PEER PERSPECTIVES

Volume II: A Novel Approach to Quality GK-12 Interactions

Graduate student involvement in GK-12 learning, presentation tips, PEER research findings, graduate and undergraduate testimonials, tips for graduate students in the classroom, and middle school lesson plans.

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Partnership for Environmental Education and Rural Health
Department of Veterinary Integrative Biosciences, TEXAS A&M UNIVERSITY
Brittany Sanchez, Dr. William Klemm, and Dr. Larry Johnson

Letter from the Principal Investigator

In the last six years, we have had two, three-year National Science Foundation (NSF) GK-12 projects. Significant contributions have been made to Fellows' development, teachers' STEM (science, technology, engineering, and mathematics) content and K-12 interest in STEM and related careers. K-12 training and experiences have been provided to 62 graduate Fellows. These graduate Fellows acquired mentoring and management skills by supervising 94 Honors undergraduates who helped them prepare lessons and activities. The graduate Fellows served as content resources for 64 Lead Teachers and 110 other teachers and over 13,620 K-12 students in twelve (mostly rural) schools (54% minority students and 59% eligible for reduced lunches).

Fellows significantly improved their ability to teach with inquiry-based methods of Reformed Teaching Observation Protocol (RTOP) evaluations and they increased classroom inquiry levels. On a survey completed at the end of the school year, 90% of graduate Fellows agreed that their GK-12 experience strengthened their career path and provided more opportunities; 80% agreed that it contributed to their understanding of their disciplines; 95% had integrated their STEM knowledge into their K-12 classroom; 85% had presented their own research and research techniques; 65% agreed that their advisor, professor, or colleague noted their presentation/teaching style had improved after GK-12 involvement; and 100% agreed that the GK-12 program made them more complete STEM scientists/mathematicians.

Fellows had a significant impact on the K-12 students and teachers. Our surveys indicated that the general decline in interest in STEM subjects in grades 6 to 8 was significantly attenuated in classes where our Fellows served. Teachers reported that fewer students were absent from school on days that Fellows were in class. Teachers improved their use of technology, expanded their mathematics and science capabilities, and reported that they enjoyed public school teaching better when having a Fellow as a content specialist in their classroom.

To extend the impact to more rural schools, we developed a Distance Learning Community of over 4,000 teachers state-wide providing communication through our Teacher Requested Resources (TRR) webpage (see http://peer.tamu.edu/DLC/NSF_Resources.asp). The TRR allows teachers in remote locations to request lesson plans, activities, and websites as they inform us of their needs and direct our development. Once a response has been produced by the Fellows, it is evaluated for content by STEM faculty and for public school and age appropriateness by middle school teachers. The TRR contains 279 lesson plans that our graduate Fellows and the management team have produced and tested in their schools. These customized, mostly 50-minute school-tested lessons are available to other GK-12 programs nationwide and will be sustained after the project.

Our group organized and hosted the first and second Southwest Regional NSF GK-12 Conferences which were attended by 10 and 16 GK-12 groups from 5 and 8 states, respectively, as well as by Dan Carpenter or Kevin Swanson, and Sonia Ortega from NSF. Following the first conference in October 2005, our group launched the Southwest Regional NSF GK-12 website (http://southwestgk12.tamu.edu/) which enables other GK-12 groups to upload lesson plans from their programs. The site is designed so that users can search a substantial collection of lesson plans. To date, 443 lesson plans have been posted to the site.

All of these activities, previous and planned, are consistent with Texas A&M University's Vision 2020 strategic plan. Imperative 12 of Vision 2020 states that Texas A&M University will "meet our commitment to Texas." This includes addressing difficult social problems like enhancing public education, environmental protection, and economic development. All of the accomplishments of the PEER program are made possible by funding from NSF and NIH and the efforts of dedicated students (graduate and undergraduate), teachers, staff, and faculty. For their dedication and efforts to improve education, meet grant requests, and help meet our commitment to Texas, I thank them. – Larry Johnson.

Dr. Larry Johnson displays two sections of the head of a dog to teach about body systems.

About Dr. Johnson: Larry Johnson, professor in the Department of Veterinary Integrative Biosciences at Texas A&M University, has published over 110 original, peer-reviewed, scientific journal articles; given invited scientific talks on four continents; won a national research award; served on a research panel for the United States Congress; served on NIH, NSF, USDA, and NIOSH grant review panels; received NIH and/or NSF funding for over 25 years; served on editorial boards of three scientific journals; and received both college-level and university teaching awards for his histology courses. He also received the Texas A&M University Chapter of Sigma Xi Science Communication Award 2001, the Association for Former Students Distinguished Achievement Award 2007, and the Bush Excellence Award for Faculty in Public Service 2009.

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Part I: Research Findings

Part II: Lesson Plans and Worksheets

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About Brittany Sanchez:
Currently a GK-12 undergraduate Fellow, Brittany Sanchez has worked for PEER since September 2008 creating lesson and activity plans, making posters for GK-12 conferences, and assisting her graduate Fellow both in and out of the classroom. Brittany initially chose to major in communication/graphic design; however, that changed after she decided instead to recognize her strengths in mathematics and science. She will graduate with her Bachelor's degree in Biomedical Engineering in May 2011 and plans on continuing to graduate school.

PEER Overview

Goals and Roles of the PEER GK-12 Program

Larry Johnson and Brittany Sanchez

Project Goals

To enrich graduate education and professional development of graduate Fellows and teachers and to enhance interest in learning and improve academic performance of K-12 students. The project hopes to inspire the next generation of researchers in academia, industry, and government to become aware of and sympathetic to challenges and opportunities in K-12 education, and of how they can contribute and improve the science, technology, engineering, and mathematics (STEM) content and interest of K-12 students and teachers.

Objectives are to:

1. Help GK-12 Fellows improve pedagogical, communication, and teamwork skills, thus enhancing future career opportunities;
2. Provide resources to rural schools throughout Texas via a distance learning community and worldwide resources through the PEER website;
3. Assess the short-term and long-term impacts of the program on middle school students, their teachers, and GK-12 Resident Scientists;
4. Assess the educational materials produced and educational partnerships established;
5. Facilitate long-term interactions between teachers, teacher educators, industry, and university scientists;
6. Facilitate a long-term, sustainable interface between Texas A&M and public schools.

Lead teachers and graduate Fellows gather for teacher-fellow training before the start of the school year.

Roles of participants in the GK-12 program: The main players are the GK-12 graduate Fellows (Resident Scientists/Mathematicians) and Lead Teachers.

The GK-12 Graduate Fellow provides STEM content expertise, demonstrations/presentations, materials and resources, and acts as a conduit to university faculty and resources. They serve as an example of scientific and mathematical thinking and as a role model of someone who enjoys and plans to make a career in STEM.

The Lead Teacher assists the GK-12 Fellows in meeting school needs, organizes and obtains resources, mentors the Fellows, and communicates to project managers how things are going in the school and what is missing. Lead Teachers mentor and provide teaching opportunities for the graduate Fellows via classroom interactions with K-12 students. ■

Teaching Technique

- 86% of our NSF Fellows plan on going into a career that will involve teaching of some sort.
- Over 90% feel that the PEER program has helped them reach their teaching goals.
- The average proficiency/comfort with various aspects of teaching was 63% before the PEER program. That number increased to 82% after the PEER program.

Lead teacher, Sonia Junek, with a group of her middle school students.

Quick Definitions

PEER- Partnership For Environmental Education and Rural Health; outreach component of CERH. Visit peer.tamu.edu for more information.

NSF- the National Science Foundation, which supplies part of PEER grant funding. Visit www.nsf.gov for more information.

NIEHS- the National Institute of Environmental Health Sciences, which supplies part of PEER grant funding. Visit www.niehs.nih.gov for more information.

CERH- the Center for Environmental and Rural Health, parent organization of PEER, with the goal of promoting rural health awareness. Visit cerh.tamu.edu for more information.

NSF GK-12 Graduate Fellow- A Texas A&M University science, technology, engineering, or mathematics graduate student who works in a local middle school classroom assisting math and science teachers. Known as a Resident Scientist/Mathematician.

NSF GK-12 Undergraduate Fellow- an undergraduate student at Texas A&M University who serves as support for a Resident Scientist/Mathematician and assists in developing activities for use in middle school classrooms.

Resident Scientist/Mathematician- NSF Graduate Fellow who acts as a content specialist in his or her middle school classroom. Teachers are asked to carefully distinguish student teachers from Resident Scientists and Mathematicians.

STEM- Science, technology, engineering, and mathematics, the areas of education where American children perform below the world average.

Lead Teacher- a teacher with whom the Graduate Fellow is assigned to work directly in his or her classroom.

TEKS- Texas Essential Knowledge and Skills, Texas educational standards for each grade level.

TAKS- Texas Assessment of Knowledge and Skills, Texas' benchmark test for academic proficiency.

Teaching Philosophy of a Scientist

Larry Johnson

Driven by curiosity and imagination, humanity distinguishes itself by its desire to learn. People want to elucidate mechanisms, predict outcomes, prevent undesirable situations or consequences, and plan for the future for themselves, their families, and for humanity. Young learners quickly realize the power of knowledge to establish and maintain self-esteem, to communicate with peers and others on interesting topics, to solve problems, and to overcome socioeconomic barriers.

A teacher's role is to facilitate students' desire to learn through helping them develop their knowledge base, their life-long learning skills, and their career choices. Teachers direct thinking behavior, motivate and encourage students, widen students' self-expectations and self-evaluation, and expand their opportunities and career choices.

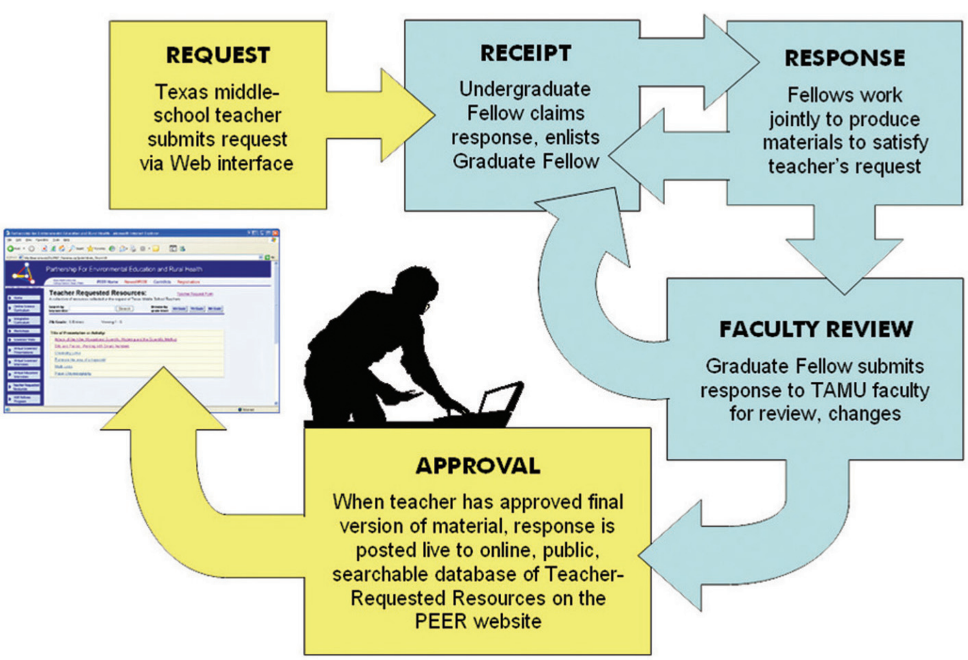
Teachers can make a difference in the lives of their students. This includes immediate and life-long learning behavior, development of learning skills, and direction of careers. How many people in academia can cite the "third grade teacher" or "college professor" who would not accept mediocrity, who directed them to a certain life-changing book, who widened their opportunity, or who prevented a wrong decision?

Teaching yields "immediate gratification" for one's efforts. The evidence of one's educational approach or point made is immediate in students' faces or behavior or in the questions they can now ask. There are distinct behaviors that indicate students are learning. "Oh, so that's how it works," a student may say. When a research discovery is made, there is at least 95% effort on verification and an expected delay in acceptance of one's discovery by the public. In teaching, the class is the public. Teaching allows scientists to try different ideas or approaches and to hold an investigation of what works with a given group, with students being the study subjects.

In summary, teaching represents a unique opportunity instructors have to mold and direct academic lives of students and to facilitate the students' inherent desire to learn through stimulation of their curiosity and imagination. In return, instructors stay young in their thoughts, stay interested and motivated in their subject, stay current, and enjoy immediate gratification for having affected a small part of humanity. ■

Dr. Johnson shows students a lung cast illustrating highly branched airways in front of a real lung.

Teacher-Requested Resources



TRR is an online interface through which teachers receive personal assistance with science and math related questions.

These resources allow teachers in remote areas of the state and around the world to request websites, activities, and even customized lesson plans which our undergraduate Fellows create with the assistance of their mentoring graduate Fellow. Teachers are able to direct our activity to better meet their needs both in terms of subject area and lesson depth. Once a response has been produced, it is evaluated for content by STEM faculty and for public school and age-appropriateness by middle school teachers.

(http://peer.tamu.edu/DLC/NSF_Resources.asp)

Bringing Local and Exotic Oceans Into the Classroom

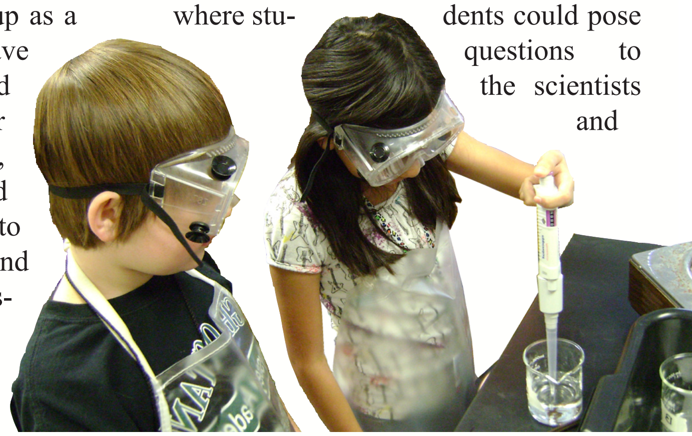
Ruth Mullins

For the past two years, I have had the opportunity to become involved with the formation of the Odyssey Academy at Stephen F. Austin Middle School (SFA). From my role as an NSF GK-12 Resident Scientist, I have invaluable opportunities to impact students' interest in science, help promote geosciences in Bryan, TX, and interact with the greatest teachers in the community! My research field, oceanography, based on first impressions, is often perceived as exotic and not a realistic career science. However, the field of oceanography encompasses every area of basic science from physics to chemistry to biology. My experiences during my graduate study have had an enormous impact in the classroom and on my skills as a successful scientist. They have also allowed me to not only teach about the oceans, but also create and enhance the geosciences curriculum for SFA. Being in the classroom and working with the Odyssey team have immensely impacted my career path and I have even worked to enhance geosciences outreach within my department and in my field.

During my first year as a Fellow, I watched previous Fellows introduce lessons specific for one or two state standards at a time. Topics in the geosciences were rarely introduced and often did not include hands-on experiments or examples to show students. I decided to prioritize my expertise to focus on enhancing geosciences activities that I could present and activities that the teacher could continue to use for years to come. One perk of my research is the interdisciplinary nature. My research focuses on physical oceanography, but I work with a variety of researchers specializing in multiple areas, ranging from topics like squid population dynamics and hurricanes. To really bring light to my research, I wanted to develop a series of lessons focused on different aspects of oceanography and involve as many researchers possible. Though this seemed like a daunting task, my teacher was extremely supportive and we started brainstorming immediately!

