

## **Reinforcing Learning Concepts via Engineering Lesson Planning**

**Jessica S Ward, Drexel University (Eng. & Eng. Tech.)**

Jessica S Ward has over 9 years of Engineering Education experience and is currently the Director of Operations for the DragonsTeach program supported by the National Math and Science Initiative and UTeach Institute and serves as the National Science Foundation STEM GK-12 Program Manager at Drexel University.

**Dr. Adam K Fontecchio, Drexel University**

Dr. Adam Fontecchio is a Professor in the Electrical and Computer Engineering Department at Drexel University, and is the inaugural Director of the Center for the Advancement of STEM Teaching and Learning Excellence (CASTLE). He has held leadership positions including Vice-Dean of the Graduate College at Drexel University, Vice-Chair of the IEEE Philadelphia Section, and Associate Dean for Academic Affairs in the College of Engineering at Drexel University. His research focuses on the area of nanophotonics. He has served as PI or Co-PI on 53 funded grants with over \$33M in sponsored research or foundation funding, and publication of >110 peer-reviewed articles. These metrics include both technical research and educational research/programs.

He was selected as the 2015 Delaware Valley Engineer of the Year, and is also the recipient of a NASA New Investigator Award, the Drexel Graduate Student Association Outstanding Mentor Award, the Drexel University ECE Outstanding Research Achievement Award and the International Liquid Crystal Society Multimedia Prize.

**Mr. Robert Shultz, Drexel University**

**Gabriel Burks, Drexel University Materials Science & Engineering**

# 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](mailto:monolith@asee.org) and [conferences@asee.org](mailto:conferences@asee.org) and [s.harrington-hurd@asee.org](mailto:s.harrington-hurd@asee.org).

Direct questions to Stephanie Harrington-Hurd, ASEE K-12 Activities Manager, at [s.harrington-hurd@asee.org](mailto: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) Last Fontecchio First Adam Affiliation NSF Drexel STEM GK-12 Director
- 2) Last Ward First Jessica Affiliation NSF Drexel STEM GK-12 Program Manager
- 3) Last Burks First Gabriel Affiliation NSF Drexel STEM GK-12 Graduate Fellow
- 4) Last Shultz First Bob Affiliation Drexel STEM GK-12 Graduate Fellow

Contact Person’s Name: Jessica Ward

Contact Person’s Email: [jward@drexel.edu](mailto:jward@drexel.edu)

Contact Person’s Phone: 215-895-6918

Contact Person’s Alternate Phone: 815-383-8147

2015-ASEE-K-12-Proposal-Form\_DrexelGK12.docxPage 1 of 8

# 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 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) Adam Fontecchio is a Professor of Electrical Engineering and the Associate Dean of Academic Affairs in the College of Engineering (CoE) at Drexel. He has served as PI or Co-PI on >\$10M in sponsored research funding, and authored >80 peer-reviewed papers.

2) Jessica S Ward has over 9 years of Engineering Education experience and is currently the Director of Operations for the DragonsTeach program supported by the National Math and Science Initiative and UTeach Institute and serves as the National Science Foundation STEM GK-12 Program Manager at Drexel University.

3) Gabriel Burks is a 3rd year PhD student at Drexel University studying Materials Science & Engineering, specializing in Polymer Nanocomposites. He received his bachelors degree in Physics from Grambling State University. He is a very active participant and leader in outreach activities within his college.

4) Bob Shultz is a 3rd year PhD student at Drexel University studying Tissue Engineering in the School of Biomedical Engineering, Science, and Health Systems. Bob currently conducts research in the field of spinal cord injury, and works with 10th grade biochemistry students to introduce engineering principles and applications of their coursework material.

---

---

## WORKSHOP INFORMATION

---

---

### Proposed Title:

Reinforcing Learning Concepts via Engineering Lesson Planning

**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.

This workshop is intended for university faculty and staff or K-12 educators that are interested in STEM K-12 programs. Workshop attendees will become familiar with the NAE Grand Challenges, how to connect the NAE Grand Challenges with elements of high school science

# 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

curriculum, and how to develop corresponding activities that are cost effective and usable in the classroom. They will also take away experience with alternative assessment techniques, including the application of scientific principles in an engineering design challenge setting, as well as the process of reviewing learned material to construct new lesson plans.

**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
- a. Participants will explore the field of statics in a hands-on setting, apply statics principles to design a structure capable of bearing maximal loads, and finally reflect on newly gained knowledge to design a lesson plan aimed at teaching statics principles to younger students.
- b. This workshop will include 3 phases: learn, build, and review.

