National Congress on Science Education

of the

National Science Teachers Association

Focus Group Resource Guide

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NSTA

The National Congress on Science Education
2006 Focus Group Resource Guide

Enclosed is a series of resource materials identified 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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NSTA Strategic Goal on ***Cooperating Internationally***

Prepared by Laura Rutledge, Congress Committee and President,
Maryland Association of Science Teachers

Discussion Questions

1. What are the global issues facing science education?
2. What issues do all nations have in common?
3. What would education communities look like if there were no barriers?
4. What types of experiences do teachers need to become competent, global minded educators?
5. What barriers exist that could prevent educators from participating in these experiences?
6. What role can NSTA, Chapters, and Associated Groups play in eliminating barriers and increasing the capabilities of teachers?

Bibliography

Carter, Lyn. (2004) *Globalisation and Science Education: Rethinking Science Education Reform*. Wiley Periodicals, Inc.

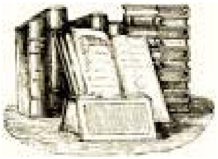
Krugly-Smolska, Eva and Taylor, Peter C. (Ed). (2004) *Inquiry in Science Education: International Perspectives*. Wiley Periodicals, Inc. (found online)

Padilla, Michael. (2005) *Developing a Worldview for Science Education*. The Science Teacher. NSTA, Arlington, VA.

Rasmussen, Karen. (1998). *Making Connections Through Global Education*. Alexandria, VA: Association for Supervision and Curriculum Development (Curriculum Update).

Skelton, Martin, et al. (2002) *Beyond Food, Festivals, and Flags*. Educational Leadership. Alexandria, VA: Association for Supervision and Curriculum Development.

Smith, Andrew F. and Czarra, Frederick R. (2003). *Teaching in a Global Context*. Alexandria, VA: Association for Supervision and Curriculum Development (Info brief).



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Teacher Education in Global and International Education. ERIC Digest.

Over the last two decades there has been increasing concern that American schools are not preparing young people to participate effectively in a world characterized by human diversity, cross-cultural interaction, dynamic change, and global interdependence. In the 1980s the National Governors' Association (1989) pointed to inadequate teacher preparation in global education and international studies as a major obstacle in the ability of the United States to meet the economic, political and social challenges of today's world. Today teacher education in global and international education is mandated by the National Council for Accreditation of Teacher Education (see 1995 NCATE Standards [1994]) and addressed through many activities of professional organizations such as the American Association of Colleges for Teacher Education, the Association of Teacher Educators, and the National Council for the Social Studies.

WHAT IS GLOBAL AND INTERNATIONAL EDUCATION?

Global education develops the knowledge, skills, and attitudes that are the basis for decision making and participation in a world characterized by cultural pluralism, interconnectedness, and international economic competition. Growing out of such fields as international relations and area/international studies, world history, earth science, and cultural/ethnic studies, the field of global education recognizes that students must understand the complexity of globalization and develop skills in cross-cultural interaction if they are to become effective citizens in a pluralistic and interdependent world. International education provides knowledge, skills, and experiences that come from in-depth

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study, work, and collaboration in education in other countries and with international students and scholars in American institutions.

Teaching with a global perspective differs in some ways from traditional approaches to studying ourselves, other peoples, and the planet:

* In teaching about cultures, global educators focus as much on cultural universals, those things all humans have in common, as they do on cultural differences. Cross-cultural understanding, open-mindedness, anticipation of complexity, resistance to stereotyping or derision of cultural difference, and perspectives consciousness--recognition, knowledge, and appreciation of other peoples' points of view--are essential in the development of a global perspective (Case, 1993; Hanvey, 1975; Kniep, 1986).

* The world is seen as a system in which technological, ecological, economic, social, and political issues can no longer be effectively understood or addressed by individual nations because the issues literally spill over borders and regions. The organization of curricula does not separate world cultures or regions but brings them together through study of contact, borrowing and diffusion of ideas, antecedents to current events, and comparative themes and concepts. Persistent global issues such as land use, peace and security, and self-determination are examined across time and place (Anderson, 1990; Kniep, 1986).

* Study of local-global connections leads to recognition that each of us makes choices that affect other people around the world, and others make choices that affect us. Because of this interconnectedness, global education includes knowledge and skills in decision making, participation, and long-term involvement in the local community and in the larger world beyond our borders. Students learn to find and process information from multiple perspectives (Alger & Harf, 1986).

WHAT ARE CONSIDERATIONS IN EDUCATING TEACHERS IN GLOBAL AND

INTERNATIONAL EDUCATION?

Global knowledge. Teachers need "global" knowledge about the world in general as well as content specific to the subjects they teach. For example, a language arts teacher not only studies literature from diverse cultures in different world regions but also learns about the historical contexts and cultural/political perspectives from which the authors wrote. Teacher educators work with colleagues in other disciplines to identify academic coursework in the humanities, sciences, and social sciences so that preservice teachers have adequate foundational knowledge and inservice teachers have access to new, emerging knowledge in their fields (Merryfield & Remy, 1995).

Cross-cultural experiences. Simulated as well as personal cross-cultural experiences at home and abroad are a significant part of global and international education. Study tours, student and faculty exchanges, semesters abroad, work with international students in American universities and schools, and student teaching in other countries or within different cultures in the United States are some of the ways teacher educators build cross-cultural knowledge, develop skills in cross-cultural communication, and motivate teachers to teach from a global perspective (Gilliom, 1993; Wilson, 1982). Simulations such as BaFa BaFa or RaFa RaFa (experiences at the secondary and elementary levels in understanding and communicating in another culture) and Baranga (an experience in how subtle differences in culture can lead to confusion and conflict) contribute to cross-cultural understanding by helping teachers develop insights into the process of understanding cultural perceptions and the relationship between instructional methods and learning outcomes in global education.

Infused throughout teacher education. Content and experiences in global and international education need to be infused throughout teacher education programs. Field experiences, internships, and sites for school/university collaboration are structured so that preservice teachers work with talented global educators. Courses in foundations, technology, and methods help teachers examine conceptualizations, cases, instructional strategies, curriculum development, interdisciplinary approaches, and assessments in global education. Research courses include relevant studies, literature, and opportunities for action research. Preservice and inservice programs set aside time for teachers and teacher educators to reflect, experiment, and share ideas and experiences with colleagues (Merryfield, 1995; Tye & Tye, 1992).

Deal with controversy. Teacher educators prepare teachers to deal with the controversial nature of global and international education. Through readings, role-plays, and collaboration with resource people in the community, teachers reflect upon the reasons for controversies over global education and approaches to resolving such conflicts (Schukar, 1993; Lamy, 1990).

Make curricular connections. Teachers learn to make curricular connections between global education and multicultural education. Global and multicultural education overlap in their goals to develop multiple perspectives and multiple loyalties, strengthen cultural consciousness and intercultural competence, respect human dignity and human rights, and combat prejudice and discrimination (Bennett, 1994). Global and peace education also share common concerns over issues such as human rights, self-determination, international conflict management, and conflict resolution. Teacher educators help teachers plan instruction that integrates global and multicultural and peace education.

All of these approaches to teacher education in global and international education are supported by the faculty's shared vision of global and international education, on-going faculty development, long-term collaboration with internationally minded colleagues on campus, in the schools and overseas, administrative leadership, and institutional commitment.

REFERENCES

Easterly, J. (Ed.). (1994). Promoting global teacher education: Seven reports. Reston, VA: Association of Teacher Educators. ED 368 704

Journal of Teacher Education. (1991, January-February). Issue entitled Educating for a Global Society, 42(1). Includes three articles on teacher education in global education. EJ 429 348-50

Merryfield, M. M. (1992, Winter). Preparing social studies teachers for the twenty-first century: Perspectives on program effectiveness from a study of six exemplary teacher education programs on global education. Theory and Research in Social Education, 20(1), 17-46. EJ 450 763

Merryfield, M. M., & Harris, J. (1992, Spring). Getting started in global education: Essential literature, essential linkages for teacher educators. School of Education Review 4, 56-66. EJ 449 411

Theory Into Practice. (1993, Winter). Issue entitled Teacher Education in Global Perspectives. 32(1). Includes nine articles. EJ 463 368-76

References identified with an EJ or ED number have been abstracted and are in the ERIC database. Documents (ED) are available in ERIC microfiche collections at more than 900 locations. Documents can also be ordered through the ERIC Document Reproduction Service: (800) 443-ERIC. Journal articles (EJ) should be available at most research libraries.

Alger, C. F., & Harf, J. E. (1986). Global education: Why? For whom? About what? In R. E. Freeman, (Ed.), Promising practices in global education: A handbook with case studies (pp. 1-13). NY: National Council on Foreign Language and International Studies. See ED 265 107

Anderson, L. (1990). A rationale for global education. In K. A. Tye, (Ed.), Global education from thought to action. The 1991 ASCD Yearbook (pp. 13-34). Alexandria, VA: Association for Supervision and Curriculum Development. ED 326 970

Bennett, C. I. (1995). Comprehensive multicultural education. Boston: Allyn and Bacon.

Case, R. (1993, October). Key elements of a global perspective. Social Education, 57(6), 318-325. EJ 476 723

Gilliom, M. E. (1993, Winter). Mobilizing teacher educators to support global education in preservice programs. Theory Into Practice, 32(1), 40-46. EJ 463 372

Hanvey, R. G. (1975, November). An attainable global perspective. New York: Center for War/Peace Studies. Reprinted in W. M. Kniep (Ed.), (1987), Next steps in global education: A handbook for curriculum development. New York: The American Forum. See ED 116 993/EJ 269 219

Kniep, W. M. (1986, October). Defining a global education by its content. Social Education, 50(6), 437-466. EJ 340 612

Lamy, S. L. (1990). Global education: A conflict of images. In K. A. Tye, (Ed.), Global education from thought to action. The 1991 ASCD Yearbook (pp. 49-63). Alexandria, VA: Association for Supervision and Curriculum Development. ED 326 970

Merryfield, M. M. (1995). Institutionalizing cross-cultural experiences and international expertise in teacher education: The development and potential of a global education PDS network. Journal of Teacher Education, 46(1), 1-9.

Merryfield, M. M., & Remy, R. C. (1995). Teaching about international conflict and peace. Albany: State University of New York Press.

National Council for Accreditation of Teacher Education. (1994). NCATE standards. Washington, DC: Author.

National Governors' Association. (1989). America in transition: The international frontier. Washington, DC: Author. ED 316 447

Schukar, R. (1993, Winter). Controversy in global education: Lessons for teacher educators. Theory Into Practice, 32(1), 52-57. EJ 463 374

Tye, B. B., & Tye, K. A. (1992). Global education. A study of school change. Albany: State University of New York Press.

Wilson, A. H. (1982, Summer). Cross-cultural experiential learning for teachers. Theory Into Practice, 21(3), 184-192. EJ 269 222

NSTA Strategic Goal on ***Supporting Student Learning***

Prepared by Almetta Hall, Congress Committee and President,
District of Columbia Science Teachers Association

Discussion Questions

1. What are the constraints facing non-English speaking students as learners?
2. How can the requirements of special needs students be addressed in the science classroom? What interventions can be used?
3. What obstacles do teachers face in providing for special needs students?
4. What support can be provided to teachers of special needs students by professional associations?

Bibliography

Acrey, C., Johnstone, C., and Milligan, C. (2006). Using universal design to unlock the potential for academic achievement of at-risk learners. *Teaching Exceptional Children*. 38(2), 22-31

Bolman, Lee G. and Deal, Terrence E. (2nd Edition). Reframing organizations artistry, choice and leadership. San Francisco: Jossey-Bass

Cavanaugh, Terrace. (2002). Ebooks and accommodations: Is this the future of print accommodation? *Teaching Exceptional Children*. 35(2), 56-61.

