Girl Scouts of Northeast Ohio Get to Know Nuclear

Christine E. Duval -- Department of Chemical and Biomolecular Engineering

CONTACT INFORMATION:

Name: Duval, Christine
CWRU ID: ced84

PURPOSE:

The PI's long-term educational goal is to increase public literacy of nuclear technology and nuclear medicine while broadening participation in STEM. The proposed workshop will provide hands-on activities for middle school aged Girl Scouts in Northeast Ohio to learn about nuclear science and technology. The PI will organize the workshop with her Ph.D. students (see letters of collaboration) and recruit undergraduate volunteers. In addition to educating middle school students about nuclear technology, this workshop will reinforce fundamental concepts of physics, chemistry and radiation science for CWRU student volunteers. Furthermore, this workshop will provide an avenue for the PI to engage in informal mentorship with CWRU students who may be interested in careers in nuclear science.

Scope

The "Get to Know Nuclear" Girl Scout Badge is endorsed by the American Nuclear Society (ANS) and focuses on learning about nuclear technology through teamwork. To earn the badge, scouts must complete five 30-45 minute activities related to nuclear-technology (see examples below). Engaging with the Girl Scouts will introduce the next generation of women to exciting career opportunities. This will be a 4-hour workshop hosted on campus at CWRU on January 25, 2020. Girls will rotate between classrooms in the AW Smith Building and small groups will participate in the activities listed below and shown in **Fig. 1.**

Fig 1. Photos from a previous workshop hosted at Clemson University: (A) The PI teaching 8-year-old girls how to use a Geiger counter. (B) PI and volunteers with girl scouts at the Oconee Nuclear Power Station. (C) Demonstrating nuclear chain reactions using balloons. (D) Girl Scout Badges from ANS.

1. Modeling half-life with M&Ms
2. Demonstrating nuclear chain reactions with balloons
3. Careers in nuclear featuring guest-speakers from local hospitals, CWRU radiation safety, etc.
4. Modeling an atom with marshmallows
5. Introduction to radiation detection

Each activity room will have a lead volunteer who explains the activity. Additional volunteers will circulate around the room to help the girls complete the activity and answer any questions. Activities are designed to be age-appropriate—an example is given for the "introduction to radiation detection" activity, below.

Introduction to Radiation Detection: Girls are asked to position a low activity, unregulated radioactive source at varying distances from the detector (Geiger counter) and plot the detector count rate vs. distance. Then, they are told an arbitrary count rate that is considered "safe". The goal of the next experiment is to reduce the count rate to the "safe" level using shielding materials (sheets of plastic, tin foil, paper). Afterwards, we will discuss radiation shielding and how radiation dose can be reduced by (1) distance or (2) physical barriers—noting that not all shields behave the same. After, we will relate the experiments to real-life experiences. One example is how we wear lead aprons during dental x-rays instead of paper aprons.

STUDENT IMPACT:

On the girl scouts: This workshop will give students hands-on experiences with radiation and radioactivity in a way that is unique from a traditional classroom setting. One of the 5 workshop activities highlights the

contributions of women to the field of nuclear science and technology and introduces careers in nuclear medicine, power generation and health physics. An intended outcome of this workshop is to give girls confidence using scientific information and skills and inspire them to pursue careers in the STEM.

On CWRU students: The workshop will be organized by the PI and there will be several student volunteers involved in planning the individual activities, leading those activities and interacting with the middle school-aged girl scouts. This workshop will provide an avenue for informal mentoring of current CWRU graduate and undergraduate students who are interested in careers in nuclear science or engineering. As CWRU does not have an established department in this area, this workshop will be a unique way to connect interested students across disciplines. The PI is the faculty advisor for student groups on campus (American Institute of Chemical Engineers and Phi Sigma Rho, Engineering Sorority) and plans to leverage these relationships to recruit undergraduate volunteers.

The PI's graduate students work in the area of radiochemistry and have enthusiastically agreed to lead activities as part of this workshop. Teaching concepts related to their research to non-experts (undergraduate volunteers and the girl scouts) with help deepen their knowledge of the field and reinforce fundamental concepts such as radioactive decay, half-life and radiation interactions with matter. Undergraduate students will gain similar benefits by teaching middle school students.

