



## **Water Reuse Engineering**

### **Veronika Zhiteneva, Colorado School of Mines**

Veronika Zhiteneva is a Master's student of Environmental Engineering Science at the Colorado School of Mines. As a fellow of the Trefny Institute for Educational Innovation at CSM, Veronika works in elementary school classrooms, assisting teachers with implementing various STEM lessons throughout the week, and runs an after school science club for upper elementary students. Veronika also does research of water and wastewater treatment techniques.

### **Dr. Barbara M. Moskal, Colorado School of Mines**

Barbara Moskal is a professor of Applied Mathematics and Statistics and the Director of the Trefny Institute for Educational Innovation at the Colorado School of Mines. She is also a Senior Associate Editor for the Journal of Engineering Education.

# 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: 2

Presenter Name(s):

- |                   |                |  |
|-------------------|----------------|--|
| 1) Last Moskal    | First Barbara  | Affiliation Professor, Colorado School of Mines        |
| 2) Last Zhiteneva | First Veronika | Affiliation Graduate Student, Colorado School of Mines |
| 3) Last           | First          | Affiliation  |

Contact Person’s Name: Veronika Zhiteneva

Contact Person’s Email: [vzhitene@mymail.mines.edu](mailto:vzhitene@mymail.mines.edu)

Contact Person’s Phone: 908-346-0289

Contact Person’s Alternate Phone:

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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) Dr. Barbara Moskal is a Professor of Applied Mathematics and Statistics and the Director of the Trefny Institute of Educational Innovation at the Colorado School of Mines. She is also a senior associate editor for the Journal of Engineering Education. Much of her work has focused on increasing diversity within engineering through outreach activities and research.

2) Veronika Zhiteneva is a Master’s student of Environmental Engineering Science at the Colorado School of Mines. As a fellow of the Trefny Institute for Educational Innovation at CSM, Veronika works in elementary school classrooms, assisting teachers with implementing various STEM lessons throughout the week, and runs an after school science club for upper elementary students. Veronika also does research of water and wastewater treatment techniques.

3)

## WORKSHOP INFORMATION

### Proposed Title:

Water Reuse Engineering

**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.

Teams will design, build, and defend a model home that demonstrates their idea of sustainable water reuse. Working within a set budget, teams will construct a water reuse system for a model home, then reuse a set amount of water as many times as possible within their budget to see what model house does the best.

**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

As the emphasis this year is on authentic engineering, the goal of this demonstration is to combine engineering principles and practices with principles of architecture, water infrastructure

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development, and economics, to demonstrate the dependence of engineering on other disciplines in realizing a successful project. The demonstration would allow groups of four to build a model home that a) is aesthetically pleasing, c) recycles water and d) demonstrates economic competitiveness in comparison with other model homes.

Workshop attendees would first be introduced to typical home building materials and the reasoning behind their common usage. These materials would be provided in the form of colored cardboard – red for bricks, brown for wood, grey for steel, and thin plastic sheets to represent glass. Each material would be given a monetary value, determined by how much heat it retains (ie glass is attractive so it is expensive, but is a poor conductor of heat, so would fall in the middle of the cost spectrum, whereas wood is cheaper, a poor conductor of heat, but also renewable, so it would be cheaper than glass).

Teams would then be told that their goal is to design a water reuse system for the home that they build out of the cardboard and plastic sheets. The goal is to design a pleasing home that is capable of reusing as much water as possible. Three different widths of plastic tubing would be supplied, each with their own monetary value per foot, to represent potable water, sewer, and water reuse pipes. Each team would be given 1 liter of clean drinking water to start out with, and will be tasked to see who can reuse the liter of water the most times in the house.

As the water travels through the drinking water pipe inside the house, it connects to the sewage pipe at the bottom of the first floor. The sewage pipe must have a t shaped valve attached to it, into which a drop of food coloring will be placed so that clean water going into the valve and through the sewage pipe will change color as it is directed into the reuse pipe or the sewage pipe. 50% of the water going through the house can be directed into the reuse pipe, while only 25% of the sewage water can be cleaned enough to be reused. Additionally, reuse filters cost \$15 each, while sewage filters cost \$10 for a set of two, and sewage must be filtered in succession (ie completely through the first filter before being filtered through the second). The reuse filter will have as much activated carbon as both of the sewage filters combined, which serves to remove food coloring and return water to drinking water appearance. The filters will be the size of Pyrex beakers, which are used to collect the water.

The teams will have \$1000 to start out with, which they can spend however they want on building materials and piping. They must first self-organize to determine how they will tackle the design challenge. The first task is to build the cardboard house and water piping system, then show it to the teacher/supervisor, who will determine how many drops of food coloring their sewage will have, in order to equalize the field between the different sizes and designs of houses. After all designs are approved, a timed competition will ensue, wherein the team's goal will be to reuse the most water in the span of 5 minutes. Teams will need to keep track of how many filters they use, and what additional supplies they use in event of mishaps, etc.

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After the competition has ended, the prices of the entire house/water system will be compared after each team has presented their design and explained the reasoning behind it. Teams will be asked how their design would change under various geographic locations, monetary constraints, in the event of a natural disaster, or other similar variables. Winning teams will then be announced – cheapest house, most water reuse, and the team that balanced cost with water reuse most successfully.

Teachers will leave the demonstration with a worksheet of directions, a worksheet for totaling house and water system costs, a list of Colorado standards that the demonstration meets, and suggestions on how to adapt the demonstration to other grade levels.

**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):

The demonstration will address the first bullet point, ‘use of an engineering design process that has at least one iteration/improvement’ by asking teams how their designs would change under different environmental and economic conditions, after the teams have completed the demonstration. A broader discussion will be facilitated wherein the teams would be asked how they would design larger complexes or apartment buildings, and how that would impact their design choices.

The demonstration will address the second bullet point, ‘attention to specific engineering habits of mind,’ by addressing each habit of mind individually. The engineering habits of mind are systems thinking, creativity, optimism, collaboration, communication, and attention to ethical considerations. This demonstration addresses systems thinking through the need to pre-plan a house design based on aesthetic appeal, critical in structural engineering, as well as water infrastructure efficiency, critical in civil and environmental engineering, to ensure that the two do not impede, but rather enhance each other. This demonstration addresses creativity because

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the teams are not told how their designs should look, and have freedom to create their incarnation of an attractive, water efficient home. This demonstration addresses optimism through creating on of the nation’s growing problems, water treatment and supply, into a challenge for the teams to solve. This demonstration addresses collaboration by requiring teams to work cohesively in order to solve the engineering challenge. This demonstration addresses communication by requiring the teams to explain their design choices to others, and defending their ideas to other teams who may have scored better in a category. Finally, this demonstration addresses attention to ethical considerations by addressing the difference in treatment extents between the water reuse water and sewage water, and the reason for requiring more treatment of sewage than water reuse due to pathogens and bacteria that are in sewage that adversely affect human health if ingested.

The demonstration will address the fourth bullet point, “attention to specific engineering careers or fields related to the lesson/activity,” by informing teams that real civil, environmental, and structural engineers deal with this design problems quite often in their professional lives.

**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):

Shelter and water are two basic human needs. While they can be exclusive, this demonstration does not require any special education or experience with either beyond what information will be presented to the teams at the beginning of the demonstration. The need for shelter and water are two things that unite people of all genders, races, religions, educations, and socio-economic statuses, and by using the ideas of people from all walks of life, we can more effectively solve problems that indiscriminately affect all of us.

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

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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:  
32

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

The participants will be in groups of 4, and will have specific tasks to accomplish within their teams.

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.**

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