

# BRINGING EUROPEAN INDUSTRY TO THE CLASSROOM

## CITIES - A NOVEL APPROACH TO MODULAR TECHNICAL TEACHER TRAINING

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**Abstract** — *In many European countries, there is an urgent need to interest more gifted young people in studying chemistry [1]. Key factors influencing their choice are their secondary school teachers. The COMENIUS project CITIES [2] has produced four teacher training modules which will help teachers to make their chemistry lessons more appealing by seeing the subject in the context of daily life. Besides basic information on European aspects of the chemical industry and chemistry teaching, CITIES offers tested course material with “hands on” experiments and a homepage [2] that presents people and products, linking everyday benefits, the making of products and their chemical background.*

**Key words** — *links industry-school, life long learning, everyday chemistry experiments*

### ANSWERING TEACHERS' NEEDS: FOUR LIFE LONG LEARNING MODULES

Many European chemistry teachers have not studied chemistry, but maybe biology or physics. Most of the chemistry teachers do not have any industrial work experience. Some have finished their studies long ago and may need training courses to bring their knowledge of research and development and of the industrial application of chemistry up to date.

A survey among European teachers showed that they want tested, up-to-date didactic material that helps them to make their classes even more vibrant. For this purpose, the CITIES team has developed **module 4** of CITIES, called "**Chemistry - Bringing it Alive**". For example, we know that students show specific interest in Forensic Science. In module 4, teachers will find appropriate experiments which lead from the forensic application to the chemical basis of the techniques used. Another set of experiments investigates the material science, food and packaging aspects of a “Tin of Ravioli”.

Other teachers may have started their career as a pupil in school, gone to university, and then back to school as teachers. They may feel that those aspects of chemistry which relate to its industrial and commercial use should be brought to them in such a way that they can use them in their classes. This would help to make students familiar with the economic and societal aspects of chemistry, and with the career perspectives that the chemical, pharmaceutical, cosmetics and related industries offer. Background information, helpful links and didactic material for this purpose is found in

**module 2**, which we have called "**Commerce and Innovation - Our Future**".

Most of our curricula in Europe are still very much centred around scientific principles, and we are bound to teach them. In some cases, curricula already contain elements of "everyday chemistry", of aspects relating the scientific content to its practical application, economic value and benefits for all of us. Starting from the film "A day without chemistry", we offer elements that make a short link between the curricular scientific content and the world in which we and our students, live. We called these contents of **module 3** "**Chemistry Changes Everything**".

Chemistry seen in a "European Context" is presented in **module 1**, "**The European Context**". Teachers will find basic information on EU policies, with special reference to the context of chemistry and the chemical industry; material concerning international educational programmes and available sources of funding; information on different approaches to chemical education in Europe with a subsection on student work experience and student mobility and on the employability of the graduates in a global economy.

CITIES offers some printed material and a CD-ROM version of some of its products. Since the internet has become the main source of information for most teachers and students, a homepage with material for download and with helpful links brings the CITIES results to the target group of this project..

### “COMMERCE AND INNOVATION — OUR FUTURE”

Chemical and related industries are presented on the CITIES homepage in a section called “**Commerce and Innovation – Our Future**”.

This section gives an introduction, relevant material and useful links for four selected topics

- Structure of the chemical industry in Europe
- The image of chemistry
- From laboratory to factory
- Industrial site visits

For the structure of chemical industry in Europe, CITIES refers to the CEFIC homepage where facts are published in a downloadable form and updated each year. Special emphasis is given to the size and scope of the chemical and related (e.g. pharmaceutical, cosmetics, food and materials) industries. Students should know that “chemical industry” is much more than just the petrochemical, raw materials and fine chemicals industry. The relative importance of SME's is

often unknown and underestimated in terms of turnover, employment and their role in the value chain of products and services.

The image of “chemistry” will be a topic in secondary schools. CITIES presents two videos. One is produced by the Union of French Chemical Industry (IUC) as a cartoon and based on a publication of Armand Lattes “What if all chemists quit?” [4]. The other is a product of Federchimica, Italy, a film without words introducing a real person. In the world of this young man, all the “chemical products” of daily life he touches vanish.

Teachers may use these films and work with their students to make them aware of the fact that chemistry is not a name for a set of “chemicals” threatening the environment and human beings. Chemistry is a (scientific) way of looking at nature (including ourselves)! They see the material and the living world as a complex set of tiny items called atoms, ions, molecules and supramolecular structures. They see molecules dance where others see nothing. Everything around us is therefore “chemistry”. The films may prompt students to also reflect the contribution of chemists to our daily lives, and to become aware of the benefits and risks of this contribution.

From laboratory and small scale experiments, it is a long way to the factory and to products. CITIES proposes to use an approach developed by APQUA in Spain, called “The coin cleaning factory”. Students are asked to develop a model company cleaning coins and selling this as a service. They will find out which components are needed to do this on large scale, including transport and logistics and waste treatment and recycling. In addition, a student activity is proposed where they search information on a wide range of aspects of copper production, including minerals, bronze age, refining, use of copper, copper as an essential element in the human body and copper recycling.

Finally, this section offers guidelines for well-prepared site visits to industry and laboratories, with hints for student and class activities making use of what was seen and experienced.

All four items are presented with a “didactic routing” for teachers who want to use the material for their classes.

### EVERYDAY CHEMISTRY PRESENTED AT THREE LEVELS

Everyday chemistry is covered at three different levels:

1. A set of simple **demonstration experiments** which can be done everywhere with a minimum of effort and material, to be found at the homepage as “**Selling Chemistry from a Sample Case**” [5]. Materials, experimental procedures and ppt-slides illustrating the context of the experiments are available. Thus, the underlying principles (acid-base reactions, solubilities) of reactions of carbonates are developed from the observation of scale in

water pipes, of stalagmites, of sherbet etc. Liquid crystals are presented from their discovery to their use in displays. Based on this material, presentations can be planned such as “A day in the life of a chemist” and “Kitchen chemistry”. The CITIES team proposes to buy and use a “sample case” to transport the material required supplying the fresh ingredients only when needed (apple, lemon, garlic, wine, mineral water etc.).

2. A set of **work sheets** with background information for self study and classroom work, accessible at the CITIES homepage under “**Chemistry Changes Everything**” (module 3). The worksheets deal with everyday life products including fuel cells, liquid crystals, self cleaning materials, condoms, packaging materials, food flavourings, margarine, deodorants and anti-perspirants. These working sheets start with the question “When did all this begin?” . This section explains the historical background and shows how discoveries are made and how long it may take to bring useful products to the market. Under the heading “Is this really chemistry?”, the scientific and chemical background of the invention and the products is described. “So you want to try something out?” offers simple, inexpensive and illustrative experiments for the classroom or for students’ self study. “How are these materials produced?” introduces the most important aspects of the industrial production of consumer and technical products. “So what are the benefits?” and “Are there any known risks?” follows. If possible, the section ‘Future developments’ gives an outlook on relevant research topics and improvements. Finally, appropriate www-material for further studies is offered: “Intrigued by what you have read? Want to find out more?”
3. A set of **tested classroom experiments** to be done under the guidance of a teacher (module 4). They cover three topics. Of high interest to students is forensic chemistry. They learn how to use “silent witnesses” such as fingerprints, footprints and tool traces. They open and study a tin of Ravioli (noodles with a meat filling and tomato sauce) and do experiments on the food as well as on the packaging material. Finally, this section contains further experiments on some aspects of everyday products.

### NATIONAL VERSIONS IN DIFFERENT LANGUAGES

Apart from the English version, the material is available in the languages of the main partners, i.e. Czech, German, Polish and Spanish. Introductory texts are found in Estonian, Portuguese and Turkish. If partners are found who want to translate more and into other

languages, the CITIES team would welcome their co-operation.

### **CITIES: A FRAMEWORK FOR EXTENSIONS AND A MODEL FOR OTHER FIELDS**

The CITIES funding ends in September 2009. The project team invites all interested colleagues in Europe and beyond to contribute with their experience and good practice examples. The basic scheme of CITIES is open for more material following this established scheme as well as for other approaches. The CITIES scheme, of which some features are presented here, takes into account aspects of contents, context and didactics. The project team assumes that the systematic approach chosen for CITIES after a thorough needs evaluation for the sector of chemistry can easily be adapted to other sectors such as physics, electronics, mechanical engineering or biotechnology.

### **INSPIRING TEACHERS FEED STUDENTS' IMAGINATION**

The author met a student from Rwanda who applied for admission to his university's Bachelor course "International Bachelor Applied Chemistry". When asked why she wanted to study chemistry, she talked about her school chemistry courses: *"It was then that I first realised that chemistry is not so much a bunch of notes and theories that you sit and read, and a couple of experiments you carry out. It is about so much more than that it is about **imagination**. Unless in your mind you can see these particles, and their interactions then no amount of study can help you completely appreciate it until you see it. And once you see it then you are immediately absorbed into a world of possibility."* The CITIES team [3] wants to contribute to a teacher training concept that supports chemistry teachers in inspiring young people in the way this young lady's teacher did.

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### **REFERENCES**

- [1] cf. e.g.  
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