Date: June 4, 2009

From: Peter Mahaffy, CCE Chair

To: IUPAC Council

Re: Committee on Chemistry Education Chair's Report to Council

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This report highlights significant CCE activities during the current year and plans for new initiatives in the next biennium, emphasizing activities leading up to the International Year of Chemistry in 2011.

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1. CCE terms of reference

(a) To advise the President and the Executive Committee on matters relating to chemistry education, including the public appreciation and understanding of chemistry.

(b) To maintain a portfolio of educational projects and to coordinate the educational activities of IUPAC.

(c) To monitor chemistry education activities throughout the world and to disseminate information relating to chemical education, including the public appreciation and understanding of chemistry.

(d) To develop liaisons with international organizations such as UNESCO, national and regional chemical societies, chemical education committees, and organizations concerned with the public appreciation and understanding of science.

2. How does CCE carry out its work to meet these terms of reference?

CCE met as a full committee at the 20th International Conference in Chemistry Education (ICCE) in Mauritius in August, 2008. Following our 2009 meeting at the IUPAC General Assembly, the committee will meet again at the 21st ICCE in Taipei in 2010. In formal meetings and beyond, CCE accomplishes its work through the dedicated efforts of 8 titular members, 8 associate members representing divisions, 23 national representatives and three ex officio members - representing 35 countries.

Our work is carried out through projects; through two subcommittees - Chemistry Education for Development, chaired by NR Mei-Hung Chiu (Taiwan) and the CCE International Year of Chemistry Subcommittee, co-chaired by Mustafa Sozbilir (Turkey) and Anthony Wright (Australia); and through biennial ICCE conferences. In addition, educational activities are carried out in cooperation with IUPAC divisions and standing committees, coordinated by TM and division liaison, Eva Åkesson (Sweden). CCE also works with partners outside of

IUPAC. Presently CCE has working and/or developing partnerships with UNESCO, Science across the World, and the Chemical Heritage Foundation (USA). Numerous additional collaborations with IUPAC Divisions and Standing Committees and external partners are formed to accomplish the objectives of particular projects.

Current priorities

As discussed in some detail in the 2007 report to Council, CCE establishes priorities for its work at the beginning of each biennium. The six priorities that presently shape the committees' work are listed below. These priorities will be the starting point for discussions at the 2009 Glasgow CCE meetings of the new priorities to guide CCE work in the 2010-2011 biennium. We anticipate that priorities for the next biennium will be framed so as to facilitate meaningful CCE and IUPAC contributions to a successful International Year of Chemistry.

(a) To foreground the importance of learner-centred chemistry curriculum, both in the developed and developing world. The extent to which this is done should be one criterion used to assess educational projects.

(b) The efforts of CCE's Public Understanding of Chemistry committee will be focused on obtaining designation for an International Year of Chemistry and contributing to implementation, as appropriate.

(c) To give priority to initiatives that highlight the relationship between chemistry and sustainable development, consistent with the goals of the UN Decade for Education for Sustainable Development.

(d) To continue to support initiatives that raise awareness and understanding of ethical issues that are important in chemistry.

(e) The biennial International Conferences on Chemistry Education are flagship activities for CCE. We seek to more fully integrate ICCE activities into the work of CCE and use ICCE conferences to report the outcomes of CCE projects and bring participants together to implement CCE strategies

(f) To build chemistry education networks, using fully the multicultural competence within CCE.

3. Highlights of recent and new CCE initiatives.

Rather than comprehensively list projects and activities that address current priorities, this report highlights several exemplary activities and significant new initiatives for CCE in 2009, and points out how they flow out of existing priorities and will help to establish new ones.

