**Chemical Education Applied to World Needs Symposium**
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**CHED 275**

## Industry expectations: Chemical education for researchers

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The CHEMRAWN (CHEMical Research Applied to World Needs) Committee of IUPAC (International Union of Pure and Applied Chemistry) is considering a conference--CHEMRAWN X "The Globalization of Chemical Education: Preparing Chemical Scientists and Engineers for Transnational Industries". At the conference, industry leaders, researchers, government agencies, and academics will examine the gap between industry expectations and current university practice in preparing graduates for research in the chemical industry. Advanced R&D in chemical companies of varying sizes requires some different educational profiles in their researchers. A survey of a number of chemical companies around the world has just been completed seeking opinions on the nature of the education needed for researchers in these firms as well as the critical issues that should be addressed at the CHEMRAWN X conference. We will review the results of this survey, prompt discussion of the issues for CHEMRAWN X, and outline for educators some implications of current R&D industry trends.

**CHED 259**

## Preparation for industrial research: What is wanted and what is not wanted

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In DuPont, we seek researchers who have the needed skill base, have the technical edge to talk with credibility, have the ability to use modern computational skills, modeling, and information technology, know how to take an idea and turn it into something of substance, have the ability to collaborate and work in teams, are able to be a non-conformist, and are courageous and committed. Universities are providing the education

to develop some of these attributes, are not providing others, and should not attempt to provide still others. We will outline DuPont's perspectives on the current state of the preparation for researchers in the firm. We will also compare and contrast this experience with the recent findings of the Council for Chemical Research – an organization of more than 200 companies, universities, and government laboratories in the United States that conduct research in chemical sciences and engineering.

**We are prepared for the 1960s**

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Universities have a dual role in society as conservators and transformers. Structural characteristics of the subject and practice of chemistry make it inherently conservative in an academic setting. For example, the cost of keeping up with modern technology works against teaching modern laboratory practices. Structural features of academic chemistry departments reinforce this conservatism. Education suffers. The effect is especially pernicious at the undergraduate level, where there are more students, and those students depend more on the institution. The legion of faculty struggling to transform academic chemistry to meet the needs of today's students are not well served by the conditions under which they operate. Global competition for human talent pressures U.S. academic chemistry to examine anew its priorities and methods.

**CHED 257**
**Multinational chemical employment: Educational needs**

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Chemistry at the undergraduate level is still today taught as a disciplinary subject with the expectation that students will either go to graduate school or work for a chemically focussed industry in analytical laboratories or as technical support personnel. The graduate students are expected to find academic positions or research positions in industrial laboratories. In all cases, no thought is given to the fact that most of the chemical and pharmaceutical companies are multinational in scope and that people who aspire to become leaders in those companies are usually expected to have some non-US experiences. One of the major educational voids is that chemistry students are not introduced to the chemical industry and its complexities at any level. The issues are how to include industrially related materials throughout the curriculum and how to provide professional guidance for all students.

**CHED 277**

**Preparing problem solvers for the chemical industry: The Doctor of Chemistry (DChem) program**

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In a global economy in which increments in productivity are often the key to profitability, there is a particular need for chemists with doctoral level skills, practical attitudes, and the ability to work in teams with engineers. The Doctor of Chemistry (DChem) Program at the University of Texas at Dallas was designed to prepare students for such careers. The DChem program provides a broad background in chemistry, experience in changing problems, and integral industrial experience through its Industrial Practicum. In the third year of the five year program, every student works for 9-12 months at an industrial site, on a project chosen both to benefit the company and to push the student's growth as a problem solver. The technical manager becomes a voting member of the student's supervisory committee. More than 90% of DChem graduates move directly from campus to career industrial positions, with the same salaries as Ph.D. hires.

## CHED 260

**Molecular science: New curricular pathways for world needs**

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In order to prepare future chemical professionals for their work on a wide range of global problems, it will be necessary for their education to be broad-based. That chemistry will be the basis of the solutions to many of the problems is a given; chemistry is not only the central science, it has rapidly become the all-encompassing science. Its boundaries have expanded into areas that have not traditionally been considered to be "chemistry," although their practitioners, who do not necessarily identify themselves as chemists, are clearly engaged in one way or another with the manipulation, transformation, and engineering of molecules and matter. These diverse areas, including the core chemistry, are, in fact, the components of "molecular science." Perhaps the time is rapidly approaching for the development of new, broad, curricular pathways, both undergraduate and graduate, in molecular science, and for the creation of academic administrative structures to facilitate education and research for world needs.

**CHED 258**

**International student and teacher exchange: The European experience**

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The science and engineering professional of the future, and indeed of the present time, requires a global perspective. One way of meeting this world need is to provide students and teachers with an international experience. Most European countries have enthusiastically embraced the idea and practice of providing international student and teacher exchange opportunities, and participation rates are constantly increasing. This presentation will give a European viewpoint on why these exchanges are considered important, what has been done to facilitate the exchanges, and what the hurdles are. The exchange networks that have developed in Europe, such as the European Chemistry Thematic Network (ECTN) have also led to various spin-off activities, for example curriculum development, short courses, and multinational/multilingual tests for the assessment of competence in chemistry. Some of these activities will also be presented

**Africa: A unique opportunity**

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Africa, particularly Sub-Saharan Africa, is enveloped by poverty to a degree almost unimaginable to Americans or Europeans. They cannot wait centuries to develop from an agrarian society into a modern industrial state. Chemistry provides an opportunity for them to develop by safeguarding the environment, ameliorating the chronic diseases endemic to the region, and opening an opporunity for economic progress. There are many African chemists who are working hard to help their people, but they cannot succeed without help from those of us in the already developed world. We must develop in our students the understanding that they have an obligation to assist their fellow human beings in Africa, not only because it is the right thing to do but also because it will help their own developed economies to continue. Even the Romans discovered in the fifth century that it is impossible to have an island of poverty surrounded by riches.

## CHED 262

**National Security Education Program (NSEP) for international education**

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The National Security Education Program (NSEP) is increasing the ability of Americans to communicate and compete globally by knowing the cultures and languages of other countries. NSEP embodies a recognition that the scope of U.S. national security has expanded to include not only the traditional concerns of protecting and promoting American well-being, but the new challenges of a global society, including economic competitiveness, sustainable development, environmental degradaton, global disease and hunger, and population growth and migration. The NSEP offers opportunities for students, faculty, and administrators to obtain education and experiences in critical less-

commonly studied and visited world regions. This presentation will discuss opportunities for U.S. students to earn undergraduate scholarships and graduate fellowships for international study, emphasizing fields of study such as biology, chemistry, environmental science, math and physics. Also covered will be opportunities for two and four-year colleges to compete for institutional grants to develop programs and materials that support international education in a wide range of disciplines.

**CHED 276**

**Improving the nation's K-12 science education: How the federal government can help**

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As the twenty-first century dawns, it is clear the prosperity we enjoy is largely due to science and technology. However, for this abundance to continue, we must ensure that our country develops and maintains the technical competence of our people. Recent evidence suggests, however, that we are not doing as well as we should in kindergarten through 12th grade (K-12) science, math, engineering, and technology (SMET) education. Three indicators highlight this disturbing trend: the Third International Math and Science Study, the National Assessment of Educational Progress, and several state tests. Legislation to improve K-12 SMET education (H.R. 4271, 4272, and 4273) has been recently introduced into the U.S. House of Representatives; however, it faces significant opposition. The legislation and its prospects for passage into law will be discussed.