NGSS: Pathways to a Pedagogy for Our Time

**A two-day workshop for all teachers by
Thornburg Center for Professional Development**

Schedule workshop dates by contacting dthornburg@aol.com or call 847-277-7695 and leave a message for rapid call-back.

Presenters may include any or all of the following:
David Thornburg, PhD
Norma Thornburg, MA
Sara Armstrong, PhD

Workshop Abstract:
This workshop explores the pedagogical underpinnings of the Next Generation Science Standards and the role various technologies can play in transforming STEM education in your schools and district.

The new national science and engineering standards require a transformation of educational practice in ways that should increase student interest in these fields – changes also supported by the Common Core standards. These standards call for a profound change in pedagogical practice that may be challenging for some educators. According to a recent article in *Science* (vol. 340, p. 1391, 21 June, 2013), while 83% of science teachers think NGSS will improve learning, only 38% think they will get the training they need. This workshop is designed to provide concrete support that makes transforming teaching and learning easier in the classroom.

The workshop explores the reasons for the new standards, and shows examples of tools that can help teachers of almost any grade embrace the spirit of them in their work with students. We are shifting from a noun-based curriculum to one based on verbs (design, invent, create, explore, etc.). Inquiry-driven project-based learning is a perfect practice in this setting, and examples related to all four disciplinary core STEM ideas (including engineering) will be explored in this workshop. Through a series of discussions and hands-on activities, participants will develop a deeper understanding of the expectations of the new standards, as well as explore and implement strategies to shift the dominant pedagogical model to one that celebrates transdisciplinarity and a deeper understanding of the ways practitioners in the various academic fields practice their craft.

Outline for the two-day workshop:

Day 1
- Activity - Quick view of NGSS.
- Overview of the new standards in context
- Epistemic frame exercise - what would be the frame for scientists? How about engineers? Work and discuss.
- The role of ethics in science
- How to create a Driving Question activity
- Search strategies
- Working through a challenge – samples from the Knights of Knowledge materials. (free to every participant)
- Walking the talk: each person picks one topic and does the first round of work.
- Using the Knights of Knowledge model to form good Driving Question - what resources are needed; where can they be found brainstorm. Practice in coming up with participants' own questions.
- Topic selection for current semester - rephrase it as a Driving Question
- Evaluation: the role of rubrics.
- Project on rubric design
- Computer simulations demo and exploration
- Feedback - where are simulations appropriate and not appropriate?
- How to create an inquiry-driven project.
- What does a finished project look like?
- Project creation and sharing: make a project based on a Driving Question from Knights of Knowledge or participants' own Driving Question and share it tomorrow.
- Demo Multimedia authoring tools

Day 2
- Project presentations by participants
- Commentary
- Discussion: What makes engineering different from science?
- Working with 3D printing
- Software for 3D design
- Exploring Thingiverse
- Connections between 3D printing and the curriculum
- Wearable computing
- Working with Arduino - demo
- Setting up the Arduino for Scratch
- Working with Scratch for Arduino
- Controlling lamps
- Sensing switches

Audience: All
Grades: K-12, and beneficial to teacher education as well.
Topic: Implementing the Next Generation Science Standards
Duration: Two-day workshop preferred, but if only one day is available, we can still accomplish a lot.
Computers: While we prefer that participants bring laptops (Windows or Mac) to the workshop, variations of the workshop can be done with Chromebooks and (to a lesser extent) tablets. Note that, as of this writing, some powerful tools we want to use only run on traditional computers, but this is changing. The workshop leaders will likely use Chromebooks as their primary tool.
Materials: Each participant will receive all needed materials.
Size limits: We can work with a maximum of forty participants.
Requirements: For the workshop, teachers need their own computers or Chromebooks. They will also need Internet access. All other curricular material is included (we need an exact headcount for this). Facilitators need Internet access and projection system with audio for their computers. (One shared projector is sufficient.) We also will need an additional table for other technological tools, such as a 3D printer (if used in the workshop).

Our leadership team:

David Thornburg, PhD
David is founder of the Thornburg Center and has worked in the field of education and educational technology for well over 30 years. His educational philosophy is based on the idea that students learn best when they are constructors of their own knowledge. He also believes that students who are taught in ways that honor their learning styles and dominant intelligences retain the native engagement with learning with which they entered school. A central theme of his work is that we must prepare students for their future, not for our past.

He was one of the reviewers for the Next Generation Science Standards, and the Knights of KnowledgeTM project grew out of his long interest in inquiry-driven project-based learning - what he believes to be the key pedagogical model for the rest of this century. His strong background and passion for mathematics makes him the ideal person to run this workshop. He, along with others of the Thornburg Center team, worked on a three-year NSF-funded project incorporating Inquiry into STEM education.

Dr. Thornburg is the recipient of several awards for product design and is the recipient of both the Gold and Platinum Disk awards from CUE (Computer Using Educators, Inc.) for his contributions to the advancement of learning and learning technologies. In 1999 he was selected as one of twenty "pioneers" in the field of educational technology by ISTE, the premiere organization devoted to the advancement of technology in learning, and was named by Technology and Learning magazine as one of the top ten most influential people in the field of educational technology in the past twenty years. He has spoken at TEDx and was the subject of a short documentary created by the George Lucas Educational Foundation. In

years past, he was an active participant in the California Math Council conferences in Pacific Grove, California.

Norma Thornburg, MA

Norma is a long-time contributor to educational projects and provides materials in Portuguese for Brazilian educators. She has been a classroom teacher, a principal, a technology coordinator, and an educational consultant. Her work brings her all over the world.

Norma's work in support of constructivist learning led her to write the first book on the Logo programming language in Brazil. She has many years experience working in the field of inquiry-driven project-based learning (PBL) and was the lead designer of a five-year PBL program that, at its peak, reached over 15,000 students throughout Brazil.

Norma is one of the leaders in constructivist and constructionist education in both Brazil and the United States, and her insights are in demand worldwide.

Norma received her MA in Instructional Technology from San José State University, and her Bachelor's in Education at Universidade Católica de Petrópolis in Petrópolis, Brazil.

Sara Armstrong, Ph.D.

Sara is a member of the Thornburg Center where she brings her deep experience in project-based learning - including developing good questions for inquiry - and her equally impressive work on rubric development for assessment.

She has been an educator for over 40 years - as a classroom teacher, principal, and professional developer. Sara is recognized for her dedication to project-based learning and the benefits that accrue to students and teachers through this practice, particularly in the elementary grades. She conducts workshops in developing effective projects across the country, and throughout the world. She is a firm believer in meaningful assessment, and presents workshops on developing effective rubrics for all aspects of project work. Sara is also interested in the power of story and storytelling, and infuses it into her presentations and workshops.

Sara is a recipient of both the Gold and Platinum Disks from Computer-Using Educators.