About This Booklet

The purpose of *A Teaching Companion to Exploring the Nanoworld* is to provide high school teachers with creative, inexpensive, hands-on/minds-on ideas that will enhance the introduction to and understanding of the nanoworld. The word *nanoworld* refers to the atomic scale. This booklet includes activities and investigations that are intended to act as stand-alone units or supplements to standard curriculum materials.

Many aspects of *A Teaching Companion to Exploring the Nanoworld* relate to students' daily lives. Making connections between students' experiences and the material they learn is essential to a good learning experience, as this will encourage students to explore various scientific concepts in greater detail. The activities in this booklet utilize new technology to illustrate core chemistry concepts, while giving students the freedom to explore and discover relationships for themselves.

This booklet begins with an overview of memory metals: what they are and how they work at the atomic scale. Following a description of these materials, a series of investigations that may either be performed by the classroom teacher or students is offered. The investigations are intended to illustrate at an exploratory level some of the unique properties of nickel titanium or Nitinol, a specific type of memory metal. A laboratory exercise with suggestions for experimentation is then presented. Finally, an example of an assessment for the mini-unit is provided.

The next section presents a detailed explanation of two techniques used extensively for determining the relative positions of atoms: X-ray diffraction and scanning probe microscopy, which includes Scanning Tunneling Microscopy (STM) and Atomic Force Microscopy (AFM). Investigations using diffraction gratings and a simulation for the STM follow. An activity requiring additional resources and the Internet can be used in conjunction with this section or may be used after all of these sections have been completed. Finally, an example of an assessment completes this unit.

The third section contains material that could be easily used as an integral part of a unit on atomic structure and periodicity. Before using this material, students must have an understanding of electron configurations in order to comprehend concepts related to light emitting diodes (LEDs). LEDs are then used as a vehicle to help students understand periodic trends as well as to learn about the devices themselves. Through demonstrations and investigations, students will gain knowledge of band theory, electrical conductivity, and metallic bonding. An understanding of solid solutions is developed and then used to help explain semiconductors and LEDs. Through additional demonstrations and an experiment students will be able to understand how composition determines the behavior of solid solutions and how the periodic table can be used to predict properties. Similar to the other units, a set of review questions and a sample assessment concludes this section.

Each section of the booklet also includes suggestions of where and how the materials in the units might be used in the standard chemistry curriculum. Additional information can be found in the appendices of each section. A glossary and list of references are included for the purpose of clarifying and/or obtaining more information if desired. While this publication is directed toward high school teachers, some portions may be appropriate for middle school at a more conceptual level and for college at a more technical level. The authors welcome comments, which may be sent to Arthur Ellis, University of Wisconsin-Madison, 1101 University Avenue, Madison, WI, 53706 (ellis@chem.wisc.edu).