## **Learn (30 min):**

Working in groups of 2-3, participants will be given time to build two separate structures from 8.5 x 11 paper and scotch tape, according to clear instructions. After building each type of structure, participants will weight-test each structure and record the maximum load prior to mechanical failure. Participants will then regroup and participate in a class discussion outlining underlying statics principles that explain why one design performs better than the other under mechanical loading.

## **Build (30 min):**

Using the provided materials, participants work in the same groups to build a structure that stands at least 1.5 inches off the table and can hold the most amount of weight. Provided materials include one piece of 8.5 x 11 computer paper, 2 feet of string, and 1 foot of scotch tape. The build process will include a 10-minute planning time, during which groups are encouraged to sketch their designs, and conduct small-scale tests on design components. After deciding on a structure, participants will be given 20 minutes to build their design. Finally, all designs will be tested, and a winner of the design challenge determined. In addition to providing participants with an opportunity to apply their newly gained knowledge of statistics, the “build” phase of this project gives participants experience with the general engineering design process, including iterations of prior designs, adhering to design criteria, and operating within externally determined design constraints.

## **Review (15 min):**

# 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

Working in the same groups, participants will create a new lesson aimed at teaching younger students one statics principle addressed previously in the workshop. A lesson template will be provided, and participants will be clear and concise in filling out each section of the template. The ultimate deliverable of this phase is a participant-composed lesson plan that can be provided, along with appropriate materials, to a high school or middle-school teacher for immediate use in his or her classroom.

- c. All participant-composed lesson plans will be made available to all participants upon close of the workshop.
- d. This activity serves to (1) introduce an engineering topic, (2) allow participants to practice and apply the taught content within the context of a traditional engineering design challenge, and (3) require participants to review the content and consider how they might teach this content to someone else. This learn/build/review model is an excellent tool for reinforcing student learning and can be applied by teachers and outreach staff in their further educational endeavors.

# 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

**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.<sup>1</sup> 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):

Many of these aspects of authentic engineering are directly addressed during the “build” phase of the workshop. Applying knowledge to construct a paper structure capable of carrying the highest load requires the use of engineering design processes with at least one iteration/improvement. When planning their design, participants are expected to conduct small tests of design components and tailor their final design accordingly. Similarly, specific engineering habits of mind are addressed in this section of the workshop: designs must follow pre-determined criteria and fit within specific constraints, such as limited building supplies. Identifying and operating within such criteria and constraints is an integral component of the engineering design process.

Throughout the workshop, the participants will naturally experience and practice all eight of the science and engineering practices as the NGSS Framework lays them out. Participation in the design challenge requires a clear definition of the problem and construction and testing of models of the final design. Evidence-based argument and mathematical thinking are required during this stage as well. Finally, participants will construct and test the planned design, providing an opportunity for data collection. During the testing portion, comparisons will be made between different groups’ designs and their performance under loading, based on the collected data. Finally, the final write-up activity provides participants with an opportunity to exercise evaluation and communication skills.

Lastly, this workshop provides an excellent framework for discussing careers within the fields of civil and mechanical engineering. Follow-up activities could include a discussion or description of load analyses of bridges, building structures, automotive components, and aviation components, among others.

# 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

**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):

Our workshop is a direct representation of diversity in engineering, and we believe that extended encouragement along with the sharing of our past experiences will further reinforce that engineering and science is a human problem and not a privilege directed at any specific race, gender, social, or economic status. We understand and practice that tough problems require diverse perspectives and that everyone's opinions must be respected and heard in order for progress to occur.

Group activities such as this workshop require cooperation between individuals of diverse and varying backgrounds—emphasis will be placed on the importance of listening to and discussing every group members’ suggestions and input.

Finally, hands-on activities of this nature present the instructor with ample opportunities to encourage all participants, including those traditionally under-represented in engineering disciplines and those who may feel as though they do not belong in engineering fields. We personally have watched shy or uneasy participants initially express discomfort with engineering disciplines, only to grow confidence as they successfully build the first structures in the “learn” phase and progress to produce thoughtful and meaningful designs in the “build” phase of the project.

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):

# 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

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

Maximum Number of Participants:  
N/A

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

Because students work in groups to complete this workshop, there is no limit on how many participants can be involved. If there are more students, simply form more groups. Cost of materials also is not prohibitive to large numbers of groups.

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.”*

Not applicable

### 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:



# **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

Proposal ID Number: