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May—June 2008

Building STEMcinnati City

NSF GK-12 Project STEP: Teacher Perspective

Withrow University High School—Year in Review by WUHS teacher Jaz Dhillon:

Standing at the front of his classroom, math teacher Jaz Dhillon can feel overwhelmed by the responsibility of guiding his students through a year of Algebra 2. Moreover, those 15 through 18 year olds can be demanding. So he has to be on his game to keep them engaged. Fortunately, this year he is participating in STEP and receiving support from graduate fellow Michael Starr. Starr has played an integral role in developing activities which draw links between Dhillon's curriculum and Starr's background in chemical engineering.

When he is in class, Starr is often called on by the students to provide help with assignments. Starr moves around the classroom with ease offering insight and assistance that is invaluable to Dhillon's classroom. Of Starr, 11th grader Randy Hill says "he's cool and smart." Recently, during one of Dhillon's Algebra 2 classes, many students could be seen intensely engaged in an experiment that related bone tissue replacement to systems of equations. Some of the students even smiled as they worked through the simulation and later completed a related assignment. Thanks to Starr and STEP, Dhillon's class saw marked benefits.



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<http://www.eng.uc.edu/step/>

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Norwood High School— GE Field Trip by teacher Sara Garrison

At Norwood High School, STEP fellow Colleen McGannon was working with STEP teacher Megan Urbaitis to create a lesson on flight to present to several freshman physical science classes during the winter.

Following the lesson, approximately 85 freshmen traveled to the General Electric Aviation Training and Education Facility in Cincinnati. While on this field trip, students heard a presentation from General Electric staff about how aircraft engines work. Then, students toured the facilities where General Electric aircraft engineers are trained. During the tour students saw several engines, including aircraft engines that have been transformed into naval engines. In addition, students got a closer look at the aircraft engines through the use of mobile cameras that are placed inside the engines and by actually standing inside an aircraft engine.

As a result of this field trip and the lessons on flight, students gained a better understanding of aerodynamics and how the

transfer of air molecules allow heavy aircraft to fly long distances. Students were exposed to math and science-related careers. The field trip also related to an engineering lesson that freshman completed in STEP teacher Sara Garrison's geometry class at the end of the year. During this lesson, students worked in teams to design and sketch a scale model of a corporate park. Colleen McGannon will assisted with this lesson.

By NHS student Emily Schneider:

Today on our GE field trip I learned that the fuel that powers airplanes is made of kerosene and gasoline. I also learned how heavy the blades in the engine are, and why they are numbered. The engines are very large. For example Becca Lynch stood on an engine to show how big they are and the engine was almost twice the size of Becca. Engines are also very loud just by starting a certain part of it. I didn't know that engines could suck people in. The engines truly amazed me. I learned that you need to be responsible and trustworthy to work at GE because these engines fly planes with many children and adults of all ages. Lives are in the workers hands and the job is very important.



Lesson — From Ants to People : Swarming Behavior

**NSF GK-12 Fellow: Aimee Frame
Newport High School**

Duration: 50 minutes

Materials Required:

In-focus machine
Power-point
Video Camera

Activity Summary

1. **Catch –**

*Have video ready to be shown before class starts. Tell the students that they are going to watch a short video and that they are to record their observations about how the animals behave.

2. **Activity –**

*Have video ready to be shown before class starts. Tell the students that they are going to watch a short video and that they are to record their observations about how the animals behave.

*Lead a short discussion on the reading assignment and what they just observed in the video. Develop definitions of swarm, swarm behavior, etc.

* Do activity sheet

*Give a short power point presentation on engineering research that relates to swarming behavior.

Summarize the major points of the lesson as question/answer session.

3. **Review and Post assessment -**

*Prior to the lesson, the students will be given an article to read with questions to answer. This will aid in our discussion on swarming behavior.

The same test will be given sometime prior to the lesson and after the lesson.

This complete lesson can be found online!

Summary & How this relates to the STEM Cincinnati Theme

- The purpose of this lesson is to introduce the concept of swarming behavior and why its study is important. As an introduction to the topic, the students are given a reading assignment that discusses the study of ant behavior. The class then begins with a short video that shows more examples of swarming behavior, including previously taped footage of the students exhibiting such behavior. Small group discussion is then used to develop definitions based on what the students have observed in the video and read in the assignment. Once the definitions have been established, an activity demonstrating how simple rules can lead to complex swarm behavior is conducted. Finally, a discussion on how swarming behavior is being applied in real-world situations and engineering research.

Objectives

Students will be able to:

Define a swarm.

Describe the characteristics of swarm behavior.

Give an example of how swarm behavior is used in engineering research.



This lesson was designed for a high school biology class, but could be used with alterations for many other levels or subjects .

