SUNRISE

SCHOOLS UNIVERSITY 'N' (AND) RESOURSES IN THE SCIENCES AND ENGINEERING

A NSF/GMU GK-12 FELLOWS PROJECT

National Science Foundation, George Mason University's Volgenau School of Engineering, CREST- Center for Restructuring Education in Science and Technology, College of Education and Human Development, College of Science, and School Divisions in Northern Virginia

PROJECT OBJECTIVE

The objective of SUNRISE project is to build a unique model of collaboration among elementary and middle schools, school division administration, and GMU to foster systemic efforts in implementing Information Technology (IT) rich STEM content-knowledge into G4-6 education by graduate Fellows, with the potential to fundamentally change the delivery of science instruction and long term professional development of science teachers.

The most exciting aspect of the SUNRISE project is that it provides an opportunity to all its participants to discover, widen and deepen knowledge within their own field, as well as a very important mechanism to deliver that knowledge through the graduate Fellows into the K-12 environment.

The end goal of SUNRISE project is to become institutionalized as a university wide program that is sustained through internal and external support. As a continuing project beyond NSF support years the goal of the project will be to reach out to more schools and continue to provide the transformative experience to all its participants.

SUNRISE GMU TEAM

GMU Team Members, left to right:
Dr. Donna Sterling, co-PI, College of Education and Human Development; **Rajesh Ganesan**, PI, Systems Engineering and Operations Research; **Alex Koufos**, Fellow; **Alex Kozera**, Fellow; **Prabal Saxena**, Fellow; **Dan Veltri**, Fellow; **Saira Ahmad**, Fellow; **Audarya Sarkar**, Project Manager.

SUNRISE members not in picture:
Dr. Phil Henning, Program Evaluator; **Dr. Bruce McDade**, Superintendent, MPCS; **Ms. Myra Thayer**, Science Curriculum Specialist, FCPS; **Ms. Melissa Hamilton**, Science Specialist, ACPS.

GMU Team Members, left to right (cropped images):
Christopher Ruck, Fellow; **Elizabeth Nohelty Romano**, Fellow.
GMU Team member not in picture: Kumnit Nong, Fellow.
SUNRISE members not in picture:
David Stewart, Teacher; **Heather Morris**, Teacher; **Christina Fentress**, Teacher (Fairfax County Public School), **Manuelita Vega**, Teacher; **Leslie Ridley**, Teacher; **Erin Turkstra**, Teacher (Alexandria County Public School), **Kelly Beatty**, Teacher; **Sarah Bianco**, Teacher; **Kelly Dumermuth**, Teacher (Manassas Park City School).

PARTICIPATING SCHOOLS

Fairfax County Public Schools
Lynbrook Elementary
Annandale Terrace Elementary
Hutchinson Elementary

Alexandria City Public schools
John Adams Elementary
Patrick Henry Elementary

Manassas Park City Schools
Manassas Park Elementary
Manassas Park Middle

FELLOW DISCIPLINES

Christopher Ruck – Environmental Science and Policy
Alexander Koufos – Computational Sciences and Informatics
Prabal Saxena – Physics/Math
Daniel Veltri – Bioinformatics and Computational Biology
Saira Ahmad – Bioscience (Microbiology and Infectious Diseases)
Elizabeth Nohelty Romano – Environmental Science and Policy
Alexander Kozera – Systems Engineering and Operations Research
Kumnit Nong – Computational Science and Informatics

APPROACH

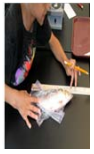
- Regular classroom assistance in both preparation and teaching by the Fellows along with teachers
- Fellows serve as resources for the teachers and work toward improving the content of science and mathematics taught in their classes
- Fellows lead the post-experiment discussion about the science behind the experiments
- Fellows encourage the use of Technology for teaching, incorporate the use of graphics and computer based models, to increase level of perception.
- Develop new IT rich STEM modules and lessons from Fellow research areas and infuse them into elementary school environment through hands on experiments
- Engage in after school programs, Discovery clubs, School science days, Judge County Science Fair projects, answer questions dropped off in the "Question Box", and participate in field trips.

CURRICULUM ENRICHMENT AND INTEGRATION OF FELLOW'S RESEARCH

How Old is this Fish?

Research Topic – Population Structure of River Herring (*Alosa aestivalis* and *Alosa pseudoharengus*)
- Christopher Ruck

My research attempts to determine the population structure and dynamics among Atlantic coast river herring (*Alosa spp.*) and will address questions of river herring as bycatch in other directed fisheries. I intend to use both genetic and phenotypic determinants to classify population subdivisions.



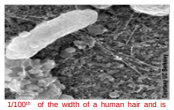
Students were asked to determine the age of a hickory shad (*Alosa mediocris*) by measuring fish length and applying it to a length at age plot. Students experienced the annular properties of hard body parts, similar to ageing trees by counting annuli (rings) on images of the fish otoliths (earstones) and prepared slides of fish scales.

This lesson incorporated three ways by which fisheries biologists determine fish age, which is critical for managers to assess population structure, growth, and stock status.

Computers In Mathematic "Synthesis Cells"

Research Topic – Optimal Growth on Specific Cell for Renewable Energy.
- Kumnit Nong

Synthesis cells allow us to potentially increase the production growth. We are interested for a possible solution for renewable energy. Some of the bacteria could produce energy. If we are able to simulate the cell cycle, we can manipulate the bacteria to produce maximum energy.



