

From Standards to Practice- Building on Past and Present Leadership Efforts to Advance K-12 Science Education – Page Keeley and Joyce Tugel, Maine Mathematics and Science Alliance

For almost two decades, science leaders have been immersed in efforts to improve science education in our K-12 schools and pre-service education. How do we avoid the "throw the baby out with the bath water" approach to realizing the vision of the Framework and prepare for implementation of the NGSS? In this session we will look back and look forward – identifying ways to build upon and sustain our past and present efforts to improve teaching and learning, consider the new challenges and opportunities the NGSS present, and consider the efficacy of linking our NGSS efforts to other school and district initiatives.

Presenters

Name: Page Keeley

Organization: Maine Mathematics and Science Alliance

Email: pkeeley@mmsa.org

Page Keeley, retired Senior Science Program Director of the Maine Mathematics and Science Alliance (MMSA), served as PI and Project Director of 3 National Science Foundation-funded projects and directed multiple state MSP projects. She founded and directed the Maine Governor's Academy for Science and Mathematics Education Leadership. Page is the author of thirteen national best-selling books, including four books in the *Curriculum Topic Study Series*, seven volumes in the *Uncovering Student Ideas in Science* series, and *Formative Assessment- 75 Practical Strategies for Linking Assessment, Instruction, and Learning*. Currently she consults nationally on building teachers' and school districts' capacities to use diagnostic and formative assessment. She is a frequent invited speaker on formative assessment in science and mathematics. She served as the 63rd President of the National Science Teachers Association (NSTA), President of the Maine Science Teachers Association, and District II NSTA Director. She is a Fellow in the National Academy for Science and Mathematics Education Leadership, was a science literacy leader for the AAAS/Project 2061 Professional Development Program, and is a science education delegation leader for the People to People Citizen Ambassador Professional Programs. Page taught middle and high school science for 15 years before leaving the classroom. She received the Presidential Award for Excellence in Secondary Science Teaching, the Milken National Distinguished Educator Award, the AT&T Maine Governor's Fellow, and the National Staff Development Council's Susan Loucks-Horsley Award for Leadership in Science and Mathematics Professional Development. Prior to teaching, she was a research assistant in immunology. She received her B.S. in Life Sciences from the University of New Hampshire and her Masters in Science Education from the University of Maine.

Name: Joyce Tugel

Organization: Maine Mathematics and Science Alliance

Email: jtugel@mmsa.org

Joyce Tugel is a Science Specialist at the Maine Mathematics and Science Alliance (MMSA). Her work is primarily focused on the areas of science professional development, standards and research on learning, formative assessment, and teacher leadership. Joyce is a co-author of two books in the NSTA Press *Uncovering Student Ideas in Science* series and editor of *Notes from the Field - Teaching for Conceptual Change: Uncovering Student Thinking in Science Through Action Research*. She has served as the Project Director for the NOAA-funded Earth as a System is Essential: Seasons and the Seas (EaSiE) project and numerous Maine Math

Science Partnership initiatives, including the Science Content, Conceptual Change and Collaboration (SC4) project. Prior to coming to the MMSA in 2005, Joyce was a science professional development specialist at the TERC Eisenhower Regional Alliance for five years and taught high school chemistry and physical science for ten years. Prior to receiving her science teaching certification, Joyce was a researcher in environmental biogeochemistry at the University of New Hampshire. Joyce is the National Science Education Leadership Association's Region A Director, and has served as the National Science Teachers Association's District II Director and Professional Development Division Director. She is a Fellow of the third cohort of the National Academy for Science and Mathematics Education Leadership. During her accomplished teaching career, Joyce received the Presidential Award for Excellence in Secondary Science Teaching, the Milken Foundation National Distinguished Educator Award, and the New England Institute of Chemists Secondary Teaching Award. Joyce received her B.S. and M.S. degrees in Microbiology from the University of New Hampshire.

Ready or Not, Here They Come – The New National Standards and Their Implication for Scientific Argumentation

Douglas Llewellyn, presenter

Audience: high school science teachers and science curriculum specialists

The *Common Core State Standards* (2010) and *A Framework for K-12 Science Education* (2012) provide a clear-cut indication to what's ahead for curriculum and professional development in science. A key component of both documents is the incorporation of argumentation into science curriculum. However, if you ask any number of pre-service and practicing science teachers if they can describe the essential features of scientific argumentation, or if they have their students write arguments from their investigations, most answer a resounding "no." To prepare science educators for implementing argumentation in their classrooms, the session will focus on six questions:

- What is scientific argumentation?
- What do the *Common Core* and *Framework* say about scientific argumentation?
- What is the role of argumentation in science instruction?
- How can students learn to make and defend arguments in science?
- How can traditional and inquiry-based labs be modified to accommodate students constructing and justifying arguments?
- How can science leaders develop a plan of action to effectively prepare their teachers for this upcoming instructional change?

Participants should bring to the session two or three traditional or inquiry-based labs where students collect data and draw conclusions. Participants will modify these labs to reflect an argument-based format and discuss the modifications in similar subject or grade level groups. By the end of the session, participants and instructional change agents should have: 1) an understanding of the role scientific argumentation plays in upcoming science reform, and 2) a plan of action for implementing argumentation from the new national science standards.

Presenter

Name: Douglas Llewellyn

Organization: St. John Fisher College, Rochester, NY

Email: dllewellyn@sjfc.edu

Douglas Llewellyn teaches science education courses at St. John Fisher College in Rochester, NY. Previously, he was the K-12 Director of Science at the Rochester City School District, a junior high school principal, and a middle school science teacher. His interests are in the areas of scientific inquiry and argumentation, constructivist teaching, and science leadership. Doug is a frequent speaker at state and national conferences on inquiry- and argument-based teaching. He has three books published by Corwin Press:

Inquire Within: Implementing Inquiry-Based Science Standards in Grades 3-8, 2nd ed. (2007)

Differentiated Science Inquiry (2011)

Teaching High School Science Through Inquiry and Argumentation, 2nd ed. (2013)

Untangling Science and Engineering Practices – Cary Sneider

In the NGSS it will not be sufficient for students to demonstrate that they understand core ideas in science. Students will also be expected to apply the idea as they engage in science and engineering practices. Most of the science practices will be familiar to science educators, although there will be some changes from the past, such as greater emphasis on the practice of arguing from evidence. However, a new twist is that each of the practices describes not only student work in science, but also engineering. This workshop will engage participants in exploring the engineering side of the eight practices, with examples drawn from the Next Generation Science Standards.

Presenter

Name: Cary Sneider

Organization: Portland State University, Portland, Oregon

Email: csneider@pdx.edu

Dr. Cary Sneider is Associate Research Professor at Portland State University in Portland, Oregon, where he teaches courses in research methodology in a Masters of Science Teaching Degree program. He also consults on diverse issues in STEM education, such as youth programs at science centers, educational standards, and assessment. He contributed to *A Framework for K-12 Science Education* (National Research Council 2012), which laid the groundwork for new science standards, and is currently a member of the writing team that is implementing the *Framework* under the title *Next Generation Science Standards*. In 2011 he joined the National Assessment Governing Board, which sets policy for the National Assessment of Educational Progress (NAEP), also known as “The Nation’s Report Card.” Until 2007 Dr. Sneider served as Vice President for Educator Programs at the Museum of Science in Boston, and prior to that he served as Director of Astronomy and Physics Education at the Lawrence Hall of Science at the University of California. Dr. Sneider’s curriculum development and research interests have focused on helping students unravel their misconceptions in science, on new ways to link science centers and schools to promote student inquiry, and on integrating engineering and technology education into the K-12 curriculum. Dr. Sneider earned a B.A. in Astronomy from Harvard College (1969), and a Secondary Teaching (1971), M.A. (1976) and Ph.D. in Science Education (1982) from the University of California at Berkeley. In 1997 he received the Distinguished Informal Science Education award from NSTA and in 2003 was named National Associate of the National Academy of Sciences.

Designing and Assessing Evidence-based Scientific Explanations – *Joseph Krajcik*

The Framework for K-12 Science Education stresses the importance of engaging students in scientific and engineering practices with core ideas to support students in learning. As such, the Framework stresses that the Next Generation of Science Standards (NGSS) should be structured as performance expectations that blend together the scientific and engineering practices with the crosscutting concepts and disciplinary core ideas. One critical scientific practice is the construction and revision explanations. Because constructing explanations engages students in problem solving, using evidence, and communicating, it can be considered an important aspect of supporting students in building 21st century skill. However, the literature shows that using integrating scientific explanations into the science classroom is challenging. In this session, Joe will provide an instructional framework for constructing scientific explanation that breaks down explanation into three components: claim, evidence, and reasoning. He will engage you in constructing scientific explanations using the framework, discuss how this framework can help students write explanations across different content areas and tasks, and share a rubric for assessing scientific explanation. Participants will be provided with examples of student work and will gain experience in applying and adapting rubrics to assess students' strengths and weaknesses. Because the NGSS blends core ideas with scientific practices and crosscutting concepts, he will facilitate participants in planning, designing and integrating evidence-based explanations into their classroom teaching that can be used as both formative and summative assessments.

Presenter

Name: Joseph Krajcik

Organization: Michigan State University

Email: krajcik@msu.edu

Joseph Krajcik serves as director of the Institute for Collaborative Research in Education, Assessment, and Teaching Environments for Science, Technology, Engineering and Mathematics (CREATE for STEM) and is a faculty member in science education at the Michigan State University (MSU). He is serving as the lead writer of the Physical Science Design Team to develop the Next Generation Science Standards. Throughout his career he has focused on improving the teaching and learning of science by designing, developing, implementing and testing innovative environments that match what is known about the how students learn. He is completing the Investigating and Questioning our World through Science and Technology Project (IQWST), a National Science Foundation (NSF) project that designed, developed and tested the next generation of middle school curriculum materials to engage students in obtaining deep and meaningful understandings of core science ideas and practices. Joe is currently focusing on a new NSF project to develop and test materials to support high school students understanding of the sub-microscopic interactions that govern biological and chemical processes. Professor Krajcik has authored and co-authored curriculum materials, books, software and over 100 manuscripts, and makes frequent presentations at international, national and regional conferences. Joe is a fellow of the American Association for the Advancement of Science and has served as president of the National Association for Research in Science Teaching (NARST), from which he received the Distinguished Contributions to Science Education Through Research Award in 2010. A former high school chemistry and physical science teacher for eight years in Milwaukee, WI, Professor Krajcik spent 21 years at the University of Michigan before joining MSU in 2011.