Territory: The Actual and Potential Impact of Research on Teaching and Learning Science on Students' Learning." Prof. Andrée Tiberghien, from the University of Lyon (France), presented research results in "Studying Science Teaching Practices in Relation to Learning." Prof. David Treagust, from Curtin University of Technology (Australia), discussed "Research-Based Innovative Units for Enhancing Student Cognitive Outcomes and Interest in Science." Prof. Ivo Cap, from the University of Zilina (Slovakia), discussed informal education in his talk. Prof. Paolo Guidoni, from the University Federico II (Italy), introduced in his talk a possible model for dealing with students' understanding. Finally, Prof. Yasmin Kafai, from the University of California (United States), discussed "Children's Apprenticeship in Learning Science by Design."

The quality of participants' presentations was ensured by a double-blind review process performed by more than 80 reviewers and organized by 20 chairpersons, experts in each of the conference subtopics. Around 10 simultaneous parallel sessions took place for each of the 9 sessions for participants. These were generally arranged around specific topics to promote significant discussion among participants.

One of the important aims of the conference was to provide opportunities for training young researchers, 150 of whom were able to attend. Conference organizers provided a reduced early registration price and provided extra panel session time to encourage young researchers' active participation. A roundtable with different editors from a variety of international research journals in the field was also organized to provide an opportunity for "face to face" interaction, with the aim of motivating and facilitating young researchers to publish their research results in high-level publications.

The next ESERA conference will be held in Malmo, Sweden, 21–26 August 2007. More information is available at <www.naturfagsenteret.no/esera/conference.html>.

Prof. Roser Pintó <roser.pinto@uab.es> was part of the organizing committee for ESERA and is a professor at the Universitat Autònoma de Barcelona.

www.esera2005-cresils.org

New Directions in Teaching, Learning, and Evaluating the Chemical Sciences at the Tertiary Level

by Neelakanthi E. Gunawardena

Towards Modernizing Chemical Science Education in Sri Lankan Universities was held 11–12 March 2006 in Colombo. The conference, which attracted nearly 80 percent of Sri Lankan academics in the chemical sciences, is the first step toward replacing the current knowledge-based education system with modern teaching methods.

Four experts in chemistry education were brought in under the sponsorship of IUPAC's Flying Chemists Program* and its Scientifically Emerging Regions program. The Royal Society of Chemistry, UK, and the University Grants Commission of Sri Lanka were the other two sponsors. The conference was organized by the Department of Chemistry of the University of Kelaniya in collaboration with the Chemical Sciences Section of the Sri Lanka Association for the Advancement of Science and the Sri Lankan branch of the Royal Society of Chemistry.

The conference provided timely assistance to the country's effort to upgrade undergraduate chemistry education. Currently, the quality of university graduates does not match the needs of the labor market in Sri Lanka. Further, the conference was of historical significance for no such gathering of academics in the chemical sciences has ever been held. Thus, a great enthusiasm was evident among the academics who participated in the conference.

The opening session was attended by the minister of science and technology of Sri Lanka, the vice chancellor of the University of Kelaniya, and the chairman of the University Grants Commission of Sri Lanka. In this session, Prof. Peter Atkins (University of Oxford, UK), introduced IUPAC as the body that governs and sets standards in chemistry. He also described the Flying Chemists Program and introduced the other major sponsor of the conference, the Royal Society of Chemistry, UK.

The first plenary lecture, titled "Educating a Chemist; the Challenge and the Opportunity," was

*For more information about the FCP see <www.iupac.org/standing/cce/FCP.html> or <www.iupac.org/projects/2005/2005-030-1-050.html>.

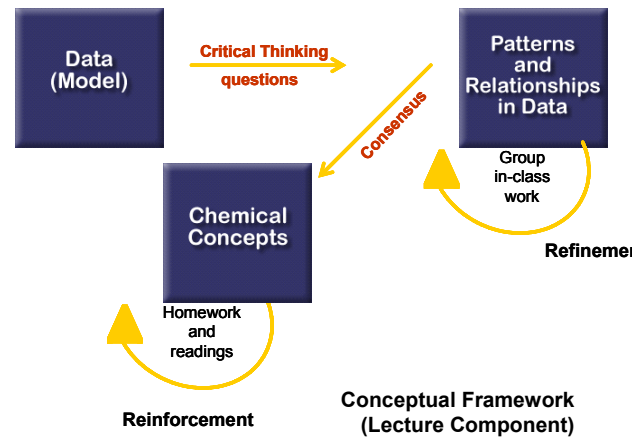
Honoring the national anthem at the Inauguration Session (from left): Mr. Premasiri de Silva, chairman-RSC SL section; Prof. M.J.S. Wijeyaratna, vice chancellor, University of Kelaniya; Prof. Tissa Vitarana, Hon. Minister of Science & Technology; Prof. N.E. Gunawardena, conference chairperson; and Prof. P.W. Atkins, University of Oxford, UK., representing IUPAC and the RSC, UK.

delivered by Prof. Atkins. He pointed out that even though chemistry is a complex subject, underlying principles are simple and that should shine through teaching. Using several examples, he showed how concepts can be taught effectively by relating them to real-life experiences. He discussed how abstraction, mathematics, and complexity are challenges in teaching chemistry and then showed how curriculum, concepts, and graphics provide ways to overcome the challenge. While highlighting the power of mathematics in understanding chemistry, Atkins said integration of mathematics in chemistry on a need-to-know basis would be more helpful to students.

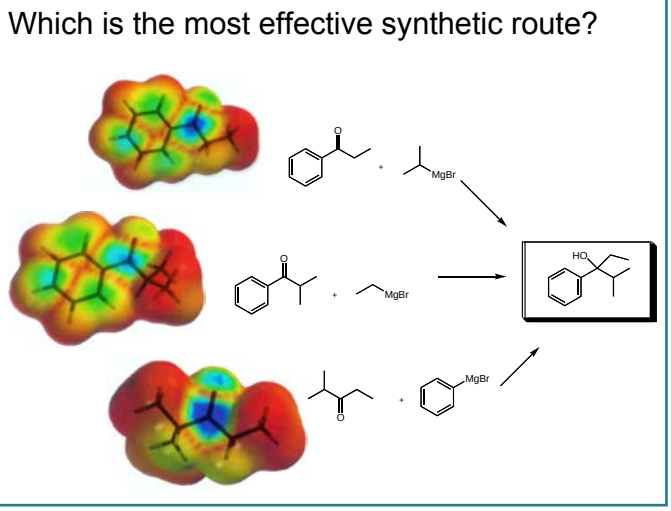
Prof. Ram Lamba (University of Puerto Rico), who delivered the second plenary lecture, titled "Why Do Students Resort to Rote Memory and Recipe Following?" said that even though the lecture model remains the preferred form of introducing new material to a class it does not automatically result in efficient learning. Quoting recent research, Prof. Lamba said that we tend to be linear thinkers, and pattern seekers. When problems break linearity, or a pattern does not fit into the known, students resort to rote-memory or reject the information. To provide meaningful learning, he said it is important to design the activities in a sequence that is compatible with the learning cycle (i.e., exploration, invention of concept, and application).

On the second day, Prof. Ingrid Montes (University of Puerto Rico) presented her lecture on "New Directions in Teaching Organic Chemistry: An Inquiry-Based Approach." She introduced three intertwined branches in chemical education: instruction, practice, and research. For the present generation of students, Montes said, the professor should not just be a source of knowledge. Instead, students should be involved in an active teaching-learning experience. A lecture course should incorporate active learning, technology, and interactive demonstrations, she said. Inquiry-based laboratory experiences and creative project proposals are effective tools and methods she recommended for the development of creativity and critical thinking . Using an ethnographic study, she showed how her newly designed inquiry-based organic experiments that address different learning styles affect the teaching-learning process in the laboratory course.

The last plenary lecture, "Introducing Environmental Chemistry and Classroom Discussion Methods into the Curriculum," was presented by Prof. Norman Colin Baird (University of Ontario, Canada). He showed how to use environmental issues in chemistry classes to generate interest among students. Some of the examples he sited were pollution by heavy metals such as mercury, arsenic, lead, acid rain, dioxins, PCBs, PAHs, and CFCs and their replacements. Analytical applications include the determination of low concentrations of atmospheric



How can we provide meaningful learning? was a question posed by Ram Lamba during his presentation.



Ingrid Montes gave examples of how to use an inquiry-based approach while teaching organic chemistry.

constituents and of pesticides and heavy metals. He showed ways to conduct interactive discussions using environmental issues to improve the learning process.

Each plenary lecture was followed by a discussion session, which was divided into four groups: organic, inorganic, physical, and miscellaneous (mostly environmental chemists and biochemists). Utilizing the material presented in the lectures, the groups focused on finding solutions to problems. Plenary lecturers in each group provided assistance with the discussions. At the concluding session, the following general conclusions were agreed upon: define a common core curriculum for the B.Sc. degree course, have a greater focus on teaching the essentials, reduce over teaching, include more technology in teaching, and include teaching of mathematics.

The conference created a high level of satisfaction among participants, especially those who came from remote universities. In response to a questionnaire, 94 percent of participants wanted to have follow-up meetings. It was a rewarding experience to the organizers too. The common bond formed within discussion groups has generated sufficient energy to initiate e-mail communication about curriculum development. The physical chemistry group is in the lead, while other groups are getting ready to do the same.

Neelakanthi E. Gunawardena <neela@kln.ac.lk> served as the conference organizer. She is a professor at the University of Kelaniya.

New Science Education Assessment: The Challenge

by Laure Joumel

The Chemical Heritage Foundation (Philadelphia, Pennsylvania, USA), which treasures the past, was focused on education for a better future during the **6th Annual Leadership Initiative in Science Education (LISE6)**, held 26–27 April 2006. The theme of the conference was "What Our Students Know: Assessment and Accountability in Science Education."

The American educational challenge for the 21st century is to improve the teaching of science in grades K-12. The federal No Child Left Behind Act (NCLBA) of 2001 requires teachers to use research-based teaching methods and to measure student's progress regularly. That gives huge importance to assessment. Assessments are the only way for teachers to check their success. Assessment sets the rhythm of a child's life at school. Assessment is the key to teaching. So how can it best be accomplished? Teachers and administrators comprised the audience for the eight speakers at the conference, all well known personalities in their fields, who covered different angles of the topic.

Teachers in students' shoes

The conference opened with an active workshop session conducted by George DeBoer, who is deputy director for Project 2061 of the American Association for the Advancement of Science and a professor of educational studies at Colgate University. DeBoer led attendees through a two-hour practical exercise that introduced them to Project 2061. Launched in 1985, this plan helps reform K-12 education by building an online collection of assessments aligned to standards.

During the second part of DeBoer's workshop, the teachers go back to school. He used the following example to illustrate the misconceptions that children often have: What is the smallest? A: an atom, B: a bacterium (micro-organism), C: a cell in your body, or D:

Project 2061 began its work in 1985-the year Halley's Comet was last visible from earth. Children starting school now will see the return of the Comet in 2061-a reminder that today's education will shape the quality of their lives as they come of age in the 21st century amid profound scientific and technological change. <www.project2061.org>.