



Project Lead The Way: Activity-, Project-, and Problem-based Engineering Education, from Kindergarten to 12th Grade

Dr. Shepherd Siegel PhD, Project Lead The Way

Dr. Shepherd Siegel is a music, career/technical and special education educator. He has over thirty publications. He joined as Project Lead The Way's Director of School Engagement (WA) after having strong success with Project Lead The Way in ten Seattle secondary schools. The KAPPAN published his article about a meaningful high school diploma. He also works on a book about play, and how it could transform our society.

Ms. Elizabeth A. Beaty

WORKSHOP PROPOSAL FORM

2015 Annual ASEE K-12 Workshop on Engineering Education
“Authentic Engineering: Representing & Emphasizing the E in STEM”
Presented by Dassault Systems

Saturday, June 13, 2015
8:00 A.M. – 5:00 P.M.
Sheraton Seattle | Seattle | WA

Please complete this form, save it as a PDF file *only* and upload it through the ASEE Paper Management system as shown in the K12 Workshop Presenter’s Kit.

All notifications will be by email from the ASEE Paper Management system.

NOTE: To ensure that emails are not obstructed by spam blockers, please make sure to WHITELIST the email addresses: monolith@asee.org and conferences@asee.org and s.harrington-hurd@asee.org.

Direct questions to Stephanie Harrington-Hurd, ASEE K-12 Activities Manager, at s.harrington-hurd@asee.org. Additional workshop details are available at: <http://www.asee.org/K12Workshop>. Thank you!

Deadline
Friday, January 23, 2015 by 5:00PM EST
Presenters will be notified of acceptance status by March 14.
Late submissions will not be accepted.
Advanced Workshop Registration will open December 6, 2013.

SUBMISSION INFORMATION

Provide the first and last name of each presenter, including affiliations. If there is more than one presenter, designate one person as the organizer and provide only that person’s contact information. The organizer is responsible for communicating to co-presenters.

Number of Presenters: 4

Presenter Name(s):

- | | | |
|-----------|-----------|---|
| 1) Holt | Gerald | Project Lead The Way |
| 2) Siegel | Shepherd | Project Lead The Way |
| 3) Ruff | Karl | Roosevelt High School, Seattle Public Schools |
| 4) Beaty | Elizabeth | Morning Star Christian School, Bend, Oregon |

Contact Person’s Name: Shepherd Siegel, PhD

Contact Person’s Email: ssiegel@pltw.org

Contact Person’s Phone: 206-619-8806

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Contact Person’s Alternate Phone: 206-933-8811

Please provide a one-paragraph bio for each presenter (in the order listed above). The bio should not exceed 70 words and should be written as you would want it to appear on the ASEE website and program materials.

- 1) Gerald Holt began his career as a petroleum engineer where mentoring junior engineers sparked a career pivot to become a high school engineering educator. His success as a teacher and leadership with after school programs was recognized by *Project Lead The Way*. Over the past five years, Gerald has applied his experience as both an engineer and educator to create impactful, innovative learning opportunities for students a Director of Instruction.
- 2) At Seattle’s Roosevelt High School, Karl Ruff applies learnings from 16 years as a Boeing engineer by creating a lab environment with the look and feel of a contemporary engineering/prototyping shop. It is a student-directed interdisciplinary innovation lab where students can practice leadership and entrepreneurship while learning engineering fundamentals. It meets the need for creative and engaged people who understand iteration and risk and disciplined self-management on a team.
- 3) Dr. Shepherd Siegel is a music, career/technical and special education educator. He has over thirty publications. He joined as *Project Lead The Way’s* Director of School Engagement (WA) after having strong success with the program in ten Seattle secondary schools. The KAPPAN published his article about a meaningful high school diploma in 2010. He also works on a book about play, and how it could transform our society.
- 4) Elizabeth Beaty began her career as a 5th grade teacher who was always interested in how to best engage students in the learning process. Through this interest she found *Project Lead The Way* and was trained in the Middle School *Gateway* program, Design and Modeling. After getting accepted for the PLTW *Launch* pilot program, Elizabeth implemented *Launch* at her school and became a Master Teacher last summer.

WORKSHOP INFORMATION

Proposed Title:

Project Lead The Way: Activity-, Project-, and Problem-based Engineering Education, from Kindergarten to 12th Grade

Abstract: Please provide a concise description that includes the workshop’s learning objectives (maximum 750 characters). The abstract is used on the ASEE website, program materials, and other K-12 Workshop promotional activities.

