MINIATURIZING CHEMISTRY
THE ECOLOGICAL ALTERNATIVE

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ABSTRACT

The use of chemical substances in educational chemistry laboratories has unsubstitutable didactic objectives. However, it is a two-sided coin where the murky one involves associated dangers and mismanagement. For many years a myriad of teachers throughout the world have been using minute amounts of substances to reduce the ecological impact of school experimentation as well as costs, dangers, time, space, and fright. This has been called Microscale (or Small-scale) Chemistry. *[AJCE, 2(1), January 2012: Special Issue]*

WHAT IS MICROSCALE CHEMISTRY AND WHAT ARE ITS BENEFITS?

Microscale techniques help to **reduce** environmental pollution, costs, exposure to chemicals, experimentation time, space, fear to chemicals, raw material depletion, etc. They also help to **increase** environmental awareness, safety, savings, experimental variety and easiness. Microscale Chemistry experiments typically use microliters or micromoles of at least one of the reagents (1). With these attributes it is not surprising that Microscale Chemistry has spread like wildfire mainly in developing countries (2). The American Chemical Society has endorsed this methodology, and its prestigious Journal of Chemical Education has featured over 300 papers dealing with it. From qualitative to quantitative experiments and comparisons, there is a wealth of information to support any of the assertions above. Other education journals interested include:

- Chemistry Education Research and Practice (U.K.)
- The Chemical Educator (USA)
- Biochemistry and Molecular Biology Education (USA)
- Australian Journal of Education in Chemistry (AUS)
- Education in Chemistry (U.K.)
- African Journal of Chemical Education (Ethiopia)
- Educacion Quimica (Mexico)

A list of books on the field is given in the appendix of this paper.

WHERE DID IT START AND WHERE IS IT BEING USED?

The adoption of Microscale Chemistry for the teaching of Chemistry in Africa and Asia is largely due to the immense efforts of Dr. John Bradley, an English photochemist who became professor at the University of the Witwatersrand in South Africa, and of his collaborators. They took an interest in bringing laboratory experiences to the schools of South Africa, particularly to the

black students (who in the period of Apartheid had little opportunity to go to school). Bradley developed chemistry kits featuring very small amounts of chemicals and miniature laboratory equipment, naming these as *microchemistry experiments.* He set up a small plant to manufacture these kits and eventually established the Radmaste Learning Center at this university to prepare written experiments and teacher guides. This enabled real laboratory chemistry to reach the majority of schools in South Africa and Bradley was honored by the State for this (3, 4).

The UNESCO's Division of Basic and Engineering Science embraced Bradley's Global Microscience Project to spread it throughout the world and it continues doing so in association with IUPAC, the Radmaste Center, the International Organization for Chemistry for Development (IOCD), and the International Foundation for Science Education (South Africa). Alexandre Pokrovsky (at IOCD and formerly at UNESCO) joined Bradley in his Foundation for Science Education (3, 4). The course materials can be downloaded from the UNESCO website (5). Figure 1 shows a map showing the UNESCO associated centers and the countries and territories where UNESCO workshops have been run (6).

Figure 1. UNESCO associated centers and countries and territories where UNESCO workshops have been run (6).

Other groups have been active in these geographical areas and in Europe and Oceania. (See their books in the Appendix).

On the other hand, the adoption of Microscale Chemistry for the teaching of Chemistry in America can be chiefly traced back to the influence of the US National Microscale Chemistry Center (NMCC, at Merrimack College, USA) and of the Mexican Center for Green and Microscale Chemistry (MCGMC, at Universidad Iberoamericana - Mexico City) which NMCC helped establish. A recent summary of Microscale Chemistry activity in Latin America is available (2). In the US, many other groups have pushed this technique with impressive results. (See their books in the Appendix).

WHAT ARE THE PERSPECTIVES FOR THE FUTURE?

Microscale Chemistry has developed profound roots throughout the world which will make the tree grow quite high for the years to come. Both developed and underdeveloped countries will continue benefiting from this approach.

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