The Significance of Systems

Over the course of this past summer, I was afforded the opportunity to attend two very different, yet very important, conferences. The Earth System Processes conference, jointly sponsored by the Geological Society of America and the Geological Society of London, brought to Edinburgh some of the leading workers in such diverse fields as geochemistry, climatology, Earth dynamics, and biogeochemistry. The relatively small size of this international conference coupled with numerous opportunities for extended discussions resulted in an intellectual environment that stimulated the exchange of information and ideas. Later in the summer I traveled to the NSF- sponsored DLESE workshop in Flagstaff, Arizona. The DLESE initiative (Digital Library for Earth System Education) is an ambitious and multi-faceted undertaking aimed at establishing a community-sponsored storehouse of earth system education resources. This conference brought together many experts on geoscience education and digital databases, as well as those who understand processes of student visualization and conceptualization of scientific ideas.

> *"The interactions among the lithosphere, atmosphere, hydrosphere, cryosphere, and biosphere require integrated interdisciplinary study and have social and economic implications."*
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> Earth System Processes Program
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> *"To assemble and foster the creation of educational materials from the community that are rich in science content; diverse in format, content, and topics covered; fresh, dynamic, and interactive; instructor-ready; and integrative across traditional disciplines."*
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> DLESE Strategic Plan

Reflecting upon these conferences, the people I met, the things I learned, I came to realize that there exists a significant disconnection between those individuals working to enhance our understanding of the Earth as a complex of systems and those who strive to bring the latest scientific advances to the classroom. In Edinburgh, internationally renowned scientists spoke of the importance of communicating their research to the general population. In Flagstaff dedicated geoscience educators struggled to find ways to bring the most recent and most extensive digital datasets to students in a pedagogically sound manner. Clearly, these are not unrelated issues. The long-term health of geoscience research ultimately depends upon the public's perception of its relevance. Creating a population that understands and appreciates the significance of science is one of the key missions of geoscience educators. Likewise, making the results of research accessible and understandable - placing advances in their proper theoretical and societal framework - must be a central part of each researcher's efforts.

The systems approach to geoscience research is not a passing fad. While perhaps not as fundamental a change in thinking as the development of plate tectonics, it does reflect a significant alteration in the large-scale distribution of funding for new projects. With greater emphasis placed on multi-disciplinary research along the boundaries of traditional scientific fields, earth systems science asks new questions in new ways. Science educators must, in turn, translate for our students the results of these efforts. Embracing a systems approach to geoscience education is not an abandonment of fact-based teaching. Rather, earth systems allow educators to more fully illustrate the complexity of nature in ways that demand a larger, not smaller, factual foundation. Within science education, there will always be a natural tension between the need to teach facts and the need to teach concepts. By focusing on the dynamics of natural processes, earth systems science education links facts and concepts into a meaningful whole.

In response to the growth of systems-based research, it is now useful to begin to consider how the standard geoscience curriculum should be restructured. Beyond changes at the introductory level, should the typical discipline-based course sequence be reevaluated? If so, what is the nature of changes that should be made? I strongly encourage everyone within the geoscience community to consider these issues - and to come forward with their ideas and suggestions. This journal serves as the only international forum for the distribution of research on teaching and learning about geoscience. As such, I hope that as programs undergo review and restructuring, the lessons learned from those efforts will be documented within these pages.

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Editor