



Teaching Creative Problem Solving

Laura Lee Lang NBCT, Sauk Prairie High School

Laura Lang is a National Board Certified Teacher who began her career as a chemical engineer at Dow Chemical Company. She has used this valuable experience to teach and model engineering practices while problem solving or during labs with her physics students at Sauk Prairie High School where she has taught for the past 30 years. She is also currently teaching a University Physics course at Madison College.

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: 1

Presenter Name(s):

1) Lang Laura Sauk Prairie High School

2) Last First Affiliation

3) Last First Affiliation

Contact Person’s Name: Laura Lang

Contact Person’s Email: laura.lang@saukprairieschools.org

Contact Person’s Phone: (608) 963-6850

Contact Person’s Alternate Phone: (608) 643-5926

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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) Laura Lang is a National Board Certified Teacher who began her career as a chemical engineer at Dow Chemical Company. She has used this valuable experience to teach and model engineering practices while problem solving or during labs with her physics students at Sauk Prairie High School where she has taught for the past 30 years. She is also currently teaching a University Physics course at Madison College.

2)

3)

WORKSHOP INFORMATION

Proposed Title: Teaching Creative Problem Solving

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.

When engineers are faced with the challenge of developing new technology to solve a problem, they need to establish the specifications for the device, provide detailed instructions for construction, and determine appropriate methods to evaluate the final product. Laura Lang, former chemical engineer and current physics teacher of traditional high school, Advanced Placement, and college students, will describe how her Advanced Placement Physics students have used engineering practices to design devices during laboratory activities. Participants will have an opportunity to use some of those engineering practices to design their own devices to solve a specific problem. Laura will share her ideas for other engineering challenges that can be used in chemistry, biology, and Earth science classes, and then participants will brainstorm to create a list of additional ideas.

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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

The Teaching Creative Problem Solving workshop is designed to help teachers answer the question of how to teach creative problem solving within the structure and time limits of a science classroom.

Laura Lang will give a step-by-step description of how her Advanced Placement Physics students have used engineering practices to design devices in laboratory activities. Participants will have an opportunity to use some of those engineering practices to design their own devices to solve a specific problem. Laura will share her ideas for other engineering challenges that can be used in chemistry, biology, and Earth science classes and then participants will brainstorm to create a list of additional ideas.

Learning Objectives:

- A. Students will practice the following Engineering Habits:
 - a. Being creative
 - b. Working and negotiating in teams
 - c. Adopting optimistic mindsets when problem solving and designing
 - d. Considering the ethical nature of engineering and its products
- B. The following NGSS standards will be addressed:
 - a. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
 - b. Evaluate a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- C. The following NGSS Practices will be used:
 - a. Asking questions and defining problems
 - b. Developing and using models
 - c. Using mathematics and computational thinking
 - d. Constructing explanations and designing solutions
 - e. Engaging in argument from evidence
- D. The following NGSS Cross Cutting Concepts will apply:

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- a. Cause and effect
- b. Scale, proportion and quantity

Participants in this workshop will be given the following engineering task:

Scenario: Ms. Curie teaches in a large classroom which includes a laboratory and a workroom with storage area in the back of the classroom. She would like to know when someone enters the door in the front of the classroom while she is busy preparing for labs in the back workroom and/or storage area.

Challenge: Create a device that will automatically alert Ms. Curie when Someone enters her classroom.

Materials Available: paper, cardboard, string, wire, pipe cleaners, clay, lead sinkers, pulleys, springs, aluminum foil, plastic wrap, rulers, scissors, wire cutters, buzzers, light bulbs, sinkers, pulleys, other miscellaneous items

Participants will take home a collection of scenarios of engineering challenges that require the development of a device. Each scenario can be modified in length and difficulty by teachers or outreach staff to meet the needs of their own students.

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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):

Engineers are often faced with the challenge of developing new technology designed to solve a specific problem. They need to establish a need for the technology and determine the importance of the many potential characteristics of the devices they design. Collaboration among engineers results in more productive brainstorming for new ideas. Once a device is designed it must be evaluated and the results compiled and presented. Science teachers can use engineering practices to teach creative problem solving and inspire their students to become our future engineers. Using the steps outlined below, Laura Lang been successful in providing her students with experience in creative problem solving using engineering practices.

Step 1: Establish a need for a device to be created.

- A. Explain the engineering challenge including the reason a new device needs to be designed.

Step 2: Determine device specifications.

- A. Brainstorm characteristics that can be used to evaluate devices.
 - a. First individually shared small groups and then with entire class.
 - a. All ideas are recorded.
 - b. Determine which characteristics to use.
 - c. Rank importance of characteristics.
 - d. Determine how characteristics will be scored.

Step 3: Design device

- A. Agree on design of device.
- B. Draw design of device.
- C. Write instruction for constructing device.

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- D. Submit order for materials of construction.
- E. Each group member creates box from written instructions.
- F. Modify instructions and order of materials
- G. Measure and record box specifications.

Step 4: Evaluate device

- A. Each group evaluates a box from all other groups recording results.
- B. Results are compiled and the rank of boxes meeting specs is determined.

Step 5: Create Scale-up of Device

- A. Use same instructions for construction to create a larger box.

Step 6: Determine how to evaluate of device while being used.

Step 7: Create apparatus to evaluate device in use.

Step 8: Test all devices in selected apparatus

Step 9: Present results to customer

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):

Creating a classroom involving collaboration to complete an authentic task where a variety of skills are necessary for success is crucial to providing a safe and welcoming environment for a diverse student body. This aspect of the engineering problem solving process will be discussed during the workshop.

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:

I will need a projector to present my information from my laptop.

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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:

25

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.”

n/a

Reminder:

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:

Proposal ID Number: