University of Houston GK12 Program: The Science Behind Harry Potter

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Abstract

The objective of our GK12 program at the University of Houston is to provide engineering graduate students engaged in state-of-the-art nanotechnology related research to learn the articulation of complex scientific and engineering issues in a GK-12 classroom environment through direct ***immersive*** interaction with students and teachers via interactive modules of the sort proposed in the book, ***The Science Behind Harry Potter***. For example, Harry Potter's invisibility cloak is used to motivate the study of optics. Here, we present our attempts to enrich secondary school science curriculum through a series of unit plans and activities. Some examples of how these ideas were implemented into the classroom include the following: (i) The students were asked to make a list of magical tools found in Harry Potter and their use. These tools were discussed as a class. The students were very excited about the idea of a tool as the class transitioned into discussing weather tools. (ii) The Latin roots present in the magical spells spoken in Harry Potter were identified. These same roots were then recognized in biology and chemistry vocabulary words. (iii) While studying plate tectonics and earthquakes, the students were shown pictures of earthquake induced building collapses. The students learned how earthquake engineers design buildings to withstand earthquakes and were able to correctly identify where structural elements of buildings should be placed for maximum earthquake damage prevention.

Educational Goals and Learning Outcomes

- **Objective: to provide engineering graduate students with the skills necessary to articulate complex scientific and engineering topics to lay audiences**
- **Approach: to pair each graduate student with a middle or high school science teacher and place the student in that teachers classroom where he or she will teach complex topics to middle or high school students through interactive modules of the type proposed in *The Science Behind Harry Potter***

Approach and Methods

- **Graduate Fellow Selection: targeted a diverse mixture of students, students were required to nearly be finished with coursework for an MS or PhD degree, have a minimum GPA of 3.5 in his or her major, and submit a questionnaire and essay on motivation to join the program**
- **Teacher Recruitment and Selection: solicited applications from past UH RET participants with recommendations/approvals from each teacher's respective school principal**
- **Matching of Graduate Fellows and Teachers: based on the scheduling, geographic locations and areas of expertise**
- **GK12 Fellow Training: program provided 30 hours of formal training during May and June 2009, training included learning the following skills: (i) writing lesson plans, (ii) lesson delivery, (iii) writing learning objectives, (iv) writing assessments, (v) accommodating the needs of special populations, (vi) inquiry-based teaching and learning (vii) classroom management, training also required that each student write three complete mini-units and perform a peer-reviewed demonstration**
- **'Nano' Conference: program provided familiarization of nanoscience related topics including an introduction to nanophysics, an overview of nanodevices and materials, fabrication at the nanoscale and nanoscale metrology**

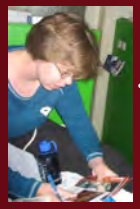
Outcomes and Broader Impact

- **Each graduate fellow learned the skills necessary to convey complex scientific and engineering issues to lay audiences through their regular interactions with middle and high school students**
- **The graduate fellows learned to make presentations interesting to a lay audience through the use of multimedia and interactive modules such as those found in *The Science Behind Harry Potter***



The Science Behind Harry Potter

- **While studying owls, the students were presented with a picture of Hedwig, the owl character in Harry Potter. The students were asked to identify what type of owl she is, her gender, why she has spots, and what she eats.**
- **The students were asked to make a list of magical tools found in Harry Potter and their use. These tools were discussed as a class. The students were very excited about the idea of a tool as the class transitioned into discussing weather tools**
- **The Latin roots present in the magical spells spoken in Harry Potter were identified. These same roots were then recognized in biology and chemistry vocabulary words.**
- **During a unit on matter, properties and change, a video of Harry Potter's invisibility cloak was shown , and the students were asked if such a cloak can exist. Through this introduction, the concept of metamaterials or composite materials with the ability to bend electromagnetic waves was explained.**



- **As part of the scientific method unit, the students learned how engineers use the scientific method everyday. This was coupled with learning about how to design a bridge. The collapse of the Millennium Bridge in *Harry Potter and the Half-Blood Prince* was studied.**

Engineering and Nanotechnology

- **While studying plate tectonics and earthquakes, the students were shown pictures of earthquake induced building collapses. The students learned how earthquake engineers design buildings to withstand earthquakes and were able to correctly identify where structural elements of buildings should be placed for maximum earthquake damage prevention.**
- **During a unit on space, the students were presented with concept of a space elevator. This led into a discussion on carbon nanofibers and their various uses across science and engineering disciplines.**

- **While teaching measurements, the macrocosm and microcosm scales were introduced while noting the upper and lower limits that humans can reach. Following the presentation, the nanoscale and its importance in science was explained**
- **Drawing inspiration from nature, application of biological principles to human designs have been repeatedly introduced. As an example, during a friction unit, research completed by nanoscientists to make controllable friction and adhesion in the toes of a nanoscientists to \climbing robot by mimicking nanohairs existing on gecko toes was discussed.**

- **During their scientific method unit, students used the scientific method to design and build paper bridges. The students tested and improved their bridges to reinforce their skills.**

Acknowledgements/Sponsors

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