A World in Motion: Utilizing the Engineering Habits of Mind and TEAMS model to engage students in gear car construction and a hill climb.

Ms. Julie Lucier, Frenchtown School District

Julie Lucier is a mathematics teacher with 22 years of teaching experience in Minnesota and Montana. She has taught at the middle school, high school, and collegiate levels. She comes from a family of engineers including a grandfather with seven patents to his name. Her background includes teaching in one of the first STEM labs in Minnesota and coaching collegiate swimming. She is currently a junior high math teacher in Frenchtown, Montana.

Mr. Julian Fallon Collins, Montana State University

Mr. Julian Collins is the Associate Director of the Engineering Minority Program (EMPower) within Montana State University's College of Engineering, and the Director of the Halliburton Teaching Engineering Applications in Math and Science (TEAMS) project at MSU. He has been the director of TEAMS since 2011, and has worked with hundreds of K-12 math and science teachers to teach them how to teach engineering concepts in their classrooms.

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: 2

Presenter Name(s):

1) Last Collins First Julian Affiliation Montana State University

2) Last Lucier First Julie Affiliation Frenchtown, Montana School District

3) Last First Affiliation

Contact Person's Name: Julie Lucier

Contact Person's Email: julie.lucier@ftsd.org

Contact Person's Phone: 218-290-4117

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) Julian Collins is the Associate Director of the Engineering Minority Program (EMPower) within Montana State University's College of Engineering, and the Director of the Halliburton Teaching Engineering Applications in Math and Science (TEAMS) project at MSU. He has been the director of TEAMS since 2011, and has worked with hundreds of K-12 math and science teachers to teach them how to teach engineering concepts in their classrooms.

2) Julie Lucier is a mathematics teacher with 22 years of teaching experience in Minnesota and Montana. She has taught at the middle school, high school, and collegiate levels. She comes from a family of engineers including a grandfather with seven patents to his name. Her background includes teaching in one of the first STEM labs in Minnesota and coaching collegiate swimming. She is currently a junior high math teacher in Frenchtown, Montana.

WORKSHOP INFORMATION

Proposed Title: A World in Motion™: Utilizing the Engineering Habits of Mind and TEAMS model to engage students in gear car construction and a hill climb.

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.

Utilizing the TEAMS model (Teaching Engineering Applications in Math and Science), participants will gain a greater knowledge of math and science content and an awareness of what engineers do using a problem-based engineering design challenge. The TEAMS model is based on the engineering habits of mind including learning from failure, teamwork and collaboration, and engaging in physical testing. Our engineering challenge will be to construct a motorized gear car that will climb an incline. Throughout this process, participants will work through the steps of an engineering challenge including problem definition, ideation, engineering drawings, cooperation, communication, construction, and testing. Our goal is to create an environment that provides each student with a hands-on, real world experience that is meaningful, engaging, and challenging.

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

Utilizing the TEAMS model (Teaching Engineering Applications in Math and Science), participants will gain a greater knowledge of math and science content and an awareness of what engineers do. Our goal is to enhance mathematics and science teaching by helping K-12 teachers incorporate engineering applications in their classrooms. To obtain this goal, we will create a learning environment that provides diverse participants with a hands-on, real world experience that is engaging and challenging. We will encourage our participants to be open-minded, optimistic, perseverant, and creative. We will focus on three tenets of the engineering habits of mind including learning from failure, teamwork and collaboration, and engaging in physical testing.

Participants will actively participate using a problem-based engineering design challenge. Our engineering challenge will be to construct a motorized gear car that will climb an incline. Throughout this process, participants will work through the steps of an engineering challenge including problem definition, ideation, engineering drawings, cooperation, communication, construction, and testing.

We will begin by discussing bicycle gears and how they work. Participants will learn about gear trains, driver gear, driven gear, gear ratio, and compound gears. We will discuss what type of gear ratio is necessary to increase torque which is the power necessary to climb an incline. We will proceed to a parts inventory and move to the design and build phase. To allow our participants to experience product refinement in the time allotted, we will discuss and demonstrate a car with a 3:1 gear ratio and explain that they will need more torque to climb the incline. Once participants have a prototype to test, they will sketch their model on a design sheet and proceed to the ramp for testing. At the ramp, torque will be measured prior to the hill climb.

Throughout our presentation, numerous scientific concepts will be discussed including force, friction, torque, simple machines, and gears. Participants will also utilize several math standards including the concept of ratio, ratio language and proportional relationships.

Participants will receive a ten-day unit plan with all resources and necessary information in detail. They will also receive all student worksheets including pre-test and post-test, teamwork worksheet, design sheet, several gear ratio and rotation worksheets, design log, ramp ticket, and final conclusions worksheet. Information about the build materials and funding grants will also be provided.

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.[i] 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):

1. **Use of an engineering design process that has at least one iteration/improvement.** We hope that our participants have time to make improvements to their first model. If they don't, we are certain that they will know what changes they would make if they had time to make modifications. In previous sessions, most teams needed three to five models to design a car that would climb the ramp.

2. **Attention to specific engineering habits of mind.** Our participants will work in **teams**. Successful teams will communicate and **collaborate** to produce the best product possible. Our participants will be engaging in **physical testing** as they move from design phase to testing phase.

3. **Attention to engineering practices** (as described in the NGSS/Framework and as practiced by engineers).
   Our lesson incorporates all of the NGSS Middle School Engineering Design standards as follows:
   - Participants will be defining a design problem that can be solved through the development of an object or tool that includes multiple criteria and contraints (MS-ETS1-1).
   - Participants will develop a model, test the model, and modify it to generate data to test ideas about designed systems (MS-ETS1-4).
   - Participants will analyze and interpret data to determine similarities and differences in findings. They may combine parts of different solutions to create a model that is better than any of its predecessors (MS-ETS1-3) .
   - Participants will evaluate competing design solutions based on design criteria (MS-ETS1-2).

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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):

Because our challenge is a hands-on, real world experience, it is appropriate and challenging for all participants. Ms. Lucier utilizes this project in general population problem solving classes that are not ability-based or electives. Creating non-homogenous groups ensures as much diversity within groups as possible.

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:
20

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

All Seating is Classroom (tables and chairs).

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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: