The National Congress on Science Education
2004 Focus Group Background Papers

Enclosed is a series of background papers created by the NCSE Planning Committee. Please read these papers prior to the meeting and **bring your copy with you to the meeting**.

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The Highly Qualified Teacher and *Professional Development*

The Issue:

The teacher quality and professional development requirements of the No Child Left Behind (NCLB) Act of 2001 are having a profound effect on state and national science teacher organizations. The professional development definition in No Child Left Behind says that allowable activities under the law must:

- improve and increase teachers' knowledge of the academic subjects the teachers teach, and enable teachers to become highly qualified;
- are an integral part of broad school wide and district wide educational improvement plans;
- give teachers, principals, and administrators the knowledge and skills to provide students with the opportunity to meet challenging State academic content standards and student academic achievement standards;
- improve classroom management skills;
- are high quality, sustained, intensive, and classroom-focused in order to have a positive and lasting impact on classroom instruction and the teacher's performance in the classroom; and
- are not 1-day or short-term workshops or conferences;
- support the recruiting, hiring, and training of highly qualified teachers, including teachers who became highly qualified through State and local alternative routes to certification.

Further, professional development programs must advance teacher understanding of effective instructional strategies that are based on scientifically based research and include strategies for improving student academic achievement or substantially increasing the knowledge and teaching skills of teachers.

Background:

State and national science teacher organizations must meet the professional development needs of teachers in this changing environment. Focus areas include teacher content knowledge; long-term, sustained professional development; and the use of data and research to guide teaching and learning.

Although the law stipulates that professional development funds can no longer be used for one-time, short-term experiences, subsequent guidance from *Improving Teacher Quality State Grants, Title II, Part A, Non-regulatory Guidance,* issued by the U. S Department of Education, states that:

> *Title II, Part A, funds may be used to pay the costs associated with having teachers and other LEA staff attend one-day or short-term workshops or conferences only if they are part of, and integral to, professional development activities that meet the other elements of section 9101(34). For example, consistent with the results of its Title II, Part A, needs assessment, an LEA might design a comprehensive set of intensive training opportunities that:*

-conform to the principles in the statutory definition; and

-carefully use participation at a short-term workshop or conference to reinforce or lay the groundwork as part of a larger, systemic, professional development plan. [USDOE, December 2002]

This document also provides guidance to states on spending dollars distributed through NCLB. Two of the four examples cited in the document for implementing effective teacher professional development activities, include 1) sponsoring conferences related to improving teacher performance and 2) disseminating information about successful programs and practices. State and national teacher organizations need to carefully consider these guidelines and their potential benefits to their members.

The non-regulatory guidance also outlines the flexibility states have in determining which types of professional development activities can be used to support highly qualified teachers:

States have the flexibility, in designing their HOUSSE procedures, to determine the extent to which various types of professional development activities can assist teachers to develop and demonstrate subject-matter competence. For instance, States may determine how professional development provided by particular institutions or organizations (e.g., universities or community colleges, textbook publishers, curriculum developers, comprehensive school reform model developers, or any other specialized in-service training provider) contributes to a teacher's subject-area knowledge. However, unless it is unusually intensive, a single professional development experience by itself will not provide the content knowledge necessary to enable a veteran teacher to demonstrate subject-matter competency.

Although increasing the content knowledge of teachers is a clearly defined goal of professional development under NCLB, schools and administrators are also required to use research-based decisions for professional development. An article in the November 2003 issue of *Educational Leadership* states "Schools can improve [increase] student achievement by training teachers how to use formative assessment results to gear instruction to individual student needs (Holloway, 2003)." A 2002 study concluded that there is a growing recognition among administrators that random instances of professional development do not lead to sustained school improvement (Sanborn, 2002). If a school administrator views a state or national conference as an isolated professional development experience, he or she may not support teacher attendance. This is further supported by the language in NCLB that education leaders are using to guide their professional development decisions.

Focusing on teachers' desires, instead of those of administrators and NCLB, a study (Parsad, Lewis and Farris, 2001) was conducted to pinpoint the choices most frequently made by teachers for their professional development. It found that teachers were likely to select the following opportunities:

1. *participating in professional development that focuses on integrating education technology into the grade or subject taught (74%)*
2. *studying in-depth the subject area of the main teaching assignment (72%)*
3. *implementing new methods of teaching (72%)*

This research indicates that teachers made professional development choices that are aligned with NCLB.

In light of available research and the requirements and definitions set forth in NCLB, state and national science teacher organizations must carefully select and plan professional development experiences and use available research and data to drive these offerings. Organizations also must carefully position and structure professional development opportunities by taking such steps as offering institutes instead of conferences or sponsoring year-long professional development experiences.

Discussion Questions:
Consider the following questions related to professional development. Also consider Appendix B, the Eisenhower National Clearinghouse document "Steps to Developing a Personal Professional Development Plan."

1. Without the knowing how current state and national conferences are run, how might we organize a professional development plan that would be considered high quality as defined in NCLB?
2. What data should we consider in developing quality professional development and how can this committee disseminate it to our larger group?
3. How can state organizations and affiliate groups help one another build strong professional development opportunities in science education?
4. How is science unique from other content-area professional development, and how do we convey that to our constituency?

References:

Eisenhower National Clearinghouse for Mathematics and Science Education, National Staff Development Council. Steps to developing a personal professional development plan. *By Your Own Design*. (http://www.enc.org/professional/guide/started/plan/document.shtm?input=BYD-003023-pdf)

Holloway, John H. Research link/sustaining experienced teachers. *Educational Leadership*, 60 (8), 87–9. (http://www.ascd.org/publications/ed_lead/200305/holloway.html)

NCLB defines professional development activities. *Gifted Child Today* magazine, Spring 2003. (http://www.findarticles.com/cf_dis/m0HRV/2_26/99983310/p1/article.jhtml)

Sanborn, Jane. Using data to avoid random acts of professional development. *The School Administrator* Web Edition. December 2002. (http://www.aasa.org/publications/sa/2002_12/Sanborn.htm)

U.S. Department of Education. Improving teacher quality state grants, Title II, Part A, Non-Regulatory Guidance. January 16, 2004. (http://www.ed.gov/programs/teacherqual/guidance.doc.) (see Appendix)

University of the State of New York, State Education Department, Office of Higher Education. Part F: Professional development for teachers. (Field Memo #09-2003) September 2003. (http://www.highered.nysed.gov/nclb09-2003f.htm)

D. PROFESSIONAL DEVELOPMENT

D-1. What is meant by "high-quality professional development"?

The term "high-quality professional development" means professional development that meets the criteria contained in the definition of professional development in *Title IX*, Section 9101(34) of ESEA. Professional development includes, but is not limited to, activities that:

- Improve and increase teachers' knowledge of academic subjects and enable teachers to become highly qualified;
- Are an integral part of broad schoolwide and districtwide educational improvement plans;
- Give teachers and principals the knowledge and skills to help students meet challenging State academic standards;
- Improve classroom management skills;
- Are sustained, intensive, and classroom-focused and are not one-day or short-term workshops;
- Advance teacher understanding of effective instruction strategies that are based on scientifically based research; and
- Are developed with extensive participation of teachers, principals, parents, and administrators.

D-2. What strategies can States use to help LEAs adopt and implement more effective teacher professional development activities?

States can, for example: (1) develop guidance on effective strategies for improving teacher quality and provide that guidance to the LEAs; (2) adopt a formal statement of State priorities; (3) improve technical assistance and monitoring for LEAs; (4) sponsor conferences and other meetings that address issues related to improving teacher performance; and (5) disseminate information about successful programs and practices.

In providing this assistance, States should consider the needs of all teachers - whether they are regular classroom teachers, special education teachers, or teachers of English language learners - so that a unified, comprehensive system of professional development is available to all who need to be highly qualified. States might also provide guidance to LEAs on effective ways of coordinating resources available for professional development from programs such as *Title I* and *Title III* of the ESEA and IDEA, Part B.

D-3. The statute authorizes LEAs to use program funds for "teacher advancement initiatives that promote professional growth and emphasize multiple career paths, such as paths to becoming a career teacher, mentor teacher, or exemplary

teacher…" [Section 2113(c)(14)]. What are some options by which LEAs can implement these activities?

Too often, the best career advancement option currently available for teachers is to become school principals or LEA administrators. This leaves fewer excellent, experienced teachers working directly with children in the classroom. Teacher advancement initiatives that offer multiple career paths can provide professional opportunities without having teachers leave the classroom. For example, an LEA could establish a system whereby teachers could opt to pursue various career paths, such as:

- becoming a career teacher, staying in the classroom with traditional instructional duties;
- becoming a mentor teacher, staying in the classroom but taking on additional duties such as mentoring first-year teachers and receiving additional pay for these duties; or
- becoming an exemplary teacher, based on a distinguished record of increasing student academic achievement, and training other teachers to do the same while receiving additional pay for these duties.

D-4. Does the law contain any restrictions on the amount of *Title II, Part A* funds that an SEA may spend on professional development?

No. However, in considering how to spend its State-level funds, the SEA should focus on its need to ensure that all teachers its LEAs employ who teach in core academic subjects meet the requirements for a highly qualified teacher by the end of the 2005-2006 school year.

D-5. In many rural areas, offering high-quality professional development activities can be challenging because there may not be a critical mass of teachers who need help in the same subject. How can rural districts address this situation?

One possible way that rural districts can provide teachers with professional development activities is by offering distance-learning opportunities. Many State colleges and universities currently offer distance learning. Through distance learning a teacher in a rural area can take professional development courses that meet his/her specific needs. For example, the Department recently awarded a grant to the Western Governors University (WGU) to develop and implement teacher training and certification courses. WGU is currently seeking State approvals for its teacher licensure and certification programs. WGU's website, at www.wgu.edu/wgu/index.html, explains how teachers from any location can access services.

D-6. What types of professional development can assist veteran teachers to develop and demonstrate subject-matter competence?

States have the flexibility, in designing their HOUSSE procedures, to determine the extent to which various types of professional development activities can assist teachers to develop and demonstrate subject-matter competence. For instance, States may determine how professional development provided by particular institutions or organizations (e.g., universities or community colleges, textbook publishers, curriculum developers, comprehensive school reform model developers, or any other specialized in-service training provider) contributes to a teacher's subject-area knowledge. However, unless it is unusually intensive, a single professional development experience by itself will not provide the content knowledge necessary to enable a veteran teacher to demonstrate subject-matter competency.

Appendix B

Steps to Developing a Professional Development Plan, Eisenhower National Clearinghouse.

Hard copy will provided at Bozeman, Montana

The Highly Qualified Teacher and *Science Content Knowledge*

The Issue:

NCLB requires that any public elementary school or secondary school teacher who teaches core academic subjects (English, reading or language arts, math, science, foreign, language, civics and government, economics, arts, history, and geography) must obtain full state teacher certification (including alternative certification), or pass the state teacher licensing exam; hold a license to teach in the state; and not have a certification or licensure requirement waived on an emergency, temporary or provisional basis.

NCLB makes teacher quality a priority by requiring that all teachers be "highly qualified" in the subjects they teach by the end of the 2005-06 school year (all teachers hired and supported by Title I funds must have met this qualification by 2002-2003.) This means that teachers who are not new to the profession must 1) hold at least a bachelor's degree; 2) demonstrate a high level of competency in each of the academic subjects in which he or she teaches by passing a subject matter test; 3) successfully complete an academic major, graduate degree, coursework equivalent to an undergraduate major or advanced certification or credentialing; or 4) demonstrate competency in all the academic subjects in which the teacher teaches based on a high, objective, uniform, state standard of evaluation (HOUSSE).

The state HOUSSE may consist of a combination of teaching experience, professional development, and knowledge in the subject garnered over time in the profession.

Background:

The Elementary and Secondary Education Act (ESEA) was first passed in 1965. This Act's foundational principle of providing educational opportunities to our most disadvantaged youth has remained strong. Congress reauthorized the ESEA and named the new federal education legislation the No Child Left Behind Act of 2001 (NCLB). It was signed into law on January 8, 2002.

NCLB redefines the federal role in K–12 education and works to close the achievement gap between disadvantaged and minority students and their peers. NCLB encompasses 45 programs across ten titles, and received approximately $22.2 billion in funding in FY 2002–03. States and LEAs receiving funding under any title are subject to the requirements and provisions of that title.

NCLB Timeline

Each state must develop a plan outlining how it will ensure that all teachers are highly qualified by the 2005-06 school year. The plan must include an annual increase in the number of highly qualified teachers and must include an annual increase in the number of teachers receiving professional development.

New flexibility guidelines to NCLB highly qualified provisions were announced in March 2004. The flexibility changes affect teachers in rural districts; science teachers who instruct in more than one discipline; and middle and high school teachers who teach multiple subjects.

Teachers in rural schools who are considered "highly qualified" in one core academic subject but teach in another now have three years to become highly qualified in the subject they teach, as long as they receive professional development, supervision, or mentoring.

Newly hired teachers in rural schools also have three additional years to demonstrate they are highly qualified to teach other subjects. States may determine, based on their certification requirements, to allow science teachers to demonstrate they are highly qualified either in a broad science field or in specific individual fields, such as physics, biology, or chemistry.

The latest round of changes to NCLB also allow current middle and high school teachers who teach multiple subjects to demonstrate their subject-matter competency one time with their state's HOUSSE process.

Discussion Questions:

1. Given the NCLB definition of a highly qualified teacher, what should be the *characteristics* of a highly qualified science teacher?
2. What is the situation in your home state in determining whether your science teachers are highly qualified?
3. What should be the role of state and national science associations in helping the state to determine the working definition of a Highly Qualified Science Teacher?
4. What has been the impact of the Highly Qualified Teacher requirements on science teachers nationally?

Websites:

Education Commission of the States website at www.ecs.org , and the U. S. Dept. of Education website at www.ed.gov

http://www.dpi.state.wi.us/dpi/esea/background.html. (This site of the Wisconsin Department of Public Instruction provides background information about NCLB.)

The following Websites contain a special report by ASCD: Spotlight on Teacher Quality. http://www.smartbrief.com/alchemy/servlet/encodeServlet?issueid=5D5DE216-41E8-4363-9015-E055AD045FE9. (Part I)

http://www.smartbrief.com/alchemy/servlet/encodeServlet?issueid=8FE1A8F5-8C3B-4504-B725-519C0E5FE667. (Part II)

http://www.weac.org/News/2003-04/mar04/esea_changes.htm (This site belongs to the Wisconsin Education Association Council and contains news on NCLB, including the article; Dept. of Education releases revised ESEA "highly qualified" rules.)

http://www.weac.org/Capitol/esea.htm (This site contains a resource page on WEAC-ESEA.)

Books:

Stronge, James H., (2002). *Qualities of Effective Teachers*. Alexandria, VA: Association for Supervision and Curriculum Development.

Danielson, Charlotte (1996). *Enhancing Professional Practice: A Framework for Teaching*. Alexandria, VA: Association for Supervision and Curriculum Development.

The Highly Qualified Teacher and *Pedagogical Content Knowledge*

The Issue:
National policy demands that all teachers meet the highly qualified standard with emphasis on demonstrating subject matter competency in science, but it de-emphasizes the importance of other domains of teacher knowledge, such as pedagogical content knowledge critical to successful teaching of K-20 science.

Background:
Science content knowledge is only one of many domains of teacher knowledge critical to teaching science effectively.

Cited in *Examining Pedagogical Content Knowledge* (Gess-Newsome & Lederman 1999), Lee Shulman (1987) states that pedagogical content knowledge (PCK) is one of seven *knowledge* domains for teaching. Among these domains are knowledge of content, general teaching strategies, curriculum, learners, educational settings, and aims of education. According to Shulman, PCK is a special combination of content and pedagogy that is uniquely constructed by teachers. It is the "special" form of an educator's professional knowing and understanding.

> It represents the blending of content and pedagogy into an understanding of *how* particular topics, problems, and issues are organized, represented, and adapted to the diverse interests and abilities of learners and presented for instruction. (Shulman, 1987, p. 8)

It is the transformation of 1) subject matter knowledge and 2) general pedagogical knowledge that is generally known as PCK. Others argue, however, that PCK is a separate category fueled by subject matter as well as pedagogical and educational context knowledge (Magnusson, Krajcik, Borko, 1999). Despite the lack of consensus, researchers agree that the unique qualities of PCK are important in understanding science teaching and science education.

Why do science teachers teach the way they do?
The National Science Education Standards (1996) state that increasing achievement for all students is best accomplished through *better science teaching*. Despite efforts at reform, however, science classes have remained virtually unchanged. Various permutations of the phrase "teachers teach as they were taught" echo throughout the research literature on science classroom practices. Thus, after 20-plus years of reform efforts, what we often see in a science classroom are the same traditional practices we experienced as students.

Traditional methods are not bad, but they are sorely overused. Nor is one teaching method any better than another, but there are limitations in relying on only one or two methods. Different methods serve different goals. Successful science teachers draw from a wealth of pedagogical strategies. Learning how to reflect upon the selection, planning, and orchestration of science content and pedagogy that can provide meaningful learning for students is the essence of pedagogical content knowledge.

Teaching is an innate ability: If you know the content, you can teach science.

Student achievement has been shown to improve when teachers have strong content background (coursework and teaching experience) and pedagogical knowledge (e.g., hands-on inquiry, training in classroom practices, and wait time). Neither strong content nor strong pedagogical knowledge *alone* is adequate to increase student achievement substantially. Thus it is the teacher's ability to transform his or her knowledge of the subject matter and pedagogical knowledge that is so crucial to student achievement.

Challenging the idea that teaching is an inborn quality, specific science teaching pedagogies are best acquired via mentoring, collaborating with colleagues, reflecting, and practicing. In order to change the way educators teach science, they must be given new experiences that enable them to learn to teach in different ways that may encompass a range of pedagogical methods that include inquiry, constructivism, 5E cycle, conceptual organizers, questioning, nature of science, cooperative learning, and authentic science laboratory investigations.

Impact of PCK on Developing and Practicing Science Teachers

Several studies have examined the practical connections of PCK to science instruction. A literature review by van Driel, Verloop, and de Vos (1998) found that teacher PCK "can be enhanced by intensive short term, skills-oriented workshops" and can generate change in teachers as a result of developing pedagogical content knowledge (Clermont et al. 1993, p. 41). Furthermore, through an empirical study, the researchers found that there is a potential value in having prospective teachers study subject matter from a teaching perspective. This and other studies (Lederman, N. & Chang, H., 1997; Smith, D.C., & Neale, D.C., 1989) have also shown the importance of PCK in teaching, especially science teaching.

Teachers need to observe, practice, and refine teaching pedagogies to master the skills required to deliver high-quality science teaching. As teachers' pedagogical content knowledge expands (both in pedagogy and content), their ability to impact learning increases (McREL, 2001).

PCK and the NSES

Study of the NSES reveals that Standard one addresses content knowledge understandings and Standard five addresses the pedagogy of science teaching. While PCK is mentioned in Standard one, it is only briefly mentioned to explain that the content standard would be looking at the content-specific aspect of this construct. Other science educators, such as Enfield & Dugganhaus (see website in later section), argue that PCK is an essential tenet in the current thinking about science teacher education and should be included as more than a mere mention.

