the girls, the dentist’s drill was the first air turbine they have ever seen up close. Looking at the dentist’s light made that day’s homework related to a parabola meaningful. Next, a doctor made arrangements for us to tour the imaging department at the hospital. Some girls had been on the receiving end of a CAT scan or an MRI, but never had the opportunity to see the images from inside the body. It also gave me a chance to talk about the refrigeration process to make the liquid nitrogen that brings the MRI’s superconducting magnets alive. We toured the campus nursing department to see how animated mannequins to teach students to diagnose conditions. These “professional patients” can go into cardiac arrest several times an hour and never die! (Much less paperwork to complete.) Finally we teamed with a female faculty member in a research lab in the BioEngineering Department at University Park campus for a capstone daytrip to see what the future holds.

Now I know what you are thinking. Since I teach at the University, I must have an inside track to all these contacts. Not true. I have the same access you do. When I was in for a checkup, I asked my dentist if he would help me for an evening. When I had my physical, I asked my doctor who I could contact at the imaging department. The trip to the BioEngineering Department was a cold call from a phone number on the web. So if you are reading this report on-line, and are lucky enough to still have medical and dental insurance, you have what it takes to put a program together similar to this one. In fact, if there is a local manufacturer of medical supplies or materials, you can also show the manufacturing process.

And if you are fortunate enough to have an engineering school nearby, there are probably folks in the Dean’s office who could help you put together a successful program. If they have a student branch of ASHRAE, organizing this program might be the highlight of their year. If you want to focus on females, the Society of Women Engineers would be a great place to start. Just keep the program small (10-20 participants per year) until you feel comfortable.

What I have learned over the years of doing these programs is that most professionals want to help students learn, but they just don’t know how to go about it. So I ask them to talk about what they do – keep them in their comfort zone. Almost everyone is willing to volunteer a couple hours of their time in the evening. I also point out before each field trip that the students’ interests might be beyond the focus of that program. If they have questions about the structural beams in the building or how the electric power to the overhead crane is fed, I try to answer them. One of my standard questions is “If I wanted to get one of these (MRI, CNC machine) for my wife for her birthday, how much money are we talking?” For kids who worry about having $40 for Friday night, a $250,000 machine price is impressive. If the tour guide has a technical background, I ask what got them interested in a STEM career. Students need to hear that most of us were clueless at their age. And you never know what tidbit might trigger each student’s interest in engineering. For some, it is the excitement of building something new and unique. For others, it is the ability to point to structures in the community and to know the person who designed them. For a few, it is the satisfaction of knowing that their life’s work has made the world a better place for others.

So start a program to show young people what we do as engineers. You will get a warm feeling about making the world a better place.