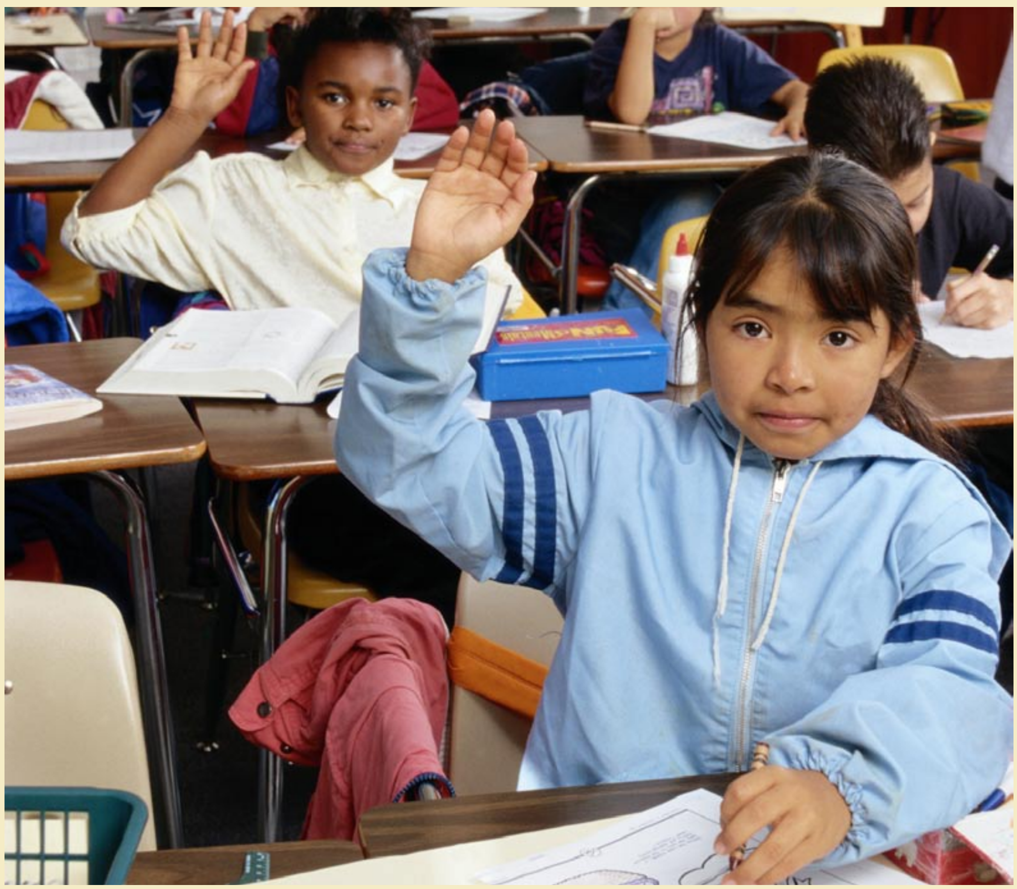
Flexer, R. W., Simmons, T. J., Luft, P., and Baer, R. M. (2001) Family involvement. Transition planning for secondary students with disabilities. Columbus, Ohio: Merrill Prentice Hall.

Garcia, Shernaz B. and Ortiz, Alba A. (2006) Preventing disportionate representation: Cultural and linguistically responsive prereferral interventions. *Teaching Exceptional Children.* 68 (4). 64-68.

Lenz, Keith and Schumaker, Jean. (2003) Adapting language arts, social studies, and science materials for the inclusive classroom. http://www.cec.sped.org/AM/Template.cfm?Section=Home&TEMPLATE=/CM/ContentDisplay.cfm&CONTENTID=4218. Last retrieved. April 3, 2006.

Practitioner Brief Series

Preventing Disproportionate Representation: **Culturally and Linguistically Responsive Prereferral Interventions**



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NATIONAL CENTER FOR Culturally Responsive Educational Systems

The mission of the National Center for Culturally Responsive Educational Systems is to support state and local school systems to assure a quality, culturally responsive education for all students.

IDEAs that Work
Office of Special Education Programs

The U.S. Department of Education's Office of Special Education Programs funds the National Center for Culturally Responsive Educational Systems (NCCRESt) to provide technical assistance and professional development to close the achievement gap between students from culturally and linguistically diverse backgrounds and their peers, and reduce inappropriate referrals to special education. The project targets improvements in culturally responsive practices, early intervention, literacy, and positive behavioral supports.

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Disproportionate representation of students from diverse socio-cultural and linguistic backgrounds in special education has been a persistent concern in the field for more than 30 years. To date, in spite of continued efforts by educators and researchers to identify contributing factors and develop solutions, student enrollments in special education range from over- to under-representation, depending on the disability category and the specific racial/ethnic group, social class, culture, and language of the students (Donovan & Cross, 2002). Although examining rates of representation can alert educators to the existence of a problem, ultimately a key question in dealing with disproportionality in special education is, "Are we identifying and serving the 'right' students?"

Prereferral intervention emerged during the 1970s in response to the concern about inappropriate identification and labeling of children for special education and has evolved over time into a variety of models. The primary concern of all models has generally been to differentiate students with disabilities from those whose academic or behavioral difficulties reflect other factors, including inappropriate or inadequate instruction. In all these models, students who are persistently non-responsive to more intensive and alternative instructional or behavioral interventions over time are viewed as the most likely candidates for special education (Fletcher, Barnes, & Francis, 2002; Ortiz, 2002).

Current discussions about response-to-intervention (RTI) models for the identification of learning disabilities (LDs) reflect these concerns as well (Vaughn & Fuchs, 2003). When RTI is implemented with culturally and linguistically diverse learners, it is critical that the prereferral intervention process is culturally and linguistically responsive; that is, educators must ensure that students' socio-cultural, linguistic, racial/ethnic, and other relevant background characteristics are addressed at all stages, including reviewing student performance, considering reasons for student difficulty or failure, designing alternative interventions, and interpreting assessment results (Ortiz, 2002). Without such examination, even prereferral intervention practices may not result in improved student outcomes and may continue to result in disproportionate representation in special education.

In this brief, we highlight four key elements of culturally- and linguistically-responsive prereferral intervention for culturally and linguistically diverse students. These elements are (1) Preventing School Underachievement and Failure, (2) Early Intervention for Struggling Learners, (3) Diagnostic/Prescriptive Teaching, and (4) Availability of General Education Problem-Solving Support Systems.

Key Element 1: Preventing School Underachievement and Failure Among culturally and linguistically diverse Learners

When educators understand that culture provides a context for the teaching and learning of all students, they recognize that differences between home and school cultures can pose challenges for both teachers and students (García & Guerra, 2004) and that school improvement efforts must be focused on preventing these types of academic and behavioral difficulties. When considering the creation of student-centered learning communities, there are many definitions for culture that can be used (Erickson, 2001). In this brief, we will highlight the fact that all students have cultures composed of social, familial, linguistic, and ethnically-related practices that shape the ways in which they see the world and interact with it. In most cases, schools are places where dominant cultural practices form the basis of social, academic, and linguistic practices and act as the driving force for the varied experiences students have in schools. In cases where dominant cultural practices shape school culture, many culturally and linguistically diverse students and their families find it challenging to function and participate in school.

Four elements of school culture are particularly important: (a) shared responsibility among educators for educating all students, (b) availability of a range of general education services and programs, (c) collaborative relationships with culturally and linguistically diverse families, and (d) ongoing professional development focused on effective practices for culturally and linguistically diverse learners. In turn, these elements influence the classroom learning environment as they influence teachers' efforts to design and implement culturally- and linguistically-responsive curricula and instruction for their students.

1.1 What can teachers do to create a positive school environment for culturally and linguistically diverse students?

Share responsibility for educating all students, including culturally responsive curricula and instruction. A positive school climate is one in which educators (teachers, administrators, and related services personnel) share the philosophy that all students can learn and that they, as educators, are responsible for creating learning environments in which their culturally and linguistically diverse students can be successful (Ortiz, 2002). Ensuring student success, however, requires that educators have high expectations for all students regardless of their cultural, linguistic, economic, and other characteristics. This understanding leads to an additive view of culture and language (Cummins, 1986), and there is a focus on designing accessible, inclusive, and equitable learning environments that develop bicultural/bilingual competence among all students. Moreover, students' success and failure are considered to be the results of a match (or mismatch) between the learning environment and their learning needs and characteristics (García, Wilkinson, & Ortiz, 1995). Finally, shared responsibility for all students also means that teachers have systematic opportunities to plan and coordinate services when students are taught by more than one teacher (e.g., middle and high school students) or are served by more than one program (e.g., students receiving pull-out English as a second language [ESL] services, instruction from reading specialists, or special education). Failure to share responsibility can create a disconnect between instruction across teachers and programs and contribute to students' learning difficulties or slow down their progress.

Supporting all students also includes culturally responsive curricula and instruction. Culturally responsive curricula and instruction go beyond an additive approach to pedagogy, where diversity is represented superficially (e.g., food festivals or culture "days"). These practices add representations of diversity, yet contribute to "othering" or exoticizing culturally and linguistically diverse students and their communities (Oakes & Lipton, 1999). culturally and linguistically diverse learners are better served by curricula and instruction that build on their prior socio-cultural and linguistic knowledge and experiences (i.e., their strengths and available resources). Students are actively engaged in the instructional process through meaningful dialogue between students and teachers, and among students in written and oral domains (Leinhardt, 1992). Classroom instruction is comprehensible at two levels: (a) it is embedded in contexts that are familiar to the students (i.e., socio-cultural relevance) and (b) the language(s) of instruction as well as the content are within their zone of proximal development (Vygotsky, 1978). This is accomplished through thematic instruction, guided participation (Rogoff, 1990), and instructional mediation using a variety of scaffolding techniques (Santamaría, Fletcher, & Bos, 2002).

1.2 What is my school's responsibility to support culturally and linguistically diverse students and their families?

Make available a range of general and special education services. When schools offer an array of programs and services that accommodate the unique learning characteristics of specific groups of students, special education is less likely to be viewed as the logical alternative for students who are not successful in general education classrooms (Rueda, Artiles, Salazar, & Higareda, 2002). Examples of such alternatives include early childhood education, Title I services, bilingual education/ESL, gifted/talented education, and services for immigrant students. In addition, community-based programs and support services can offer teachers, students, and families access to resources that support learning. When coordinated effectively, these efforts can be successful in developing resilience and increasing educational performance (Wang & Kovak, 1995). These programs are academically rich (i.e., focus on higher-order thinking and problem solving in addition to basic skills) and provide high-quality instruction designed to meet high expectations (García et al., 1995). Of course, high quality instruction presumes the availability of highly qualified teachers who have expertise related to culturally and linguistically diverse students. These two factors are particularly relevant because a large percentage of culturally and linguistically diverse students is being educated in low-income and urban schools staffed with teachers who are relatively inexperienced with culturally and linguistically diverse learners, teaching out-of-field, and/or on emergency certification plans (Barron & Menken, 2002). This once again raises questions about the contribution of inadequate instruction to students' difficulties.

1.3 It's difficult to get my students' families involved. What can I do?

Create collaborative relationships with students and their families. To increase the likelihood of student success, parents/family members must be seen as valuable resources in school improvement efforts and as partners in promoting academic progress (García et al., 1995). In a positive school environment educators reject interpretations of student failure that place the responsibility and blame on families and adopt an additive framework that appreciates the funds of knowledge among all families, including those with limited resources (Moll, Amanti, & Neff, 1992). Given the focus on shared responsibility and equity, teachers work closely with parents and other family members from a posture of cultural reciprocity (Kalyanpur & Harry, 1999). These efforts communicate to families that their language and culture are valued, their educational goals for their child are important, and educators are committed to working within the family's cultural comfort zone (García, 2002). Ultimately these messages can serve to develop an atmosphere of mutual trust and respect, in which culturally and linguistically diverse families are more likely to actively participate in a variety of roles, including school governance and decision-making.

1.4 What can schools do to enhance teacher development for culturally and linguistically diverse students?

Focus professional development on effective practices for culturally and linguistically diverse learners. Given the limited availability of teachers with adequate preparation in effective practices for culturally and linguistically diverse learners, it is essential that educators engage in professional development that will lead to culturally competent practice. Effective staff development on this topic requires attention to participants' cultural self-awareness, attitudes/expectations, beliefs, knowledge, and skills (Lynch & Hanson, 1998). This should lead to an increased understanding of socio-cultural influences on teaching and learning, as well as the socio-political contexts of education in culturally and linguistically diverse communities. Given the emphasis on shared responsibility for all students, school-wide professional development also provides a foundation of shared knowledge from which educators can work together. The following general topics are important to include:

(a) Cultural influences on children's socialization at home and at school

(b) First and second language acquisition and dialectal differences

(c) Instructional strategies that promote proficiency in first and second languages/dialects

(d) Characteristics of culturally responsive pedagogy

(e) Culturally responsive curricula for literacy development, academic content, and social skills

(f) Culturally-responsive classroom and behavior management strategies

g) Informal assessment strategies to monitor student progress

(h) Building positive relationships with culturally and linguistically diverse families and communities

In summary, professional development related to diversity must go beyond cultural sensitivity and appreciation to equip educators with explicit, research-based pedagogical knowledge and skills that they can use in the classroom (García & Guerra, 2004).

Key Element 2: Early Intervention for Struggling Learners

Even when school-wide practices are focused on prevention, it is likely that some students will experience academic or behavioral difficulties. In such instances, early intervention strategies must be implemented *as soon as these learning problems are noted*. In this discussion, the term "early intervention" is purposefully substituted for "prereferral intervention." All too often, prereferral activities are viewed as a hurdle before students can be tested for special education. Moreover, the prereferral process is often activated too late to be successful. Thus, general education's failure to intervene in a timely fashion, not the presence of a disability, may be the real source of students' difficulties. Research shows that if students are more than a year below grade level, even the best remedial or special education programs are unlikely to be successful (Slavin & Madden, 1989). Timely general education support systems for struggling learners are important components of early intervention aimed at improving academic performance and reducing inappropriate special education referrals.

As with prevention efforts, early intervention has classroom- and school-level components. At the classroom level, teachers use diagnostic/prescriptive teaching approaches to validate the source(s) of the difficulty. When such efforts are not adequate, they have access to school-wide support systems, such as peer and expert consultation, general education problem-solving teams, and alternative programs such as those that offer tutorial or remedial instruction in the context of general education (Ortiz, 2002).

Key Element 3: Diagnostic/Prescriptive Teaching

Clinical teaching involves instruction that is carefully sequenced. Teachers (a) teach skills, subjects, or concepts; (b) reteach using significantly different strategies or approaches for the benefit of students who fail to meet expected performance levels after initial instruction, and (c) use informal assessment strategies to identify students' strengths and weaknesses and the possible causes of academic and/or behavioral difficulties (Ortiz, 2002). Teachers conduct curriculum-based assessments (e.g., using observations, inventories, and analyses of student work/behavior) to monitor student progress and use these evaluation data to plan and/or modify instruction (King-Sears, Burgess, & Lawson, 1999). In the case of English language learners (ELLs), for example, results of assessments of conversational and academic language proficiency are critical in selecting the language(s) of instruction and in determining learning goals and objectives for native language and English instruction (Ortiz & García, 1990). Assessment data, along with documentation of efforts to improve student performance and the results of these efforts, are invaluable if students are later referred to remedial or special education programs (Ortiz, 2002).

Key Element 4: Availability of General Education Problem-Solving Support Systems

When clinical teaching is unsuccessful, teachers should have immediate access to general education support systems for further problem solving (Ortiz, 2002).

4.1 Peer or expert consultation

Peers or experts can work collaboratively with general education teachers to develop strategies to address students' learning problems and to guide them as they implement recommendations. For example, teachers can share instructional resources; they can observe each other's classrooms and offer suggestions for improving instruction or managing behavior; ESL teachers can help general education peers by demonstrating strategies for successfully integrating ELLs into their classes; teachers can meet to coordinate ESL and content instruction; and so forth (Ortiz, 2002).

4.2 Teacher Assistance Teams (TAT)

Teacher Assistance Teams (TAT) (Chalfant, Pysh, & Moultrie, 1979) can help teachers resolve problems they routinely encounter in their classrooms. These teams, comprised of four to six general education teachers and the teacher who requests assistance, design interventions to help struggling learners. At the TAT meeting, team members (a) reach consensus as to the nature of the problem; (b) determine priorities for intervention; (c) help the teacher select the methods, strategies, or approaches to be used in solving the problem; (d) assign responsibility for carrying out the recommendations; and (e) establish a follow-up plan to monitor progress (Chalfant, Pysh, & Moultrie, 1979). The teacher then implements the plan, with the assistance of team members or other colleagues, if needed. Follow-up meetings are held to review progress toward problem resolution. If the problem is resolved, the case is closed; if not, the team repeats the problem-solving process.

When teachers contact the team, their focus is on *requesting assistance from the TAT for themselves*; they are not *referring students to the team*. In other words, they continue to "own" the problem but seek to resolve the situation with the assistance of peers, creating shared responsibility. This distinguishes the TAT process from prereferral interventions that are initiated because the teacher views the student's difficulties as the responsibility of others, such as remedial or special education teachers.

Across the various types of support systems available at the school level, it is important to systematically monitor and document student progress as well as the fidelity of implementation of the recommended interventions. While TATs have been reportedly successful, there is scant discussion, if any, in these reports regarding the cultural and/or linguistic appropriateness of interventions. For this reason, when students do not appear to respond to more intensive or alternate interventions, schools need to consider whether or not the intervention responds to the cultural and/or linguistic needs of the students. Additionally, schools need to assess factors related to the cultural context of classrooms, such as appropriateness of the curriculum and/or instruction.

In addition to individual teachers receiving support for problem-solving, school-wide support systems are beneficial to the entire school in a variety of ways. Serving on the TAT is an excellent professional development activity for team members and especially for teachers who request assistance from the team (Ortiz, 2002). The next time they encounter a student with a problem similar to one that the team helped them resolve, they know what to do. An additional benefit is that the TAT coordinator can analyze the types of problems for which teachers requested assistance and share this information with the principal (without identifying the teachers who requested assistance). The principal can thus identify issues that need to be addressed on a broader scale (e.g., the need to revise the school's discipline plan or to implement a tutoring program) or professional development topics that might be beneficial to the entire faculty (e.g., how to determine when students are truly proficient in English or when to transition students from reading in their native language to reading in English). As a result, the problem-solving process can generate data to refine or modify other components of the educational system in ways that are tailored to the unique characteristics of the school.

4.3 Alternative Programs and Services

When teachers request assistance from school-wide, problem-solving teams, it is important that they have access to a range of alternative services to support their efforts. General education alternatives for struggling learners may include one-on-one tutoring, family and student support groups, family counseling, services supported by federal Title I funds, and so forth. The support provided to students through these programs is supplemental to, not a replacement for, general education instruction (Slavin & Madden, 1989). Moreover, services should be intensive and temporary; students who have had to be removed from their regular classrooms for supplemental instruction should be returned to those classrooms as quickly as possible (Anderson & Pellicer, 1998). Finally, as with all other components of the model, it is critical that such alternatives are based on what is known to be effective for culturally and linguistically diverse students, and that they reflect the same philosophy as the rest of the school (i.e., high expectations, equity practices, additive orientation, and resilience-focused).

Next Steps: What happens after prereferral?

Prevention and early intervention are not intended to discourage special education referrals. Rather, they are fundamental to preventing referral of students whose problems result from factors other than the presence of a disability. When these approaches fail to resolve learning difficulties, then referral to special education is warranted (provided that implementation was appropriate). Decisions of the referral committee are informed by data gathered through the prevention, early intervention, and referral processes (Ortiz, 1997).

Prevention and early intervention efforts can significantly improve the academic achievement of culturally and linguistically diverse students. In turn, this will reduce the number of students (a) perceived to be at risk of failing, (b) inappropriately referred to remedial or special education programs, and/or (c) inaccurately identified as having a disability. These outcomes are critical given the concern that as the linguistic and cultural diversity of students increases, the special education system may be at risk of being overwhelmed by referrals of culturally and linguistically diverse students because the general education system has failed to accommodate their needs.

References

Anderson, L. W., & Pellicer, L. O. (1998). Toward an understanding of unusually successful programs for economically disadvantaged students. *Journal of Education for Students Placed at Risk, 3*(3), 237–263.

Barron, V., & Menken, K. (2002, August). What are the characteristics of the shortage of teachers qualified to teach English Language Learners? *AskNCELA No. 14*. Retrieved May 31, 2004 from http://www.ncela.gwu.edu/expert/faq/14shortage.htm.

Chalfant, J., Pysh, M., & Moultrie, R. (1979). Teacher assistance teams: A model for within—building problem solving. *Learning Disability Quarterly, 2*(3), 85–96.

Cummins, J. (1986). Empowering language minority students. *Harvard Educational Review, 56*, 18–36.

Donovan, M. S., & Cross, C. (Eds.). (2002). *Minority students in special and gifted education*. Report of the National Research Council's Committee on Minority Representation in Special Education. Washington, D.C.: National Academy Press.

Erickson, F. (2001). Culture in society and in educational practices. In J. Banks & C. M. Banks (Eds.), *Multicultural education: Issues and perspectives* (pp. 31–58). New York, NY: Wiley.

Fletcher, J. M., Barnes, M., & Francis, D. (2002). Classification of learning disabilities: An evidence-based evaluation. In R. Bradley, L. Danielson, & D. P. Hallahan (Eds.), *Identification of learning disabilities: Research to practice* (pp. 185–250). Mahwah, NJ: Erlbaum.

García, S. B. (2002). Parent-professional collaboration in culturally-sensitive assessment. In A. J. Artiles & A. A. Ortiz (Eds.), *English language learners with special needs: Identification, assessment and instruction* (pp.87–103). Washington, D.C.: Center for Applied Linguistics and Delta Systems Co., Inc.

García, S. B., & Guerra, P. L. (2004). Deconstructing deficit thinking: Working with educators to create more equitable learning environments. *Education and Urban Society, 36*(2), 150–168.

García, S. B., Wilkinson, C. Y., & Ortiz, A. A. (1995). Enhancing achievement for language minority students: Classroom, school, and family contexts. *Education and Urban Society, 27*, 441–462.

Kalyanpur, M. & Harry, B. (1999). *Culture in special education*. Baltimore, MD: Brookes.

King-Sears, M. E., Burgess, M., & Lawson, T. L. (1999). Applying curriculum-based assessment in inclusive settings. *Teaching Exceptional Children, 32*(1), 30–38.

Leinhardt, G. (1992). What research on learning tells us about teaching. *Educational Leadership, 49*(7), 20–25.

Lynch, E. W., & Hanson, M. J. (Eds.). (1998). *Developing cross-cultural competence: A guide for working with young children and their families* (2nd ed.). Baltimore, MD: Brookes.

Moll, L. C., Amanti, C., & Neff, D. (1992). Funds of knowledge for teaching: Using a qualitative approach to connect homes and classrooms. *Theory into Practice, 31*, 132–141.

Oakes, J., & Lipton, M. (1999). *Teaching to change the world*. Boston, MA: McGraw-Hill.

Ortiz, A. A. (1997). Learning disabilities occurring concomitantly with linguistic differences. *Journal of Learning Disabilities*, *30,* 321–332.

Ortiz, A. A. (2002). Prevention of school failure and early intervention for English Language Learners. In A. J. Artiles & A. A. Ortiz (Eds.), *English Language Learners with special education needs: Identification, assessment, and instruction* (pp. 31–63). Washington, D.C.: Center for Applied Linguistics and Delta Systems Co., Inc.

Ortiz, A. A., & García, S. B. (1990). Using language assessment data for language and instructional planning for exceptional bilingual students. In A. Carrasquillo & R. E. Baecher (Eds.), *Teaching the bilingual special education student* (pp. 25–47). Norwood, NJ: Ablex.

Rogoff, B. (1990). *Apprenticeship in thinking: Cognitive development in social context*. New York, NY: Oxford University.

Rueda, R., Artiles, A. J., Salazar, J., & Higareda, I. (2002). An analysis of special education as a response to the diminished academic achievement of Chicano/Latino students: An update. In R. R. Valencia (Ed.), *Chicano school failure and success: Past, present, and future* (2nd ed.) (pp. 310–332). London: Routledge/Falmer.

Santamaría, L. J., Fletcher, T. V., & Bos, C. S. (2002). Effective pedagogy for English Language Learners in inclusive classrooms. In A. J. Artiles, & A. A. Ortiz (Eds.), *English language learners with special education needs: Identification, assessment, and instruction* (pp. 133–157). Washington, D.C.: Center for Applied Linguistics and Delta Systems Co., Inc.

Slavin, R. E., & Madden, N. A. (1989). What works for students at risk: A research synthesis. *Educational Leadership, 46* (5), 4–13.

Vaughn, S., & Fuchs, L. S. (Eds.). (2003). Redefining LD as inadequate response to instruction: The promise and potential problems [Special issue]. *Learning Disabilities Research & Practice, 18*(3) 137–146.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Wang, M. C., & Kovak, J. A. (1995). Bridging the achievement gap in urban schools: Reducing educational segregation and advancing resilience-promoting strategies. In B. Williams (Ed.), *Closing the achievement gap: A vision to guide change in beliefs and practices* (pp. 9–24). Philadelphia, PA: Research for Better Schools.

Additional Resources

Artiles, A. J., & Ortiz, A. A. (Eds.). (2002). *English language learners with special needs: Identification, placement and instruction*. Washington, D.C.: Center for Applied Linguistics and Delta Systems Co., Inc.

Cartledge, G., & Milburn, J. F. (Eds.). (1996). *Cultural diversity and social skills instruction*. Champaign, IL: Research Press.

García, S. B., & Dominguez, L. (1997). Cultural contexts which influence learning and academic performance. *Child and Adolescent Psychiatric Clinics of North America*, *6*(3), 621–655.

García, S. B. & Ortiz, A. A. (1988, June). *Preventing inappropriate referrals of language minority students to special education*. New Focus Series, No. 5. Washington, D.C.: National Clearinghouse for Bilingual Education. Available from http://www.ncela.gwu.edu/pubs/classics/focus/05referral.htm.

Hollins, E. (1996). *Culture in school learning*. Mahwah, NJ: Erlbaum.