PCK as a pertinent element of thinking about science teaching is recognized in the content section of the NSES, which implicitly demonstrates how these two standards are inextricably linked when taken in context. For example, the pedagogy standard suggests that teachers know about "organization of classroom experiences" (National Science Teachers Association, 1998). To design such "organizations," however, requires a deep understanding of content. This is what Shulman (1987) is talking about when stating, "the key to distinguishing the knowledge base of teaching lies at the intersection of content and pedagogy" (pg. 15). To have a set of standards that

implies that pedagogy takes precedent over content or vise versa seems to ignore much of the research.

Discussion Questions:

1. What are the essential elements of high-quality instruction in science?
2. Do we (or should we) consider PCK an essential part of instruction in science teacher education?
3. How does PCK fit (or not fit) into the NCLB/highly qualified teacher policy?
4. Is it sufficient to be highly qualified in a science content area to be a highly qualified teacher?

Pedagogical Content Knowledge in Science Websites:

http://www.msu.edu/~dugganha/PCK.htm (This site relates to the Standards.)

http://www.mcrel.org/PDF/EDThoughtsScience/6804IR_EDThoughtsScience_13.pdf (This is the pdf version of the article "How does teacher pedagogical knowledge affect science instruction?")

http://www.ied.edu.hk/apfslt/v4_issue2/mulhall/mulhall5.htm (This site gives two different frameworks.)

http://www2.educ.sfu.ca/narstsite/publications/research/pck.htm (This site contains the article "Pedagogical Content Knowledge: Teachers' Integration of Subject Matter, Pedagogy, Students, and Learning Environments.")

http://www.sii.soe.umich.edu/documents/pck%20final%20report%20revised%20BR100901.pdf (This site deals with examining teacher pedagogical content knowledge.)

http://www.sv.ntnu.no/ped/sigrun/publikasjoner/values.html (This site offers an article about the value of PCK.)

References

Clermont, C.P., Krajcik, J.S., Borko, H. (1993). The influence of an intensive in-service workshop on pedagogical content knowledge growth among novice chemical demonstrators. *Journal of Research in Science Education 31*, 419-441.

National Research Council (1996). *National Science Education Standards*. National Academy Press: Washington, DC.

Gess-Newsome, J., & Lederman, N. (1999). *Examining Pedagogical Content Knowledge*. Boston: Kluwer Publishing.

Lederman, N., & Chang, H. P. (1997). An interpretive investigation of preservice science teachers' pedagogical and subject matter knowledge structures. *Procedings of the National Science Council of Taiwan, Part D: Mathematics, Sciences, and Technology Education*, 7(2), 110-122.

Magnusson, S., Krajcik, J., & Borko, H. (1999). Nature, sources, and development of pedagogical content knowledge for science teaching. In Gess-Newsome, J., & Lederman, N. (Eds.). *Examining Pedagogical Content Knowledge* (pp. 95-128). Boston: Kluwer Publishing.

Author Unknown-McREL (2001). How does a teacher's pedagogical knowledge impact instruction? Excerpt from *ED Thoughts: What We Know About Science Teaching and Learning*.

Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, 57, 1-22.

Smith, D., & Neale, D. (1991). The construction of subject matter knowledge in primary science teaching. In J. Brophy (Ed.), *Advances in Research on Teaching* (vol 2, pp. 187-243). Greenwich, CT: JAI Press.

van Driel, J. H., Verloop, N., & de Vos, W. (1998). Developing science teachers' pedagogical content knowledge. *Journal of Research in Science Teaching*, 35(6), 673-695.

The Highly Qualified Teacher
Recruiting, Retaining, and Recognizing

The Issue:
Many school districts across the country have had and continue to have difficulty finding and hiring teachers who are qualified to teach the sciences. This problem is exacerbated by ineffective recruiting procedures and practices, failure to retain good teachers once they enter the profession, and the lack of acceptable and respected recognition programs for teachers.

Background:
A shortage of science teachers is forcing many school districts to hire individuals who are not certified, trained, or prepared to teach science. Reasons for the shortage include a growing student population, teacher retirement, persons trained as teachers who choose not to teach, and a high turnover rate once teachers enter the profession. For these reasons, the U.S. Department of Education projects that we will need 2.2 million new teachers by 2010. Public enrollment for grades K–12 is projected to reach an all-time high of 44.4 million students in 2006.

Many individuals are choosing not to teach. Between 25 and 40 percent of the graduates who complete traditional teacher training programs in California, for example, never take a teaching job in the state, according to the report **(cite reference).** In contrast, 87 percent of the teachers licensed by alternate-route programs enter California classrooms. However, the attrition problem among younger teachers is so acute, some experts say, that it outweighs retirement as a cause of teacher shortages.