PROFESSIONAL IMPACT:

This is the first year that the workshop will exist at Case Western Reserve University. This workshop will further develop me as a professional educator by providing opportunities to (1) mentor graduate and undergraduate students in education and outreach and (2) broaden my teaching activities to include public outreach and K-12 education. If awarded, the Nord Grant would be used to establish the inaugural workshop at CWRU. The successful implementation of the inaugural event will provide preliminary data for future external proposals that will seek to broaden the impact of the workshop. For example, next year I plan to apply for an outreach grant through the American Physics Society ($10,000/year) to purchase additional radiation detection equipment and support future operational costs like consumable supplies and administrative fees for multiple workshops (spring and fall).

METRICS AND DATA COLLECTION:

Measuring impact on the girl scouts: During the introductory session, girls will be given a brief survey using word associations surrounding nuclear science and technology. At the end of the day, they will be given the same survey to gauge if their perception shifted over the course of the day. We will also collect demographic information (troop location) to see which girl scouts are engaging in the workshop and which are not being reached. This information will be used for future recruitment efforts to target girl scout troops in diverse areas of Northeast Ohio and broaden the impact.

Measuring impact on the CWRU students: Surveys will be given to CWRU students before and after volunteering on this project. These surveys will focus on several key aspects such as (1) perception of nuclear; (2) confidence in specific nuclear science concepts and terms; and (3) knowledge of career options in nuclear science and technology. The PI will retain records of the students who participate (name, year at CWRU, major).

UCITE FUNDS:

This project aligns with UCITE's mission of innovating teaching and learning in several ways. First, this project is interdisciplinary in nature and provides out-of-the-classroom learning opportunities for undergraduate and graduate student volunteers. Student volunteers will deepen their understanding of nuclear chemistry by teaching non-experts (girl scouts). Second, this workshop will provide a new avenue for informal mentoring of current CWRU graduate and undergraduate students who are interested in careers in nuclear science or engineering as CWRU does not have an established department in this area.

Nord Grant
Girl Scouts of Northeast Ohio Get to Know Nuclear
Christine E. Duval
Department of Chemical and Biomolecular Engineering, Case Western Reserve University

Departmental Financial Contact: Kathleen Bates, Kathleen.bates@case.edu

Expenses (Budgeting for 50 participants)

Expenses	
Radiation detectors	$3,000
Un-regulated radioactive items	$500
Consumable supplies	$300
Lab coats	$900
GSNEO Administrative Fees	$300
TOTAL EXPENSES FUNDED BY AWARD	$5,000

Budget Justification

Radiation detectors: The PI can lend some radiation detectors from her laboratory, but the girls experience would be improved if additional detectors are available. This increases the amount of "hands-on" time each girl can have. The Geiger counters would be used explicitly for outreach activities and will be used for other outreach demonstrations like the Engineering Carnival organized by the Gelfand Center for STEM Education.

Un-regulated radioactive items: Common items such as uranium glass, fiesta-ware plates, thorium mantles for camping lantern, uranium-rich granite all emit measurable (but perfectly safe) levels of radioactivity. These items can be used in future demonstrations outside of this workshop, like the Engineering Carnival organized by the Gelfand Center for STEM Education.

Consumable supplies: Workshop activities require consumable supplies like balloons, paper plates, aluminum foil, popsicle sticks, M&Ms, tape, dry ice, etc.

Lab coats: Each girl will be given a lab coat that she will wear throughout the day and will be able to take home as a souvenir (if she wants).

GSNEO Administrative Fees: The Girl Scouts of Northeast Ohio collects a $6/scout fee for workshops that utilize their advertising and online registration portals. These fees help cover the cost of printing programs, administrators, insurance, etc.

