



# Green Chemistry Education

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## GREEN CHEMISTRY IN THE SCIENTIFIC CONTEXT

The **science of chemistry** is central to addressing the problems facing the environment. Through the utilization of various subdisciplines of chemistry and molecular sciences, there is an **increasing appreciation** that the emerging area of green chemistry is needed in the design and attainment of sustainable development.

A central driving force in this increasing awareness is that Green Chemistry accomplishes both **economic** and **environmental** goals, simultaneously through the use of sound, fundamental scientific principles.

The term “**Green Chemistry**”, as adopted by the IUPAC Working Party on Synthetic Pathways and Processes in Green Chemistry, is defined as: “*The invention, design, and application of chemical products and processes to reduce or to eliminate the use and generation of hazardous substances*”.

# GREEN CHEMISTRY IN THE INTERNATIONAL CONTEXT

Through the vehicle of Green Chemistry, IUPAC is engaging the international community in **issues of global importance** to the environment and to industry, through **education of young and established scientists**, provision of technical tools, governmental engagement, communication to the public and scientific communities, and the pursuit of sustainable development.

By virtue of its status as a leading and internationally representative scientific body, IUPAC is collaborating closely in furthering individual national efforts as well as those of multinational entities.

In this context, educational opportunities to train chemists in the scientific principles and technical methodologies of Green Chemistry are, of course, of primary importance. To establish and carry out the Green Chemistry educational programs, there needs to be a partnership among government entities, industry, and academic institutions. This partnership should focus on the importance of **development** and **dissemination** of new science and technology that form **the basis** of Green Chemistry and on the related education and training.

These target audiences need curriculum materials to be developed and a suitable educational infrastructure in Green Chemistry to be made available to teachers, instructors, and professors.

# IUPAC AND OECD EVENTS RELATED TO GREEN/SUSTAINABLE CHEMISTRY

- Founding of the IUPAC Working Party on Synthetic Pathways and Processes in Green Chemistry (Seoul, Korea, August 1996)
- International Conference on “Challenging Perspectives on Green Chemistry”, Venice, Italy, September 1997 (sponsored by IUPAC)
- OECD Workshop on Sustainable Chemistry (Venice, Italy, October 1998)
- Meeting of the IUPAC Working Party on Synthetic Pathways and Processes in Green Chemistry (Venice, Italy, October 1998)
- OECD International Meeting on Sustainable Chemistry R&D and Education (Rome, Italy, March 2000)
- IUPAC ICOS 13 (MiniSymposium on Green Organic Synthesis), Warsaw, Poland, July 1-5 2000
- Special Topic Issue and Symposium-in-Print on Green Chemistry (Pure and Applied Chemistry, July 2000)
- OECD Workshop on Research and Development in the Context of Sustainable Chemistry (Tokyo, Japan, October 2000)
- Institution of the Sub-committee on Green Chemistry within the Commission III.2 of IUPAC Division III (December 2000)
- IUPAC International Symposium on Green Chemistry, Delhi, India, January 10-13, 2001
- IUPAC CHEMRAWN XIV, World Conference on Green Chemistry, Boulder, Colorado, June 9-13, 2001
- IUPAC 38th Congress (Environmental Chemistry and the Greening of Industry), Brisbane, Australia, July 1-6, 2001;
- IUPAC Committee on Teaching of Chemistry, Satellite Conference, Brisbane, Australia, July 1<sup>st</sup>, 2001.

# Workshop on Green Chemistry Education

The IUPAC Organic and Biomolecular Chemistry Division, in collaboration with other IUPAC Bodies, and OECD (Organization for Economic Cooperation and Development), is organizing a Workshop on Green Chemistry Education, to be hosted by the Interuniversity Consortium on Chemistry for the Environment, and held in **Venice**, from **12-14 September 2001**.



**INCA**  
Inter-university Consortium  
*Chemistry for the Environment*

The Workshop will be open to representatives (governmental institutions, academia, industry, national and international chemical societies, industrial organizations, environmental institutions and associations, etc.) with a relevant background on Green Chemistry educational themes.

The focus of the Workshop will be on **the educational aspects** of Green Chemistry and will deal with **5 major topics**.

## ***Topic 1 - Existing government and industry programs (R&D, awards, information, tools, etc.) useful for incorporating Green Chemistry into the education systems***

### **Tasks:**

- Develop a survey and collect information among the participants on the existence of programs and materials on Green Chemistry (OECD, IUPAC, Industry, Academia, NGOs, GOs, etc.)
- Report on existing collaborations among international organizations (educational and industrial communities) for incorporating Green Chemistry concepts into the education system
- Identify the existing Awards dedicated to Green Chemistry that stimulate education, information exchange, and promotion of Green Chemistry to the public

### **Outcome:**

An Account will illustrate the actions and programs on Green Chemistry for incorporating these new concepts into the educational system.

## **Topic 2 - Existing Green Chemistry educational material, tools, initiatives and sources**

### **Tasks:**

- Identify (and assess) the existing Green Chemistry educational sources (e.g. university programs, scientific societies, government programs, industrial programs, schools, etc)
- Identify educational material and tools suitable for scientific faculties belonging to the Universities involved in Green Chemistry programs

### **Outcome:**

A resource guide of existing Green Chemistry educational materials and tools

## **Topic 3 - Commitments and recommendations necessary to carry out Green Chemistry educational programs**

### **Tasks:**

- Recommend future initiatives and programs on Green Chemistry Education, specifying mechanisms, tasks, and tools to implement them

### **Outcome:**

A list of possible recommendations in order to stimulate education communities as well as industrial and governmental interests in the mechanisms that are available or that need to be created to incorporate Green Chemistry effectively into the education systems

## **Topic 4 - Educational areas that address Green Chemistry Education**

### **Tasks:**

Identify educational areas that address Green Chemistry Education, in particular:

- Scientific (with a specification of the different levels)
- Industrial (with a specification of the different kinds of training)
- General public (to improve the awareness of the benefits deriving from the Green Chemistry approach)
- Business (to explain and demonstrate the benefits for the market deriving from the Green Chemistry approach)
- Government (to identify the appropriate channels to involve government in the adoption of national Green Chemistry educational programs/projects/activities)

### **Outcome:**

An Account will illustrate the mechanisms required to promote the incorporation of Green Chemistry concepts into various levels of chemical education.



## **Topic 5 - Elaborating and carrying out the Green Chemistry educational programs/projects with new educational materials/tools**

### **Tasks:**

- Identify the Green Chemistry educational programs/projects, such as curriculum materials, teacher training, targeted funding, outreach mechanisms, etc.
- Identify new materials/tools for Green Chemistry Education with more emphasis on new types of educational courses on Green Chemistry, such as new e-technologies (i.e., groupware applications, digital libraries, etc.)

### **Outcome:**

An Account will illustrate the Green Chemistry educational programs/projects and the benefits of new materials/tools for a faster and wider dissemination of Green Chemistry concepts.

# A Guide for Green Chemistry Education

*As the principal Workshop Outcome, a background document explaining the barriers, needs, and benefits of Green Chemistry Education will be developed. It will illustrate the scientific and social potential of Green Chemistry.*

*The resulting document will constitute a **Guide** for Green Chemistry Education, a **reference** for the programmatic future educational initiatives in the context of Green Chemistry.*

The documents discussed during the Workshop will be useful to the OECD and its countries. They will be invited to participate, and the OECD Issue Team on Sustainable Chemistry has been consulted on the organisation, so that the results can be functional for their overall project on Sustainable Chemistry.

**This project is an activity of the Organic and Biomolecular Chemistry Division (III)**

## **Subcommittee on Green Chemistry**

<b>Chairman</b>	<b>Prof. P. Tundo</b>
<b>Members</b>	<b>Dr. P. Anastas</b>
	<b>Prof. David StC. Black</b>
	<b>Dr. J. Miyamoto</b>
	<b>Prof. Torbjorn Norin</b>