Diversity and Equity in the Next Generation Science Standards (NGSS):
"All Standards, All Students"

The NGSS Diversity and Equity Group will address how to make the NGSS accessible to all students, hence the title: "*All Standards, All Students*."

National Context

According to the 2010 U.S. Census data, 36% of the U.S. population are racial minorities. Among the school-age population under 19 years old, 45% are racial minorities (U.S. Census Bureau, 2012). It is projected that the year 2022 will be the turning point when racial minorities will become the majority in terms of percentage of the population but are likely to remain minorities in terms of status. Today, more than 20% of school age children speak a language other than English at home, and limited English Proficient (LEP) students (the federal term) have more than doubled from 5% in 1993 to 11% in 2007*(National Center for Education Statistics, 2011a).* While the student population in the U.S. is increasingly more racially, ethnically, and linguistically diverse, science achievement gaps have persisted by race, socioeconomic status, and language (*National Center for Education Statistics, 2011b).*

The participation of 26 lead states to guide the development and provide feedback to the NGSS design team suggests a high level of interest for coherent science standards among state leaders.

Diversity and Equity for NGSS

The charge of the NGSS Diversity and Equity Group is to ensure the NGSS are accessible to all students by highlighting changing demographics of the student population and identifying emerging national initiatives for a new wave of standards. The scope of work for the Group involves three primary tasks:

(1) review of standards statements,
(2) drafting a Diversity and Equity discussion chapter, and
(3) vignettes of diverse student groups.

First, the Group will review the standards statements to reflect diversity and equity issues and to avoid bias against race, ethnicity, language, socioeconomic status, students with special needs, and gender.

Second, the Group will write a stand-alone chapter on how to make NGSS accessible to all students. In identifying student diversity, we will start with accountability groups defined in No Child Left Behind (NCLB), which include:

- major racial and ethnic groups,
- students with disabilities,
- limited English proficient,
- economically disadvantaged, and
- gender.

In addition, the Group will extend student diversity by including gifted and talented students and students in alternative education programs. The chapter will highlight practicality and utility of implementation strategies that are grounded in theoretical frameworks. The chapter will provide the *context* of student diversity by addressing changing demographics, persistent achievement gaps and educational policies affecting diverse student groups. It will also detail effective strategies for *implementation* of NGSS in the science classroom, school, home, and community. The chapter will end with suggestions for the *professional development of teachers* to make NGSS accessible to all students by connecting the science classroom and school to students' home and community.

Finally, the Group will offer vignettes of specific student groups that will start with a story and be followed by key points of the student demographics, science achievement and policy that are addressed in the stand-alone chapter. The vignette will end with suggestions for effective strategies embedded in the story by linking the science classroom and school to students' home and community – see the following pages for examples.

References

National Center for Education Statistics. (2011a). *The condition of education 2011* (NCES 2011-033). Washington, DC: U.S. Department of Education.

National Center for Education Statistics. (2011b). *The nation's report card: Science 2009.* Washington, DC: U.S. Department of Education.

U.S. Census Bureau.(2012). *Statistical abstract of the United States, 2012.*Washington, DC: Government Printing Office. Accessed online at http://www.census.gov/compendia/statab/cats/education.html

English Language Learners

Demographics

The number of school-age children (children ages 5-17) who spoke a language other than English at home rose from 4.7 million to 11.2 million between 1980 and 2009, or from 10% to 21% of the population in this age range (National Center for Education Statistics, 2011). Currently, 21% of school-age children speak a language other than English at home, and limited English Proficient (LEP) students (the federal term) have more than doubled, from 5% in 1993 to 11% in 2007. This statistic does not account for students who were classified as English language learners (ELLs) when younger but who are now considered fluent English speakers. While Spanish speakers make up approximately 80% of the ELL population in the U.S., there are over 400 different languages spoken by U.S. students (U.S. Department of Education, 2007).

Science Achievement

While the ELL population in the U.S. is increasing, their science achievement is well below that of native English speaking students. For example, based on the National Assessment of Educational Progress (NAEP) science scores, the science achievement gaps between ELL and non-ELLs widened considerably from 2005 to 2009 for 4th, 8th, and 12th graders. According to the 2009 NAEP science results using 300-point scale scores, the gaps were 40 points for 4th graders, 50 points for 8th graders, and 47 points for 12th graders (NCES, 2011). These widening gaps were a reversal of the trend from 1996 to 2005, in which the gap narrowed slightly for 4th and 8th graders.