Losen, D., & Orfield, G. (Eds.). (2002). *Racial inequity in special education*. Cambridge, MA: Harvard Education Publishing Group.

National Alliance of Black School Educators. (n.d.). *Addressing over-representation of African American students in special education: The prereferral process*. (An administrator's guide). Washington, D.C.: Author. Available from http://www.nabse.org/addressing.htm.

Ortiz, A. A., & Kushner, M. I. (1997). Bilingualism and the possible impact on academic performance. *Child and Adolescent Psychiatric Clinics of North America*, *6*, 657–679.

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Tel. (202) 362-0700
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http://www.cal.org

National Alliance of Black School Educators
310 Pennsylvania Avenue, SE
Washington, D.C. 20003
Toll Free: (800) 221-2654
Phone: (202) 608-6310
Fax: (202) 608-6319
http://www.nabse.org

National Association for Bilingual Education
1030 15th St., NW, Suite 470
Washington, D.C. 20005
Phone: (202) 898-1829
Fax: (202) 789-2866
Email: nabe@nabe.org
http://www.nabe.org

National Clearinghouse for English Language Acquisition & Language Instruction Educational Programs
2121 K Street NW, Suite 260
Washington, D.C. 20037
Phone: (800) 321-6223, (202) 467-0867
Fax: (800) 531-9347, (202) 467-4283
TTY: (202) 775-9193
http://www.ncela.gwu.edu

The Civil Rights Project
125 Mt. Auburn Street, 3rd Floor
Cambridge, MA 02138
Phone: (617) 496-6367
Fax: (617) 495-5210
Email: crp@harvard.edu
http://www.civilrightsproject.harvard.edu

The Council for Exceptional Children
1110 North Glebe Road, Suite 300
Arlington, VA 22201
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Practitioner
Brief Series

NATIONAL CENTER FOR
Culturally Responsive
Educational Systems

NSTA Strategic Goal on ***Supporting Quality Teachers of Science***

Prepared by Sue Whitsett, Congress Committee and NSTA District XII Director
And Mary McDougall, Congress Committee and NSTA District XVIII Director

<u>Discussion Questions</u>

1. What are the obstacles to providing high quality professional development?
2. What are strategies to address these obstacles?
3. How can teachers address the obstacles?
4. What are some resources NSTA. Chapters, and Associated Groups provide to support quality professional development?

<u>Bibliography</u>

Association for Supervision and Curriculum Development. 2006. Theme issue: Improving Professional Practice. *Educational Leadership*. 63(6).

Committee on Biology Teacher In-service Programs, Board on Biology, Commission on Life Sciences, National Research Council. 1996. *The Role of Scientists in the Professional Development of Science Teachers*. Washington, D.C.: National Academy Press.

Danielson, C. 1996. *Enhancing Professional Practice: A Framework for Teaching*. Alexandria, Va.: Association for Supervision and Curriculum Development.

Eisenhower National Clearinghouse for Mathematics and Science Education. 1999. *Ideas that Work Science Professional Development.* 99-004 Filby, N.N. 1995. *Analysis of Reflective Professional Development Models*. San Francisco: WestEd.

Guskey, T. 2003. What Makes Professional Development Effective? *Phi Delta Kappan*. 84(10): 248-251.

Hassel, Emily. 1999. *Professional Development: Learning from the Best. A Toolkit for Schools and Districts Based on the National Awards Program for Model Professional Development.* Oak Brook, Ill.: North Central Regional Education Laboratory.

Holloway, J. 2003. Linking Professional Development to Student Learning. *Educational Leadership*. 61 (3) 85-87.

Howe, Ann C., and Harriet S. Stubbs. 1997. Empowering Science Teachers: A Model for Professional Development. *Journal of Science Teacher Education* 8(3): 167-82.

Lewis, Anne, Willis D. Hawlely, Donna C. Rhodes, and Robert McClure. 1999. *Revisioning Professional Development. What Learner-Centered Development Looks Like*. Ann Arbor, Mich.: National Staff Development Council.
Loucks-Horsley, S., P.W. Hewson, N. Love, and K. Stiles. 1998. *Designing Professional Development for Teachers of Science and Mathematics*. Thousand Oaks, Calif.: Corwin Press.

Rhoton, Jack and P. Bowers, eds. 2001. Professional *Development planning and design*. Arlington, VA: NSTA Press.

Rhoton, Jack and P. Shane, eds. 2006. *Teaching Science in the 21st Century*. Arlington, VA: NSTA Press.

Yager, Robert, ed. 2005. Exemplary Science: Best Practices in Professional Development. Arlington, VA: NSTA Press.

Classroom Materials

Ideas that Work

Effective Professional Development for Teachers of Science

By Susan Loucks-Horsley

> Professional development plays an essential role in successful education reform. Professional development serves as the bridge between where prospective and experienced educators are now and where they will need to be to meet the new challenges of guiding all students in achieving to higher standards of learning and development (U.S. Department of Education, 1995, p. 2).

The image of a bridge is useful for those who provide professional learning opportunities for science teachers and others responsible for helping young people to learn the science they will need for the 21st century. A bridge, like professional development, is a critical link between where one is and where one wants to be. A bridge that works in one place almost never works in another. Each bridge requires careful design that considers its purpose, who will use it, the conditions that exist at its anchor points (beginning, midway, and end), and the resources required to construct it. Similarly, each professional development program or initiative requires a careful and unique design to best meet the needs of the teachers and the students to be served.

The current scene in professional development in no way resembles the ideal of a sturdy bridge to the future--a critical link that is carefully and uniquely designed to meet particular needs. Instead, the professional development teachers experience is typically weak, limited, and fragmented, incapable of supporting them as they carry the weight of adequately preparing future citizens. Programs fall far short of helping teachers develop the depth of understanding of science content they must have, as well as how best to help their students learn it.

This weakness in current professional development programs for science teachers is particularly serious because, unfortunately, many teachers enter the classroom unprepared to teach challenging science. The average teacher of grades K-6 takes three or fewer science or science education classes in college. Eighteen percent of high school science teachers do not have a major or minor in science, and over half of physical science teachers are out-of-field by this criterion (U.S. Department of Education, 1993-1994).

Teachers' lack of preparation becomes even more critical in light of the *National Science Education Standards* (National Research Council, 1996) and *Benchmarks for Science Literacy* (American Association for the Advancement of Science, 1993), as well as many recent state science standards, which call for the teaching of more challenging science. In the future, students will be expected to think scientifically and to learn fundamental concepts of life, physical, and Earth and space sciences in elementary school.

Recent U.S. and comparative international data show that American students should be learning more challenging science. The Third International Mathematics and Science Study (TIMSS) compared the mathematics and science achievement of a half-million students from 41 countries at the fourth, eighth, and twelfth grades. In science, U.S. fourth graders were among the highest in performance in the world, U.S. eighth graders performed at the international average, and U.S. twelfth graders performed significantly below the international average--even those taking advanced placement courses, who are considered the country's best students. One reason for this pattern of decline is that the content of U.S. curriculum is less demanding beginning around fourth grade and continuing through high school.

The need for more challenging science content for students means that their teachers will also have to learn more challenging science content and how to teach it. The purpose of this publication is to suggest new ways of designing and implementing effective professional development to reach these goals.

The publication is for those who have some responsibility for designing or conducting professional development programs or initiatives. They can be teacher leaders, school or district administrators, university science educators or scientists, curriculum developers, trainers, or consultants. They can be designing long-term, whole-district initiatives, courses for high school teachers, teacher enhancement projects drawing teachers from across a state or the nation--just about any opportunity formulated to support teacher learning. This publication may also be of interest to teachers selecting their own learning opportunities, evaluators interested in what to look for in effective programs, and funders who appreciate guidance about the kinds of programs that have the greatest likelihood of success. First and foremost, this publication is for anyone interested in "breaking set" with traditional schemes for professional development and exploring new designs for learning.

This publication can be used by any of the above audiences for identifying what works in professional development. While the strategies contained in Section II will help designers of professional development opportunities, they are included also so that educators can identify elements of programs that will lead to new ways of teacher and student learning and improved student achievement. The strategies, the additional resources, and the example programs all provide educators with grounding in how to select programs and where to go for additional information.

Strategies, Summaries of 15 Strategies for Professional Development, provides a description of each strategy including the elements necessary for design and implementation, along with issues for educators to consider. The discussion of each strategy concludes with a real-life example of the strategy in action. Sections III and IV feature descriptions of other existing programs.

Contact information for the programs described in Sections II, III, and IV is provided so that readers can obtain more details about these particular projects or assistance in developing or adapting their own programs. Section V, Technical Assistance Providers, furnishes a list of organizations that offer educators professional development training and information.

Principles of Professional Development

Knowledge from research, theory, and the "wisdom"of experienced, practicing professional developers suggests five principles of effective professional development:

1. *Professional development experiences must have students and their learning at the core--and that means all students.*

   Science education reforms--and the national, state, and local standards on which they are based--share a common commitment to high standards of achievement for all students and not just the few who are talented or privileged. This implies a different perspective on the content students should learn and the teaching strategies that should be used by their teachers. To meet this challenge, all professional development resources, including teacher time, must be focused on rigorous content and the best ways to reach all students

2. *Excellent science teachers have a very special and unique kind of knowledge that must be developed through their professional learning experiences.*

   Pedagogical content knowledge (Shulman, 1987) involves knowing how to teach specific science concepts and principles to young people at different developmental levels. This kind of knowledge and skill is the unique province of teachers and distinguishes what they know from what scientists know. Knowledge of science content, although critical, is not enough, just as knowledge of general pedagogy is not enough. The goal of developing pedagogical content knowledge must be the focus of professional development opportunities for teachers.

3. *Principles that guide the improvement of student learning should also guide professional learning for teachers and other educators.*

   Professional developers must "walk their talk" because people tend to teach in ways in which they have learned. Engaging in active learning, focusing on fewer ideas more deeply, and learning collaboratively are all principles that must characterize learning for teachers if they in turn will apply these to helping their students learn.

4. *The content of professional learning must come from both inside and outside the learner and from both research and practice.*

   Professional development opportunities must honor the knowledge of the practicing teacher as well as draw on research and other sources of expertise outside schools and classrooms. Artful professional development design effectively combines theory and practice.

5. *Professional development must both align with and support system-based changes that promote student learning.*

   Professional development has long suffered because of its separation from other critical elements of the education system, with the result that new ideas and strategies are not implemented. Although professional development is not a panacea, it can support changes in such areas as standards, assessment, and curriculum, creating the culture and capacity for continuous improvement that is so critical for educators facing current and future challenges.

Note that the principles, design framework, and strategies for professional development described in this publication are elaborated in *Designing Professional Development for Teachers of Science and Mathematics* by Susan Loucks-Horsley, Peter W. Hewson, Nancy Love, and Katherine E. Stiles, with Hubert M. Dyasi, Susan N. Friel, Judith Mumme, Cary I. Sneider, and Karen L. Worth (Thousand Oaks, CA: Corwin Press, 1998). The book is a product of the National Institute for Science Education, funded by the National Science Foundation.

CONTENTS

Citation information

Ideas That Work: Mathematics Professional Development. 1998.
Columbus, OH: Eisenhower National Clearinghouse.

NSTA Strategic Goal on ***Partnerships in the Science Community***

Prepared by Jean Tushie, Congress Committee and NSTA District IX Director

Discussion Questions

1. What are the obstacles to building partnerships with families, informal institutions, industry, the scientific community, and the general public?
2. What are some strategies to build strong partnerships?
3. How do barriers change based on the type of partnership?
4. What types of partnerships are available to NSTA, Chapters and Associated Groups?

Bibliography

Epstein, J.L. "School/family/community partnerships: Caring for the children we share." Phi Delta Kappan, May 1995: 701-712.

Epstein, Joyce. "Paths to Partnerships: What We Can Learn." Phi Delta Kappan, Jan.1991: 344-349.

Jasso, Gayle. Finding corporate resources: maximizing school-business partnerships. Thousand Oaks: Corwin Press, 1996

Rubin, Hank. Collaborative leadership: developing effective partnerships in communities and schools. Thousand Oaks: Corwin Press, 2002.

Salinas, Karen Clark. School, family, and community partnerships: Your Handbook for Action. Thousand Oaks: Corwin Press, 1997

Leaders for Tomorrow's Schools
http://www.ncrel.org/cscd/pubs/lead21/2-1toc.htm

Epstein, J.L. (1995, May). School/family/community partnerships: Caring for the children we share. *Phi Delta Kappan, 76*(9), 701-712.

http://www.ncrel.org/cscd/pubs/lead21/2-1toc.htm

http://www.ncrel.org/cscd/pubs/lead21/2-1b.htm

http://www.ncrel.org/cscd/pubs/lead21/2-1l.htm

http://www.ncrel.org/cscd/pubs/lead21/2-1l.htm

Institute for Educational Leadership. (1994). *Preparing collaborative leaders: A facilitator's guide.* Washington, DC Author.

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Feature

Points of View: Effective Partnerships Between K–12 and Higher Education

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Note from the Editors
CBE *is pleased to present "Points of View," a series designed to address issues faced by many people within the life sciences educational realm. We present several differing points of view back-to-back on a given topic to promote discussion of the topic. Readers are encouraged to participate in the online discussion forum hosted by* Cell Biology Education *at www.cellbioed.org/discussion/public/main.cfm. We hope op-ed pieces on Points of View will stimulate thought and dialogue on significant educational issues.*

In this issue, we address the question "How do we construct effective partnerships between K-12 education and higher education?" K-12 educators and college/university faculty share many interests, and need to work together to ensure effective teacher education and that curricula are articulated. Yet, we work in different settings; some would say different cultures. In Points View, we examine the needs and the responsibilities of our institutions of higher education to support K-12 science education, and examine how we can build interactions that recognize the strengths and help remedy the weaknesses of each partner.

The points of view we present in this issue provide a number of responses to those questions. We invite you to share your ideas, experiences and insights on the discussion board.

Building Successful Partnerships Between K–12 and Universities

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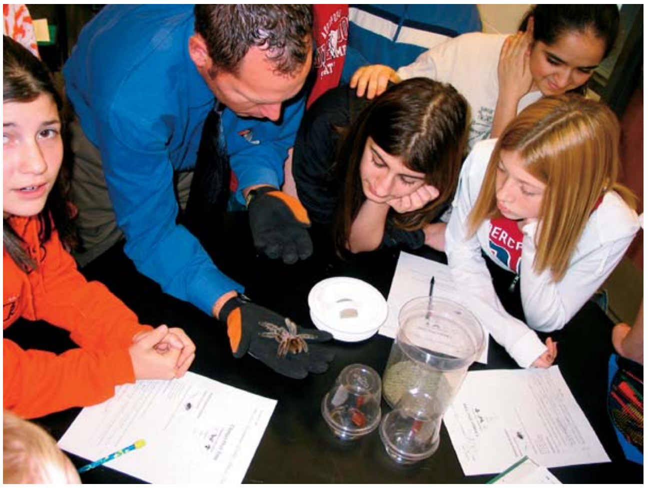
When I was a high school science teacher, my interactions with university faculty members were limited. Occasionally, depending on the district in which I was teaching, university faculty members in the region or state would send us letters inviting us to summer workshops and classes. My science teaching colleagues and I generally valued these opportunities because we believed the classes kept us up to date in our fields and knowledgeable about contemporary ideas and big questions in biology. We viewed these occasions largely as opportunities for ongoing professional development. Our relationship was based on our perceptions that the university faculty had expertise and knowledge from which we could benefit.

However, partnerships today between university faculty and K–12 teachers imply something more than an instructional relationship based on a one-way flow of information from an expert to his or her novice students. The construct of "partnership" implies direct benefits for all parties involved. Partnerships involve two or more people, each with expertise or skills to contribute, working toward a common goal. The idea is that something is there to be gained by everyone, an idea that is at the heart of the National Science Foundation's Mathematics and Science Partnerships (MSP) program, which is offered as a special initiative by the Directorate for Education and Human Resources. The common goal of the large MSP projects is to improve the science and mathematics learning of all students, K–12 through university. Today, partnership models are replacing one-time summer courses and workshops as vehicles for improving science, technology, engineering, and math (STEM) education in the United States. However, the ways in which partnerships between schools and universities become established and are maintained is not well documented.

One developing partnership that I have been observing with interest is at North Dakota State University. The project is called NDSU GraSUS: A Graduate Student-University-School Collaborative. I am the external evaluator for the National Science Foundation–funded GK–12 project. The GraSUS project involves placing graduate students in the STEM disciplines in year-long fellowships with practicing middle or high school science and mathematics teachers. One of the goals of the project, now in its fourth year of operation, is "increased collaboration between NDSU scientists and mathematicians and area middle and high schools." Thus, this led to the evaluation questions for my work, "What comprises the collaboration to which the project aspires?" and "Does the project collaboration represent a partnership between K–12 and university scientists, and if it does, how do we know it when we see it?" In its first year of operation, I was somewhat critical of the degree to which this project was advancing toward the goal of increased collaboration and partnership. Early on, the project was designed so that STEM graduate students, with input from classroom teachers to whom they were assigned and with supervision from university faculty, were to develop in-class activities at the university that could be transported, as it were, to middle school and high school classrooms. The idea was to enhance the science curriculum with inputs created at the university.

However, the GraSUS project leaders quickly recognized that the one-way flow of activities from the university to middle and high school classrooms created little reason for teachers to take ownership of the project or to consider using the activities that had been developed in the curriculum. The GraSUS project was modified so that teachers, rather than faculty and graduate students, originated the ideas for the curriculum enhancements. Teachers knew which units of instruction needed upgrades, and they were also aware of which areas in which they felt weak. The shift resulted in a substantial increase in interactions among the graduate students in the project, the teachers, and the supervising university faculty members. To document the increased collaboration, the project director began keeping records of all interactions and the reasons for them. The GraSUS project changed in less than 1 year from one with few interactions between faculty and teachers to one in which dozens of interactions occur each year.

I believe the GraSUS project is successfully documenting collaboration and growth of a partnership because the university-based project leaders realized early on that reasons for a partnership must be grounded in the needs of the teachers who will be making the decisions about how and whether to use the "products" that are created. High-quality activities and curriculum enhancements make a difference only if individual teachers regularly use them. With the GraSUS project, each graduate student fellow works on a different project. Yet, each fellow is involved in improving the educational experiences of the middle and high school students with whom they work. They accomplish this through activities the fellows create or revise in response to what a teacher specifically needs.



I also believe the GraSUS partnership is enabled by the presence of the graduate student fellows who serve as conduits between the university and school cultures. In other words, I do not believe the collaboration and resultant partnership would happen without the graduate student fellows. Their presence allows teachers' needs to be interpreted and then communicated to faculty members at the university. Because the graduate student fellows spend a significant amount of time directly involved with the teachers in their classrooms, they gain knowledge of the K–12 learning environment, which is largely invisible to many university faculty members. The fellows occupy a unique position in the project in that they can confidently communicate with teachers as well as with the university faculty members.

Finally, there is some evidence in my project evaluation data to suggest that the partnership is working both ways. Graduate students report that the year-long fellowships spent working with science and mathematics teachers in their classrooms and on curriculum enhancements has resulted in their own greater awareness and understanding of student learning and teaching. Some of the graduate student fellows I interviewed also reported changes in their own instructional approaches to laboratory courses they often teach at the university. As these graduate students are just now beginning to graduate and pursue academic or industry careers, we have only been able to speculate about how the project will affect their thinking and actions. A goal for the next several years is to document the ways in which the GraSUS project has affected the fellows and their careers.

In sum, successful K–12/university partnerships do not begin with what university faculty members believe must be changed in K–12 classrooms. Rather, successful partnerships develop in response to needs identified by practicing teachers for their specific classrooms and curricula.

Furthermore, curricular needs are best articulated by individuals who have dual knowledge of the science and the school learning environments in which the improvements will be implemented. Finally, successful partnerships involve university faculty members asking how involvement with K–12 schools and teachers can enhance the education of their own students.

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Science Education Partnerships: Being Realistic About Meeting Expectations

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Much of our science education professional literature is filled with detailed prescriptions of how to implement successful partnerships to enhance K–12 school science. These resources provide well-grounded recommendations about earning the support of administrators, teachers, and parents before beginning a new science program in schools. Quality curricula, adequate materials, and other physical resources, as well as professional development for teachers and appropriate evaluation strategies, are also identified as important elements in K–12 science education programs. Most science organizations and their representatives incorporate these elements to greater or lesser degrees into the school partnership they undertake. Certainly, in our work at the Center for Educational Outreach at Baylor College of Medicine (BCM), we apply the recommendations of the National Science Education Standards (National Research Council, 1996) and other similar resources to every extent possible in our partnerships with teachers, schools, and districts. We work closely with our colleagues in K–12 schools and strive to address mutual concerns and needs. In numerous cases, our partnerships have achieved measurable successes in developing teacher content knowledge, facilitating student achievement, promoting changes in teachers' science teaching practices, or fostering the emergence of local science education leaders (Moreno, 1999; Moreno and Tharp, 1999; Moreno, *et al.*, 2001, 2004). I suspect, however, that our experiences are not unlike those of many others who work as school partners within their local communities. In most situations, our partnership efforts yield sustainable outcomes. In a few cases, however, despite our best, well-informed and skilled efforts, we do not achieve the predicted changes in science teaching and learning. Which leaves us asking, "Why do partnerships sometimes fall short of expectations?"

The answer to this question is different in each instance. In some cases, intrinsic factors in schools work against innovations in science teaching and learning. In others, elements of the partnership itself prove to be inadequate for the challenges that arise during implementation. Based on our experiences, partnerships that do not meet expectations may have experienced one or more of the following pitfalls.

1. The partnership is one-sided. Even experienced science partners will sometimes fall into the trap of trying to be Superman. Unidirectional partnerships, in which one partner (Superman) single-handedly tries to rescue the other, rarely achieve their goals. Much more desirable is the Batman and Robin model, in which a more-experienced partner mentors a newer, or less-experienced partner; or the Superfriends model, in which each partner makes equivalent, but different contributions, based on needs and individual resources of the partners. These models are valid at all partnership levels, from individual scientist/teacher partnerships to institutional partnerships. The Baylor Science Leadership Program summer institute, which we conduct with HULINC, the Urban Systemic Initiative of the Houston Independent School District, is an example of a Superfriends-type partnership. This model evolved from a typical higher education summer institute offered to local elementary teachers to a true collaboration. The school district identifies critical content areas to be included in the institute curriculum, recruits and enrolls participants, pays stipends, conducts the technology training portion of the program, and holds school-year follow-up sessions. BCM plans the curriculum, manages purchases and logistics, provides all instruction using master teachers and scientists, and designs and conducts short-term and long-term evaluations. This combined program, provided to more than 800 teachers, has been much more effective in terms of increasing teacher content knowledge and science teaching efficacy beliefs than professional development delivered primarily by one or the other partner.
2. Science education is not given equal priority by all partners. Science research institutions sometimes assume that science teaching and learning should be of the highest priority in all K–12 schools at all times. Unfortunately, teachers and administrators are challenged daily by issues related to student test scores; inadequate facilities; parent concerns; drop-out rates; student mobility; needs of at-risk and disadvantaged students; students who speak English as a second language; and vast socioeconomic, racial, and ethnic diversity. It is not surprising that 29.5 percent of public school teachers surveyed by the National Center for Educational Statistics (2003) indicated that students come to school unprepared to learn. Thus, even when schools genuinely want to participate fully in a given science education initiative, administrators and teachers may have to divert their attention to other more immediate and pressing concerns. We have learned not to be disappointed when a scheduled meeting or teacher workshop has low attendance because, in many cases, teachers are unable to attend due to last-minute meetings or schedule changes at schools. For important in-service sessions, we schedule make-up days or work one-to-one with teachers.
3. Partnership activities are viewed as an add-on in schools. Within the current climate of accountability and high stakes assessments, schools feel pressured to focus on topics within the curriculum that will appear on student assessments. The challenge to science partners is to identify science themes that will engage students in real issues, but also build skills and basic understandings of content areas that will appear on standardized tests.
4. Minimum physical resources for science instruction are not in place. Many elementary schools, in particular, do not have adequate classroom or laboratory facilities for conducting hands-on science activities. A standard joke among elementary science teachers is, "Oh yes, I have running water in my classroom . . . I run down the hall to bring back a bucketful." Middle and high schools usually have laboratory-style classrooms, but may have outdated equipment or lack funds to buy needed consumable materials and supplies. Thus, a science education partnership that provides hands-on, inquiry modules or kits to teachers, for example, also should

develop mechanisms for the refurbishment of consumable supplies, so that the kits may be used for instruction year after year.

5. Professional development does not match the needs of teachers. Recent studies have shown that, nationally, 24 percent of secondary school classes in core subjects are taught by teachers lacking even a college minor in those subjects. In the nation's high-poverty schools (more than 50 percent of students eligible for free or reduced lunch), the percentage of teachers teaching out-of-field increases to 34 percent (Jerald, 2002). As a result, science partners who provide professional development need to be prepared to address differing levels of knowledge and preparation among participating teachers. Over time, we have found that preassessments can help identify areas needing special attention during workshops or teacher institutes. Feedback from teachers about what works in classrooms also can be very helpful.
6. Mismatch between professional practices of scientists and K–12 teachers. As noted by Tanner *et al.* (2003), scientists and teachers work in environments that encourage different kinds of behaviors and require different kinds of knowledge. Scientists are highly specialized, with access to abundant scientific and academic resources, and are accustomed to providing critical or skeptical feedback to colleagues. Teachers, on the other hand, have broad knowledge, work in environments with limited or scarce resources, and typically provide encouragement or constructive feedback in their interactions with learners or colleagues. As a result, partnerships in which scientists and teachers are expected to work together can be diminished by clashes between these two cultures unless the differences are appropriately anticipated and addressed. Otherwise, scientists may be disappointed in the lack of appropriate equipment in schools, or teachers may find scientists' probing style of asking questions intimidating or offensive. At BCM, we conduct two programs that partner local teachers and scientists. The Howard Hughes Medical Institute–funded Science Education Leadership Fellows program teams elementary teachers and BCM graduate students or postdoctoral fellows. Our GK–12 program, which is funded by the National Science Foundation, partners high school biology teachers with BCM graduate students. In both programs, members of the most productive teams have learned to appreciate each other's expertise and learn to build on each other's strengths. Strategies that we have found to be effective in promoting productive teams include 1) having scientists co-teach under the guidance of teachers in K–12 schools, 2) allowing teachers to experience the world of science through short research projects at BCM, and 3) requiring scientists and teachers to work together to develop a specific product, such as a curriculum unit or an instructional video.
7. No time to develop a culture of professional learning and improvement in schools. Many K–12 teachers feel overwhelmed by the demands placed on their time by students, parents, and increased accountability and paperwork requirements in schools. This leaves no time for professional and collegial activities such as co-planning or mentoring. Further, in many cases, teachers must use their personal time after school or on weekends to complete professional development requirements. In order to collaborate effectively, science partners need to be sensitive to existing demands on teachers' time and energies.
8. Partnership is not sustained long enough to achieve results. Educational reforms take time. Some partnerships require 10 or more years to achieve desired outcomes in teaching and student learning. Unfortunately, most grants for science education partnerships provide support for only three to five years. Finding ways to nurture and sustain partnership activities beyond the initial grant period is one of the greatest challenges and obstacles to the success of partnerships.

Being aware of some of the pitfalls is the first step in building productive partnerships. Some of the following approaches can be useful.

1. Value all partners. Superman saves the day only in Hollywood. Real partnerships are much more productive when the contributions of all participants are valued and recognized. Effective partners jointly identify needs, and plan and work together to solve issues such as those related to resources in schools or to find appropriate times for teacher professional development.
2. Involve only those who want to participate. Unwilling partners are not effective. In projects involving individual teachers, enroll only those who are willing to participate. Often, more reluctant teachers will join in once other teachers begin to experience success. At the levels of schools or districts, administrative cooperation and buy-in is essential if partnership goals are to be achieved.
3. Pitch your teacher professional development to the appropriate level. Many teachers, particularly in elementary schools, have been trained to teach reading or language arts. As a result, teachers may feel nervous about teaching science because they have had few opportunities to experiences science inquiry for themselves. Being aware of the current teaching practices and knowledge levels of partner teachers is an important part of providing appropriate teacher professional development.
4. Deliver what you promise. If you promise kits, make sure they arrive on time. If you provide a workshop, make sure it meets the needs that teachers and students identified.
5. Stick around. K–12 education is plagued by programs and instructional strategies that last a couple of years and disappear. In order to be taken seriously, partners from science institutions need to collaborate consistently over time.
6. Focus your efforts where you can make a difference and do not be afraid to go elsewhere. Every so often, partnerships come up against intrinsic or extrinsic factors that will make achieving project goals almost impossible. When this happens, do not be afraid to acknowledge the situation and reallocate your limited resources to where they will be more effective.
7. Create a winning environment. Teachers, scientists, and their institutions have a lot in common. They have chosen a service profession and focus on making things better for society. It's hard work and little recognition ever comes their way. Open and frequent communication, in addition to shared credit for accomplishments, works to build trust and friendships.

Finally, and most important, sometimes it is necessary to adjust the definition of "success." Thus, while partnerships sometimes may fail to meet original expectations, they may generate successes in ways that were unanticipated. For example, not all teachers may become enthusiastic science instructors after one professional development program—but that one teacher who did get excited may some day become a science specialist and influence curriculum decisions for an entire school district. We have learned that it is not realistic to expect immediate changes in teaching and learning as a result of science education partnership activities. Change can happen, but it takes time.

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REFERENCES

Jerald, C.D. (2002). All talk, no action: putting an end to out-of-field teaching. Based on data analysis by Richard M. Ingersoll, University of Pennsylvania. Original analysis for the Education Trust of the 1999–2000 Schools and Staffing Survey. Education Trust, August. http://www.edtrust.org/main (accessed 18 November 2004).

Moreno, N., Griffin, R., Denk, J., and Jones, W. (2001). Real-world science: achieving better returns in student learning. School Business Affairs *67*(8), 17–19.

Moreno, N. (1999). K–12 Science education reform: a primer for scientists. Bioscience *49*(7), 569–576.

Moreno, N., Tharp, B. (1999). A national interdisciplinary project developed at Baylor to make science exciting for all K–5 students. Acad. Med. *74*(4), 345–347.

Moreno, N., Denk, J., Roberts, J., Tharp, B., Bost, M., and Thomson, W. (2004). An approach to improving science knowledge about energy balance and nutrition among elementary- and middle-school students. Cell Biol. Educ. *3,* 1–9.

National Center for Educational Statistics. (2003). Digest of Education Statistics, 2003. Teacher perceptions about serious problems in their schools, by control and by level of school: 1993–1994 and 1999–2000. http://nces.ed.gov/programs/digest/d03/tables/dt072.asp (accessed 15 November 2004).

Tanner, K.D., Chatman, L., and Allen, D. (2003). Approaches to biology teaching and learning: science teaching and learning across the school–university divide: cultivating conversations through scientist–teacher partnerships. Cell Biol. Educ. *2,* 195–201.

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Modern Genetics for All Students: An Example of a High School/University Partnership

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Teaching laboratory science in a high school setting has never been easy. Time is available in short blocks; laboratory facilities are often quite limited. In most American high schools, teachers are responsible not only for preparation of their lesson plans, but also for ordering and preparing any materials to be used in a lab, with little or no technical support. Nonetheless, there is an expectation that science instruction will be inquiry-based, giving students opportunities to carry out their own investigations of the natural world. In biology, the challenge is compounded by the fact that the field is changing rapidly, with new information, experimental approaches, and social issues arising at an increasing rate.

With these concerns in mind, a group of Washington University (WU) faculty invited the science teachers at a local high school, University City, to meet with us in 1989 to explore ways that we could work together to find ways that the strengths of the university could be used to support local high schools. Our brainstorming sessions concerning biology became focused with the opportunity to apply for a Science Education Partnership Award (SEPA) from the National Institutes of Health (NIH). A particular concern of the teachers was to find ways to incorporate DNA science into their curriculum while maintaining a grounding in genetics, but adding hands-on experiments that would help students to understand the science underlying developments such as personal identification through DNA samples, the sequencing of the human genome, and other recent advances with societal implications.

In preparing our grant application for NIH, we identified two important limitations that could be overcome by appropriate use of the funding. First, while both university and high school faculty come up with great ideas when brainstorming together on new teaching tools and labs, neither group has the time to render these ideas into well-written, lab-tested classroom materials. It is essential to identify individuals with good writing skills, a solid science background, and classroom experience to become "lead writers/organizers" for the project. This person must have salary support from a grant (or other sources) to allow him or her to devote appropriate time to the project. University and high school faculty will make essential contributions at every step, from first draft, to testing, to critique and review, but the lead writer is the person who then goes back and generates the revised text using the results from critique and discussion. Second, while university faculty generally has enough flexibility to be able to arrange meetings with colleagues, high school faculty frequently does not. To overcome this obstacle to a group effort in writing and implementation, we budgeted funds to provide an extra science teacher for the high school, allowing the high school administration to create a schedule with all biology teachers having an extra, common planning period to work together with us in creating *Modern Genetics for All Students*.

Our goal was to design curriculum materials that could be used throughout the St. Louis area, in any of the 30-plus public school districts, or in private or parochial schools. This creates a second set of challenges. Each district or school has its own curriculum, and several different textbooks are in use. Thus the unit needed to be sufficiently complete to be used as such, without other supporting materials, but also flexible enough to be incorporated into a wide number of different ongoing biology curricula. Thus the core of our curriculum development effort became the generation of a number of activities—wet labs, simulations, model building, discussions, or role playing—that would engage students and could be incorporated into any first-year high school biology class. Flexibility is critical; some schools will use all of the activities, some only a few, the decision often being driven by available time. As biology textbooks get thicker and thicker, one cannot simply add a new unit (e.g., "Molecular Genetics") to the curriculum. One must instead provide teachers with materials that allow them to strengthen the work in a given portion of their current curriculum. It is essential to provide a "guide" to *Modern Genetics,* showing where each experiment or activity can be used to advantage with any of the several textbooks commonly in use. More recently, we have also prepared a similar guide showing how the use of *Modern Genetics* allows schools to help their students meet the science standards for the state of Missouri.

Both high school and university faculty agreed that our curriculum project should be targeted to students taking their first high school biology course. While most high schools encourage taking more science, only two year-long science courses are required for graduation in Missouri (and many other states). Thus, if we are to reach all of our citizens, we must target the first-year biology course. The development of DNA science in the United States—the advent of methods of gene cloning and analysis, the sequencing of the human genome, and so on—has been fueled by tax dollars, and we felt it important that all citizens have an opportunity to learn about what their tax dollars had purchased. In order to exercise their right to genetic privacy, to make use of genetic information when it might help the family to make health care decisions, and to contribute to the dialogue on how DNA technology should be used, all students need to have a basic understanding of genetic principles and the availability of DNA sequence information. This decision, however, generated a further challenge: that of choosing language that was both scientifically accurate and accessible to this audience. Here the collaboration of university and high school faculty was absolutely essential. Accurate simplification requires a deep understanding of the science involved, while generation of accessible information requires the teacher's knowledge of the student. Careful work and many revisions are required to achieve the right balance—minimizing jargon while at the same time teaching vocabulary, providing guidance and examples while at the same time stimulating problem solving.

The current version of *Modern Genetics for All Students* is now available in print or on the Web (http://www.so.wustl.edu/) and includes both student and teacher materials. The four chapters are "DNA: The Hereditary Molecule" (which includes spooling DNA, modeling DNA structure, the gene expression dance, and transforming bacteria with *lux* genes to glow in the dark), "Passing Traits from One Generation to the Next" (which includes sea urchin fertilization, modeling inheritance with Reebops and other simulations, a genetic cross with yeast or Fast Plants, and an introduction to the chi-square test), "How Genes and the Environment Influence Our Health" (which includes inducing mutations with UV light, examining heart disease, and investigating human genetic disorders using gel electrophoresis), and "Controlling Our Genetic Futures" (which includes a discussion of the *Promise & Perils of Biotechnology: Genetic Testing,* from Cold Spring Harbor Laboratory Press, and an introduction to group decision making, with two case studies to challenge the students to resolve issues resulting from genetic testing).

In assembling *Modern Genetics,* we made use (with permission) of many excellent materials developed by others, creating de novo materials only as needed. The current version represents more than 10 years of testing in local classrooms, with several rounds of revision. Assessments to date show the materials are effective, as measured by average learning gains on pretests and posttests; a more intensive assessment is currently under way. However, DNA science continues to move ahead at a rapid rate, and we are now in the process of creating additional chapters that will provide material for either an honors first-year or a second-year biology class, including human genome sequencing and implications for health care, how plants are transformed and the implications for agriculture, and other recent developments. Both the materials developed for *Modern Genetics* and the "workshop" style of teaching commonly practiced by high school teachers are now being used in a course (DNA Science: A Hands-on Workshop) for nonscience majors at WU.

Developing curriculum materials is of no practical value if teachers cannot implement them, and again, our partnership between high school and university faculty has been essential in developing a practical implementation model. After development work with University City High School, the partnership was expanded to test the materials in urban, suburban, and rural high schools in the St. Louis area. Implementation of *Modern Genetics* is most effective if the "unit" for joining the project is the high school; specifically, all of the faculty teaching first-year biology need to agree to implement this change together. Administrative support is essential; we ask the principal, the science coordinator, and the superintendent for curriculum to write a letter of agreement as part of the partnership development. As the number of participating schools has grown (now more than 20 and adding 3–4 each year), recruiting new schools to the project has not been difficult. Teachers appreciate the opportunity to work together and to work with the university.

For a high school to implement *Modern Genetics,* three things are needed in addition to commitment: teacher training, start-up equipment, and classroom-ready supplies and support. Many current teachers received their formal training before DNA science was commonly taught to undergraduates. We provide a one-week (full-time) summer workshop to provide background in molecular biology, an opportunity to work through most of the *Modern Genetics* activities, and presentations and discussions with WU researchers and other users of DNA technology. The workshop (which can be taken for graduate-level academic credit) is a joint responsibility, engaging both current WU staff and high school teachers already using *Modern Genetics* who can speak knowledgeably about classroom implementation, providing coaching in this regard. To date, we have been able to support direct costs of the workshop from grant funding, but the school districts provide the stipends to support their participating teachers. Each school joining the project also needs a start-up set of equipment (pipettors, gel rigs, power supplies, etc.). A basic classroom set is provided from grant funding, and additional loaner equipment is available. In some cases (usually following the first year of implementation), an enthusiastic Parent-Teacher Organization (PTO) has provided additional funds to expand this base.

As noted above, most high school teachers do not have access to technical support, and many are with students almost all of their working day. Thus an experiment requiring sterile agar plates has required either a substantial supply budget to purchase these or a teacher willing to spend the weekend with a pressure cooker to prepare same. The sort of preparation facilities available at most universities can be used to overcome this problem, and provide economies of scale. We have prepared order sheets that allow teachers to specify when they need materials for a given lab, how many students are in each class, and so on. We then generate materials in a classroom-ready form—including those sterile agar plates, aliquoted samples of competent Escherichia coli and DNA, and so on—and deliver these to the school when needed. If a teacher would like support during the first year when implementing a new, technically demanding lab with his or her students, a member of the WU Science Outreach staff will arrange to be with the teacher in the classroom that day. If things go "wrong" (e.g., no transformation! no DNA bands on the gel! etc.), WU staff will troubleshoot, checking the materials and working with the teacher to identify the problem. Support is provided by dedicated Science Outreach staff, with faculty assistance as needed. This support helps teachers overcome a natural barrier to implementing new materials while working with large numbers of students, generally on a tight schedule. In teaching high school biology, there is no time to go back and do something over, so a high success rate in lab work is essential! The different venues of communication help us to develop a personal relationship with each teacher and each school. During the first two years of implementation, WU provides supplies at no cost to the school, using grant funds for this purpose. Starting the third year, we ask schools to pay the cost of raw materials for the supplies they order, while still using core grant support to cover the cost of preparing and distributing materials. Most of the experiments described in *Modern Genetics* can be implemented at a total cost of about $3 to $4 per student per year (for raw materials) under this scheme. The exception is sea urchin fertilization, a wonderful lab experience, but expensive in the Midwest!

On the whole, we count the *Modern Genetics* program a success. All of the partner high schools that have joined the program remain affiliated, and others are eager to join us, as resources become available. Our continuing dialogue with high school teachers has informed our efforts to improve beginning undergraduate instruction at WU, both for majors and nonmajors. The most significant problem in maintaining the program is turnover of staff, both at the university and at the high school. Depending on their backgrounds, new university contributors may have a steep learning curve as they develop the appreciation to embrace both the science involved and the committed teaching environment of the high school. Teachers new to a partner school may not "buy in" to the same degree as those making the original commitment, and they often need an opportunity to participate in the summer workshop. Without strong leadership within a high school, the original commitment can disappear, as a new superintendent, new high school principal, and/or new biology teachers arrive on the scene; in urban schools, such turnover can easily be in excess of 100% in 10 years.

Nonetheless, the partnership that forms the basis for *Modern Genetics* is now becoming woven into the fabric of the St. Louis educational community. The summer workshop has become a WU standard summer school course. While sustaining the *Modern Genetics* program represents only one way in which a university and its surrounding high schools can work together, it provides a cornerstone for us, creating a pool of university and high school faculty who know each other and are comfortable working together. This in turn can provide a foundation for many kinds of interactions, positions us as a group to take advantage of funding opportunities targeted to partnerships, and is building a stronger educational community for the St. Louis area.

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Moving from Outreach to Partnership: Striving for Articulation and Reform across the K–20+ Science Education Continuum

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> Scientists and engineers working in partnerships with local teachers represent an essential new force that will be required for effective science education reform... But to be effective, we scientists must first be willing to be educated about the opportunities and problems in our schools. This means that we must approach this problem with a humility that reflects how little most of us really understand about how children learn, as well as our respect for the tremendous energy, devotion, and skill required to be a successful K–12 teacher in today's schools.
>
> —Bruce Alberts, President, National Academy of Sciences

One would be hard-pressed to find a college or university in the United States without at least one outreach program designed to support science education in local K–12 schools. Over the last three decades, scores of thriving science education outreach programs have had significant and extraordinarily positive effects on K–12 science education. Driven by funding initiatives from federal, state, and private agencies and the pioneering efforts of many university scientists and K–12 educators, these programs have resulted in increased communication between institutions, innovative K–12 science curricula, greater presence of scientists in K–12 schools, and an increased interest in collaborations among K–12 teachers and students and university scientists and students. Many outreach programs, including our own, have made successful initial forays into K–12 science education reform. Yet, they have been largely unidirectional in their goals and activities, focusing primarily on the challenges and shortcomings of K–12 science education. In looking forward, we propose that the role of institutions of higher education must change, moving from initial efforts in outreach, a stance characterized by offering expertise and supporting external reform, to a more enduring approach of partnership, which demands that both partners examine their own science teaching and learning and promote both external and internal reform. Many wonderful outreach programs that have not been bi-directional in their goals and activities are poised to blossom into partnerships in which K–12 teachers and university scientists collaborate to create a coherent and articulated science education experience for students across the K–20+ science education system (Tanner et al., 2003).

In this Point of View we argue that crafting effective science education partnerships requires moving beyond K–12 science education reform and toward examination of the connections and disconnections between K–12 and university science pedagogy. In particular, we believe that three major shifts must occur: 1) the adoption of a mutual learning model of partnership, 2) the integration of partnership into the training of scientists, and 3) the development of sustained infrastructures for partnership. Such shifts, we believe, are the stuff of Kuhnian revolutions and could catapult us toward what we all desire: a coherent, articulated, and inquiry-based approach to science education from kindergarten through graduate school.

A MUTUAL LEARNING MODEL OF PARTNERSHIP

Few would question that legions of university scientists and K–12 educators share a common interest in improving science education for our nation's young people. In our opinion, however, an effective reform effort must be grounded in a genuine commitment to mutual learning. In many instances, relationships between the K–12 and university systems have adopted a "provider-recipient" approach in which scientists are placed in the role of content providers and K–12 educators as recipients of this scientific expertise. We believe that this approach overlooks a rich opportunity for deep reflection about science teaching and learning. The old adage that "we teach the way we are taught" places university scientists in a position of great influence in the pedagogical training of future science teachers. In addition, college and university faculty have both the opportunity and responsibility to engage their students in deep science learning and to guide them in becoming scientifically literate citizens. Consider the words of senior scientist and long-time science education reform leader, James Bower:

> In this workshop, I was, as usual, haranguing the participants about the importance of inquiry-based science teaching. Accordingly, there was an almost audible sigh of relief when I announced that I had to leave to give a lecture on the neural control of eye movements. Fortunately, I had remembered to bring my lecture notes to the workshop, so I could maintain my fervent support for inquiry teaching techniques up to the very last second. However, as I rushed to the lecture hall, it occurred to me what I was about to do. ... At that moment a connection was made between my experiences observing outstanding elementary science teachers and my own responsibilities as a science educator. For the first time I realized that I had not done the hard work of converting what I preached into what I practiced. All my zealous efforts at early science education reform had not, until that moment, penetrated my own approach to science teaching.
>
> —James Bower, Professor, California Institute of Technology and Co-Founder of the Cal Tech Pre-college Science Initiative (CAPSI)

Partnerships are outstanding venues through which scientists grapple with their knowledge about teaching and to learn from professional educators. As a scientist, what have you struggled with in your own teaching experiences? What is your philosophy and how does it influence your approach to assessing what students know, addressing students' misconceptions, using appropriate vocabulary, involving all students, engaging multiple learning styles, and managing classroom behaviors? What teaching strategies and skills could you learn from your teacher partners? In addition to scientists adopting a learning stance, K–12 teachers must also be willing and given license to share their expertise about teaching science to young people. With partners taking on these additional roles, collaborations can shift from a provider-recipient model to a mutual learning model. While some individual programs have gravitated toward mutual learning, the National Science Foundation's recent Math Science Partnership (MSP) initiative has been pioneering in its requirement that proposed programs identify and pursue reform strategies in both the K–12 and collegiate settings. Yet, with the anticipated conclusion of the federal MSP initiative, this driving force for a mutual learning model of partnership may wane just as it is beginning.

INTEGRATION OF PARTNERSHIP INTO THE TRAINING OF SCIENTISTS

Because many of the scientist partners engaged in collaborative work with the K–12 system are graduate students, postdoctoral fellows, and other scientific trainees, science education partnerships provide a wonderful opportunity to integrate teaching and learning into the routine training of scientists. There is emerging evidence from many efforts that scientists, unsurprisingly, benefit from their involvement in partnerships with K–12 educators with respect to their communication and pedagogy skills (Tanner, 2000). In addition, the majority of these trainees will go on to teach undergraduates. Yet most join partnerships and pursue careers as university faculty without even a crash course in the teaching and learning of science. How can partnerships explicitly engage trainees in reflection and scholarly learning about their emerging teaching practice? How can course work in pedagogical methods be integrated into the training of future scientists? What roles can K–12 educators play as teaching mentors for scientific trainees? Although a few outreach programs have offered formal training in science pedagogy for scientific trainees, the NSF has once again led the way with the GK–12 Fellowship Program. More than 100 institutions around the country now engage science, math, and engineering graduate students in intensive partnerships with K–12 teachers and students, supplemented by course work on the theory and practice of science education. Still, we are decades away from the systematic inclusion of training on science pedagogy in the preparation of future scientists.

DEVELOPMENT OF SUSTAINED INFRASTRUCTURES FOR PARTNERSHIP

> Working with K–12 schools is not like crop dusting—you can't just sprinkle information around and go away. New students come each year who can benefit from school partnerships with universities. There needs to be a long-term, sustained and sustainable relationship.
> —Mary Margaret Welch, Mercer Island High School, Mercer Island, WA

What efforts and infrastructure are necessary to foster large-scale K–20+ partnerships? Although each partnership has unique needs, sustained infrastructure is necessary to support long-term programming and innovation, rather than efforts developed and supported on a grant-by-grant basis. The mundane but crucial infrastructural needs of partnerships include money and space, but these alone are insufficient for strategic development of programs by numerous stakeholders from multiple participating institutions. Universities and K–12 institutions have limited resources to develop and sustain partnerships without grant funding. How can decision-makers at both types of institutions be convinced to use scant resources to foster partnerships? Coordinated efforts across departments and colleges would begin to build a sustainable infrastructure in which partnerships could endure and expand. Yet, only through a shift from the mindset that partnership is an admirable but dispensable community service to an acknowledgment that partnerships generate internally valuable knowledge, will the commitment of resources be justified and infrastructure established. Such a shift requires changes

Table 1. Changing emphases

Moving away from...	Moving toward...
Outreach	Partnership
Reform of K–12 science education	Reform of K–20+ science education
Provider-Recipient model in which university scientists provide content expertise that K–12 educators receive	Mutual Learning model in which university scientists gain pedagogical skills and insights, and K–12 educators learn about the culture, content, and process of science
Individual, isolated science education programs and efforts	Institutionalization of multiple, coordinated programs and efforts within university science departments and K–12 school districts
Science education efforts as optional service by some scientists within some universities	Science education efforts as an integral part of the scientific endeavor in universities that is acknowledged and rewarded
Universities develop science education programs that are offered to K–12 schools	Universities and K–12 schools collaborate to determine disconnects across the K–20+ continuum of science teaching and learning and work together to develop mutually beneficial programs
Universities and K–12 schools operate in isolation	Universities host teachers learning scientific content and experiencing research, and K–12 schools host scientists learning pedagogy

in scientists' perception of the boundaries of science and in the reward structures within colleges and universities, as well as cross-institutional planning and commitments. In looking toward the future, the development of sustained infrastructure is furthest from reach, with no clear driving force for reform in this direction.

THE CODA: MOVING FROM OUTREACH TO PARTNERSHIP

We believe that effective science education improvement lies in moving from initial outreach to sustained partnership, considering K–20+ science education reform as a discipline within the realm of responsibility and expertise of the sciences. Such a movement will require changing emphases in university and K–12 relationships, as highlighted in Table 1. Although there are seeds of change in institutions all around the country, we present this as a vision for the future, because no effort we are aware of, including our own, has conquered all of these challenges or achieved all of these goals. Much as the National Science Education Standards put forward Changing Emphases tables as roadmaps to a vision for K–12 science education (National Research Council, 1996), the table represents ideas to ponder in moving from outreach to partnership, not goals already achieved nor easily reached.

