Professional Development Literature and Resources compiled by the 2009-2010 NSTA Professional Development Committee

in response to

NCSE Motion 7/09CNG10

"Be it resolved the National Congress on Science Education recommends NSTA compile and disseminate an appropriate set of resources to chapters, affiliates, and associated groups for the purpose of conducting principal/administration professional development that supports inquiry-based science." (7/09CNG10)

and amended by the NSTA Board of Directors Motion 7/09BOD10 to state:

"That NSTA's Professional Development Committee compile and disseminate an appropriate set of resources to chapters, affiliates, and associated groups for the purpose of conducting principal/administration professional development that supports effective science instruction." (7/09BOD10).

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Background

During the 2009 National Congress on Science Education, the Issue Forum on *Components of a Support System for Science Teachers* drafted a resolution that stated, "Be it resolved the National Congress on Science Education recommends NSTA compile and disseminate an appropriate set of resources to chapters, affiliates, and associated groups for the purpose of conducting principal/administration professional development that supports inquiry-based science." (7/09CNG10) This resolution passed through the NSTA Council and was amended at the NSTA Board of Director's meeting to state, "that NSTA's Professional Development Committee compile and disseminate an appropriate set of resources to chapters, affiliates, and associated groups for the purpose of conducting principal/administration professional development that supports effective science instruction." (7/09BOD10).

Process

Throughout the 2009-2010 academic year, the Professional Development Committee reviewed this charge and proceeded with the following actions and in the following direction in order to accomplish this charge.

- The committee held conference calls in August, September and October as they worked on the additional charge provided to them at the July 2009 Board Meeting and noted above. They worked in small subgroups electronically between October and January researching, sharing, and discussing possible articles for inclusion in the document.
- Specifically the committee narrowed and then examined topics for possible inclusion in this document and decided that there would be four key question areas that they would focus on as they developed a listing of resources for dissemination. The four guiding questions throughout the remainder of the task focused on the following:
  - How do principals/science leaders/district supervisors know what they need for professional development? This would allow for investigation into their current science program and utilize data that is available around which to make decisions.
  - What Professional Development experiences look like and what should be included in a PD session for science educators? This topic looks at the traits and qualities of "good" PD for science educators.
  - How do we support teachers now that they have received PD? Looking at this section would focus on the ongoing aspects of district support for science educators.
  - Is it working? This is the evaluation aspect of implementing a PD program in a district or school.

    It was also decided that several key documents would be included with annotation with the document as well as additional references that are recommended and administrators may choose to consider.
- The PD committee utilized their meeting during the National Conference on Science Education in Philadelphia, PA in March 2010 to further discuss the key articles/reports that were found and divide up the responsibilities for reading and writing annotations.

Dissemination

An electronic discussion was held with the NSTA Presidential Chain and NSTA leadership regarding the dissemination of this document. It was decided that the list of resources would be disseminated at the 2010 National Congress on Science Education by being placed at the registration table; included in the September e-packet that is sent to all CAGs officers; and that it will be sent out via the CAGs list-serv as well.

Committee comment

The list of resources provided here has been reviewed and discussed by the committee as informative literature in the professional development process as well as related to science education and science instruction. While there are many books and articles published on the topic of professional development and related terms in the charge given to the committee, we chose to focus on finding documents and reports that may be overlooked and provide key information that supports the need for specific professional development. With that stated, many of the national reports are general in nature but support "good" professional development and can thus be adapted to providing quality professional development in the science education/instruction areas. The listing should not be considered exhaustive in nature and leaders should continue to pursue additional reference materials to provide to their own administration. Recommendations for additions to this list are welcomed and can be sent to the NSTA Professional Development chairperson at the email listed below.

It was noted within the committee discussions, that this charge was to provide resources for administrators thus giving them the tools to plan and conduct professional development rather than "how" to get them to plan science education related professional development programs. The 2009-2010 Professional Development Committee was comprised of the following members:

- Carol Cassells, District K-12 Science Facilitator, Cedar Rapids Community School District, Cedar Rapids, IA
- Jacqueline Clymer, Lead Teacher K-12 Science, Quakertown Community School District, Quakertown, PA
- Janey Kaufmann, K-12 Curriculum Coordinator Coronado PDC, Scottsdale, AZ
- Manley Midgett, Science Curriculum Specialist, North Carolina Teacher Academy, Morrisville, NC
- Kevin Niemi, Outreach Program Manager II-Center for Biology Education, University of Wisconsin-Madison, Madison, WI
- Steve Rich, K-5 Science Program Specialist, Georgia Department of Education, Atlanta, GA
- Marsha Winegarner, K-12 Science and Literacy Education Consultant, DeFuniak Springs, FL
- Shawna Young, Executive Director, Office of Engineering Outreach Programs, MIT, Cambridge, MA
- Gregory McDougall, NSTA District VI Director and Science Specialist, Central Savannah River Area Mathematics and Science Regional Center, Aiken, SC
- Brenda Wojnowski, National Science Education Leadership Association 2009-2010 President and President and CEO, Wojnowski and Associates, Dallas, TX
- Christine Anne Royce, NSTA Professional Development Division Director and Associate Professor of Education, Shippensburg University, Shippensburg, PA (caroyce@aol.com)

Annotated Resources

Banilower, E., Cohen, K., Pasley, J.& I. Weiss. (2008). *Effective science instruction: What does research tell us?* Portsmouth, NH: RMC Research Corporation, Center on Instruction. Retrieved from: http://www.centeroninstruction.org/files/Characteristics%20of%20Effective%20Science%20Instruction%20REVISED%20FINAL.pdf

Summary

Many ask the question as to what constitutes effective science instruction. This summary shares the research on science learning to inform a common vision of science instruction and describes the extent to which K-12 science education currently reflects this vision. There are five characteristics of effective instruction as well as sample lessons or classroom scenarios which are described making a clear picture of what effective science instruction looks like in a classroom. Interesting, the elements of effective instruction are in evidence in both reform-oriented or traditional classrooms. The last section explains implications for policymakers and practitioners in hopes of finding ways to integrate these findings from research to the classroom.

The five characteristics of effective science instruction:

- Motivating students since most students need some level of motivation to want to learn
- Eliciting prior knowledge to be able to sort out what current thinking is about the concepts or topics being studied
- Intellectual engagement meaning learning activities must be linked to learning targets
- Use of evidence to critique claims helping students think scientifically
- Opportunities for sense-making

This would be useful to principals, curriculum and professional development coordinators, and teacher leaders in planning for high quality instructional practices and professional development. It would also be helpful for districts and states in policy planning and grant applications.

Blank, R. K. & de las Alas, N. (2008) *Current models for evaluating effectiveness of teacher professional development: Recommendations to state leaders from leading experts.* Council of Chief State School Officers: Washington, DC. Retrieved from: http://www.ccsso.org/content/pdfs/Current%20Models%20for%20Eval%20Effect%20of%20Teacher%20PD%20summary%20Report.pdf.

Summary:

The reader should know that this is a summary of a summary report of conference held by the Council of Chief State School Officers (CCSSO). The report summarizes a conference by the CCSSO in which they invited 10 leaders in the field of research and evaluation of teacher professional development to present to state education leaders across the country.

This report is an excellent beginning point for educators wishing to learn some basic information related to the most recent and important trends in evaluating teacher professional development. As such, the document is useful for those designing or evaluating teacher professional development. It includes nine short (one page) summaries of important work such as Guskey's five critical levels of evaluating professional development as well as some specific suggestions about the design of professional development. Each of the nine summaries ends with a link to a full presentation for those who wish to learn more.

Blank, R. K., de las Alas, N. & Smith, C. (2008).*Does teacher professional development have effects on teaching and learning?: Analysis of evaluation findings from programs for mathematics and science teachers in 14 states*. Council of Chief State School Officers: Washington, DC. Retrieved from: http://www.ccsso.org/content/pdfs/cross-state_study_rpt_final.pdf

Summary (from website)
This final report covers the review of 41 evaluation studies from a sample of 25 professional development initiatives across the U.S. The report primarily addresses evaluation findings from professional development activities conducted during the period 2004 through 2007. Among the key findings are

- One-third of evaluation studies reported measurable effects of teacher professional development;
- Significant effects of professional development programs for teachers of math and science were found when the programs include focus on content knowledge in the math and science subject areas plus training and follow-up pedagogical content knowledge;
- One-third of the programs reviewed did have well-developed evaluations that produced findings with measurable effects on student achievement or change in instructional practices;
- Smaller programs typically had to choose a few measures and methods of evaluation; and
- Measurement of change in teaching practices in the classroom is a promising outcome worthy of further use and expansion to other PD studies.

Blank, R. K., & de las Alas, N. (2009). *Effects of teacher professional development on gains in student achievement: How meta analysis provides scientific evidence useful to education leaders*. Council of Chief State School Officers: Washington, DC. Retrieved from: http://www.ccsso.org/content/pdfs/Final%20Meta%20Analysis%20Paper%20full.pdf

Summary:
The Council of Chief State School Officers (CCSSO) was awarded a National Science Foundation grant to conduct a meta analysis study for the purpose of providing education leaders with scientifically-based evidence relating the effects of teacher professional development to improved student achievement. The analysis focused on previously completed professional development studies regarding such effects. The meta analysis showed cross-study evidence

that teacher professional development in mathematics does have significant positive effects on student learning. The analysis results also confirmed the positive relationship of key characteristics of professional development design identified in previous studies over the past decade to student outcomes.

The study is designed to help K-12 education decision-makers, at the state and local levels, base their professional development decisions on initiatives showing evidence of effectiveness in producing positive results in student achievement.

Darling-Hammond, L., Wei, R. C., Andree, A., Richardson, N., & Orphanos, S. (2009). *Professional learning in the learning profession: A status report on teacher development in the United States and abroad*. Stanford, CA: National Staff Development Council. Retrieved from: http://www.nsdc.org/news/NSDCstudy2009.pdf

Summary:
This report supports a new paradigm for teacher professional learning that is transformative and collaborative. The report is broken into 3 sections with major findings listed below:

- Effective Teacher Development: What Does the Research Show?
    - Professional development should be intensive, ongoing, and connected to practice
    - Professional development should focus on student learning and address the teaching of specific curriculum content.
    - Professional development should align with school improvement priorities and goals.
    - Professional development should build strong working relationships among teachers.
    - Additional promising strategies include school-based coaching programs and mentoring and induction programs
- Professional Development Abroad: Trends and Strategies
    - Ample time for professional learning is structured into teacher's work lives.
    - Beginning teachers receive extensive mentoring and induction supports.
    - Teachers are widely encouraged to participate in school decision-making.
    - Governments provide significant levels of support for additional professional development.
- The Status of Professional Learning in The United States
    - Most U.S. teachers participate in some form of professional development every year.
    - Much professional development focuses on academic subject matter, but not with much depth.
    - Nearly half o fall U.S. teachers are dissatisfied with their opportunities for professional development.

- U.S. teachers tend to receive little funding or other support that might allow them to participate in additional professional development.
- Support for and participating in professional development varies widely among schools.
- Relatively few U.S. teaches engage in intensive professional collaboration around curriculum planning.
- Beginning teachers are increasingly likely to experience induction programs, but they have varying access to mentoring and other high-quality induction features.

This report is a summary of the research on what make professional development effective. The first section provides examples of "what research says" is effective professional development. The second section speaks to what has been effective in other countries. While the third section speaks to progress we have made in the U.S. and where we have yet to improve. This document could prove useful when planning on-going professional development.

National Research Council. (2007). *Taking science to school: Learning and teaching science in grades K-8*. Committee on Science Learning, Kindergarten Through Eighth Grade. Duschl, R. A., Schweingruber, H.A., & Shouse, A. W.(Eds). Board on Science Education, Center for Education. Division of Behavioral and Social Sciences and Education Washington, DC: The National Academies Press.

Summary (from Book Jacket)
What is "science" for a child? How do children learn about science and how to do science? Drawing on a vast array of work from neuroscience to classroom observation, *Taking Science to School* provides a comprehensive picture of what we know about teaching and learning science from kindergarten through eighth grade. By looking at a broad range of questions, this book provides a basic foundation for guiding science teaching and supporting students in their learning. *Taking Science to School* answers such questions as:

- When do children begin to learn about science? Are there critical stages in a child's development of such scientific concepts as mass or animate objects?
- What role does non-school learning play in children's knowledge of science?
- How can science education capitalize on children's natural curiosity?
- How can teachers be taught to teach science?

This book also provides a detailed examination of how we know what we know about children's learning of science – about the role of research and evidence. This book will be an essential resource for everyone involved in K-8 science education – teachers, principals, boards of education, teacher education providers and accreditors, education researchers, federal education agencies and state and federal policy makers. It will also be a useful guide for parents and others interested in how children learn.

North Cascades and Olympic Science Partnership (2008). *Science classroom observation protocol.* Retrieved from:

http://cascadesolympic.mspnet.org/media/data/Science_Classroom_Observation_Guide_REFERENCE_EDITION_4_1_.pdf?media_000000005767.pdf

Summary
The North Cascades and Olympic Science Partnership (NCOSP) developed science classroom observation guides and protocols intended to build a common vision of effective science instruction. The observation guide includes 4 sections each broken into subsections:

- Classroom Culture is Conducive to Learning Science
    - Ideas, questions, and contributions are exchanged respectfully.
    - Discussions are based on scientific evidence.
    - Science content is made accessible to each student.
- Science Content is Intellectually Engaging
    - Science content is significant, accurate, and worthwhile.
    - Science content builds on students' prior ideas or experiences.
    - Science content is intentionally connected to the classroom activities and experiences.
- Instruction Fosters and Monitors Student Understanding
    - Instruction fosters students' emerging understanding of science content.
    - Instruction monitors students' emerging understanding of science content.
- Students Organize, Relate, and Apply Their Scientific Knowledge
    - Students make sense of the intended scientific ideas and concepts.
    - Students reflect on their own understanding of the science content.
    - Students make connections between the science content in the current lesson and prior experiences in and out of school.

