The SUNRISE project aims 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 G4-5 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.

**Fellow Disciplines**

- Christina Henderson - Physics and Astronomy
- Frank Andreani - Mathematics
- Golaya Arya - Chemistry
- Jennifer Ambler - Environmental Science and Policy
- Lane Nixon - Computational Sciences and Informatics
- Manisha Shrestha - Biochemistry
- Megan Durham-Colleen - Biosciences, Microbiology, and Infectious Disease
- William Brehm IV - Physical Sciences

**Curriculum Enrichment and Integration Of Fellow’s Research**

**Electronic Structure and Superconductivity**

Research Topic: Computational solid state physics and electronic structure calculations of high pressure systems

In this lesson students are introduced to the properties of the transition metals. Students are shown how the fundamental underlying concepts they are learning are used in Electronic Structure Calculations to help explain and predict the quantum mechanical superconducting bond. To simulate and approximate evaluation, students observe, record, and analyze the damping oscillations of two markites, of different color and size, in a smooth chip dip tray.

**Monera-Kingdom**

Research Topic – Cloning expression and in vitro refolding of human beta defensin -2 and -3 and mutant peptides – Manisha Shrestha

Students are introduced to the kingdom “Monera”, characteristics of organisms in this kingdom, and how bacteria can be used in research. Different classes of bacteria have been used in research as a host for cloning and expression of proteins. In this lesson, students learn one of the techniques to grow bacteria including optimal temperature, growth condition, and incubation time. Students observe and swab different surfaces to observe bacterial growth. Students observe slides of coccus, bacillus, and spirillum under the microscope to learn that bacteria can be categorized based on their shapes.

**Biofilm Formation**

Research Topic - Quorum Sensing and Biofilm formation using two component systems – Megan Durham

In our lab, we study the genes that control biofilm formation with the goal of designing antimicrobial agents that could target in vivo biofilm (a biofilm that forms inside the human body). Although the approach we take in studying biofilm formation is highly molecular, this lesson seeks to study biofilms at an observational level which is more appropriate for 6th graders.

**Galactic Evolution in the Classroom**

Research Topic – Analysis of Hubble data to determine bulge properties of low-bulge galaxies – William Brehm

Some topics simply capture a child’s interest. For example, telling them that we suspect that there is a giant whirling machine of death in the center of every galaxy is always a hit and the fifth graders are, not surprisingly, what the children tended to remember most when asked about what they had learned later.

**Investigating the Solar Wind**

Research Topic - Analysis of Ulisses data to confirm or reject model/data about the solar and heliospheric current sheet – Christina Henderson

In this lesson, students use knowledge gained from simple hands-on projects to predict whether or not the Sun has wind. Then they analyze real solar wind data to better understand how the solar wind changes over time. The lesson’s premise is to predict whether or not the Sun has wind. Histogram of 36 years of solar wind speed data accessed at virbo.org.

**Modular Arithmetic and Encryption**

Research Topic - Enumerative combinatorics and Euclid’s polynomial – Frank Andreani

Since the children were familiar with clocks (arithmetic module 12), clocks with a different number of hours were shown to explain modular arithmetic. In conjunction lessons with some basic encryption schemes were presented. Afterwards there was a discussion on the application to computers and the internet.

**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.
- Fellows use IT rich STEM modules and lessons from Fellow research areas and infuse them into elementary school environment through hands on experiments
- Fellows engage in after school programs, Discovery clubs, School science days, Fairfax County Science Fair projects, answer questions dropped off in the “Question Box”, and participate in field trips.

**Integration of Methionine Biosynthesis into Grade 5**

Research Topic – Chirality, the biosynthesis enzyme -Golaya Arya

This integration of research was applied in the mason to micro unit. At the beginning of the five kingdoms of the living things, amino acids were introduced.

Students were introduced to amino acids as the twenty building blocks of life. Methionine was introduced as one of the amino acids.

**Marine Animal Sounds**

Research Topic – Habitat use of large whales in Virginia nearshore and marine conservation opinions of the whale-watching public in Virginia beach, VA – Jennifer Ambler

Students listened to and saw spectrograms of marine animal sounds, including sounds made by humpback whales. They were then asked to determine which were high and low frequency sounds. This lesson complimented their studies on compression waves and my research interests in marine mammal ecology and conservation. Spectrograms and sounds courtesy of Ocean Conservation Research, available at www.ocr.org.