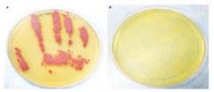
1/100th of the width of a human hair and is called Microbial fuel cell. Microbial fuel cells generate electricity in direct current (DC) form, the same as the power produced by batteries.

This lesson is to demonstrate my research on bacterial cells which is based on the foundation unit that students are currently learning. This is designed to review the unit on animal and plant cells. We hope to demonstrate and encourage all students the importance of basic science.

Microbial Growth and Treatment

Research Topic – Identification of Molecular Targets for *Francisella* Biofilm Formation
- Saira Ahmed

My research focuses on determining the mechanisms involved in biofilm formation of *Francisella* bacteria. Peptides are used to identify molecular targets of the bacteria involved in biofilm growth. Identifying these genes will then be used to determine ways to treat biofilm formation.



http://mrbarlow.wordpress.com/2009/01/page/2/

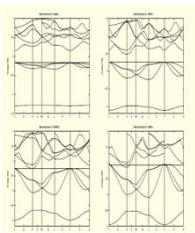
In this lesson, the students expand on their knowledge about the kingdoms and living things. The students are introduced to my research about microbial growth and research methods for treatment. Students swab their hands onto agar plates. To test for microbial treatment, the students then either wash their hands or use sanitizer, followed by swabbing their hands onto another agar plate. Bacterial growth between the two samples is then observed.

Computers in Science

Research Topic – Electronic Structure Calculations of Heavy Elements: Radon (Z=86) and Francium (Z=87)
– Alexander Koufos

Electronic structure calculations allow scientists to predict the properties of solids. The study consists of two heavy elements, Radon and Francium, the last elements from the noble gas and alkali metal groups, respectively. The mechanical and electronic properties of these elements were calculated.

The school lesson consisted of comparisons between real-life video and animated computer based simulations of car crashes. These simulations were preformed using finite element methods to model and compute the deformation of the vehicles. This lesson showcased the ability computational scientists have to model and visualize complex systems. I model quantum mechanical systems of bulk materials.

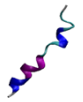


ENERGY BANDS FOR FCC RADON

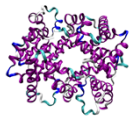
Science Question Box:

Research Topic – Noise Reduction for Improved Cathelicidins: *A Family of Antimicrobial Peptides*
- Daniel Veltri

Cathelicidins are a family of antimicrobial peptides found in the innate immune system of mammals. In searching amino acid sequences for functional patterns, there is the potential to better engineer peptides for medical applications.



Cathelicidin Peptide Render



Human Hemoglobin Render

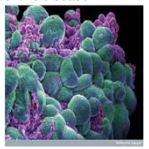
In addition to our regular lessons, students have been submitting excellent science-related questions to our class "science question box" to go over each week.
My fourth graders have been interested in "what it inside blood?" We have looked at 3D models of hemoglobin using the Visual Molecular Dynamics (VMD) program; a common tool used by protein researchers. We talked about why hemoglobin is important to us and why our blood turns red in air.

Environmental Effects of the BP Oil Spill and the Public Policies of the Issue

Research Topic – The Environmental Triggers and Public Policy Regarding Breast Carcinoma
- Elizabeth Nohelty Romano

Cancer is the second leading cause of death in the United States, and breast cancer is the most common invasive cancer and the leading cause of death in American women. Becoming familiar with cancer and its molecular mechanisms through my undergraduate and Master's degrees has made me want to pursue my research in environmental mechanisms for its inception and the policies surrounding the field in order to aid in the halt of this disease.

The students were required to "recreate" the oil spill on a small-scale using vegetable oil and cocoa as the "oil." They then had to try to clean the oil off of the wildlife, in our case, bird feathers. We discussed the harm the oil spill had on the environment, the effects on wildlife and public policies leading up to the event and the policies in the aftermath of the disaster. This ties into my research by engaging discussions in how the environment can impact human health and the policies that respond to these effects.



A cluster of breast cancer cells. Scanning electron micrograph.

Exploring the Solar System by Evaluating Habitability

Research Topic – Hydrodynamic Model of Atmospheric Capture by Charon with applications to EGP's
- Prabal Saxena

The research is centered around the potential capture of an atmosphere by Charon from the loosely bound atmosphere of its parent planet Pluto. Analogous situations with Extrasolar Giant Planets (EGP) and their moons could widen the current views on potentially habitable bodies outside our solar system.

Sixth grade students explored the related notion of habitability by researching the physical characteristics of selected bodies in our solar system and then comparing them to what they had created as criteria for habitability. They then conferred with each other and chose the most suitable body to explore.

Statistic-based Prediction

Research Topic – Stochastic Modeling
- Alexander Kozera

Stochastic modeling is a technique of presenting data or predicting outcomes that takes into account a certain degree of randomness, or unpredictability. Rather than using fixed variables such as in other mathematical modeling, a stochastic model incorporates random variations to predict future conditions and to see what they might be like. To do this, computer simulations and models are run hundreds of times or more to gain insight into how the model will act and the variations that will occur.

Students were introduced to trending and equilibriums. Students gained data in a simple experiment - heating and cooling water and measuring the temperature with thermometers. We then plotted the data and talked about future values. I taught them about trends and what would happen at the points of water boiling and freezing. I tried to get them to understand the strength of a quantitative model and their applications to a wide variety of problem. My research is strongly tied to this usage of mathematical models.