Kentucky Standards

Geometry and Spatial Sense Standard –

Intended grade level and subject: Grade 9 Biology

Kentucky Core Content:

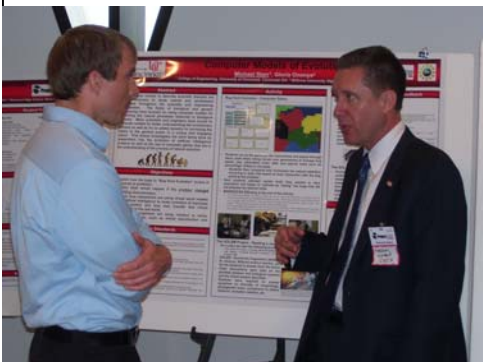
- **SC-HS-3.5.2:**
Students will:
*predict the success of patterns of adaptive behaviors based on evidence/data;
*justify explanations of organism survival based on scientific understandings of behavior.
*The broad patterns of behavior exhibited by organisms have changed over time through natural selection to ensure reproductive success. Organisms often live in unpredictable environments, so their behavioral responses must be flexible enough to deal with uncertainty and change. Behaviors often have an adaptive logic.

More STEP lessons to use:

For more information, including lesson plans and handouts, visit the STEP website at <http://www.eng.uc.edu/step/activities/>.

NSF GK-12 STEP Open House April 30, 2008

The NSF GK-12 Project STEP Open House featured many speakers and presentations on April 30, 2008. Lead PI, **Dr. Anant Kukreti**, welcomed the UC community to view the lessons that the five



STEP Fellows created over the course of the year. There were over 15 poster presentations by the STEP Fellows. After a poster session, **Andrea Burrows**, grant coordinator, gave an overview of Project STEP and the accomplishments of the year. Helping Burrows were STEP Fellows **Carol Clinton**, **Safa Herfat**, and **Michael Starr**.



Clinton presented information on the "extras" of STEP, like student field trips. Herfat gave a student perspective of the program. Starr spoke of his international experience to Tanzania. Dinner and conversation was followed by Newport High School teacher **Carol**



Dunn contributing to the international Tanzania experience. The STEP Fellow working with Dunn, **Aimee Frame**, shared stories from NHS. The final presentation was by STEP Fellow **Colleen McGannon**. She gave the STEP Fellow perspective of Project STEP. One of the



teaches that she worked with, **Megan Urbaitis**, shared interesting tidbits from the year. Over 45 people attended the open house including the 7 Project Oversight Committee (or POC) members. Project STEP is looking forward to another outstanding year in 2008-2009.

Michael Starr

As part of my STEP fellowship I developed and conducted 5 major lessons in Chemistry, Biology, Algebra 2 and Physics at Withrow University High School. The first lesson I conducted was in November of 2007 in the Chemistry class and had the students determining which reactions were chemical and which were physical based on their observations and prior knowledge. The next lesson was conducted in the Algebra 2 classes and introduced the students to some of the tools used by surveyors and engineers and had the students build their own inclinometers, which they used to measure the heights of the football goal posts on their schools campus. The third lesson I conducted was of the module type and was an engineering design project revolving around the University of Cincinnati's student bridge competition. Students had to work as teams to conduct a complete design process from brainstorming to research to budgeting all the way to completion and testing. The fourth lesson I conducted was on computer simulations and artificial intelligence studies of evolution in the Biology class. Students were introduced to an interactive computer games that helped explain the process of evolution as well as research conducted in artificial intelligence evolution by a professor at Cornell University. The final lesson I conducted was in the Chemistry class and was a lab that dealt with polymers, cross-linking and elasticity. Student's studied temperature effect on elasticity as well as how cross-linking the polymers in white glue formed elastic like material. My favorite major lesson I conducted was the computer models and artificial intelligence studies of evolution. I really enjoyed the student's reaction to the lesson as well as the class discussions we had based on the research done on the evolution of artificial intelligence.

In addition to the 5 major lessons I did a few mini activities with the different classes. I helped students with the BEST robotics competition in the fall, building a complete remote controlled robot from a box of parts and objects capable of moving and picking up and dropping objects. I also arranged for Ken Simonson from Emerging Ethnic Engineers to come to Withrow to talk to freshman and sophomore students as well as seniors. We also planned a field trip for students from the different classes in which I worked to come and tour the engineering facilities at the University of Cincinnati.

Safa Herfat

Having the opportunity to teach at Western Hills Design Technology High School throughout the year has definitely elevated my teaching skills while also allowing me to mentor the secondary students. Both the students and STEP teachers were a pleasure to work with. The activities outside of the classroom such as the science fair and the field trips to UC and COSI gave me a valuable opportunity of bonding with the students. I really enjoyed the diversity amongst the students. One very important thing I have taken away from this experience is the difficulty in preparing most inner city students for college. The students are bright and in need of good learning experiences. STEP has inspired me to continue mentoring to provide the students with a positive role model.



NSF GK-12 Project STEP Year in Review

Aimee Frame

Through the course of the year, I have gotten to know each STEP teacher at Newport High School, as I worked with their classes, developed my STEP lessons (“Minimizing Tension: A Lesson on Vectors” for Ann Greely’s AP calculus class; “Surface Area, Volume, and Heat Transfer” and “Trigonometry Superbowl” for Gabrea Bender’s geometry classes; “Ants to People” for Jean Becker’s biology classes; and “Alternative Fuels” for Carol Dunn’s chemistry class), and attended the KSTA conference in November. I have also gotten to know many of the students while helping them with labs or group work, teaching the STEP lessons, assisting with the bridge competition, and other interactions.

Although I enjoyed developing and teaching each of the STEP lessons, my personal favorite was the lesson on swarming behavior for the biology class. I had been looking forward to this lesson all year, ever since I taped the class while they looked at each other’s cell models back in the fall. The students’ reaction to seeing themselves on tape was priceless and was a great opening to the lesson. After the opening, the lesson flowed nicely from discussion to activity and back to a discussion on how I have used swarming behavior in my research.

As we near the end of the year, it is hard to say goodbye to all the students and teachers that I have worked with at NHS. Although I may never see some of them again, the lessons that they have taught me will stay with me forever.

Colleen McGannon

Throughout this year, I completed a variety of lessons with the Norwood team of teachers including the biology lessons: The Difference Between Prokaryotic and Eukaryotic Cells and The Genetic Engineering of Bt Corn, the physical science lessons: Ionic and Covalent Modeling and Talent, for the pre-calculus classes: The Exponential Spread of West Nile Virus and the geometry lessons: Packaging Engineering Utilizes Surface Area and Volume. I enjoyed helping address the age old question that was asked in every single classroom...“When will I use this?” It has been very rewarding to watch the students progress throughout the year. They have heard about *E. coli* (the bacteria that I research) and then asked me about it, read and critiqued primary literature, used math in real world applications and have indicated that they were interested to learn about a new branch of engineering.

(Colleen McGannon: Year in Review continued)

At the close of the year, during an exam review session, one student fired off an answer about ionic bonding based on a cheer she had made up for the talent portion of the lesson. It was a great opportunity to remind the students that learning and retaining the material becomes easier if it is put within a context that they already enjoy. Overall, I have found it very rewarding to have had the opportunity to work with these students and plan on continuing in the future.

Carol Clinton

“The hardest job you’ll ever love” is usually a phrase used to describe parenting. I think it works here, too. But being a Fellow is more like being a grandparent: you get to come into the classroom and have fun without issuing detention slips!

This year I was fortunate to work at Hughes Center’s Cincinnati Academy for Math and Science (CAMAS) program with three inspiring teachers: Sharon Bachman (in her grades 11 & 12 Science classes), Anna Hutchinson (grade 10 Science), and Rebecca Richmond (grade 10 Geometry).

Over the course of the year, I developed and delivered the following lessons:

Tantalizing Triangles: a Geometry lesson on basic triangle properties (measuring and calculating lengths and angles, classifying triangles, creating congruent and similar triangles) and coordinate geometry (defining and plotting ordinants of vertices) using local Cincinnati bridge trusses as examples and incorporating tangrams;

Triangle Transformations: a Geometry lesson on translation, rotation and reflection of shapes, plus computation of slopes and line equations, with tessellation art as an extension;

Drinking-water Dilemmas: a unit that began with a discussion of whether to ban the dangerous chemical dihydrogen monoxide (water! – a good demonstration of the need for scientific skepticism) that included several days of lecture on global drinking water supply and management, potential impacts of global climate change, water cycle, computation of a Cincinnati water balance and prediction of future scenarios, my graduate research on drinking water treatment, and a competition where students used engineering methods to design and test devices for treating Ohio River water;

Skittle Statistics: a lesson using colored candies to represent environmental contaminant levels and teach basic statistical computation and graphing methods (also exposed students to concepts of toxicology and environmental engineering); and

Planetary Processes and Personal Choices: a unit that evolved during the year to include lectures, labs and field trips covering formation of the atmosphere (biogeochemistry), plate tectonics, origin of major life forms, global water and carbon cycles, ice ages (including impact of glaciers on Ohio), past climate variations and predictions of upcoming climate change, the respiratory system and chemistry of respiration, major air pollution sources and health effects, Cincinnati air quality data, and the impacts of transportation options on sustainability (environment, equity and the economy).

While I taught the concepts listed above, I learned an amazing amount! Besides the new pedagogical knowledge I gained and practiced, preparing the lessons helped me distill my own understanding of the topics and really reinforced my pride in engineering, truly the foundation that makes modern society possible.

(Reflections by Fellows Safa Herfat and Michael Starr are found on pg 3.)