Statistics show that the best and the brightest individuals are choosing not to teach. The lure of better-paying jobs in business and industry, more attractive benefits, and less stress continues to siphon the best graduates from the teaching profession. The resulting shortage is forcing many schools to hire applicants who are unqualified or unprepared to teach science. An NSTA survey conducted in 2000 found that 48 percent of middle schools and 61 percent of high schools responding to the survey reported difficulty finding qualified science teachers. A University of Texas report showed 26 percent of U.S. science teachers of grades 7–12 did not major in science.

<u>Recruitment</u>
Inadequate and cumbersome recruitment and hiring procedures in many schools and districts exacerbate the teacher shortage problem. A RAND Corporation study found that because of uncoordinated recruitment of applicants, last-minute hiring decisions, ineffective teacher assignment and transfer policies, and obstacles to teacher mobility, many districts do not hire the most qualified teaching applicants.

There have been many initiatives to recruit new candidates into teaching, but most have proven inadequate on a large scale. Programs include Troops-to-Teachers, which is designed to entice career-changing military professionals into the teaching profession, and Teach for America, which aims to lure the "best and brightest" into understaffed schools.

Many states and districts are looking overseas to fill vacant teaching positions. Palm Beach County, Florida is recruiting from the Philippines, and New York education officials are attracting math and science teachers from Austria. In Houston, schools have hired teachers from Moscow in an effort to meet the demand for nearly 30,000 teachers in the next five years. This practice provides a temporarily solution to the teacher shortage problem, but it does not address or alleviate the long-term, chronic problem.

Because of the urgent need to hire science teachers, many districts are ignoring entrance requirements, licensure, and certification requirements for new teachers. Furthermore, many states offer ample opportunities to skirt certification requirements in order to fill staffing vacancies. Most students interested in becoming teachers traditionally attend a state-approved program at a college or university and are awarded a teaching license upon graduation. In the early 1980s, concerns about teacher quality and barriers to pursuing careers in education made way for the creation of alternatives to traditional teacher education programs.

But, there are challenges connected with the practice of recruiting mid-career, non-teaching professionals, especially when those individuals are awarded higher starting salaries. As the numbers of alternatively certified teachers increases, their impact on the character of the profession will increase. Resentment can be real or perceived, but it should be addressed in an open forum.

Two of the major goals of the report *Before It's Too Late: A Report to the Nation from The National Commission on Mathematics and Science Teaching for the 21st Century* focus on teacher recruitment and training. The report calls for increasing significantly the number of science teachers, improving the quality of their preparation, enhancing the working environment, and making the teaching profession more attractive. It also states that "the way to interest children in mathematics and science is through teachers who are not only enthusiastic about their subjects, but who are also steeped in their disciplines and who have the professional training—as teachers—to teach those subjects well."

Many schools have chosen to offer incentives such as signing bonuses, student loan forgiveness, and low-interest home loans to attract new science teachers. In the first year of a program in Massachusetts, 59 new teachers received $8,000 signing bonuses. Dallas also incorporated these measures when it offered bonuses to 900 new hires in an effort to staff its classrooms.

Retention

"Clever incentives may attract new teachers, but only improving the culture and working conditions will keep them," said Susan Moore Johnson from the Harvard Graduate School of Education.

According to Dr. Richard Ingersoll of the University of Pennsylvania, the turnover rate for all teachers, especially those new to the profession, is higher than that of many other occupations. After 3 years in the classroom, nearly 30 percent of all beginning teachers leave the profession, and this number jumps to nearly 40 percent after 5 years. An NSTA science teacher survey conducted in 2000 found that nearly 40 percent of science teachers polled were considering abandoning the profession due to job dissatisfaction.

Teachers face many challenges, including little support and few opportunities for professional development. Research by Dr. Ingersoll found that such factors as low salaries, a lack of support from administration, student discipline problems, low student motivation, and few opportunities to participate in school decision making were most likely to encourage teachers to leave the profession. Other challenges include lack of professional development, insufficient time in the school day to interact and plan with other teachers, too few resources, and large class size.

In addition, job stress is prevalent among educators. Adding to the stress is the growing amount of work that teachers carry home every evening, the shrinking summer breaks, and the required course work and professional development.

Recognition

There are two important elements of recognition for highly qualified teachers: the status of being recognized as highly qualified and the social recognition that can and should accompany it. They can exist together or separately, but they are both important to the teacher. The beginning teacher needs to know the necessary steps and procedures for becoming highly qualified and should be recognized for earning the title.

Some universities offered programs to help teachers achieve the status of master teacher. The required courses, professional development, and years of teaching were set forth for the teacher in the degree plan. NCLB has done the same thing. The definition of highly qualified has been set. At the same time, notice was taken of the logistics of the requirements. The U.S. even eased facets of the education law. Also, rather than requiring teachers to return to school, states could measure competency by experience, expertise, and professional training.

Discussion Questions: Recruiting Teachers

1. How has the Highly Qualified Teacher requirement of NCLB impacted recruiting qualified teachers in your state?
2. Should highly qualified prospective science teachers, including teachers entering the field through alternative certification methods, be provided additional incentives not normally provided to teachers, such as differential or merit pay, in hard to staff areas?
3. What action can the NCSE take to address these issues?

Discussion Questions: Retaining Teachers

1. How has the Highly Qualified Teacher requirement of NCLB impacted the existing science teachers in your state?
2. How are states responding to the increasing need for science teachers as retention rates decline?
3. What does your district/state do to retain a highly qualified science teacher?

Discussion Questions: Recognizing Teachers

1. How are states and districts supporting teachers who do not meet the Highly Qualified Teacher requirement?
2. What does your school/district do to recognize quality science teachers?
3. Are highly qualified science teachers used as mentors or content coaches for new recruits?

The Highly Qualified Teacher and *Assessment and Accountability*

The Issue:

On April 3, 2004, Dr. Susan Sclafani, Counselor to the U.S. Secretary of Education, addressed the National Science Teachers Association in Atlanta, Ga. Dr. Sclafani stated that the No Child Left Behind Act (NCLB) will provide a new focus on science, and that assessment at all levels (state, school, and classroom) will be an important part of this effort. Dr. Sclafani made an important point about the need for good assessment feedback in order to inform our schools' science programs, our teaching practice, and our students' understanding of important science concepts. Unfortunately, many schools, districts, and states are struggling to develop high-quality assessment systems for science.

As we address this issue, we need to consider strategies that will enable teachers to become highly qualified in the area of science assessment and empower them to assume leadership roles related to science assessment issues at the school, district, state, and national levels.

Background:

The NCLB legislation requires that all states assess students in science by the 2007-08 school year once between grades 3–5, 6–9 and 10–12. The current legislation does not mandate that states include science scores as an indicator of adequately yearly progress (AYP) for accountability. This difference in the accountability requirement for science compared to mathematics and reading offers the possibility that science assessments can be developed for the purpose of providing valuable assessment feedback rather than for simply identifying low-performing schools. The challenge in meeting this goal, however, is significant.

According to the National Science Education Standards, standards-based assessments should be the primary feedback mechanism in the science education system. "They provide students with feedback on how well they are meeting expectations, teachers with feedback on how well their students are learning, school districts with feedback on the effectiveness of their teachers and programs, and policy makers with feedback on how well policies are working. This feedback, in turn, stimulates changes in policy, guides the professional development of teachers, and encourages students to improve their understanding of science." (National Research Council, 1996) However, states' success at using good science assessments in defining important science curricula, facilitating good science teaching, and most importantly, in improving science literacy among all students has fallen short of the vision outlined in the Standards.

At the local level, many schools have responded to the national call for more testing by developing systems that replicate their state's assessment program, using similar tools at different grades. Since large-scale, norm-referenced, or criterion-referenced tests are not designed to provide reliable individual student growth information, testing all students for this purpose can become a waste of time (Robinowitz & Ananda, 2001). This practice also can add to a perception among teachers that classroom assessments and external assessments are not mutually supportive and can even be in conflict. What seems effective for one purpose may not

serve or even be compatible with another (National Research Council, 2001; Bol and Strange, 1996).

Compatibility between classroom assessment (formative and summative) and external assessment can be fostered by making external assessments more accessible to classroom teachers through their involvement in the development and interpretation of these tasks and by helping teachers embed large-scale assessment in the instructional program in meaningful ways (National Research Council, 2001). Helping teachers acquire the skills and expertise needed to develop local science assessments will ensure the greatest degree of match between what is valued at the local level and what is assessed. Locally developed assessment systems that involve staff at all phases of the development and implementation process will ensure the support for and commitment from teachers (Robinowitz & Ananda, 2001).

If schools are going to build a capacity to ensure that all students have the opportunity to learn science, teachers need to be supported and empowered to make decisions that are crucial for effective learning (National Science Resources Center, 1997).

Discussion Questions:

In order to develop strategies that will enable teachers to become highly qualified in the area of assessment literacy and strategies that will empower teachers to assume leadership roles related to science assessment issues at the school, district, state, and national level, consider these questions for discussion.

1. Which practices, resources, and support should we encourage in our states, districts, and schools?
2. Which practices should we discourage?
3. What actions can we take as representatives of our states' science teachers?
4. What has been the impact of large-scale statewide assessments in science?

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The Highly Qualified Teacher
Equity, ESL and Diversity Issues

The Issue:
The "highly qualified teacher" requirements of the No Child Left Behind Act of 2001 (NCLB) appear to challenge equity in our nation's schools. Science educators must move progressively forward with the reform effort to ensure equal access and opportunity for *all* students.

Background:
According to the law, highly qualified teachers must be certified or licensed, hold a bachelor's degree, and have demonstrated competencies in their teaching area. By the end of the 2005–2006 school year, all states must ensure that every core subject classroom teacher, including every science teacher, is highly qualified.