Each subsection lists observable student or teacher behaviors indicative of best practice in science instruction. These documents provide a means to observe and discuss effective science instruction. It is the goal that using these documents will de-privatize practice by focusing on evidence of student learning and effective instruction rather than personal opinions. NCOSP recommends that observers focus on one of the 4 sections at a time. The data collected from the observations could be used to determine professional development needs or for collaborative processes including professional learning communities, lesson study and planning curriculum units.

National Research Council (1996). *National science education* standards. National Academies Press: Washington, DC.

Summary
Chapter four of the *National Science Education* Standards focuses on the Standards for Professional Development of Teachers of Science and states "the growth of a teacher's skill and understanding is developed through personal reflection, interactions with colleagues, and mentoring as well." Within this chapter, recommendations and information is provided for teachers to become life-long learners in the field of science and science education.

Additional Resources on Professional Development

Gar**e**t, S.M., Porter, C.A., Desimone, L, Birman, F.B., & Yoon, S K. (2001). What makes professional development effective? Results from a national sample of teachers. *American Educational Research Journal, 38*(4), 915-945.

Guskey, R.T., & Yoon, S.K. (2009). What works in professional development? *Phi Delta Kappan, 90*(7), 495-523.

Hill, C.H. (2009). Fixing teacher professional development. *Phi Delta Kappan, 90*(7), 470-476.

Hirsh, S., & Killion, J. (2009). When educators learn, students learn: Eight principles of professional learning. *Phi Delta Kappan 90*(7), 464-469.

Kaser, J. (2004). Professional development for you: Suggestions for choosing the most appropriate professional development for you school. *Science and Children*, 41(5), 26-29.

Loucks-Horsley, S., K. E. Stiles, & P. Hewson. (1996). *Principles of effective professional development for mathematics and science education: A synthesis of standards: NISE brief*. Madison, WI: University of Wisconsin at Madison, National Institute for Science Education.

Loucks-Horsley, S., Stiles, K. E., Mundry, S., Love, N., S., & Hewson, P. (2010). *Designing professional development for teachers of science and mathematics (3rd Ed.).* Thousand Oaks, CA: Corwin Press.

Mundry, S., & Stiles, K. E. (2009). *Professional learning communities for science teaching: Lessons from research and practice.* Arlington, VA: NSTA Press.

National Science Teachers Association. (2006). *Position statement on professional development in science education*. Retrieved from: http://www.nsta.org/about/positions/profdev.aspx

North Cascades and Olympic Science Partnership (n.d) *Professional Learning Community Observation Protocol.* Retrieved from: http://hub.mspnet.org/index.cfm/17753

Piburn, M., Sawada, D., Falconer, K., Turley, J. Benford, R., Bloom, I. (2000). Reformed teaching observation protocol (RTOP). Retrieved from: http://physicsed.buffalostate.edu/AZTEC/RTOP/RTOP_full/index.htm

Weiss, I.R., Pasley, J. D., Smith, P. S., Banilower, E. R., & Heck, D. J. (2003). *Looking inside the classroom: A study of K-12 mathematics and science education in the United States.* Chapel Hill, NC: Horizon Research, Inc.

Whitcomb, J., Borko, H., & Liston, D. (2009). Growing talent: Promising professional development models and practices. *Journal of Teacher Education 60*(3), 207-212.

Additional Resources on Science Education

American Association for the Advancement of Science (AAAS). (1993). *Benchmarks for science literacy*. New York: Oxford Press.

American Association for the Advancement of Science (AAAS). (2000). *Designs for science literacy.* New York: Oxford Press.

American Association for the Advancement of Science (AAAS). (2001). *Atlas for science literacy.* New York: Oxford Press. (There is a volume 1 and 2).

Bransford, J., Brown, A., & Cocking, R,. (1999). *How people learn: Brain, mind, experience, and school.* Washington, DC: National Academy Press.

Donovan, S., & Bransford, J. (Eds.) (2005). *How students learn: Science in the classroom.* Washington D.C: National Academy Press.

Donovan, S., Bransford, J., & Pellegrino, J. (1999). *How people learn: Bridging research and practice.* Washington D.C: National Academy Press.

Doran, R., Chan, F., & Tamir, P. (1998). *Science educator's guide to assessment*. Arlington, VA: National Science Teachers Association.

Keeley, P. (2005). *Science curriculum topic study: Bridging the gap between standards and practice*. Thousand Oakes, CA: Corwin Press.

Michaels, S., Shouse, A.W., & Schweingruber, H.A. (2008). *Ready, set, science! Putting research to work in K-8 science classrooms*. Board on Science Education, Center for Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

Mundry, S., Keeley, P. & Landel, C. (2010). *A leader's guide to science curriculum topic study*. Thousand Oakes, CA: Corwin Press.