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Activities for International Year of Chemistry Organized and Facilitated by the Committee on Chemistry Education (CCE) in IUPAC

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Introduction

The International Year of Chemistry 2011 (IYC 2011) is a worldwide celebration of the achievements of chemistry and its contributions to the well-being of humankind. Under the unifying theme "**Chemistry—our life, our future**" IYC 2011 offers a range of activities for all ages. IYC 2011 is intended to reach across the globe, with opportunities for public participation at the local, regional, and national level [1].

The concept of IYC 2011 started with the recognition within the IUPAC Bureau that a number of scientific disciplines (e.g. World Year of Physics [2] and International Year of Astronomy 2009 [3]) have achieved significant benefits from securing designation by the United Nations of an international year pertaining to their field of study. The idea of having IYC 2011 has been discussed at IUPAC General Assembly in Turin, Italy in August 2007 and a resolution in favor of the proclamation of 2011 as the International Year of Chemistry was approved. Less than a year later, the UNESCO Executive Board recommended the adoption of such a resolution [4], submitted by Ethiopia, and which subsequently lead to the declaration in December 2008 by the UN General Assembly [5] of 2011 as the "International Year of Chemistry"[6].

IYC 2011 has four main purposes [1]:

- Increase the public appreciation and understanding of chemistry in meeting world needs,
- Increase interest of young people in chemistry,
- Generate enthusiasm for the creative future of chemistry,
- Celebrate the 100th anniversary of the Mme. Curie Nobel Prize and the 100th anniversary of the founding of the International Association of Chemical Societies.

IUPAC and the Committee on Chemistry Education CCE

IUPAC was formed in 1919 by chemists from industry and academia. For nearly 90 years, the Union has succeeded in fostering worldwide communications in the chemical sciences and in uniting academic, industrial and public sector chemistry in a common language. IUPAC is recognized as the world authority on chemical nomenclature, terminology, standardized methods for measurement, atomic weights and more. In recent years, IUPAC has been proactive in establishing a wide range of conferences and projects designed to promote and stimulate modern developments in chemistry, and also addressing education and public understanding of chemistry [1].

CCE is one of the committees of IUPAC. It has four main duties listed below [7]:

- To advise the President and the Executive Committee on matters relating to chemistry education, including the public appreciation and understanding of chemistry.
- To maintain a portfolio of educational projects and to coordinate the educational activities of IUPAC.
- To monitor chemistry education activities throughout the world and to disseminate information relating to chemical education, including the public appreciation of chemistry.
- To develop liaisons with international organizations such as UNESCO, national and regional chemical societies, chemical education committees, and organizations concerned with the public appreciation of science.

CCE is one of the groups which is actively involving in the organization of IYC 2011 educational activities [8]. CCE has worked with partners to collect and bring ideas to the IYC Management Committee [9] about high profile global events that would raise awareness about the importance of chemistry in our lives; such events could be carried out by the public (especially students) in various places around the world. Each country freely organizes their own activities, however, CCE worked out mostly on global activities. These are described below.

Global Activities

Involving the public, and in particular students, in the activities of the IYC is one of the most important goals. Several global and local activities special to IYC 2011 have been organized around world. IUPAC and UNESCO have developed, in partnership with chemical industry and others, a set of activities called the *Global Chemistry Experiment* (GWE) to entice students around the world to learn about how chemistry contributes to one of the most important resources in their daily lives. The global experiment engages students in schools across the world in practical activities around the theme "Water: A Chemical Solution". The chemistry of water as a solution as well as the role of water in society and the environment is highlighted [10]. GWE come a central flagship unifying activity for IYC 2011 with the hope of reaching hundreds of thousands of young people around the world with hands-on experiments related to the substance water, which is vital to all forms of life on earth. GWE was launched on the UN World Water Day, March 20 - 22, in Cape Town, South Africa.

Although water is the most abundant substance on the Earth's surface, about 70% of the planet's surface is covered with water, it is rarely found pure. 97% of the water on Earth is sea water of high salt content and is not adequate for most uses. Therefore the availability of water around the world, in terms of both quality and quantity, requires that practical methods be found for proper treatment. Water fit for human consumption, or potable water, is essential for health and well-being. Purification of potable water demands adherence to a series of quality criteria embodied in physical, chemical and microbiological parameters, all of which require measurement according to prescribed procedures. The Global Chemistry Experiment demonstrates these concepts clearly and simply for students around the world [10].

The Global Chemistry Experiment consists of four component activities; each can be carried out by children of all ages in schools across all continents [11]. The activities are adaptable to the skills and interests of students of various ages and use equipment that is widely available at little or no cost. Short description of each activity is given below. The details for the activities can be accessible through the links given at the references.

Activity 1- *Acidity - pH of the Planet*: Students measure the pH of a local water source and explore the acidity of the water sample [12].

Activity 2- *Salinity - Salty Waters*: The salinity of a salty water sample is measured by evaporation [13].

Activity 3- *Water Treatment - Water: No Dirt, No Germs*: A dirty water sample is first clarified with a homemade filter and then disinfected [14].

Activity 4: *Distillation - Solar Still Challenge*: Students construct and test a solar still, exploring how it works, and then construct a still to their own design [15].

An interactive website [16] developed with help from *European Schoolnet* for the experiment now is in use includes all information for the GWE. Through the registration site school teachers can register their interest in the project and sign up their school to the activities. The data submitted is displayed via a mapping tool displaying the global data, school information including a Google map in color. Currently, as of end of October 2011, over thousand teachers and 24 thousand students were performed the experiment from total of 1174 registered classes in 25 different country throughout the world and submitted data [17].

Global Stamp Competition: Chemistry as a Cultural Enterprise

This activity is aimed to design a national stamp that reflects on 'Chemistry as a Cultural Enterprise', showing the chemical impact on the culture and/or everyday life in participants' country. The competition was open to students all over the world in 3 age categories (12-14, 15-18 and undergraduates/teacher students from all subjects (not only chemistry!) [18]. This activity was launched during the official opening ceremony of the IYC in UNESCO headquarters in Paris, France on January 27-28, 2011. Students uploaded their designs to a publication platform that allowed peer review. The submissions were collected until the June 15, 2011. 247 entries from 18 different countries were received. Most of the entries were from 15-18 age groups and the competition was most popular in Asia Pacific (total number 142 with 105 entries from Malaysia). Both stamps produced on the computer and pictures of stamps, drawn by hand were received. From Western European countries quite a few students' groups collaborated on one design. A panel of experts from IUPAC and all partners judged the entries. The winners of the stamp competition for each age group are given below in Figure 1[19].



Figure 1a. Vasilena Vasileva (Age 14)
Bulgaria



Figure 1b. Muszhafar Hassan Ismail (Age 18)
Malaysia



Figure 1c. Peter Yuosef M. Rubio (undergraduate)
Philippines

Figure 1. Winners of the Global Stamp Competition.

The jury also selected runners-up stamps too. Runners-up for 15-18 age groups are Stavrou Maria, Spyrou Chrisia and Stylianou Chrysovalento from Cyprus, Luqman Safwan Che Mohd Fauzi from Malaysia, and Kyle Stratford and Max Willinger from USA.

Due to a generous gift of GlaxoSmithKline the organizers were able to send the winners \$500 and the runners-up \$250 (for the group). All mentioned

students received a personal certificate. All other participants got a certificate of participation. A selection of the best designs will be on show during the IYC Closing Ceremony in Brussels. The winners and the runners-up also received additional prizes from their national chemistry societies and local authorities. Moreover Cyprus issued a customized stamp with the runners-up design, and the National Dutch Postal Services did the same with the Dutch winners' design.

Developing Toolkits for National Chemistry Weeks during IYC

This activity aimed to develop toolkits for national chemistry days and weeks during IYC 2011 in order to raise awareness of the importance of chemistry as the central science by highlighting the applications of chemistry in daily life [20]. The project essentially fulfilled the following two objectives:

To collect information about the planned activities for IYC2011 from countries which already have established national chemistry days or week.

To develop toolkits to facilitate the widespread celebration of national chemistry days or weeks around the world, particularly in countries that do not have a strong tradition to date of doing so.

In carrying out this project, it is hope that 2011 may be the beginning of on-going celebrations of the importance of chemistry in some new countries around the world.

The task group was collected information about the planned activities for IYC 2011, especially from countries having a strong tradition in celebrating chemistry at national level. The planned activities then published on the project web site to facilitate the sharing of those ideas with other nations, especially those that do not have already established national chemistry day/s or weeks, and that desire guidance for the celebration of chemistry days or weeks during IYC. Currently ideas and activities for IYC 2011 are available at the project web site [21].

Visualizing and Understanding the Science of Climate Change

Understanding and responding to global climate change is one of the defining challenges of the 21st Century. This IUPAC CCE project [22] provides a set of peer-reviewed, interactive, web-based materials [23] to help learners visualize and understand the underlying science of climate change. As a contribution to the IYC 2011, this project results from a three-year collaboration between the faculty and student research team at the King's Centre for Visualization in Science (The King's University College, Edmonton, Canada) and chemists and educators from the Royal Society of Chemistry (RSC - UK), UNESCO, IUPAC CCE, the American Chemical Society (ACS - USA), and the Federation of African Societies of Chemistry (FASC). The target populations are 16-19 year old students, teachers at the secondary and first year tertiary levels, and chemistry professionals. The materials are freely accessible to the general public. At present 4 of the planned 9 interactive web based modules are published and accessible through the project web site at www.explainingclimatechange.ca [23], and the remaining 5 modules have been drafted and are undergoing both scientific and pedagogical peer review prior to posting them on the web.

Local Activities

There are some other events that have been done with the help of IUPAC CCE and others at some localities. Among them are the Flying Chemists Program (FCP), Young Ambassadors for Chemistry (YAC) events and Women Sharing a Chemical Moment in Time.

Flying Chemists Program (FCP)

The FCP intends to provide emerging or economically disadvantaged countries means to improve the teaching and learning of chemistry at primary, secondary, and tertiary levels. The FCP provides a country with the expertise and external sounding board to strengthen chemistry education and to assist it in its own development [24]. A very successful FCP program visit was held in February 2011 in Ethiopia in conjunction with an IUPAC CCE project which aims to empower Ethiopian chemists and teachers to modernize chemistry education at secondary and tertiary levels [25]. The Ethiopia FCP program events were scheduled to coincide with the official national launch IYC in Ethiopia, the country that led the way in obtaining designation at UNESCO and the UN. FCP activities bring together at the national level a critical mass of chemistry educators to improve chemistry education, facilitated by external resource persons with expertise in areas targeted by the country, and including experience with previous FCP programs.

Ethiopia carried out a survey of chemistry education at secondary and tertiary level, and then brought together a network of chemists and chemistry educators to review the results and discuss ways to enhance the capacity of the country to provide quality chemistry education at these levels. Particular emphases were placed on laboratory instruction; visualization at the molecular level; designing and implementing contextualized and learner-centered chemistry education; promoting innovative ways of training quality chemistry teachers; and placing chemistry education in rich contexts related to local, national, regional, and global challenges. The FCP visit began with a half-day official launch of IYC in Ethiopia, and after three days of workshops, lectures, and brainstorming, was followed by the 27th Annual Conference of the Chemical Society of Ethiopia. The FCP visit was planned in consultation with both the Chemical Society of Ethiopia and the Federation of African Societies of Chemistry. The FCP program was made possible by supplementing the small amount of IUPAC funding with additional support from the Royal Society of Chemistry (UK), UNESCO, the Governments of Ethiopia and Germany, and the Federation of African Societies of Chemistry [26].

Young Ambassadors for Chemistry (YAC)

The YAC project [27] is a partnership between IUPAC CCE and the Science Across the World (SAW) network [28] to facilitate the flow of ideas between chemistry and society. This project uses the 'train the trainer' model to create public interest in chemistry. YAC has been running for years with several successful activities throughout the world. During IYC four of them were done in Ethiopia, Kuwait, Jordan and Puerto Rico. The YAC event in Ethiopia was held during 18-19 February 2011 in Addis Ababa with the help of Federation of African Chemical Societies (FASC) in University of Addis Ababa [29]. In April two individual YAC events was held in Kuwait and Jordan in April 18 and 20 respectively. YAC in Kuwait was organized by Kuwait Chemical Society

and the Yarmouk University organized the YAC in Jordan. The Final YAC event in IYC 2011 was held in Puerto Rico on July 29 during 43rd IUPAC World Chemistry Congress in San Juan in Puerto Rico.

Women Sharing a Chemical Moment in Time

CCE Associate Member Mary Garson from Australia designed and carried out with the support of Fabienne Meyers and others a very successful global activity to celebrate the role of women in chemistry. Women chemists from 44 countries organized morning events on January 18, 2011 through an international networking event entitled "Women Sharing a Chemical Moment in Time". This event was a "prequel" to the official launch of IYC 2011 in 27-28 January 2011. Roughly 5000 women chemist came together to make it one of the largest gatherings of women scientist worldwide. A number of countries held multiple gatherings while some of them just had one gathering [30].

Conclusion

The goals of IYC2011 are to increase the public appreciation and understanding of chemistry in meeting world needs, to encourage interest in chemistry among young people, and to generate enthusiasm for the creative future of chemistry. The activities described above were planned and implemented by IUPAC CCE to fulfill the above goals. It has been a very busy year and it is still continue to be so. Chemists are enjoying the promotion of chemistry and reaching their voices to the far ends of the public. IYC 2011 is not just the celebration of past achievements of the chemistry, but is also a celebration for the future of the chemistry. As we approach officially the end of the IYC 2011, it is time to think about the sustainability of the events carried out during IYC 2011. For this purpose world leading chemists came together on a virtual conference to discuss the sustainable future of chemistry. Next stage of the events should be focused on how to keep this motivation achieved by IYC 2011 events for the sustainable future of our chemistry. As officially declared by the IYC 2011 management committee "Chemistry is our life- our future".

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