Place-Based Geosciences Courses in a Diverse Urban College: Lessons Learned

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ABSTRACT

Recognizing the need to attract more students, especially those from underrepresented groups, a team of college faculty and experienced New York City Department of Education (DOE) Earth Science Teachers redesigned the two foundational Earth and Environmental Science courses required for all teacher and science major students in the Department of Earth and Environmental Sciences (EES). These two foundation courses have been taught in a survey style with broad, but shallow, content. The redesign team worked together to place greater emphasis on science process skills, technology, and discovery and chose air quality and beach morphodynamics as integrating topics for skill and content development throughout the courses. Students conducted long-term, place-based research within the city in ways that allowed them to apply the scientific method and develop skills necessary for practicing geoscientists, which included conducting online data searches, performing statistical analyses, graphing, using geographic information systems (GIS) and global positioning system (GPS), and making and giving presentations. Students used research-grade equipment, scanning electron microscopes (SEM), survey instruments, and petrology microscopes to collect and analyze their data. Iterative evaluations were conducted on the courses to provide guidance on ways to improve, and they formed the basis for course revisions in more-advanced courses. *© 2014 National Association of Geoscience Teachers*. [DOI: 10.5408/12-372.1]

Key words: postsecondary curriculum, place-based, urban

INTRODUCTION

The Department of Earth and Environmental Sciences (EES) at Brooklyn College, City University of New York (CUNY), is transforming its undergraduate curriculum from a more-traditional, lecture-oriented pedagogy to one that encompasses effective practices in teaching to meet the needs of the students of the 21st century (P21, 2009; NSF, 2012). Through grants from the Petrie Foundation and Fund for the Improvement of Postsecondary Education (FIPSE), committees of Earth and Environmental Sciences faculty, New York City Department of Education (NYCDOE) teachers, and EES undergraduate students were formed to design innovative course curricula for the two foundation courses. The redesign committees worked closely to identify guiding principles for course structure and content that resulted in courses with greater emphases on skill development, group research, and collaborative place-based learning while balancing Earth and Environmental Science content. Courses have been offered two or three times with evaluations and course revisions based on these evaluations. This article describes the process of developing and revising the foundation courses and discusses lessons learned from student evaluations for the first 2 y.[2]

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CONTEXT: BROOKLYN COLLEGE STUDENT BODY

To engage Brooklyn College students in EES opportunities, we closely examined the demographics of our students, including their economic status, and family influences on their academic and career interests. Brooklyn College is a nonresidential, public institution. More than three-quarters of its students come directly from New York City public high schools. Our student body reflects the ethnic and cultural diversity of the city with individuals from more than one hundred nations, speaking some ninety-five languages. Seventy percent of Brooklyn College's 15,600 students receive financial aid, and 77% work at full- or part-time jobs, often to support their families financially. Most are the first generation of their families to attend college, and parents exert influence with respect to their children's academic choices. Mathematically or scientifically inclined students tend to pursue academic routes in medicine, computer science, and accounting/business. Career, financial security, and community well-being are of fundamental concern, and drive decisions regarding college education by both students and their parents.

Recognizing the concerns and needs of incoming of students, EES faculty wanted to apply an approach to teaching that would motivate, expand, and retain talented students while providing a pipeline for local EES careers. EES faculty also realized the need for increasing the percentages of ethnic and racial minorities in EES. Although ethnic and racial minorities comprise a substantial percentage of the American workforce, approximately 25% in 2009, the percentage of underrepresented minorities in Environmental Science and Geoscience occupations decreased to only 2.2% (American Geological Institute, 2010), and Geoscience departments confer the lowest percentage of bachelor's degrees to underrepresented minorities of all

Science, Technology, Engineering, and Mathematics (STEM) fields (Huntoon and Lane, 2007; Gonzales et al., 2009). These statistics greatly motivated us to realize the potential Brooklyn College has to offer.

GUIDING PRINCIPLES

Our program and course redesigns were based on the following three guiding principles. These guiding principles were grounded in literature around effective practices in urban STEM education and workforce readiness.