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Participants will experience two lessons from *Project Lead The Way's* engineering program, attaining the following learning objectives:

- Kindergarten: Build A Beanstalk
Students
 - Are introduced to the engineering design process by modeling a beanstalk using pipe cleaners with a goal of creating the tallest free-standing model possible
 - Compare heights and test the strengths of each beanstalk model by adding mass (a golden egg) to the top.
 - Optimize their design to improve height and strength.
- 9th Grade: Puzzle Design Challenge
Students
 - Learn and understand the design process
 - Model an idea before making the final prototype
 - Understand assembly constraints
 - Address gender and age
 - Understand domain and function
- Begin to learn about the continuously improving Activity-, Project-, and Problem -based pedagogy practiced by PLTW, and how it is implemented

Workshop Description. Please provide a detailed description of the proposed workshop that, at minimum, explicitly addresses the following (maximum 4,000 characters):

- a. Learning objectives
- b. Hands-on activities and interactive exercises
- c. Materials that participants can take with them
- d. Practical application for teachers and outreach staff

Project Lead The Way offers a different approach to learning and teaching. Through activity-, project-, and problem-based curriculum, PLTW has students from Kindergarten through 12th grade apply what they know, identify problems, find unique solutions, and lead their own learning. Workshop attendees will experience this powerful approach to learning as they participate in two activities from the *Project Lead The Way* engineering programs. The first activity is designed for kindergarten students and is part of the PLTW *Launch* program designed for K-5 students. The second activity is designed for 9th grade students and is part of the PLTW *Engineering* program.

The overarching learning goal of the workshop: Participants will understand that application of a design process as a step-by-step method that can be used to guide the development of solutions to real-world problems. This method can be scaffolded in complexity through a wide range of grade levels..

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The activity designed for kindergarten students is entitled Build A Beanstalk. In a classroom, students are introduced to the design process through the familiar story of “Jack and the Beanstalk.” Students use pipe cleaners to build the tallest beanstalk possible that could also support mass (golden eggs). The models are tested for height and the mass which it can support. Participants will perform this activity in timed stages to intentionally follow a design process. Participants will optimize their design to improve performance.

The learning objectives for this activity are:

1. Participants will understand that the design process is a step-by-step method used to guide people in developing solutions to problems.
2. Participants will understand that engineers and designers create new products or improve existing products and technology to meet human needs and wants.
3. The practical application for a teacher or outreach staff is to experience an example of an engaging activity structured so that students intentionally apply a design process.
4. Materials that a workshop participant can take are information about the PLTW *Launch* program.

The project designed for 9th grade students is entitled Puzzle Design Challenge. In a classroom, students follow an engineering design process to complete a challenge. Students design, build and test a puzzle. Students apply hand sketching and CAD modeling skills as part of an engineering design. Students test solution time of a population sample then use statistical tools to analyze the level of challenge of a puzzle. Participants will design a portion of a puzzle using an engineering design process including hand sketching. Participants will see examples of puzzles and how statistical analysis is applied to the project.

The learning objectives for this activity are:

1. Participants will use graphical, computer, physical and mathematical models as appropriate to represent or solve problems.
2. Participants will fabricate a simple object from technical drawings that may include an isometric view and orthographic projections.
3. The practical application for a teacher or outreach staff is to apply statistical analysis to an engaging design activity.
4. Materials that a workshop participant can take are information about the PLTW Engineering program.

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Authentic Engineering Connection. Identify and describe how you will explicitly address the ways in which your lesson or activity is representative of the processes, habits of mind and practices used by engineers, or is demonstrative of work in specific engineering fields.¹ At least one of those must be within the first four listed, below; i.e., do not only check “other”. Check all that apply:

- Use of an engineering design process that has at least one iteration/improvement
- Attention to specific engineering habits of mind
- Attention to engineering practices (as described in the NGSS/Framework and as practiced by engineers)
- Attention to specific engineering careers or fields related to the lesson/activity
- Other (please describe below)

Provide a description of how you will explicitly address these aspects of authentic engineering in your workshop (maximum 2,000 characters):

The PLTW *Launch* and PLTW *Engineering* curriculum were designed in alignment with the engineering practices as described in the NGSS/Framework. In both the *Build a Beanstalk* and the *Puzzle Design Challenge*, students learn to evaluate their first attempt and project how a second iteration or improvement would differ from the original model. Also, in both activities, crucial aspects of the Design Process, a core engineering habit of mind, are learned: Students Define a Problem; Generate Concepts; Develop a Solution; Construct and Test a Prototype; and Evaluate the Solution. All *Project Lead the Way* courses and lessons are aligned with Next Generation Science Standards (& Technological Literacy and Common Core Math). Attendees will be provided a document showing all of the standards to which the lessons they are learning align.