Educational Policy for ESOL/ESL, Bilingual Education, and Home Language

Part A of Title III of NCLB, the English Language Acquisition, Language Enhancement and Academic Achievement Act, provides for monitoring ELLs for Adequate Yearly Progress (AYP) in English language proficiency and content areas. This Act emphasizes increased accountability of ELLs in content-based academics and delivers funding according to each school's ability to meet AYP. Content area assessment and measures of AYP for ELLs cannot be separated from the language programs that serve the students. If a state supports bilingual education, then it is likely that at least some portion of science instruction is conducted in the student's native language while academic language proficiency in English is being developed. In states that follow an "English only" policy for ELLs, then all science instruction takes place in their second language and science knowledge has to be developed concurrently with academic English. Overall, educational policy for ELLs has been moving away from bilingual education and multicultural perspectives, and toward accountability for standards-based content learning and English proficiency.

Effective Strategies

NGSS defines what it means to learn science by moving away from prior approaches of detailed facts or loosely-defined inquiry to a three dimensional view of science and engineering practices, crosscutting concepts, and disciplinary core ideas. Particularly, scientific and engineering practices are language intensive and require students to engage in classroom science discourse. Students must read, write, view, and visually represent as they develop their models and explanations. They speak and listen as they present their ideas or engage in reasoned argumentation with others to refine their ideas and reach shared conclusions. These practices

offer rich opportunities and demands for language learning at the same time as they support science learning.

In developing a vignette for ELLs, we will start with a case study featuring ELLs. Then we will highlight effective strategies embedded in the case study and whether these strategies apply to the classroom, school, home, and/or community. As scientific and engineering practices according to the NGSS are language intensive, the vignette will highlight both language demands and language learning opportunities for ELLs as they engage in these practices. In addition, it will highlight that rich language learning environments as well science learning environments and scientific and engineering practices will support both science and language learning for ELLs.

We will describe five areas where teachers can support science and language for ELLs. First, teachers highlight various strategies for literacy development (reading and writing), such as activating prior knowledge, having explicit discussion of reading strategies for scientific texts, prompting students to use academic language functions (e.g., *describe*, *explain*, *predict*, *infer*, *conclude*) in science practices, engaging students in scientific genres of writing (e.g., keeping a science journal), teaching the uses of graphic organizers (e.g., concept map, word wall, Venn diagram), and encouraging the reading of trade books or literature with scientific themes.

Second, teachers provide language support strategies with ELLs, typically identified as English for Speakers of Other Languages (ESOL) strategies. They use hands-on activities, realia (real objects or events), and multiple modes of representation (gestural, oral, pictorial, graphic, textual). They guide students to comprehend key science vocabulary in context – both general academic terms (tier II words) and discipline specific terms (tier III words).

Third, discourse strategies focus specifically on the teacher's role in facilitating ELLs' participation in classroom discourse to enhance their understanding of academic content (i.e., adjust the level and mode of communication). A major challenge for teachers is in how to structure activities so as to reduce the language barrier for participation while maintaining the rigor of science content and processes.

Fourth, teachers can build upon and make use of students' home language to support science learning in English. Teachers may introduce key science terminology in both the home language and English, highlight cognates as well as false cognates between English and the home language, allow code-switching, and encourage proficient, bilingual students to assist less English proficient students in home language.

Finally, based on the literature on cultural congruence, teachers need to understand that students participate in classroom interactions in ways that reflect culturally-based communication and interaction patterns from their home and community. In addition, they need to elicit students' "funds of knowledge" related to science topics and use students' cultural artifacts and community resources in ways that are academically meaningful and culturally relevant.

References

National Center for Education Statistics. (2011). *The condition of education 2011* (NCES 2011-033). Washington, DC: U.S. Department of Education.

U.S. Department of Education. (2007). Participation in education: Elementary and secondary education. Washington, DC: U.S. Department of Education.

Students with Disabilities

Demographics

The number of children and youth ages 3-21 receiving special education services under the Individuals with Disabilities Education Act (IDEA) rose from 4.1 million to 6.7 million between 1980 and 2005, or from 10% to 14% of the student enrollment (National Center for Education Statistics, 2011). That number decreased to 6.5 million or 13% of student enrollment by 2009. Students with disabilities are also protected under Section 504 of the Rehabilitation Act of 1973. While special education services under IDEA are provided for eligible children and youth who are identified by a team of professionals as having a disability that affects academic performance adversely, Section 504 covers all persons with a disability from discrimination in educational settings based solely on their disability. Section 504 does not require students to have an Individualized Education Plan (IEP), but does require a documented plan in which the school provides reasonable accommodations, supports, and auxiliary aides to allow the student to participate in the general curriculum.