AN EMERGING DISCIPLINE OF K-20+ SCIENCE EDUCATION PARTNERSHIP

Finally, we believe that a movement from outreach to partnership can serve as the groundwork for a new discipline of science education partnership. As efforts in this arena are increasingly studied, theorized, and assessed, one can sense a scholarly field operating at the intersection of teaching, learning, cognitive theory, assessment, and inquiry, developing its own theoretical underpinnings, standards of evidence, and professional specialization. Consider the field of neuroscience, in which we were both trained. This discipline developed at the intersection of psychology, biology, cognitive science, and chemistry. Thirty years ago, there was no distinct field of neuroscience, no Society for Neuroscience (now 30,000 members strong), no *Journal of Neuroscience*, no doctoral degrees awarded in neuroscience, nothing but a strong vision for a new field of inquiry that could address driving questions about brain and behavior that were unstudied and under-theorized. What are the implications for the field of science education partnership, currently understudied, under-theorized, and lacking in field-based studies of specific models? Science education partnership may not ever enjoy the expansive growth and lucrative funding that neuroscience has. Yet, increasing study of partnerships that are achieving the shifts described above will produce an evidence-based literature that can guide the development of theoretical frameworks for successful partnerships and make this vision for the future a reality.

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REFERENCES

Alberts, B. (1994). Scientists have important roles, responsibilities in future of science education. National Academy of Science's Resources for Involving Scientists in Education. http://www.research.att.com/~kbl/APS/nov94/alberts.html (accessed 19 December 2004).

Bower, J. Scientists and science education reform: myths, methods, and madness. National Academy of Science's Resources for Involving Scientists in Education. http://www.nas.edu/rise/backg2a.htm.

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

Tanner, K.D, Chatman, L. and Allen, D.E. (2003). Science teaching and learning across the school-university divide—cultivating conversations through scientist-teacher partnerships. Cell Biol. Educ. 2, 195–201.

Tanner, K.D. (2000). Evaluation of scientist-teacher partnerships: benefits to scientist participants. National Association for Research in Science Teaching Conference Paper, New Orleans, LA, April.

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NSTA Strategic Goal on ***Science Advocacy – Political Outreach***

Prepared by Kenn Heydrick, Congress Committee and President-elect,
Science Teachers Association of Texas

Discussion Questions

1. What are the political issues that affect the mission/purpose of education organizations?
2. How involved should we become in political issues and why should we become involved?
3. How do we reach out to the broader community?
4. What strategies can we use to address political issues?
5. What role can NSTA, Chapters and Associated Groups play in achieving the issue of addressing political issues?

Bibliography

NSTA Website – Legislative Handbook
http://www.nsta.org/legaffairs

ASCD Website – Action Center
http://www.ascd.org/portal/site/ascd/menuitem.6f662ce249e8980edeb3ffdb62108a0c/
Also Advocacy Kit http://www.ascd.org/advocacykit/

Phi Delta Kappa (PDK) – Advocacy for Education
http://www.pdkintl.org/advocacy/advhome.htm

Advocacy Institute – Telling Your Story
http://www.advocacy.org/publications/tellingyourstory.htm
or PDF http://www.advocacy.org/publications/pdf/tellingyourstory.pdf

Blank, H., and N.O. Poersch. (1996). *Working with State and Local Elected Officials: A Guide for Early Care and Education Advocates.* Washington, D.C.: The Children's Defense Fund.

Nicklas, S.K., and J.S. Seltz. (1994). *Influencing the Education Agenda*. Alexandria, Va: Association for Supervision and Curriculum Development.

Influencing the Future of Higher Education

The NGA Center for Best Practices
2001-2004 Postsecondary Education Agenda

New Policies for a New Century

Recognizing the importance of postsecondary education and training to our nation's future, the National Governors Association established the *Influencing the Future of Higher Education* initiative. In 2001-2002, the initiative is co-led by Governors Paul E. Patton of Kentucky and Jane Swift of Massachusetts.

The driving force behind the 21st century economy is knowledge, and developing human capital is the best way to ensure prosperity. As the nation's most important public policymakers influencing education – pre-Kindergarten through lifelong learning – governors are in a unique position to determine our educational infrastructure.

Postsecondary education, in particular, presents the governors with both unparalleled opportunities and unprecedented challenges.

- ***The landscape of postsecondary education is becoming significantly more varied and competitive***. In addition to traditional two-year and four-year colleges, universities, proprietary schools, and corporate and union training, there is a rapidly growing market of Internet-based, distance learning systems and vendor-endorsed certification programs. These new forms of learning cut across the public and private sectors and transcend state and even national boundaries.

  On-line learning technologies are an increasingly important vehicle to extend student-centered postsecondary learning and credentialing to adult and other "non-traditional" students. The value of electronically mediated learning services delivered by distance learning organizations, portals, enablers, and e-commerce was estimated at $7.1 billion in 2000; it is projected to reach $40.2 billion by 2005.[1] Public policies need to be thoughtful about the possibilities and limitations of this new universe of higher education providers.

- ***The demand for education and training is accelerating.*** The Bureau of Labor Statistics estimates that 8 out of 10 new jobs created over the next ten years will require some education beyond high school. Nationwide, the number of undergraduate college students will increase from 13.4 million to about 16 million, according to a new study from Educational Testing Service.[2] Many of these new students will be young, but a growing number of them will be adults retooling their knowledge for this fast-paced, higher skill

- ***The American society is more diverse, but the gap in educational attainment between whites and ethnic minorities is stubbornly high.*** Today, a white adult is two times more likely to have a college degree than a Black adult and two and a half times more likely to

[1] Campbell, Gregory W., Scott Wilson, and Michael Husman. *E-Learning for the Knowledge Economy*. (Boston, MA: Credit Suisse First Boston, 2000). Portals are web-based communities of learning. Enablers help distance learning companies deliver their content over the internet.
[2] Carnevale, Anthony P. and Richard A. Fry. *Crossing the Great Divide: Can We Achieve Equity When Generation Y Goes to College?* (Princeton, N.J.: Educational Testing Service, 2000).

have a degree than a Hispanic adult. To retain our nation's economic competitiveness, we must close these educational gaps.

- ***Funding for higher education is not based on information about educational outcomes and quality is judged on the basis of inputs and institutional reputation.*** As the National Center for Public Policy and Higher Education noted in its higher education report card, no state policymaker has comparable information about student learning to help make investment decisions. With the multiplication of providers and proliferation of e-learning, state policymakers need to shift their attention from inputs to measuring outcomes.

- ***Higher education, to a large extent, has been absent from state efforts to improve the quality of teachers, curriculum, and instruction in the K-12 system.*** Meanwhile, high school student achievement is flat and two out of three community college students take at least one remediation course.[3] The National Commission on the High School Senior Year, chaired by Governor Patton, recommended new K-16 policies to prepare all high school students for success in postsecondary education.

- ***The U.S. higher education system is failing to meet the demand for science, math, and engineering degrees needed in the New Economy.*** From 1998–2008, employment in science and engineering-related occupations will increase at almost four times the rate for all occupations. Though the entire economy will provide approximately 14 percent more jobs over this decade, employment opportunities for science and engineering jobs are expected to increase by about 51 percent, or about 1.9 million jobs.

  Meanwhile, U.S. colleges are under-producing graduates in these disciplines. According to the National Science Foundation, colleges awarded 37 percent fewer degrees in computer science, 24 percent fewer in math, 16 percent fewer in engineering, and 2 percent fewer in physical sciences.[4] Graduate enrollments in science are up but only because so many foreign students study in the United States. Governors need to create incentives to encourage students to study in these fields and colleges to expand their capacity.

- ***State fiscal realities compel more efficient use of scarce resources.*** A majority of states do not have the revenue to support continued, unchecked growth in higher education expenses, where increases annually exceed the consumer price index. This is becoming increasingly evident with declining state revenues. To meet increased demand for at least 2.6 million **more** students, states will have to find more cost-effective ways to provide higher educational opportunities.[5]

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[3]U.S. Department of Education. National Center for Education Statistics. *The Condition of Education 2000*." (Washington, D.C.: U.S. Department of Education, 2000), 25 and 52.
[4] National Sciences Board, *Science and Engineering Indicators - 2000*. (Arlington, Va.: National Science Foundation, 2000).
[5] The research of the late Hal Hovey, a noted expert on state finance, indicates that thirty-nine states face structural deficits. With a structural deficit, state expenditures will exceed revenues over the next ten years unless taxes are raised or spending is cut. See Hovey, Harold, *State Spending For Higher Education in the Next Decade: The Battle to Sustain Current Support*. (San Jose, Calif: National Center for Public Policy and Higher Education, 1999) p. vi. Also see Anthony P. Carnevale and Richard A. Fry, *Crossing the Great Divide: Can We Achieve Equity When Generation Y Goes to College?* (Princeton, N.J.: Educational Testing Service, 1999).

First Principles for the Future of Higher Education

The 21st century workforce is based on the contributions of the knowledge worker. While governors can't control many factors shaping the New Economy, including geographic location and natural resources, the development of human capital is a factor governors can control. Governors can develop this human capital throughout individuals' lifetimes, closing divides that have long eluded resolution by addressing the following principles.

1. *Insist that higher education contributes to the state's economic development.* Competitive states in the 21st century recognize that an educated workforce is critical to economic vitality. In the New Economy, the fastest-growing regions are those attracting firms that constantly innovate, bring new products to market, and maximize the use of technology in the workplace. Savvy states in this New Economy will strengthen the capacity of their research institutions and encourage the growth of industry clusters around the state's universities.

   > *"Changing education is a slow process. Changing an economy is also slow. The two go hand-in-hand. They're the two rails of that railroad that will take us to a better standard of living and quality of life." Kentucky Governor Paul E. Patton*

2. *Confront the challenge of educating a more diverse citizenry.* With individual and state prosperity dependent of all citizens having the skills and the ability to learn, competitive states in the 21st century will vigorously identify and implement strategies to "leave no adult behind." State policies will seek to boost college access and success for low income, ethnic minorities and adults with disabilities populations.

   > *"Unfortunately, too many of our citizens are priced out of the college classroom and – unacceptably – out of promising careers and successful lives. Today, a sound kindergarten through twelfth grade education is not sufficient." Maryland Governor Parris N. Glendening*

3. *Promote a customer orientation.* Savvy states in the 21st century will focus on postsecondary customers: the learner, the employer, and the public who supports educational opportunities. In competitive states, resources will increasingly flow to the learner, and state regulatory policies will encourage institutional flexibility. Education and training programs will increasingly be tailored to the abilities and learning styles of the customer and stronger student advising and workforce connections will occur throughout the learner's education.

   > *"The Commission recommends a redesign of higher education that places the primary stakeholders of education – students and their parents, instead on institutional structures." Texas Governor Rick Perry's Special Commission on 21st Century Colleges and Universities*

4. *Hold high expectations for postsecondary education providers, and expect results.* Higher education's increased role in society brings more and higher expectations for access, quality, cost containment, civic engagement, public/private partnerships and innovation. In the 21st century, the savvy states will direct funding to higher education systems to meet state expectations. Comparing data on outcomes, including student learning, competitive states will move their limited resources toward those activities and actors that yield the greatest public return on investment.

> *"Our colleges and universities are the envy of the world. But too many young people believe higher education has not kept pace with their needs in this rapidly changing new economy. With higher tuitions must come higher performance and higher responsiveness. Our universities must be committed to that goal, and we must be committed to helping them meet it." Pennsylvania Governor Tom Ridge*

NGA Center for Best Practices' Role

The *Influencing the Future of Higher Education* will focus on three issues designed to help states develop responsive higher education policies.

1) **Increasing student access, learning and degree attainment**
2) **Creating seamless learning pathways, particularly preK-16 systems**
3) **Fostering economic development.**

To help governors and their key advisors, the Center conducts the following activities.

- Develop *Issue Briefs* and electronic publications. The Center develops publications describing research findings and state best practices for improving higher education.
- Convene national forums**.** The Center hosts national forums on student financial assistance and postsecondary education productivity.
- Sponsor learning laboratories. State best practices are shared at meetings focused on Kentucky's economic development strategies, Indiana and Oklahoma's early intervention strategies for low-income youth, and Florida's K-20 educational governance system.
- Convene a policy academy for eight states. Current quality assurance practices in higher education consist largely of measuring inputs. A policy academy for eight states will be convened to help governors implement state policies that seek and reward evidence of postsecondary education effectiveness. Collectively, the academy's meetings and related technical assistance will help Governors define and implement quality assurance models that both inform the higher education marketplace and improve its accessibility and productivity.