

# Scientists in the Classroom

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Being an educator in the twenty-first century is exciting, stimulating, fun, challenging, and dynamic - with a great emphasis on the challenging and dynamic. The scope and depth of the materials we teach, or can teach, to our students is overwhelming and increasing exponentially every year. The list of challenges for science educators is formidable. We have found that one logical piece of the puzzle to help address these challenges is for educators to invite practicing and real-world researchers, engineers, doctors, business owners, and other STEM (science, technology, engineering, mathematics) professionals into the classroom, or take students on field trips to businesses and industries. These scientists in the classroom do not come as mere guest speakers, as an add-on or afterthought, and are not meant to be an interesting diversion from the normal schedule and curriculum. Quite the opposite, the explicit purpose for their presence is to assist and support the teacher, and to present, teach, and discuss discrete, focused, and curriculum-related lessons and topics.

## **Gains for Students**

How will having scientists in the classroom help our students? Most importantly, they can provide real-world and in-the-field examples and applications of information, technology, and methods. They present a new and different face to the students, giving a different perspective on the material, by someone with credentials, experience, and credibility in that particular field. They help connect what the students are learning in the classroom to the real world - a professional face, a real job, and a real application of their learning. The students can address their own questions and interests to the scientist, learning from their experiences, with the teacher acting as a guide and moderator. Students become excited and energized to new areas and potential career pathways. The students begin building a network of con-

tacts and connections with the surrounding community, and gain a greater awareness and appreciation of that community, and of the scientific and professional community.

When experts are brought into the classroom, it can be challenging for students to approach and to interact with them. But when those experts pay attention to students, carefully and thoughtfully listening and responding to their questions they blossom. They gain self-confidence in their abilities to interact with professionals, and can learn important real-world skills. When teachers ask questions, they model that it is permissible not to know everything, and students will truly learn that there is no stupid or bad question to ask. This will serve students well as they move into becoming lifelong learners, future decision makers, policy makers, and leaders of our global community.

Having a professional in the classroom can provide your students with cutting-edge information and a novel perspective. It also provides stimulation for your students - the excitement of someone new and different coming to class. We all know as educators that it is important to vary what we do, to change things up a bit, to maintain student interest. Classroom visitors and/or field trips can help motivate your students.

After any visit or experience, we encourage you to have your students hand-write thank you notes to the professional(s) who visited or contributed to their learning experiences. This provides an opportunity for your students to reflect on the experience, as well as providing another one of those value life lessons.

## **Benefits for Educators**

Educators can't be expected to know everything about all topics, and staying current in even a few areas that you are really interested in can be challenging. Your job is to facilitate learning, using a variety of strategies to engage diverse

**Table 1: Questions and topics that professionals have addressed with students.**

Scientist/Professional	Question/Topic
Engineer	Road and bridge planning and construction
Pet Store Owner	Selection of a class pet
Physician/Cancer Researcher	Comparison of normal and cancerous cells for a unit on cell function and cell organelles
Forest Preserve Naturalist	Biodiversity and local changes in plant and animal diversity due to suburban development
Local Food Growers	Transport and storage of fruits and vegetables
Sports Shoe Store Owner	Testing and design processes for various shoe types

learners with different learning styles and interests. Use guest scientists to bring current topics and knowledge into your classroom. This will help students see the association of what they are learning in your classroom to what is occurring in the real-world. Having professionals in the classroom energizes and assists educators, helping in their own professional development, and giving them fresh perspectives they can pass on to all of their students.

### **Roles for Professionals in Education**

There are many roles that professionals can play, at every grade level, to foster student learning. Professionals can provide expertise by simply offering information and answering student questions. They can become more involved by teaching or demonstrating skills. Those who work at interesting and unique facilities can provide tours. They can pose an authentic problem for students to solve and then participate in discussion and critique of student solutions. Some may be able to offer internships and research experiences to older and more advanced students. The role can be as simple as a short classroom discussion to a one-on-one year-long, or more, mentoring experience.

Professionals can provide expertise, either within the context of an authentic problem, or in connection with the regular classroom curriculum. While having a professional actually come into your classroom is ideal, other formats of interaction can also be effective. These formats can include web conferencing, Skype, conference calls, and email. No matter the format of the interaction, it is particularly effective to have the students submit their questions to the professional in advance. That way the students

can clarify their questions, and the professional can be prepared to meet their needs. In these interactions students can gain skills in note taking, interviewing, and interactive discussion. Table 1 provides some examples of questions that a professional might help our students address.

Facility tours are another way professionals can share their expertise with students. Student preparation is vital for ensuring that students get the most out of these visits. Often locations that are not usual field trip destinations can provide very enriching experiences for students. Students can participate in all aspects, including writing a letter or email requesting a visit. Prepare your students by having them research the business, industry, or person that they will be visiting. Make sure that they dress appropriately; you want them to represent you and the school well and there may be safety requirements, such as closed toe shoes, at some facilities.