SIGNATURES OF INDIVIDUALS REVIEWING THE EXPENSES

Applicant: Christine Duval, Christine Duval

Department Chair: Dan Lacks,

Department of Chemical and Biomolecular Engineering
Case Western Reserve University
Cleveland, OH 44106
(216) 368-4238

Daniel J. Lacks
Department Chair
C. Benson Branch Professor
daniel.lacks@case.edu

September 22, 2019

Dear Sir or Madam,

I am writing in support of Prof. Christine Duval's application for a Nord grant to help her create an outreach program on nuclear science. This is a great idea, which I highly support, for a number of reasons: First, it teaches children about a very important topic that is not covered in school curricula. Second, it will provide visibility to CWRU, and I can foresee this leading to increased student interest in CWRU. Third, it provides a strong professional development experience for the CWRU students involved in the workshop. And fourth, it gives Prof. Duval a strong and unique outreach activity that she could use in external grant proposals, such as the NSF Career grant.

The proposal is very well thought out, and everything is appropriate, including budget, timeline and the overall plan of action.

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Sincerely,

Daniel J. Lacks

Christine E. Duval, PhD

EDUCATION

Doctor of Philosophy in Chemical Engineering 2012-2017
Clemson University Clemson, SC
Dissertation Title: Uranium-selective adsorbent materials for environmental radiation sensing

Bachelor of Science in Chemical Engineering 2007-2011
University of Connecticut Storrs, CT

APPOINTMENTS

2017-present	Assistant Professor, Department of Chemical and Biomolecular Engineering Case Western Reserve University, Cleveland OH Research interests: radiochemistry, medical isotope purification, radiation detection
2017	Department of Energy Scholar, Nuclear Materials Information Program, Office of Intelligence and Counterintelligence, US Department of Energy, Washington DC
2012-2017	Graduate Research Assistant, Department of Chemical and Biomolecular Engineering Clemson University, Clemson SC
2012	Director of Marketing Amastan LLC, Mansfield CT
2011-2012	Business Analyst, Innovation Accelerator Program Connecticut Center for Entrepreneurship and Innovation, East Hartford, CT

SYNERGISTIC ACTIVITIES

- Engage in faculty development activities for education. Participant (2018) and co-leader for the *Inclusivity* training block (2019) for the **NSF-sponsored Mobile Summer Institute (MoSI)** on the CWRU campus.
- Designed and taught **new hands-on courses in membrane separations** at Clemson University (as a graduate student) and Case Western Reserve University (as a faculty) in which students were able to design, build and test their own filtration systems that can be used in the classroom and for outreach demonstrations (2015 – now).
- Faculty advisor to student organizations such as Phi Sigma Rho (Engineering Sorority) and the American Institute of Chemical Engineers student chapter at Case Western Reserve University (CWRU). Advisor activities include speaking on **panels about women in STEM**, coordinating student travel (and traveling with the students) to regional and national conferences, hosting workshops for **students to understand the graduate school application process** and generally mentoring students about their positions as leaders within student organizations (2017 – now).
- **Engage with the community outside of CWRU about nuclear forensics** with special presentations such as “So you found some Uranium—now what?” on the history of nuclear science and the domestic/international nuclear forensics response to interdicted materials given at the Cleveland Science and Human Rights Coalition meeting in Cleveland, OH (April 2019).

SELECTED RESEARCH PRODUCTS

1. Suresh, P; Duval, CE. “Membrane adsorbers for radiochemical separations”. *American Filtration Society Meeting.* Cleveland, OH. Fall 2019
2. Duval, CE; Darge, AW; Ruff, CL; DeVol, TA; Husson, SM. “Rapid sample preparation for alpha spectroscopy with ultrafiltration membranes”. *Analytical Chemistry*. 2018 (90) 6, 4144-4149.

Department of Chemical and Biomolecular Engineering
Case Western Reserve University
Cleveland, OH 44106

September 23, 2019

Nord Grant Review Panel

University Center for Innovation in Teaching & Education (UCITE)
11000 Euclid Avenue
Allen Library, Room 1
Cleveland, OH 4416-7025

Subject: Collaboration letter for Nord Grant application

To whom it may concern:

As current Ph.D. students in Prof. Duval's research group, we are excited to participate in the first "Get to Know Nuclear" workshop at CWRU which is scheduled for Saturday, January 25, 2020. Each of us will help develop and lead hands-on activities for the girl scouts according to the workshop guidelines presented by the American Nuclear Society and the Girl Scouts of America.

Sincerely,

Priyanka Suresh Maura Sepesy Bethany Kersten