cific research using specific research designs. The limitations on funding along with myopic reviewers perpetuate the divergence between curriculum theory and pedagogical practice. It is also important to note that in an attempt to make school research more neat and tidy, therefore, more direct and clinical; school interactions are oversimplified by focusing on the impact of a curriculum innovation or a novel pedagogical strategy. These combined effects are not unique to mathematics education although mathematics education tends to garner more research dollars thus capturing a larger proportion of the media.

In summary, curriculum theory and teaching theory are only useful in practical application. It is impractical, quite possibly a threat to validity, to foster research in one without attention to what actually happens in classrooms. It is this interaction that could and should iteratively inform both curriculum and teaching theory and practical classroom pedagogy.

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Bridging the Divide Between Curriculum Theory and Practice for Nonmainstream Students in Science Education

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The need to bridge the divide that often exists between curriculum theory and practice is critical in meeting the learning needs of students, especially nonmainstream students who have traditionally been underrepresented in the sciences and underserved in science education. Nonmainstream stu-

dents, including culturally and linguistically diverse students and students of poverty, face various sociohistorical barriers that have long disadvantaged them academically by failing to provide equitable distribution of physical, human, and material resources (including curriculum) needed to excel at learning science. Understanding the curricular implications of these sociohistorical barriers requires a critical look at traditional science curriculum and pedagogy. In this essay, we outline key considerations for developing curriculum materials that bridge the divide between curriculum theory and practice for nonmainstream students in science education.

Multicultural science educators and feminist philosophers of science have critiqued the traditional assumption, embedded in science curriculum, that science is universal and "culture-free." Researchers have claimed that such a model fails to consider other cultures' views of the natural world (Atwater, 1996; Harding, 1993; Rodriguez, 1997). This literature conceives of science as a socially and culturally constructed discipline, questions the dominance of Western modern science, and advocates for inclusion in the curriculum of non-Western, indigenous, or other racial/ethnic traditions of knowing the natural world.

While much of the debate on science epistemology has taken place at the level of theory, researchers have also explored what the infusion of sociocultural perspectives into a Western modern science curriculum might look like in practice. Approaches based on different sociocultural perspectives have been considered. Curricular approaches grounded in theories of cultural congruence aim to integrate the beliefs and worldviews of non-Western peoples, while recognizing the explanatory and predictive power of Western modern science and ways of knowing (Aikenhead & Jegede, 1999; Loving, 1997). Curricular approaches grounded in theories of practice attempt to make explicit the ways in which individuals from diverse backgrounds have both embraced and resisted the traditional norms of science, and in so doing, have gradually changed these norms to be more accepting of diverse perspectives (Buxton, 2001; Carlone, 2004; Eisenhart & Finkel, 1998).

Bringing together the sociocultural analysis of science epistemology and practical attempts to infuse such analysis into the science curriculum has gradually strengthened the knowledge base. It is important to have practical examples, and not just a theoretical foundation, if curricular reforms are to make their way out of the ivory towers of academia and into teacher education programs and science classrooms. University science educators should take seriously the challenge of how to make theoretical ideas about teaching nonmainstream students both accessible to

classroom teachers and applicable to their daily practice. Three approaches to scholarship that are bridging this theory practice divide when working with nonmainstream students in science classrooms are presented below.

One approach to promote science learning and careers for nonmainstream students is to develop science curriculum materials and other teacher resources that portray scientists from diverse backgrounds, present diverse traditions of constructing and transmitting knowledge about the natural world, and include information about diverse languages and cultures. Aikenhead (2001) has developed both a conceptual framework for designing culturally relevant curriculum materials and practical examples of such curricula. His work is based on the notion of "cultural border crossing" between students' everyday worlds and the culture of science.

In addition to understanding the mainstream culture, English language learners must learn academic content while acquiring English language and literacy simultaneously. Lee and colleagues have developed curriculum materials used to implement professional development interventions with elementary teachers of English language learners. Over the years, the research team has created a series of science units for students, teachers' guides, and supplies including trade books for third, fourth, and fifth grade students. These materials integrated both theoretical and practical considerations with an emphasis on three domains: (a) science inquiry, progressing along a continuum from teacher-explicit instruction to student-initiated inquiry, (b) integration of English language and literacy in science instruction, and (c) incorporation of students' home language and culture in science instruction. The results of this research indicate the positive impact of the intervention on students' science and literacy achievement and on narrowing of achievement gaps (Fradd, Lee, Sutman, & Saxton, 2002; Lee, Deaktor, Hart, Cuevas, & Enders, 2005).

A theoretical understanding of the needs of students from low socioeconomic backgrounds has led some researchers to believe that academic curriculum should begin with the incipient knowledge that students bring to the classroom from home and community and then gradually advance toward formal science knowledge. Calabrese Barton and colleagues have studied what this theory might look like in practice by developing the "LiFE" (Linking Food and the Environment) curriculum focusing on inquiry-based investigations of food and the food system (Calabrese Barton, Koch, Contento, & Hagiwara, 2005). Implemented in high poverty urban schools in New York City, the curriculum explicitly connects scientific

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"How Can We Look Toward the Horizon, with Our Ears to the Ground?"

Some challenges to conceptualize science teacher education from a culturally responsive perspective

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The gender and ethnicity gap in science achievement continues to plague our best hopes for science education reform and our science education discipline has tried to explain or justify this recurring trend since the Sputnik era. Explanations range from a disparaging cultural deficit interpretations to more progressive socioconstructivist models. The latter perspective explicates differences in science discourses as being so incommensurate with other home-based discourses that it's a broad and specialized knowledge of science and culture to help underrepresented students achieve. Regardless of one's perspective, there is irrefutable evidence that school science often acts as a stratifying tool to separate students (Anyon, 1997; Erickson, 1973; Oakes & Guiton, 1995).

My colleague and I argue as advocates for underrepresented children in science but coming admittedly from the perspective of privileged backgrounds. Hence, we defer our right to speak on behalf of anyone but share our opinions that emerge from years of inserting ourselves as teacher/researchers in a variety of rural and urban contexts in Michigan, North Carolina, California, and New York schools. We have researched science classroom discourse and inserted ourselves into the lives of students who have been alienated by the school science experience and found that shifts in discourse are possible, albeit arduous. However, having taught children in a variety of contexts, we continue to see few advocates in the school context for helping underrepresented students with histories of failure learn and also appropriate science as a discourse.

"Why," we ask, "are there disproportionately small numbers of teachers advocating for the success of underrepresented students?" The problem may be that the task of teaching science has become so overwhelming often the best teachers want the students with greatest histories of success and the newest, less knowledgeable teachers are assigned groups of general science students with low expectations for their success. Another ex-