- **UNESCO and UN designation of IYC.** Since the last report to Council, a major preoccupation of the CCE chair has been to give leadership, along with others on CCE and the Bureau, to navigate the complex web of processes needed to obtain designation by UNESCO and the UN of 2011 as an International Year of Chemistry. It was most rewarding to work closely with our colleagues at UNESCO Division of Basic Sciences and Engineering, who laid the groundwork for this successful outcome by meeting in person with key individuals to seek their support and obtain timely advice. The IUPAC secretariat provided the needed vital and timely communication with NAOs and other participants in the process. The success, however, was due in large part to the extraordinary support by many NAOs who worked at national and regional levels. In particular IUPAC owes a huge debt of gratitude to the chemists and diplomatic community of one of the newest members of the IUPAC family, Ethiopia – who championed this at both the UNESCO and UN levels with countless colleagues. The

process of obtaining designation, has, in itself, strengthened important bridges for IUPAC with global partners that we must build on leading up to 2011 and far beyond. I draw Council's attention to the list of countries that formally sponsored this resolution at the UNESCO Executive Committee and the United Nations alongside Ethiopia, and note that many do not have official ties to IUPAC. This group of countries has formally advocated at the United Nations for a celebration of the importance of chemistry and chemistry education, and working with them leading up to and following IYC presents a strategic opportunity for IUPAC to build an even stronger and more truly global network of chemists and educators.

Sponsoring countries (UNESCO Executive Committee): Ethiopia, Algeria, Benin, China, Côte d'Ivoire, Cuba, Democratic Republic of the Congo, Egypt, France, India, Japan, Kuwait, Madagascar, Malaysia, Morocco, Niger, Nigeria, Republic of Korea, Russian Federation, Senegal, South Africa, Togo, Uganda, United Republic Tanzania and Zambia.

Sponsoring countries (United Nations): Ethiopia, Brazil, Cuba, Democratic People's Republic of Korea, Djibouti, Egypt, Ghana, Israel, Japan, Kenya, Libyan Arab Jamahiriya, Malawi, Nigeria, Oman, Republic of Korea, Rwanda, Sierra Leone, South Africa, the former Yugoslav Republic of Macedonia, Ukraine, United Republic of Tanzania, Uruguay, Viet Nam and Yemen. (*At time of writing this report, this preliminary list is incomplete, and the full list of about 35 countries will made available to Council in Glasgow.*)

- **Formation of CCE International Year of Chemistry Subcommittee.** IYC 2011 provides the opportunity of a lifetime to catalyze imaginative thinking by chemists, students, and the general public about what it's like to live in a chemical world. As was highlighted in the 2007 report to Council, CCE recommends that we see the developing networks and activities of IYC not as an end point in 2011, but as the first steps toward building further IUPAC's leadership role in the areas of public understanding and science policy.

  In keeping with CCE's terms of reference, our resources and global educational network will be directed to whatever extent possible to mesh and build synergy with other IYC activities and programs over the next biennium. To that end, as identified in Priority (b) above, CCE has determined that its public understanding of chemistry activities should be focused on contributing to the planning and activities needed for a successful International Year of Chemistry.

  Our recently appointed CCE IYC Subcommittee replaces the CCE Public Understanding of Chemistry Sub-Committee for this biennium. Two CCE members (Mahaffy and Tarasova) also serve on the IYC Management committee, and they will help ensure good two-way communication, and also avoid duplication of efforts. While the subcommittee mandate will be further fleshed out in Glasgow, we see its role as (a) advising on some global educational activities that might be part of the year's activities, (b) advising on how activities might be made available to countries with less well-resourced chemical societies and NAOs, (c) recommending ways to integrate existing CCE programs such as YAC, FCP, and microscale workshops into IYC activities, and (d) using the momentum of IYC to build sustainable partnerships with UNESCO and other partners and regional networks of chemistry educators.

- **Current CCE activities with potential for contribution to IYC.** Several on-going projects and activities have significant potential for contributing to IYC. These include:

  – **Young Ambassadors for Chemistry (YAC).** The YAC program was originally set up as a partnership between CCE and Science Across the World. Using a '*Train the*

Trainers' approach, YAC facilitators have worked with teachers and students to increase public appreciation for and understanding of chemistry in Argentina, Bulgaria, Egypt, Jordan, Korea, Lithuania, Russia, South Africa, and Taiwan.