Exposure to Science Research that Is Collaborative, Place-Based, and of Local Relevance Encourages Underrepresented Students to Pursue STEM Careers

Science education research often points to the disconnection between school science and students' day-to-day lived experiences as reasons for a lack of interest in science (Lemke, 2001; Roth and Tobin, 2007). Minority and immigrant students are often at greater risk, given the added cultural and linguistic disconnect between school, school science, and their life worlds (Basu and Barton, 2007; Rahm, 2007). Lack of engagement with real-world problems and solutions in the classroom has been proven a predictive factor in students dropping out of high school and, correspondingly, the STEM pipeline (Connell et al., 1995; Rumberger, 2004). Although these studies focus on high schools, we feel that this is also relevant to college students, particularly for foundation courses because such courses often comprise mostly freshman and sophomore students who retain many high school perceptions and attitudes. Through related work, we have learned that underrepresented students are driven by goals that focus on their home, family, community, and career (Powell et. al., 2009; Adams, 2010).

We used the local environment as the context for the course because not only have we found this to be a motivator for student learning but also a way of connecting geoscience to students' daily lived experiences. Science learning experiences that emphasize place are valuable in engaging students in science, especially those from underrepresented groups (Chinn 2006; Lim and Barton 2006). Place-based science education allows students to develop scientific literacy in ways that "expand both their control over the commons… and their room to maneuver in the community" (van Eijck, 2010, p. 187). In addition, place-based education in an urban context allows students to grapple with the complexities of natural science along with the social, political, and cultural aspects of environmental issues, which makes for a truly interdisciplinary learning experience (van Eijck, 2010). Gruenewald (2003) cites the importance of developing pedagogies that are meaningful to "lives of learners and communities from which they come" (p. 4). Thus, we focused the foundation courses on Brooklyn in ways that allow students to learn more about their community through a scientific lens (Lim and Barton, 2006).

Career Can Be Used as a Motivator for College Learning

Career is an important consideration for college students. The Cooperative Institutional Research Institute (Sax et al., 2001) noted that 72% of American freshman consider training for careers to be a goal of their college education. Seymour and Hewitt (1997) found that successful STEM programs acquaint students with the range of careers open to science graduates and describe the financial and personal/social reward of those careers. The students they interviewed did not solely concentrate on salary issues; students were looking for careers that were personally fulfilling and had a social purpose. Similarly, Miele and Powell (2010) demonstrated the potential of career-focused strategies to improve recruitment and retention of students in the sciences.

Edelson et al. (2006) noted that for lessons to lead to usable knowledge, students must recognize the usefulness of the knowledge or skill. Clearly, college curricula that integrate opportunities to develop practical, workplace-valued skills could further motivate students. Surveys of employers of college graduates indicate considerable congruity of skill-development priorities of both colleges and employers of college graduates. However, colleges could greatly improve the potential for success in postgraduate workplace experiences by placing greater emphasis on the development of critical skills. According to a 2006 survey by a consortium of four major career and management oriented organizations including The Conference Board, Corporate Voices for Working Families, the Partnership for 21st Century Skills, and the Society for Human Resources Management only one-quarter of recent college graduates were considered excellent in skills deemed essential to career success (Workforce Readiness Project Team, 2006). The National Association of Colleges and Employers (NACE) (2007) rated communication, interpersonal, analytical, problem-solving, technical, teamwork, computer, and leadership skills; a detail-oriented, strong work ethic; flexibility/adaptability; and initiative as qualities that were very important to potential employers.

Many of the EES faculty at Brooklyn College work with local community organizations in the government, private, and not-for-profit sectors to engage students in place-based opportunities, career-readiness, and interactions with local professionals. We are in an ongoing dialogue with local partners to keep abreast of career and internship opportunities in the New York City area and are responsive to changing workforce needs. Furthermore, the department has begun tracking the EES alumni (formerly called Geology) to keep track of their career trajectories while providing incentives and examples for undergraduate students selecting EES for their major. For the foundation course revisions, we made inquiries to geoscience employers in the New York City area about desired skills and dispositions of potential employees. In addition to the qualities cited in the NACE survey, they mentioned the application of geospatial technologies (GIS, remote sensing, and GPS), sampling procedures (air, water, soil, rock), field monitoring and measurements, and organizing and analyzing data in spreadsheets as specific technical skills they most valued. Accordingly, a curriculum that provides rich opportunities to develop these skills/qualities will not only motivate urban students but also supply the nation with a viable geoscience workforce.

Strengthening STEM Workforce Requires Preparation and Inspiration

The 2010 President's Council of Advisors on Science and Technology (PCAST) report noted that both preparation and inspiration are keys to strengthening the STEM workforce of the nation. Although that report focused on K–12 education, the foundational college years are developmentally similar to latter high school years. Preparation meant bringing all students, including underrepresented students, up to a level of proficiency (PCAST, 2010). Although that report was released after the course redesign, our redesign priorities are in alignment with the report.

Recognizing that many of our students come from local public high schools, some with inadequate STEM preparation for college-level studies, we designed our courses so that students would be exposed to a variety of subjects in geosciences and to basic skills needed to successfully pursue geoscience-related studies. Inspiration refers to "capturing the curiosity and imagination of students" (PCAST, 2010, p. 20). This includes engaging individual and group experiences both in the school and community as well as opportunities to collaborate with peers, teachers, and mentors. The team-teaching and collaborative research design of our courses afforded students multiple opportunities to work with peers and faculty through engaging in place-based activities that allowed them to learn about their local surroundings. For us, inspiration also meant giving students the opportunity to build science-related identities through the social/collaborative nature of the course. Recent science education research has pointed to identity development as an indicator of positive performance in STEM-related pursuits (Olitsky, 2007; Rahm, 2007; Tobin, 2007; Luehmann, 2009; Adams and Gupta, 2010). Thus, we used an "identity-in participation" framework in which identity development was shaped through activity and in relation to others (Hull and Greeno, 2006; Adams and Gupta, 2010). Developing opportunities that allow students to contribute to the scientific enterprise provides the space for them to build identities around science with the corresponding skills and dispositions that contribute to successful pursuit of the discipline. We decided that collaborative learning and research on Brooklyn-based topics were essential components of the EES foundation course redesign. Emphasis was placed more on "thinking like a geoscientist," rather than acquiring geoscience content and facts, to encourage the development of critical thinking skills and a deeper understanding of the research process.

COURSE DEVELOPMENT AND IMPLEMENTATION

Each member of the course redesign teams brought unique expertise that contributed to the final curricula. The NYCDOE Earth Science teachers brought their understanding of what skills and content knowledge were important for practicing teachers as well as knowledge of the state and local standards. The undergraduate student was an upper-level geoscience major who had taken the traditional foundation courses and was planning to be an Earth Science teacher. She was invited to participate because of quality of her undergraduate work and her demonstrated ability to contribute effectively in collaborative projects. This student brought a perspective on whether the content and approach would be engaging to her peers. Faculty had varied science expertise, whereas the chair provided the context for how the foundational courses would fit with programmatic revisions planned for the department.

The teams worked collaboratively identifying the goals and skills of the courses and the structure of the redesign. The goals and skills for "EES1" are shown in Table I. Those for "EES2" were very similar because EES2 was intended to build on the skills and content introduced in EES1.

After considerable discussion, the teams decided that the courses would focus on integrating themes of air quality in Brooklyn for EES1 and beach morphodynamics for EES2. These topics were chosen to expose students to both Earth and Environmental Science topics in a place-based context. Through an exploration of air particulates, students would learn about rocks and minerals, weather and climate, weathering and erosion, as well as petroleum combustion and energy. For beach morphodynamics, students would learn about sediments, wave processes, weather, and coastal erosion.

The courses would be team-taught by faculty with complimentary expertise to expose students early in their programs to the EES faculty and to the diversity of topics covered in geosciences. The first half of the course would focus on content and skill development, whereas the second half would emphasize group research projects where students would design and execute a place-based project. EES1 students conducted research in Brooklyn, whereas EES2 students studied Plumb Beach, a local beach within Gateway National Recreational Area. As an exciting engagement experience for EES1, we integrated the use of professional-grade research equipment; students examined particulates under a scanning electron microscope (SEM). Students learned how to prepare samples for SEM analysis and used the SEM under the close supervision of either faculty or laboratory technicians. In EES2, students presented their research findings to National Parks personnel to demonstrate that their scientific endeavors were of immediate value to the community.

An annotated version of the EES1 syllabus is shown in Appendix 1 (see online supplemental file available at http://dx.doi.org/10.5408/12-372s1) to illustrate the design framework, timetable of student learning, and the implementation of effective practices in teaching. The course emphasized a "city-as-lab" approach where New York City was the context in which students learned and conducted research. This allowed students to use Earth and Environmental Science content and concepts to connect to the local environment and strengthen the immediate relevancy of the course material. Air particulates in New York City were used as a starting point for studying Earth Science, and through that, the students explored the interconnections of Earth System components, in particular, atmosphere, lithosphere, and biosphere. During the 14 wk, students learned the ancillary skills identified in Table I (e.g., online searches, graphing and statistics, GPS, mapping) to meet course goals also listed in Table I. Career related skills (e.g., teamwork, presentation, and computer applications) were integrated in the course curriculum with ample opportunities to practice and refine skills. Because this course was in the early implementation stage, there was ongoing dialogue between students and the faculty about the direction of the course. Students' opinions about the content and activities were solicited and incorporated into the course design wherever possible. Students completed a final reflection of the course and were given opportunities for peer review and

TABLE I: Goals and skills for course redesigns.

Goals
Students will be able to
1. Inform members of the community about an environmental issue of local relevance that they analyzed from the perspective of a geoscientist
2. Evaluate a claim of an environmental risk as presented in the media
3. Effectively and accurately describe complex data and procedures
Ancillary Skills
1. Public speaking and presentation
2. Online search strategies
3. Simple statistics and graphing with Excel
4. Use of presentation or graphics software
5. Use of GIS and GPS
6. Map reading
7. Team work

faculty feedback on final projects before they were submitted for a grade.

COURSE EVALUATIONS

At the end of each course offering, all students were surveyed, and six students volunteered to participate in a 1 h focus group discussion (see Appendix 2 in the online supplemental file). The demographics of students in the course were representative of the ethnic and racial makeup of the college; five of the six students were members of underrepresented groups. The evaluation instruments were devised to discern whether goals for the course redesign were met and to discern how students experienced the course redesign. Specifically, we wanted to learn whether (1) the students found value in the course activities, (2) students saw the connection of the course to real-world applications and the doing of geosciences, (3) students found value in the collaborative research project, and (4) students were more aware of careers and topics in the geosciences. Because this was a foundations EES course and students often entered with limited knowledge of the geosciences, a preassessment test was not administered (Rockwell and Kohn, 1989). Analysis of the survey and focus group data revealed the following themes.

Collaborative Research and Authentic Inquiry in the Geosciences

Appendix 3 (in the online supplemental file) shows the results in percentages of the written surveys using the Likert scale for EES1 and EES2, whereas Appendix 4 (also in the online supplemental file) shows the results for the second iteration of EES1, which had a slightly different list of questions. The open-ended and Likert-scaled questions are shown in the online supplemental file, Appendix 5. Survey results from the different classes showed clearly that students valued the collaborative research project: results ranged between 77% and 100% agreeing or strongly agreeing that they learned a lot from the collaborative project. One student noted,

> *"The research project was valuable experience because it gave me a sense of how an actual scientist would work and think. Collaboration with other members of classroom brought in their strong knowledge of geology."*

The "felt" or "think" like a scientist was a recurring theme in the evaluation and focus-group data, especially for the hands-on laboratory and field experiences. Survey results indicated that 85%–100% agreed that they were able to "think and act like a scientist" during the collaborative research. One student said that she "felt like a scientist" when she used the SEM and was waiting for results,

> *"Using the geology equipment such as the SEM/EDS. The hands-on experience with the equipment was great and it also introduced me to another aspect of geology that I didn't expect. (I thought labs were basically using chemistry apparatus e.g., test tube labs)."*

An important lesson we learned was that students valued using field and laboratory equipment that directly relates to answering their own question(s). Student responses from the different classes ranged between 77% and 100% agreeing and strongly agreeing that they learned how to use geosciences laboratory equipment, geoscience technology, and geoscience data sets to answer scientific questions.

Place-Based Context

A strong aspect of the courses and the one that received the most-positive student response in the narratives was the appreciation of place-based field experiences. Survey results ranged between 77% and 100% with students stating that they either agreed or strongly agreed that they learned about Brooklyn-based environmental issues and felt that they could confidently speak about them, although for the second iteration of EES2 that percentage dropped to 59%.

Students discussed the "fun" and "frustration" of collecting "particulate matter" in the environment. They felt that it was a valuable learning experience, as one student said:

> *"[T]he course encouraged you to ask questions and find creative answers through your data."*

The Plumb Beach field experience was mentioned by a number of students as the highlight of the class experience because they were able to apply the content and skills that they learned in class to actual scientific activity in the field. Almost 70% of them strongly agreed that the field trip to Plumb Beach was a valuable learning experience:

> *"[Level of interest in geosciences] increased drastically, I expected a class based mainly on lectures. Never expected to go on a field trip to Plumb Beach and work as if we're geologists."*

Much of the place-based content was learned and experienced during the group project. In the second iteration of the EES1 course, students noted on the surveys that they felt the project was rushed and dense with content information.

Increasing Students' Awareness of Careers in the Geosciences

Many of the students taking EES foundation courses, particularly EES1, have not yet declared their majors. We included geoscience career exposure in the course redesign to make the connections between the course and major content and employment, a strategy that has been beneficial in encouraging underrepresented students to pursue STEM careers (Edelson et al., 2006). Student opinions varied as to whether the courses increased their awareness of careers in the geosciences with 46%–56% agreeing or strongly agreeing that they "learned about career options in the geosciences." This was one of the weaker outcomes of the evaluation because about half of the students felt they had learned about career options in geosciences. However, many students in the surveys and focus groups indicated increased interest in pursuing a geosciences career. As one student stated:

> *"My interest increased a lot—at least in the possibility of pursuing a career in the sciences."*

DISCUSSION AND CONCLUSION

Through iterative restructuring, enactment, and revision of the courses we have learned valuable lessons about teaching geosciences and engaging underrepresented students in the geosciences, which will have enduring effects on the courses we offer and the programs we design. We believe that our three guiding principles were sound and that we were effective in providing preparation and inspiration to students through involvement of place-based authentic science activities. However, our student evaluations indicate that we may need to devise ways to better expose students to geosciences careers and to make sure that group projects are adequately paced and not overwhelming in content and skill development.

We are inspired by the student responses to place-based, authentic inquiry. That fit well with a strategic theme at Brooklyn College to "capitalize on Brooklyn as a learning environment and gateway to the world" (Strategic Plan for Brooklyn College, 2011–2016). Coupled with other college-wide strategic themes aimed at providing an outstanding educational experience to our students and fostering a "dynamic, responsive, and inclusive academic community," the Earth and Environmental Sciences Department will continue to use place-based, authentic inquiry experiences to engage students in science learning. We aim to recruit and hire new faculty and adjuncts with research interests that focus on the local environment. We also continue to work to engage and sustain partnerships and collaborations that extend beyond the campus so that our students will have a myriad of opportunities for place-based learning experiences that directly transfer to geosciences workforce knowledge and skills.

REFERENCES

Adams, J. 2010. Community science: Capitalizing on local ways of enacting science in science education. *In* Fraser, B., Tobin, K., and McRobbie, C., eds., Second International Journal of Science Education. Alphen aan den Rijn, Netherlands: Kluwer Academic Publishers.

Adams, J. and Gupta, P. 2010. The continuum of participation in meaningful, purposeful out of school experiences mediating identity development as STEM learners, consumers and producers [Whitepaper]. Minneapolis, MN: National Science Foundation Innovative Technology Experiences for Students and Teachers Convening, Science Museum of Minnesota.

American Geological Institute 2010. Underrepresented minorities in the U.S. workplace. *Geoscience Currents,* 34:1.

Basu, S.J., and Barton, A.C. 2007. Developing a sustained interest in science among urban minority youth. *Journal of Research in Science Teaching,* 44:466–489.

Chinn, P. 2006. Preparing teachers for culturally diverse students: Developing cultural literacy through cultural immersion, cultural translators and communities of practice. *Cultural Studies of Science Education,* 1:367–402.

Connell, J.P., Helpem-Felsher, B.L., Clifford, E., Crichlow, W., and Usinger, P. 1995. Hanging in there: Behavioral, psychological, and contextual factors affecting whether African American adolescents stay in high school. *Journal of Adolescent Research,* 10:41–63.

Edelson, D.C., Tarnoff, A., Schwille, K., Bruozas, M., and A. Switzer. 2006. Learning to make systematic decisions. *Science Teacher,* 73:40–45.

Gonzales, L., Keane, C., and Martinez, C. 2009. Status of the geoscience workforce, 2009. Alexandria, VA: American Geological Institute.

Gruenewald, D. 2003. The best of both worlds: A critical pedagogy of place. *Educational Researcher,* 32:3–12.

Hull, G.J., and Greeno, J. 2006. Identity and agency in nonschool and school worlds. *In* Bekerman, Z., Burbues, N., and Silberman-Keller, D., eds., Learning in places: The informal education reader. New York: Lang Publishers, p. 77–98.

