CBE—Life Sciences Education
Vol. 8, 108–110, Summer 2009

Feature
Current Insights

Recent Research in Science Teaching and Learning

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This feature is designed to point *CBE—Life Sciences Education* readers to current articles of interest in life sciences education as well as more general and noteworthy publications in education research. URLs are provided for the abstracts or full text of articles. *Current Insights* typically alternates between highlighting a variety of current literature and featuring a group of articles on a particular theme. This themed issue focuses on lessons learned from the study of scientific practices and scientists-in-action and their implications for science teaching and learning.

1. Desai, K. V., Gatson, S. N., Stiles, T. W., Stewart, R. H., Laine, G. A., and Quick, C. M. (2008). Integrating research and education at research-extensive universities with research-intensive communities. *Adv. Physiol. Educ. 32*, 136–141.

[Open access: http://advan.physiology.org/cgi/content/full/32/2/136]

In response to the Boyer Commission's call (Boyer, 1998) for undergraduate learning "through inquiry rather than transmission of knowledge," Desai and colleagues developed and studied a "research-intensive community" as a scalable model for involving undergraduates in research. This approach has special appeal for research universities that may not otherwise be sufficiently equipped to involve large numbers of students in one-on-one apprenticeships typical of undergraduate research experiences. Desai and colleagues designed the research community experience to allow for graduate or experienced undergraduate student mentorship of undergraduate teams, ownership of research by teams, and communication within, across, and beyond the teams. They collected data on graduate and undergraduate students' perceptions of their experience through interviews and on the entire group's scientific productivity based on their publications and conference presentations. The authors argue that, per faculty member, this model has the potential to involve many more undergraduates in the practices of science, including sharing their findings with the broader scientific community while encouraging graduate students' development of leadership and managerial skills.

DOI: 10.1187/cbe.09–03–0020
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2. Feldman, A., Divoll, K., and Rogan-Klyve, A. (2009). Research education of new scientists: implications for science teacher education. *J. Res. Sci. Teach.* Published online.

[Abstract available: www3.interscience.wiley.com/journal/122245082/abstract]

Feldman and colleagues study how scientists learn to do science (i.e., "research education" of undergraduate and graduate students) as a model for K–12 science learning. The authors interview a group of science and engineering professors to understand their views of graduate education as an experience that prepares scientists to do research rather than solely to understand science. Based on their results, the authors describe a developmental continuum of a scientist-in-training, from novice researcher to proficient technician to knowledge producer. Novice researchers helped maintain the research setting and collect data. Proficient technicians mastered skills associated with designing, conducting, and reporting results of investigations. Knowledge producers were able to "warrant" new knowledge, contributing to the field by making novel claims supported by defensible evidence. The respondents in this study emphasized that doctoral students are expected to produce knowledge, which typically does not occur until late in their training. Feldman and colleagues conclude by posing a series of questions regarding the extent to which science teachers should engage in practices that move them along this continuum, primarily, whether a teacher must be a science knowledge producer to teach children how to do science and whether it is desirable and worthwhile to expect science teachers to be knowledge producers in the scientific (as well as teaching) domain.

3. Gengarelly, L. M., and Abrams, E. D. (2009). Closing the gap: inquiry in research and the secondary science classroom. *J. Sci. Educ. Technol. 18*, 74–84.

[Abstract and free PDF preview available: www.springerlink.com/content/t006215213762130/?*p*=812f085544224da6af4b087970630892&pi=7]

Gengarelly and Abrams explore how graduate students (i.e., fellows) view classroom inquiry and the inquiry they do as scientists-in-training. The fellows spend two days each week collaborating with secondary school teachers in introducing inquiry-based instruction into science and math classrooms as part of a Graduate Teaching Fellows in K–12 Education project. The authors made multiple observations of each fellow during classroom activities to characterize the level of inquiry they implemented, from confirmation inquiry (i.e., question, methods, and solution of the inquiry are provided to students) to open inquiry (i.e., students generate their own questions, methods, and solutions). The authors also interviewed the fellows to understand their conceptions of inquiry and the relationship between inquiry practiced by scientists and by students. Although most of the results confirm findings from other studies about barriers to teaching by inquiry, one particularly unique finding was how fellows could empathize with students and offer them guidance in their struggles with open inquiry, for example, in dealing with ambiguous results. In addition, the fellows modeled scientific habits of mind learned in their own training, including curiosity, skepticism, and observation skills. Gengarelly and Abrams posit that graduate students may be better able to empathize with secondary students regarding the challenges of inquiry than "veteran" scientists who are practiced at overcoming the challenges of inquiry.

4. Hsu, P.-L., and Roth, W.-M. (2009). From a sense of stereotypically foreign to belonging in a science community: ways of experiential descriptions about high school students' science internship. *Res. Sci. Educ.* Published online 26 February 2009.

[Abstract and free PDF preview available: www.springerlink.com/content/u2865r04h8271456/?*p*=4e1d356d0d4c4155aaaf3532a7489684&pi=1]

In this study, Hsu and Roth identify aspects of research internships that are salient for high school students. Research internships, in the form of lab or field apprenticeships, are considered valuable models for involving learners in authentic science experiences. The authors were most interested in how the high school students experienced their internships (i.e., phenomenography), rather than how an outside- or participant-observer saw their experience (i.e., ethnography). Data sources included observations, field notes, videotaped lab and field experiences, and videotaped interviews of the students throughout their internship experience and in their classrooms, as well as interviews and observations of their high school teacher and scientist mentors. Multiple strategies (e.g., articulating the researcher's viewpoint, designing interviews based on the students' reflections, etc.) were used to ensure that the findings were credible and that analysis focused on the participants' experiences rather than the researchers' perspective. High school students recognized that these internships were "authentic," giving them a better understanding of what scientists and universities are like. During their internships, the students came to appreciate the complexity of the knowledge and the time-consuming nature of the procedures necessary to do science, which for them indicated the dedication and passion of the scientists. The students also saw the internships as connecting the communities of high school and university science and offering opportunities for reflection and self-exploration, especially with respect to their interests in and attitudes toward science. Finally, the students valued internships for offering a more comprehensive view of science by combining science knowledge with hands-on activity as well as consideration of the purposes and implications of research.

5. Norris, S. P., Macnab, J. S., Wonham, M., and de Vries, G. (2009). West Nile Virus: using adapted primary literature in mathematical biology to teach scientific and mathematical reasoning in high school. *Res. Sci. Educ.* Published online 31 January 2009.

[Abstract and free PDF preview available: www.springerlink.com/content/y0183r306855151h/?*p*=457a233a7b0a463f90febade7dead677&pi=14]

This descriptive article is part of a special issue of *Research in Science Education* on reading scientific texts during science learning, especially at the high school level (see Yarden [2009] for an introductory editorial). Norris and colleagues describe a protoype of "adapted primary literature" (APL; described in Baram-Tsabari and Yarden, 2005) articles that are adapted from primary scientific literature in a way that maintains its structure while using less technical language (i.e., distinct from reviews and secondary literature [SL] such as newspaper or magazine articles). The prototype is an adaptation of a research article on the development and validation of a mathematical model of West Nile Virus epidemiology (available at www.kcvs.ca/projects_files/models/west_nile/main%20text/westnileframeset.html). The researchers describe briefly several preliminary observations made during a randomized controlled study of students' work with APL vs. SL versions of the article (forthcoming). Students reported an understanding of how the model was an "approximation based on several compromises" rather than a literal interpretation of a phenomenon. This outcome is especially notable given students' misconceptions about the meaning and uses of scientific models, for example, that models are meant to be exact replicates of reality and are intended to represent all aspects of a phenomenon.

6. Park, J., Jang, K.-A., and Kim, I. (2009). An analysis of the actual processes of physicists' research and the implications for teaching scientific inquiry in school. *Res. Sci. Educ. 39*, 111–129.

[Abstract and free PDF preview available: www.springerlink.com/content/l4×2356171601510/?p=b47b585c5cf24702a3dc58b5f940706a&pi=0]

In an effort to help students perform scientific inquiry in a more authentic way, Park and colleagues studied scientists' conduct of research to identify the skills they used and the types of results their work yielded. They combined interviews of practicing physicists with analysis of their published research to develop a more realistic view of how scientists go about inquiry. This group of physicists used a variety of inquiry skills, from defining roles and responsibilities of individuals within a research team, to conjecturing possible explanations of results, to revising the research after obtaining results. Some skills used by these scientists resemble those emphasized in school science, while others were quite distinct. For example, students often think that there is a single result that is correct for a particular inquiry, such that they do not consider whether alternative interpretations are possible. In addition, students often approach inquiry as a linear, unidirectional process that cannot be altered once it is initiated, again prompting them to stick to an initial experimental plan, even when results suggest that alternative approaches are warranted. Regarding results of their inquiries, scientists determined that a variety of outcomes were important, including (1) new data, materials, techniques, and theory, (2) greater precision or verification of assumptions and theory, and (3) falsification of hypotheses or theory. School science primarily emphasizes scientific inquiry for generating new knowledge. Finally, the authors graphically depict relationships among the physicists' motivations, skills, and results in a way that demonstrates the nonlinear processes of research as a "more practical model for scientific inquiry in school."

7. Wong, S. L., and Hodson, D. (2009). From the horse's mouth: what scientists say about scientific investigation and scientific knowledge. *Sci. Educ. 93*, 109–130.

[Abstract available: www3.interscience.wiley.com/journal/119427575/abstract]

Understanding of the nature of science (NOS) has been emphasized as a key component of scientific literacy for decades. Wong and Hodson surveyed and interviewed a group of well-established scientists representing diverse disciplines to learn their perspectives on NOS. The authors then identified NOS elements embedded in all of the scientists' responses. In this article, they report on the elements related to the methods of scientific investigation and the role and status of scientific knowledge. First, the scientists noted the diverse ways scientific knowledge is generated beyond experimentation, and several highlighted how advances in technology have enabled the mining of data in fields where experimentation used to be the primary modus operandi. Second, these scientists highlighted the importance of creativity and imagination at all stages in an investigation, from design to communication. Third, the scientists described their views on laws, theories, and models. Interestingly, several scientists expressed what would be considered by some science philosophers and educators an "inadequate understanding" of the terminology, which clearly did not affect their abilities to conduct research. Some even argued that the term "law" should no longer be used because it engendered confusion about the robustness of the term "theory." Based on these results, the authors argue that NOS changes with time such that NOS teaching and learning must be revisited. They also propose that researchers be "wary of crude categorizations of NOS views" as documented using survey approaches, since a seemingly naïve view may be held in conjunction with a much more sophisticated understanding of NOS.

I invite readers to suggest current themes or articles of interest in life sciences education as well as influential papers published in the more distant past or in the broader field of education research to be featured in *Current Insights*. Please send any suggestions to: Erin Dolan (edolan@vt.edu).

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