Since the last CCE report, a successful YAC event was held in Mauritius in August 2008, just prior to the ICCE conference. The model and activities used here have now catalyzed new programming in the Mauritian ministry of education. Another YAC program was organized in Nicosia, Cyprus in April 2008. The FCP program visit in the Philippines (see next item) has also led to interest in a YAC program, with two YAC events tentatively planned for October 2009, one in Manila and one in the South.

CCE felt it important to ensure that careful assessment of the impact of this program on teacher attitudes is carried out. To provide the data needed for this assessment, IUPAC project # 2007-005-2-050 has been initiated to provide research-based evidence about longer term outcomes. TM Lida Schoen has been the tireless and imaginative moving force behind the YAC initiative, and leadership for the overall program is now shared with other CCE members, particularly NR Erica Steenberg and TM Mei-Hung Chiu.

CCE envisions both YAC programs and the model used by YAC to be important contributions to IYC 2011. Sharing YAC strategies will take place at both the IUPAC Congress in Glasgow and the 2010 ICCE Conference in Taipei.

- **Flying Chemist Program (FCP)**. The third FCP program visit took place in April 2008 in the Philippines, following an organizational workshop six months earlier coordinated by Chemistry Education for Development sub-committee chair Mei-Hung Chiu and the CCE chair. Designed to improve teaching and learning of chemistry at the tertiary level in the Philippines, a group of 324 tertiary-level chemistry teachers came together for a two-day event, organized by the Commission on Higher Education (CHED), the government body covering higher education institutions in the Philippines, in cooperation with the Kapisanang Kimika ng Pilipinas (Chemical Society of the Philippines) and the University of Santo Tomas. Attendees came from all the regions of the country and represented 89 different institutions of higher education in the Philippines. Among the participants were 12 young chemistry teachers who received travel grants through the IUPAC Program on Financial Support of Conferences.

  CCE intends to organize two additional FCP programs in the next biennium, and to coordinate this initiative in 2011 with regional IYC activities, perhaps in sub-Saharan Africa. Chemistry Education for Development sub-committee chair Mei-Hung Chiu has given excellent guidance to the FCP program, and she would welcome your ideas about the future of the program.

- **Using chemistry education networks.** CCE has played an important role in establishing and supporting regional chemistry education networks. Leading up to the IYC, we will make use of networks such as the Network of Inter-Asian Chemistry Educators (NICE), Asian Chemistry Education Network of the Federation of Asian Chemical Societies (ACEN-FASC), and various African, American, and European networks to coordinate regional IYC activities. In particular, the NICE network resulted from discussions within CCE and the ICCE conferences, and four present and former CCE members co-chair the 3rd NICE symposium, to be held in Tokyo in July 2009 - Masahiro Kamata (Japan), Masato M. Ito (Japan), Mei-Hung Chiu (Taiwan), and Choon H. Do (Korea).

- **Microscale program**. John Bradley (South Africa) continues to guide a program of introducing teachers in developing countries to microscale techniques and experiments, and this was also one of the themes of the FCP visit to the Philippines, facilitated by resource person Jorge Jibañez (Mexico). Additional microscale workshops would be appropriate activities during the IYC.

- **Role of chemistry in understanding and providing solutions to climate change.** The UN resolution declaring 2011 as an IYC highlights the role of chemistry in sustainable development and in addressing challenges such as global climate change. CCE has initiated a project (# 2008-043-1-050) in collaboration with the Royal Society of Chemistry, the American Chemical Society, UNESCO, and the Alberta Centre for Research in Youth Science Teaching and Learning (CRYSTAL Alberta) to develop and disseminate a set of interactive, web-based materials to visualize and understand the underlying science of climate change. We propose delivering these materials in time for the International Year.

  As chair of this project task group, I draw to Council's attention that the visual icon of our present day scientific understanding of the changing role of CO_2 in our planet's climate is a graph of atmospheric CO_2 concentrations from the Mauna Loa observatory in Hawaii, beginning in 1957 (the 'Keeling Curve'). Discussions during the 1957 International Geophysical Year drew attention to the need for better fundamental scientific understanding of trace atmospheric gases. This set the stage for using the Mauna Loa observatory for monitoring studies.

  As a legacy of understanding to future generations, might IYC 2011 serve to challenge the network of IUPAC chemists to imagine and implement both scientific and educational accomplishments of similar impact relevant to gaps in our understanding of the chemistry of our changing climate and the development of solutions to climate change?

- **Interdivisional/standing committee projects.** CCE is committed to contributing to joint projects with other divisions/committees – at present this includes the development of an isotopic periodic table, an abridged version of the Green book, and the ethical conduct of chemists. Division liaison Eva Åkesson has gone to substantial effort to build stronger relationships with divisions, and we look forward to fruitful collaborations in the next biennium.

- **Development of a framework of priorities for CCE.** A project proposal is under review to develop a framework to assist CCE (and through CCE, IUPAC) to more effectively prioritize its educational activities. This project, which is led by former NR Tony Ashmore (UK), should be particularly helpful in considering what educational activities CCE and IUPAC can best coordinate during IYC 2011, and which might best be carried out by national chemical societies and others.

- **Areas of strong interest, possibly to be developed into projects.** Under consideration at our Mauritius meeting were several topics which we anticipate may develop into projects. These include: learning outcomes, student misconceptions in chemistry, sharing ideas of how countries can best tell their own stories of chemical achievement leading up to IYC, and green chemistry.

- **ICCE conferences.** The 20th ICCE was held in Mauritius, August 3-8, 2008, with a satellite conference in Nairobi, Kenya (http://www.uom.ac.mu/20icce.htm) immediately following. The 21st ICCE will be held in Taipei in August 2010. CCE has expressed a strong preference for locating the 2012 meeting in Europe, perhaps jointly with a European chemistry education meeting. Bids from several European conference hosts

have been received, and CCE will make a decision on the venue for this conference at its Glasgow meetings. Morton Hoffmann (USA), our conference coordinator has worked closely with local organizers to facilitate this important biennial event for CCE.

- **Communication, the secretariat and Chemistry International.** The success of all of these activities and projects depends on CCE being able to communicate effectively with others within IUPAC and with external partners. We owe a debt of gratitude to the secretariat for their assistance, and particularly to Fabienne Meyers for her excellent coverage of IUPAC's educational activities in our official newsmagazine, Chemistry International.

4. Current CCE Projects

- 2008-042-1 - Development of a framework of priorities for CCE
- 2008-043-1-050 - Visualizing and understanding the science of climate change
- 2007-005-2-050 – Research-Based Evaluation of the Young Ambassadors for Chemistry (YAC) Programme
- 2002-021-2-050 - A feasibility study of the scope and limitation of machine translations as a means of disseminating useful reading material for chemical education on the internet

Completed in the past year

- 2007-018-1-050 – Toward an Improved Teaching and Learning of Chemistry at the Tertiary Level in the Philippines
- 2007-011-1-050 - International Year of Chemistry - Initial strategy planning
- 2006-043-3-050 - The Social Responsibility of Chemists: Responsible Stewardship

Joint Projects with Other Divisions/Standing Committees

- 2007-038-3-200 - Development of an isotopic periodic table for the educational community
- 2007-032-1-100 – Green Book – Abridged Version, Joint with Div I
- 2007-050-2-600 – Climate and Global Change: Observed Impacts on Planet Earth, joint with Div VI
- 2007-022-2-020 – Recommendations for Codes of Conduct
- 2006-050-3-100 – Wet Surface Vibrational Spectroscopy Experiments, Joint with Div I
- 2004-037-1-400 – Design of Polymer Education Material for French Speaking Countries, joint with Div. IV
- 2004-045-1-700 – Training of School Children on Pesticides and Health – Toxicology in the Classroom, Joint with Div. VII

Projects Under review

- 2008-017-4 – Green chemistry – creation and implementation of international cooperation in teaching and investigations.