The Building the Beanstalk applies a design process appropriate for this grade range and aligned to these same standards. The students define the problem—that they need to build the tallest beanstalk possible (K-2-ETS1-10) Students model the beanstalk using pipe cleaners. They evaluate the model by comparing the height of their beanstalks with others, followed by a teacher-led discussion on the features, strengths, and weaknesses of the different beanstalk designs (K-2-ETS1-3).

The Puzzle Design Challenge applies an engineering design process appropriate for this grade range and aligned to these same standards. Students begin with defining the problem, then develop hand sketch and physical block models to test the puzzle components relative to the design problem (HS-ETS1-2). Students test their solution and gather data such as time to complete the puzzle (HS-ETS1-3).

Other examples of NGSS standards met in the *Build A Beanstalk*:

- Science and Engineering Practice - Developing and Using Models -Modeling in K–2 builds on prior experiences and progresses to include using and developing models (i.e., diagram, drawing,

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physical replica, diorama, dramatization, or storyboard) that represent concrete events or design solutions.

- Crosscutting Concept – Structure and Function - The shape and stability of structures of natural and designed objects are related to their function(s).

Diversity. This year is the American Society for Engineering Education’s “Year of Action on Diversity.” It is essential that we have a diverse engineering workforce to solve diverse problems. To do that and to have an engineering-literate public, it is essential that we reach *every* preK-12 student with high-quality engineering education, drawing on issues of access and equity in the classroom and in the curriculum. Reviewers would like to know how your proposed workshop will address diversity.

Provide a description of how you will explicitly address diversity – e.g., diversity with respect to gender/sex, ethnicity or race, special education inclusion, socio-economic status, or LGBT status – in your workshop (maximum 2,000 characters):

The activity is based on a story that is a familiar book for male and female students. Observations made of this activity in a PLTW *Launch* classroom show that male and females paired together work with significantly less gender bias than is seen at middle and high school. Specifically, male and female inputs are valued equally. Introducing problem-solving using a design process and learning effective teamwork strategies at early grades could be a valuable strategy to forming gender neutral respect for colleagues.

In the Puzzle Design Challenge, students are asked to run trials and investigate whether the gender or the age of the puzzle solver has any correlation to the solution time. Specifically,

1. *How does the gender of the puzzle solver affect solution time? Be specific and provide evidence to support your answer.*
2. *How does the age of the puzzle solver affect solution time?*
 - a. *Make a specific statement related to the rate of increase or decrease of solution time with respect to age. Provide evidence that supports your statement.*
 - b. *Write an equation using function notation that represents **puzzle solution time** in terms of **age**. Be sure to define your variables and identify units.*
 - c. *Predict the solution time on the first attempt of a child who is 3 years of age. Show your work.*
 - d. *Predict the solution time on the first attempt of a person who is 95 years of age. Show your work.*
 - e. *Do these predictions make sense? Why or why not?*
 - f. *What is a realistic domain for the function?*
 - g. *Collect additional data to verify your mathematical model.*

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Project Lead The Way is an organization firmly committed to the full representation of all students in PLTW classes, and in the engineering colleges and engineering professions. Information on specific projects that address equity in the PLTW network will be provided.

Are there any online components to the proposal or presentation? (Note that these online components may only be available to presenters or those who have their wireless subscriptions, since wireless may not be available during the workshop sessions.)

- No
 Yes

Please describe:

Grade Level Target Audience (check all that apply):

- Primary (EC–2)
 Elementary (3–5)
 Middle School (6-8)
 High School (9-12)

Maximum Number of Participants:

22

If this number is greater than 25, please describe how your workshop will equally engage all participants.

All Seating is Classroom (tables and chairs).

Audio Visual Equipment Requests:

Note: An LCD projector, screen and podium with attached microphone are provided. Requests for additional equipment or resources (e.g., internet connection or laptops) will incur extra charges. If you do not have additional requests, please indicate with “Not applicable.”

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Reminder:

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Presenters must register and pay the registration fee to support their workshop attendance and audio/video costs.

Thank you for completing this proposal form!
Please review this document prior to submitting it to ensure that all items are complete.

ASEE USE ONLY

Date Received:

Received By:

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