The Association of Community Organizations for Reform Now (ACORN), in its study on the implementation of NCLB in 23 states plus the District of Columbia and 64 school districts, found that the law's promise of providing every child a highly qualified teacher has not been fulfilled. Fourteen states surveyed have not defined what "highly qualified" means in their state, putting local districts in a quandary as to how to comply with this requirement.

Unless all teachers become highly qualified, the potential for inequities in our schools is high. One could argue that students taught by a highly qualified teacher will receive a better education than those who are not. Generally speaking, teachers who are certified in their fields and have demonstrated competency in subject-matter teaching are better prepared to provide more effective learning opportunities than teachers who lack certification and evidence of demonstrated competence.

The study's findings generate challenging questions that can be asked by all states. Will *all* teachers be highly qualified by the end of the 2005–2006 school year? By the 2006–2007 school year, will *all* students receive instruction from highly qualified teachers? Will there be an equitable distribution of highly qualified teachers for *all* students in *all* locations—urban, rural, and suburban? Are parents properly informed? If these issues are left unresolved, the resulting inequity will have the biggest effect on those students (and their parents) who do not have highly qualified teachers. These families may lack equitable access to quality instruction.

The Southeast Center for Teaching Quality (2002) asserts that the responsibility for defining "highly qualified" rests with states and that NCLB's definition of "highly qualified" is minimal and inadequate. The Center also questions teacher testing as a measure of competency. Given the growing diversity of public school students, The Center believes that teachers not only must have strong content knowledge, but also must have the skills to provide standards-based quality instruction for *all* students. The definition of highly qualified "promotes a narrow conception of what effective teachers should know and be able to do and allows states to set a low teacher-quality bar" (p. 2).

The Center further asserts that if states are left with too few resources to recruit, prepare, and retain the most qualified teachers for the hardest-to-staff schools, they will likely set the quality bar as low as possible to address their teacher shortages. Could this lead to some highly qualified teachers being more or less highly qualified than others? Are states satisfied with the methods used to determine who is a highly qualified teacher?

Another important issue is the challenge of recruiting experienced teachers for schools in urban, low-income, and diverse areas (Dendo, Grant, & Jackson, 2001). More than ever, rural districts are experiencing shortages in the numbers of new and experienced teachers and expressing concern about pay disparities between rural and non-rural districts. In a Rural Trust report, *The Competitive Disadvantage: Teacher Compensation in Rural America* (2003), Lorna Jimerson points out that on a national level, teachers can expect to earn less in rural districts than in non-rural districts. Experienced teachers (those with a master's degree plus 20 years experience) in non-rural districts earn more than 17 percent more than their counterparts in rural districts. The more than 400,000 educators who teach in rural schools represents 31 percent of all public school teachers (Jimerson, 2003). Could salary gaps lead to greater inequities within the educational system?

Since NCLB was signed into law, the Department of Education has made changes to address concerns about its implementation. To address the issue of who is highly qualified among rural educators who frequently teach multiple subjects, for example, the U. S. Education Secretary Rodney Paige issued three NCLB policy guidelines that provide flexibility (ED.Gov 2004). Science educators must continue to question and examine the NCLB policy, and work with the Department to correct potential inequities in schools and science education caused by the highly qualified teacher requirement. We must be aware of and responsive to the following with regard to all aspects of schooling:

- effects of standards-based education on the equity of *all* students (Huggins 2001).
- effects of standards- and assessment-based education on the equity of students with special needs (Count Me In, *Education Week*, 2004).
- effects of school accountability systems (testing, etc) on the equity of low-income children, especially children of color (Scheurich et al, 2000).
- effects of the "Digital Divide" (technology gap) on the equity of *all* students ("Dividing Lines," *Education Week* 2001).
- effects of distribution of funding on the equity of *all* students and *all* teachers.

Our mission is to provide excellence and equity for *all* students. "*All* students, regardless of sex, cultural or ethnic background, physical or learning disabilities, future aspirations, or interest in science, should have the opportunity to attain high levels of scientific literacy" (NRC 1996, p. 221).

By 2020, students of color will represent nearly half of the elementary and secondary population (Gollnick and Chinn, 2002). We will see an increase of English-language learners, students with disabilities, and economically disadvantaged children. A major concern is that schools cannot provide equity without highly qualified teachers—those who are prepared to help students reach their potential and promote equity in key components of educational equity—adequate access,

instruction, materials, attitudes, interactions, language, and assessment. The Northwest Regional Educational Laboratory's Equity Center provides a description of these key components (NWREL 2001).

Discussion Questions:

1. What are the unique challenges our urban, rural and low income schools face in ensuring that all their teachers are highly qualified? How can NSTA and state chapters help address these challenges and ensure the bar is set high when determining HQT's of science.
2. How will the NCLB highly qualified teacher requirements affect teacher distribution and teacher quality across our nation?
3. How could the NCLB mandate that every student have a highly qualified teacher affect *science for all*—equity and excellence?
4. What are possible effects of the NCLB highly qualified teacher requirement on professional development guidelines that promise to increase equity for students in science education?

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