Demonstrating and emphasizing workplace skills are roles that professionals can bring to your students and your classroom. Professionals have both “hard” skills and “soft” skills. For example, an engineer might work with students on using computer-aided design (CAD) software. A utility company can train high school students to conduct an energy audit of their school, and a biotechnology company might train high school students in laboratory techniques for raising mosquito larvae in order to test methods of mosquito control. But they can also help reinforce important life and job skills, such as appropriate communication, proper dress, being on time, and general responsibility. These are abilities that students may not have learned to appreciate yet, and that supervisors require as the basics for someone being a successful employee.

One way to increase student engagement in their learning is to have a professional pose an authentic problem to a class and then give the students feedback on their proposed solutions. Many students find such an approach to be highly motivating because it gives them the feeling that what they do at school really matters to someone in the real world. Table 2 provides some examples of these. They are integrative and real-world issues, and students learn research skills and problem-solving, and can communicate their ideas in various venues, including making an informative pamphlet, producing a visual poster, or giving an oral report.

Providing students with the ability to conduct authentic research is becoming more and more important, especially at the high school level. At IMSA, the Student Inquiry and Research (SIR) program places hundreds of students into businesses, research institutions, and university laboratories each year. This involves hundreds of scientists, researchers, technicians, graduate students, undergrads, post-doctoral fellows, research associates, and so forth. These individuals mentor and advise students on a one-on-one basis so that they can complete a research investigation. This experience is highly valued by the students, as well as by the colleges and universities that they matriculate to. Some of these students will co-author publications and presentations with their advisors, truly giving them real-world research experiences and providing an opportunity for them to contribute to new knowledge. Many other schools in Illinois and around the country and beyond are taking advantage of the willingness of scientists, researchers, businesses, and

entrepreneurs to work with interested and motivated students. These experiences are becoming essential for college and work readiness.

### **Finding Qualified Professionals**

How can an educator find interested, willing, and qualified individuals to come to their classroom? Those with the scientific background relevant to critical components of the science curriculum abound in medicine, engineering, business, and technology. The possibilities are truly limited only by imagination and effort, and it is surprising how flattered and excited many people are to be asked to come and help teach. More often than not, no one has simply ever invited them before.

At a parents' night or an open house, let parents know that you are looking for their help and experience, and directly invite them to inform you of their work and expertise. You might even consider using a brief questionnaire. Consider the jobs, education, and experiences of family, friends, and neighbors. What businesses are located in your area? Many members of the local business community are ready and willing to share the knowledge and practical applications of science used in their products and services, things likely familiar and relevant to students.

The staff members of government and community non-profit institutions, such as park districts, water and sewage treatment plants, and animal control units, hospitals, museums, and local businesses and factories are all potential sources of support. Some individuals have a requirement for community outreach; coming into your classroom or interacting with your students

**Table 2: Examples of problems that students have worked to provide solutions to for business and industry partners.**

<b>Business/Industry</b>	<b>Problem</b>
Ethanol Manufacturer	Feasibility of developing other biofuel sources
Insurance Company	Teenage perspective on texting and driving
Sheriff's Department	Scientifically assessing noise levels
EPA and Landscape Designer	Water conservation
Sand Mining Operation	Environmental recommendations
Concrete Supplier	Road design
Pharmaceutical Company	Dialysis equipment design improvement
Energy Company	Energy audit of the school

in other ways can help them meet that commitment. Investigate the expertise of the faculty and staff members, especially researchers, at local colleges and universities.

Think about what is going on in your local community. Is the local hospital expanding? Is a road being widened or a new water tower being constructed? Has a new business opened recently? The opportunity for individuals involved in changes to speak with students can be a win-win situation for both parties - your students become knowledgeable about a change in the community, and the community leaders can talk discuss and inform your students about the changes and rationale for those changes.

A key factor for success is to make it easy and appealing to the visiting scientists. Find those areas of experience and knowledge they are comfortable with, and be focused and specific in guiding them in what should be covered, targeted to identified concepts and topics within the curriculum, and for which they can provide concrete and relevant connections to the experience of the students. The teacher - you - should be another student in the class, but prepared to help guide the discussion with leading questions students may not ask. As previously stated, you model lifelong learning for your students, which is invaluable.

The scientist/visitors can gain unique ideas from novices that can move their own work forward. They can gain the perspective of students of a specified age, for example, an insurance company desiring to know how to address the issue of texting while driving with teenagers. (It should be obvious to ask teenagers how to solve this problem!) As stated earlier, volunteering to work with students can help scientists and researchers fulfill work or grant requirements for outreach. It provides them with a forum to tell students about potential careers, and to recruit students to their profession. And it can also be used by supervisory individuals as training for their younger colleagues, helping them to interact and work with younger and more novice individuals - a contribution to professional development. Scientists in the classroom can truly be a winning experience for all parties involved.

### **Part of Standards-Based Instruction**

How would scientists in the classroom help teachers and schools fulfill the requirements of both the current Illinois state standards for teaching and for science curriculum, and the newly adopted Next Generation Science Standards, to be implemented in 2016? Goals 13-A and 13-B of the current standards require helping instructing students to “understand the relationships among science, technology and society” by “applying the concepts” and “applying the practices” of science (<http://www.isbe.state.il.us/ils/science/pdf/goal13.pdf>). That is, what is the actual context and relevance of the science concepts being taught? What is real-world about them? As often-expressed by the students, “Why do I need to learn this?”

Bringing working, practicing scientists, engineers, and others who daily use the mathematics, tools, and technology accepted and necessary to their work will better illustrate, explain, and help form a connection for the students to answer that why question. Hearing real people talk about solving real problems and meeting real goals in an authentic social context, by applying the same concepts students are learning in the classroom, can be one of the best ways for the science to come alive and to motivate students to use their imagination to apply that science to problems and goals they consider important.

Equally, the 2013 version of the Illinois professional teaching standards, which set performance indicators and expectations for all teachers, direct them to teach in such ways as to incorporate students' current life experiences to connect them to future career and work experiences, and to work effectively with parents and other members of the community to develop cooperative partnerships that promote student learning (<http://www.isbe.net/rules/archive/pdfs/24ark.pdf>).2] Bringing scientists to the classroom is one of the ways of meeting these expectations for the benefit of the students.

Finally, in addition to the other benefits already described, the NGSS greatly increases emphasis on students learning and understanding science practices: the engineering and problem solving process; use of tools and technology

of the field relevant to the problem or question; and the methods for collecting, measuring and analyzing data (<http://www.nextgenscience.org/next-generation-science-standards>). Effective instruction and curriculum to meet the future standards must include concrete, real world, authentic examples and modeling of these practices, and delivering this instruction should include students seeing, hearing and modeling the work of real practitioners of the concepts and ideas being studied.

### Discussion

The concept of inviting scientists into the classroom as partners and in support of teachers and education should not be that surprising, and it is not new. Australia has had an “adopt a scientist” program since 2007, called a “new big idea” by Dr. James Peacock, the former chief national scientist. Students create a continuing relationship with scientists to learn about their work, tools, and research methods, and regularly visit with them, Skype or follow one of the scientist’s projects (<http://www.scientistsinschools.edu.au/index.htm>). Science World at TELUS World of Science in British Columbia has created a similar program, Scientists and Innovators in the Schools (SIS), (<http://www.scienceworld.ca/sis>). Educators can request a scientist to visit K-12 classrooms. And in November 2012, NSTA devoted almost the entire issue of Science Scope, the middle school science journal, to different approaches of community-based science. Stephens wrote about inviting scientists from the community into the classroom to explore the practical applications of science. Science Screen Report (<http://www.ssrvideo.com/virtualscientist.html>) has the Virtual Scientist Lecture Series; grades 6-12 educators can request an Internet-based, 30 minute scientist visit, which includes a question and answer session. Closer to home, Northwestern University (NU) has the Reach for the Stars program (<http://osep.northwestern.edu/projects/reach-for-the-stars>). This National Science Foundation grant funded program places NU graduate students into GK-12 science class-

rooms for about ten to fifteen hours per week. Participating classrooms do need to be in close proximity to NU.

Plenty of examples for utilizing scientists and professionals in the classroom exist, and they are winning experiences for all participants - students, educators, and the professionals themselves. We think that these examples should help you convince your colleagues, department chairs, and principals that scientists in the classroom is a good idea.

### References

- Illinois Learning Standards for Science, State Goals 13-A. and 13-B. (<http://www.isbe.net/ils/science/pdf/goal13.pdf>)
- The Illinois Professional Teaching Standards Beginning July 1, 2013, Illinois Administrative Code, Title 23, Subtitle A, Chapter I, Subchapter b., Part 24, Section 24.130, (<http://www.isbe.net/rules/archive/pdfs/24ark.pdf>)
- APPENDIX F –Science and Engineering Practices in the NGSS, from Next Generation Science Standards, April, 2013, © 2011, 2012, 2013 Achieve, Inc. Based on A Framework for K-12 Science Education, © 2012, National Academy of Sciences. (<http://www.nextgenscience.org/next-generation-science-standards>)
- Reach for the Stars (<http://osep.northwestern.edu/projects/reach-for-the-stars>), Northwestern University, Office of STEM Education Partnerships, Access Feb. 23, 2014.
- Scientists and Innovators in the Schools (SIS), (<http://www.scienceworld.ca/sis>), Science World at TELUS World of Science, Accessed Feb. 23, 2014
- Scientists and Mathematics in Our Schools. <http://www.scientistsinschools.edu.au/index>. Accessed Feb. 23, 2014
- Stephens, Karol. 2012. Speaking of Science: Invite Speakers From Your Community to Bring the Science Curriculum to Life. Science Scope. November 2012 v36 n3 p29-32– need issue/page numbers
- The Virtual Scientist Guest Lecture Series, (<http://www.ssrvideo.com/virtualscientist.html>) Science Screen Report, Accessed Feb. 23, 2014.