

Make Science & Chemistry Exciting to Students and the General Public

Follow the Success of the Exciting Science Group* of NCL

Science, Chemistry and Technology are so exciting, full of adventure, challenge and fun. However, the way it is taught and propagated in our schools and colleges simply kills the excitement and fun. So what do you have? Students and society conjuring images of old work benches, stinking laboratories and polluting chemicals. The teaching is always a rush to complete the curriculum before the exams.

Now a group of lively scientists at NCL have formed the aptly titled, 'Exciting Science Group', conducting outreach programmes since 2008, to students and the general public and they have been tremendously successful in putting the fun back. They don't teach or lecture; they create the thrill of discovery through a sense of "wow" kindled in the students. And the excitement is simply becoming unstoppable.

Read their wonderful pursuits in this article.

We live in exciting times. The Indian economy is growing appreciably and this growth is being fueled by entrepreneurship across all sectors. Science and technology has played a key role in facilitating this growth story, and will become even

more important as we grapple with the challenges of sustaining this pace of growth. We will need massive innovation in the chemical sciences and engineering to create the next generation of materials and medical therapies, to ensure food and energy security, and to

create infrastructure as we grow, while at the same time, preserving the environment for future generations.

At the National Chemical Laboratory, the excitement of the times that we live in directly translates into the exciting research challenges as we work on solutions for a better tomorrow. A little over two years ago, we embarked on a programme to share our enthusiasm with school



Making ice cream with liquid nitrogen and other demos during Dr Magesh Nandagopal's talk (May 2010, "Chemistry that you can eat")

*NCL scientists have launched the 'Exciting Science Group' in 2008, which is an initiative to share the excitement of science with the school children. It not only holds popular talks and reaches out to school students, but also mentors various science projects. This article was collectively compiled and written by Dr Guruswamy Kumaraswamy, Dr Sayam Sengupta, Dr Magesh Nandagopal, Yogeshree Phadke and Bhakti Dhamdhare, who are the pioneers of this group.



Students looking at an attractive, illustrated periodic table; and doing experiments during Dr. Guruswamy's talk on the Chemistry of Elements in Vidya Niketan, Pune (July 2010).

students and with the people who live in and around Pune. The main message that we aimed to get across was simple – *science and technology is fun and it is relevant to everyone*. As scientists and engineers, we have very interesting jobs. Each morning, as we walk into our laboratories, there is the promise of new challenges that we will be confronted with and that we will solve. This is the fun, exciting part of our work.

A school student's exposure to science lectures and practical laboratory work does not capture the joy of *practicing* science and technology. Science and chemistry, in particular, as it is taught in our schools and colleges today focuses on textbook learning and there is less emphasis on "learning by doing" or research-based approaches. There is a vast curriculum to be covered and, for most students, science is reduced to the print in their text books. What is the student's or society's view of working in a chemistry lab? The images that come to their mind are probably those of old work benches and stinking laboratories or polluting factories. This certainly does *not* describe our work environment and that is not the impression we would like students to have, at the stage when they choose their careers.

We work in a vibrant laboratory. We interact with bright students and talented colleagues, who believe that progress in science and technology can improve our quality of life, solve daunting problems and provide insight into nature's deepest mysteries. That is what science and technology (and chemistry,

in particular) is all about. It is difficult not to be passionate about this kind of work.

Therefore, our programme is aimed at communicating this enthusiasm to students by creating a forum for them to listen to and meet with passionate NCL scientists. Training in science and technology guarantees a job in our fast growing economy. However, historically, the brightest students have chosen careers in science not because of job security, but because of their innate curiosity and also because of the satisfaction that comes from participating in the thrilling journey of discovery, while enhancing the quality of life for society. We felt that, if our programme could reignite this spark in students, then they might choose to take up careers in science and technology because they would want to share in our dream and not just because their parents felt that it was a safe option.

The response to our programme from students, parents and teachers has been overwhelmingly positive. Our lectures are oversubscribed and we receive so many invitations from schools, that we are unable to oblige all of them. Our lectures are frequently covered by the print media and that helps us to connect with a larger section of people. Apart from the goodwill, we have also received financial support for our activities from several local well wishers including Battelle India, Forbes Marshall, the Praj Foundation and Ms. Anu Aga. As all our events are run free of cost to the students, support from these supporters has been

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critical to our functioning. In addition, NCL provides refreshments to students who attend our talks, and the talks are hosted at the Venture Center in the NCL Innovation Park campus. It has been a humbling experience to see the confidence we enjoy from students, local industry and the society in Pune.

There is clearly a huge appetite in our society to learn by engaging more strongly with workers in the chemical sciences and technology – from academia, national laboratories and industry.

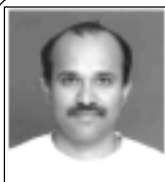
We kicked off our Outreach programme in late 2008, with a monthly series of Popular Science talks. These talks are held on Sunday mornings at the NCL Innovation Park campus and combine live demonstrations, experiments and problem solving exercises to involve the students and engage their attention. At these talks, school students get to hear a first hand account of what it means to do research and to get a feel for the thrill of discovery. The speakers do not attempt to teach science to the students – rather, the idea is to create a sense of “wow” and to kindle the students’ curiosity. For example, in Dr Magesh Nandagopal’s

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talk on the “Chemistry in Food”, he discussed vitamins and followed up this discussion with a demonstration of how one could determine the vitamin C content in food items. An indicator solution for vitamin C can be easily prepared at home using a few drops of starch solution (for e.g., water drained out

after boiling rice) and a few drops of iodine (commonly known as tincture). The resulting solution will be deep blue in color. Food items with vitamin C in them (like lemon juice), when added to this solution, will make the solution lose the blue color and turn transparent, whereas foods with no vitamin C will result in no change in the blue color of the solution. (Caution should be used when doing this experiment at home, since iodine solution or the food items contacted by iodine solution should not be consumed.)

Speakers for our popular talks are carefully selected so that, apart from being good scientists, they are also excellent communicators, who can effectively connect with school students. While most of our speakers have been from NCL, we have also had our friends from IIT-Bombay, IISER-Pune, the National Institute of Vi-



Dr Guruswamy Kumaraswamy (B.Tech-IITB, MS/Ph.D, USA) joined NCL after postdoctoral research at the Max Planck Institute, Germany. His group investigates complex fluids and polymers. Dr Guruswamy received the Landau Award at Caltech; and he was a finalist for the American Physical Society Padden Prize (2000) and the American Chemical Society ICI Prize (2000). He also received the CSIR Young Scientist Award in 2005. In addition to science, Dr Guruswamy is passionate about science outreach and has been associated with the Exciting Science group since its inception.

Dr Sayam Sengupta is an inorganic chemist by training and works in the area of catalysis and biomaterials. He runs a research lab at NCL and also teaches undergraduates at IISER-Pune. He had joined NCL as a scientist in Dec 2006 after two post-doctoral stints in the US & Germany. Earlier, he had done his Masters from IIT-Kanpur and then moved to the US for his doctorate from Carnegie Mellon University at Pittsburg.



Dr. Magesh Nandgopal (Ph.D-Polymer Science-USA; MBA-Finance, USA) scientist in NCL Innovations, is involved in managing and commercializing NCL technologies and intellectual property. His current interests include science policy research, intellectual property management, technology management, investments and portfolio management.

Yogeshree Phadke lives in Pune, and is an enthusiastic supporter of science outreach activities. She has been involved with schools, and specifically with quizzing at schools in Pune. She is also passionate about Marathi literature and classical music.



Bhakti A. Dhamdhare joined the Exciting Science group in March 2010. Ms. Dhamdhare has an M.Sc. in organic chemistry, and was previously associated with the Science Express Train (an initiative of the Vikram Sarabhai Community Science Center, Max Planck Society and DST).

rology, the National Center for Cell Sciences, TIFR and industry who have generously volunteered their time to give talks and interact with students. Our talks are open to all and our schedule is available on our web site: <http://www.exciting-science.org> and we also have a presence on Facebook and Orkut to connect with our young friends from schools. Students register for the talks through our web site or by sending us email.

Encouraged by the success of these talks, in 2010, we put together modules of lecture-demonstrations, based on the science taught in 8th to 10th grade text books. These lectures cover the interesting parts of science that textbooks leave out – the history behind discoveries and inventions, the personalities involved, controversies, how these topics impact our daily lives, etc. These engage the students' attention and make the science more interesting by providing perspective and context. And of course, these lectures involve several videos and experiments performed "live" in the schools. Many of these experiments can be easily recreated by the students and/or teachers.

Apart from these lecture demonstrations, we offered mentoring sessions to school students doing research based projects for science fairs. This was motivated by our firm belief that *doing* science is the best way to discover the excitement of science and research. This effort, too, was met with enthusiasm. After several years during which no entries from Pune had been selected to the DST-Intel-CII sponsored National Science and Technology fair, there were three projects from Pune in 2010. Interestingly, all the three projects from Pune were in the area of chemistry, out of a total of eight chemistry projects from all over India. Our Outreach programme is now coordinated by

a group of volunteers, including scientists from NCL and enthusiastic supporters of science and technology around NCL. When we started the Popular talk series two years ago, we could not have anticipated that our activities would expand so much and so rapidly; and we certainly did not anticipate the support that we would receive for this work.

As 2011 is the **International Year of Chemistry**, our programme is poised at the cusp of even larger growth and we hope to recruit similar minded people from academia, other national laboratories, and industry as we evolve new programmes to create interfaces between society and, scientists and technologists. The International Year of Chemistry is an exciting opportunity for all – science laboratories, as well as the media – to engage with the public and with students, to impress on them the excitement that pervades chemistry, the opportunities for careers, as well as for highly satisfying, rewarding jobs. For example, we wonder if we could possibly have a chemistry show on TV, like a cookery show, where we demonstrate experiments. We imagine that going back to the tradition of public demonstrations, similar to Faraday's demonstrations in front of the Royal Society of Chemistry in London, at the dawn of modern chemistry, would bring the excitement of science and technology of chemistry live to the public. At NCL, we are constantly looking for ways by which we can continue to engage society and to excite people about the possibilities offered by science and technology.

Our website (<http://www.excitingscience.org>) compiles slides from our talks, that are available to all, as well as information on our planned activities.