Science Achievement

On the National Assessment of Educational Progress (NAEP) in science, the gap in 12th grade scores between students with disabilities and students with no disabilities persisted from 38 points in 1996, to 39 points in 2000, and to 37 points in 2005. The 8th grade gap continually decreased from 38 points in 1996, to 34 points in 2000, to 32 points in 2005, whereas the 4th grade gap increased from 24 points in 1996, to 29 points in 2000, and then decreased to 20 points in 2005. In 2009, the science achievement gaps between students with disabilities including those with 504 plans and students with no disabilities were 32 points at 12th grade, 30 points at 8th grade, and 24 points at 4th grade. Factors affecting inclusion rate of students with disabilities on the NAEP are the type and severity of disability, the type of plan (IEP or 504), and the types of accommodations needed and allowed by NAEP. Students with disabilities in the years 1996-2005 included those on a 504 plan, who were given accommodations based on their IEP and 504 plans as allowed by NAEP.

Educational Policy for Students with Disabilities

Enacted in 1975, Public Law 94-142 (P.L. 94–142) the Education for All Handicapped Children Act mandated the provision of a free and appropriate public school education in the least restrictive environment for children and youth ages 3–21 who have disabilities. Public schools were required to develop an educational plan (IEP) with parental input that would be as close as possible to a non-handicapped student's educational experience. The IEP specifies the types and frequencies of services to be provided to the student, including speech-language, psychological, physical and occupational therapy, and counseling services. In addition, the IEP describes the student's present levels of academic performance and the impact of disabilities on the performance. Finally, it specifies the accommodations and modifications that are to be provided for the student in instruction and assessment.

In 1990, this act was revised and renamed the Individuals with Disabilities Education Act (IDEA). The most recent revision and reauthorization was completed in 2004 with implementation in 2006. Students with disabilities are also protected under Section 504 of the Rehabilitation Act of 1973. While special education services under IDEA are provided for

eligible children and youth who are identified by a team of professionals as having a disability that affects academic performance adversely, Section 504 covers all persons with a disability from discrimination in educational settings based solely on their disability. Section 504 does not require an IEP, but does require a documented plan in which the school provides reasonable accommodations, supports, and auxiliary aides to allow the student to participate in the general curriculum.

Under NCLB regulations, students with disabilities are monitored for Adequate Yearly Progress (AYP) in the content areas of mathematics and communication arts with increased accountability expected. Data on their science progress is also collected and reported once at the elementary school level, middle school level, and high school level. In 2007, final regulations under NCLB and IDEA were released to allow more flexibility to states in measuring the achievement of students with disabilities (U.S. Department of Education, 2007).

Effective Strategies

NGSS defines what it means to learn science through a three dimensional view of science and engineering practices, crosscutting concepts, and disciplinary core ideas. The demands of scientific and engineering practices that require students to engage in classroom science discourse will present opportunities and challenges for students with disabilities who must listen, speak, read, write, and visually view and represent ideas and explanations. Student IEPs provide for accommodations and modifications that teachers must provide to the students with disabilities in the classroom to support science learning. Modifications change or lower performance expectations of students, whereas accommodations allow students to overcome or work around their disability with the same performance expectation of their peers.

In developing a vignette for students with disabilities, we will start with a case study featuring students with disabilities in the inclusive science classroom. Some of the difficulties that these students may experience in the science classroom are with written text, spoken or written expression, numeric data, and memory and recall. Then we will highlight effective strategies embedded in the case study. The vignette will highlight both accommodations and modifications in the environment and instructional delivery, as well as general strategies in instructional differentiation (e.g., activating prior knowledge, strategies for reading scientific text, use of graphic organizers, multiple modes of representation, etc.) that support students with disabilities to achieve the expectations of NGSS.

References

National Center for Education Statistics. (2011). *The condition of education 2011* (NCES 2011-033). Washington, DC: U.S. Department of Education.

U.S. Department of Education. (2007). *Modified academic achievement standards.* Washington, DC: U.S. Department of Education.