Huntoon, J.E., and Lane, M.J. 2007. Diversity in the geosciences and successful strategies for increasing diversity. *Journal of Geoscience Education,* 55:447–457.

Lemke, J.L. 2001. Articulating communities: Sociocultural perspectives on science education. *Journal of Research in Science Teaching,* 38:296–316.

Lim, M., and A.C. Barton., A. 2006. Science learning and a sense of place in an urban middle school. *Cultural Studies of Science Education,* 1:107–142.

Luehmann, A.L. 2009. Students' perspectives of a science enrichment programme: Out-of-school inquiry as access. *International Journal of Science Education,* 31:1831–1855.

Miele, E., and Powell, W. 2010. Science and the city: Community cultural and natural resources at the core of a place-based science teacher preparation program. *Journal of College Science Teaching,* 40:18–22.

National Association of Colleges and Employers. 2007. NACE research job outlook 2006. Houston, TX: NACE International, 28p.

Olitsky, S. 2007. Identity, interaction ritual, and students' strategic use of science language. *In* Roth, W.M., and Tobin, K., eds. Science, learning, identity: Sociocultural and cultural historical perspectives. Rotterdam, Netherlands: Sense Publishers, p. 41–62.

Partnership for the 21st Century Skills (P21). 2009. P21: Framework definitions. Available at http://www.p21.org/overview (accessed 26 June 2012).

Powell, W.G., Boger, R., Branco, B., and Yarrow. L.M. 2009. Place-based initiatives for urban students of introductory geoscience courses in Brooklyn. *In* Proceedings of the GSA Annual Meeting; 18–21 October 2009; Portland OR, Paper 187-19. Boulder, CO: Geological Society of America

President's Council of Advisors on Science and Technology. 2010. Prepare and inspire: K–12 education in science, technology, engineering and math (STEM) for America's future. Available at http://www.whitehouse.gov/ostp/pcast (accessed 14 October 2010).

Rahm, J. 2007. Science learning and becoming across time and space. *In* Roth, W.M., and Tobin, K., eds. Science, learning, identity: Sociocultural and cultural historical perspectives. Rotterdam, Netherlands: Sense Publishers, p. 63–79.

Rockwell, S.K., and Kohn, H. 1989. Post-then-pre evaluation. *Journal of Extension,* 27(2). Available online, http://www.joe.org/joe/1989summer/a5.php (accessed 15 September 2013).

Roth, W-M. and Tobin, K., eds. 2007. Science, learning, identity: Sociocultural and cultural historical perspectives. Rotterdam, Netherlands: Sense Publishers.

Rumberger, R. 2004. Why students drop out of school. *In* Orfield, G., ed., Dropouts in America: Confronting the graduation rate crisis. Cambridge, MA: Harvard Education Press, p. 131–155.

Sax, L.J., Astin, A.W., Korn, W.S., and Mahoney, K.M. 2001. The American freshman: National norms for fall 2000. Los Angeles, CA: Cooperative Institutional Research Program, American Council on Education.

Seymour, E., and Hewitt, H.M. 1997. Talking about leaving: Why undergraduates leave the sciences. Boulder, CO: Westview Press.

Strategic Framework for Education and Diversity. 2012. Facilities, international activities, and data and informatics in the geosciences: A special GEO vision follow-on report. Available at from http://www.nsf.gov/geo/acgeo/geovision/start.jsp (accessed 26 June 2012).

Strategic Plan for Brooklyn College: 2011–2016. Available at http://www.brooklyn.cuny.edu/pub/about_bc/documents/strategic_plan_2011-16.pdf (accessed 15 September 2013).

Tobin, K. 2007. Structuring new identities for urban youth. *In* Roth, W.-M., and Tobin, K., eds. Science, learning, identity: Sociocultural and cultural historical perspectives. Rotterdam, Netherlands: Sense Publishers. p. 15–40.

van Eijck, M. 2010. Place-based (Science) Education: Something is happening here. *In* Tippins, D. Mueller, M., van Eijick, M., and Adams, J., eds. Cultural studies and environmentalism: The confluence of eco-justice, indigenous knowledge systems and sense of place. Dordrecht, the Netherlands: Springer Press.

Workforce Readiness Project Team. 2006. Are they really ready to work? Employers' perspectives on the basic knowledge and applied skills of new entrants to the 21st century U.S. workforce. Washington, DC: Conference Board, Corporate Voices for Working Families, Partnership for 21st Century Skills, and the Society for Human Resource Management.