

WHAT DO WE MEAN BY NANOSCIENCE OR NANOTECHNOLOGY EDUCATION?

Donald R. Baer

Pacific Northwest National Laboratory

Box 999, Richland, WA 99352

Don.baer@pnl.gov

ABSTRACT

Even if only a portion of the impact expected from Nanotechnology were to occur, it will have a large effect on many different technologies and economies around the world. Therefore it is at a minimum appropriate and more likely essential that the nature of workforce training and education needs relevant to nanotechnology be discussed in many different forums such as this workshop. This talk will raise several issues and share our experiences in teaching intensive courses on nanotechnology.

As will be noted by other presenters at this workshop, the overall breadth and multi-disciplinary (or cross-disciplinary) nature inherent in nanoscience and nanotechnology is at least somewhat incompatible with traditional highly focused education approaches, especially at the graduate level. However, the broadness of nanotechnology would also not be adequately served by creating nanotechnology generalists that do not have adequate depth in one area to make valuable contributions to research teams. The president of one nanotechnology company noted that he has not hired anyone trained in nanoscience or nanotechnology and did not expect to ever do so. Therefore an increased value will be placed on highly trained subject matter experts that also have skills associated with team formation, the ability to communicate across many disciplines, and the ability to grasp essential ideas from other of disciplines.

In addition to language and working style issues, additional educational (and research) challenges relate to other fundamental aspects of the nature of nanotechnology. Currently many different physical concepts and ideas are “covered-over” by using the term nanotechnology. Different fundamental physical principles and concepts associated with nano-structured materials are often not identified or distinguished. Therefore the different physical reasons that nanomaterials have interesting or novel properties are ignored. To some degree this is a terminology issue. Challenges of adequately characterizing nanostructured materials also seem to be underestimated. An increased variety of experimental tools may be needed to characterize nano-objects and many researchers do not have needed level of knowledge to use the tools to the adequate level. The different issues related to measurements on individual nano-items and industrial needs to understand large collections of nano-items are often not well addressed. Thus a range of conceptual, metrology, analytical and even theoretical issues related to nanoscience and nanotechnology should be more fully identified and addressed in education programs. We are addressing some of these topics in intensive multi-disciplinary courses in nanotechnology associated with PNNL, the University of Washington and Washington State University (www.nano.washington.edu/pnnl/outline.html).

In addition to training experts and leaders, it is important to equip members of society with the language and base level knowledge to deal with the societal, environmental and economic choices and risk that nanotechnology presents to society. Without this base level of knowledge and open discussion, nanotechnology (or indeed any technology) that creates revolutionary change in society will create hostility, fear and related disruption. Other educational questions are associated with more general workforce training issues such as the general workforce skills needed for nanotechnology.