5. Current Membership, Roles and Sub-Committees (2008-2009)

- Prof. Peter G. Mahaffy (Canada) – *Chair*
- Prof. Eva Åkesson (Sweden) – *Secretary and division liaison*

Titular Members

- Prof. Mei-Hung Chiu (China/Taipei)
- Prof. Choon H. Do (Korea)
- Prof. Ram S. Lamba (Puerto Rico)
- Dr. Lida Schoen (Netherlands)
- Prof. Mustafa Sözbilir (Turkey)
- Prof. Natalia P. Tarasova (Russia)

Associate Members (Divisional Representatives)

- Prof. A. James McQuillan (New Zealand)
  Physical and Biophysical Chemistry
- Dr. Javier Garcia-Martinez (Spain)
  Inorganic Chemistry
- Prof. Mary Garson (Australia)
  Organic and Biomolecular Chemistry
- Prof. Jean-Pierre Vairon (France)
  Polymer
- Prof. Roger M. Smith (United Kingdom)
  Analytical Chemistry
- Dr. Hemda Garelick (United Kingdom)
  Chemistry and the Environment
- Dr. Mukund S. Chorghade (United States)
  Chemistry and Human Health
- Prof. Richard Hartshorn (New Zealand)
  Chemical Nomenclature and Structural Representation

National Representatives

- Prof. Tony Wright
  Australia
- Ludo Brandt
  Belgium
- Prof. Borislav Toshev
  Bulgaria
- Prof. Qiankun Zhuang
  China/Beijing
- Prof. Ameen Farouk M. Fahmy
  Egypt
- Dr. Christiane Reiners
  Germany

- Prof. Miklos Riedel
  Hungary
- Prof. Uday Maitra
  India
- Prof. Peter E. Childs
  Ireland
- Dr. Mordechai Livneh
  Israel
- Prof. Liberato Cardellini
  Italy
- Prof. Masahiro Kamata
  Japan
- Prof. Abdulaziz A. Al-Najjar
  Kuwait
- Prof. Farzana Mahmood
  Pakistan
- Prof. Erica Steenberg
  South Africa
- Prof. Katarina Edström
  Sweden
- Prof. Phillippe Boesch
  Switzerland
- Prof. Morton Z. Hoffman – *Conference coordinator*
  United States
- Prof. Norman Reid
  United Kingdom

Ex Officio

- Prof. John D. Bradley (South Africa), *Consultant for microscale programme*
- Mark C. Cesa (USA), *COCI Representative*
- Audra Wolfe (USA), *Chemical Heritage Foundation*

Subcommittee on Chemistry Education for Development

- Prof. Mei-Hung Chiu (China/Taipei), *Chair*
- Prof. John Bradley (South Africa)
- Prof. Bob Bucat (Australia)
- Dr. Derek S.P. Cheung (China/Hong Kong)
- Prof. Masahiro Kamata (Japan)
- Prof. Ram Lamba (Puerto Rico)
- Dr. Jing-Wen Lin (China/Taipei)
- Dr. Lida Schoen (Netherlands)
- Dr. Erica Steenberg (South Africa)
- Prof. Natalia Tarasova (Russia)

CCE Subcommittee on International Year of Chemistry

- Prof. Mustafa Sözbilir (Turkey), *co-chair*
- Prof. Anthony Wright (Australia), *co-chair*
- Prof. Liberato Cardellini (Italy)
- Prof. Christiane Reiners (Germany)
- Dr. Lida Schoen (Netherlands)
- Prof. Jana Soukupova (Czech Republic)
- Prof. Natalia Tarasova (Russia)

CCE Project Group

- Prof. Choon H. Do (Korea) – *Project Coordinator*
- Prof. Mei-Hung Chiu (Taiwan)
- Prof. Kristina Edström (Sweden)
- Prof. Morton Z. Hoffman (USA)
- Prof. Masahiro Kamata (Japan)
- Prof. A. James McQuillan (New Zealand)
- Prof. Mustafa Sözbilir (Turkey)