My classroom environment is different than the standard classroom. The Odyssey program provides students with a laptop, is designed around block periods (1.5 hours instead of 40 minutes) and has students and teachers set up as a permanent team. Therefore I have more flexibility to design and teach multi-stage and longer inquiry lessons. Additionally, I expand the lessons beyond the science classroom and into language arts, social studies, and mathematics! With this, my lessons are developed with an introduction to an ocean issue, a geographical focus, by bringing examples of instruments used to study the problem, and by involving the students in the actual monitoring of the problem, including data analysis and presenting conclusions. Two examples of this included the students monitoring the oceans around the Galapagos Islands and in the Gulf of Mexico. The Galapagos Islands experience was a virtual trip of a lifetime for the students! Time at sea is a crucial part of my research and this was a major aspect I wanted to bring into the classroom.

During my graduate study, I had opportunities to participate in Galapagos Island research surveys with the Ecuadorian Navy and TAMU oceanographers. To engage the students with this cruise, I structured the involvement into three parts. Before the cruise, students learned about Ecuador and the Galapagos Islands in social studies, conducted experiments to learn about the oceanographic research in science, and designed research hypotheses for investigating the effect of pressure in the ocean for language arts. Students learned about the role of ocean density, how to calculate it, and how to apply it to global ocean circulation. While on the cruise, I communicated by Internet showing students life at sea, culture and ecology of the Galapagos Islands, and research progress. Students interacted with researchers on the cruise through an interactive blog site where students could pose questions to the scientists and



Students prepare samples of water with a pipette to test salinities of different water sources around the globe.

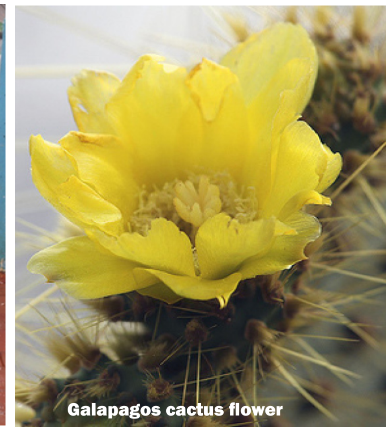
where scientists could post data, video, and pictures from the cruise. This site was such as success that I even had parents ask questions about the Islands! At sea, I ran students' experiments testing the impact of ocean pressure on Styrofoam cups. Students analyzed the results from the cruise and recorded observations into their science journals. Throughout the semester, students continued to analyze the data, as it was applicable to the TEKS covered, such as identifying different species of phytoplankton and zooplankton to learn biology. From the success of this virtual adventure, we developed a strong partnership with the TAMU and Ecuadorian researchers to continue this project on future cruises.

Another project that we were able to complete directly involved students in my dissertation research and even con-


Ruth with a Galapagos Giant Tortoise


Saltwater grotto in a lava tube


Pelicans and Sea Lions on Santa Cruz


Galapagos cactus flower

vinced my graduate advisor to continue this educational outreach in his research efforts. From the success with the Galapagos project, my advisor and I collaborated on building an outreach component to involve students in understanding and researching the coastal environment. Our group focuses on studying hypoxia in the Gulf of Mexico, which is seasonally occurring low oxygen at the bottom of waters off Louisiana and Texas caused by physical conditions and the influx of agricultural nutrients. This condition can severely affect the coastal environment and ecology, is persistent year-to-year, and has extreme political implications between the coastal and farming industries. As with the earlier example, we structured this lesson to have three components. The lesson was introduced in both my SFA classroom and a 5th grade classroom at St. Joseph's Catholic School in Bryan, Texas. The first part, the pre-cruise, introduced students to the problem and how we research hypoxia, taught them about designing a cruise plan and about the types of instrumentation we use. The second component, the cruise, had students track our daily progress by downloading information, pictures, and video from our websites. The third component, the post-cruise, had students analyze samples brought back from the cruise to contribute data to the project, including ecology of mud samples and plankton to measure salinity and analyze graphs of oxygen concentrations collected by our sensors. After completion, students were recognized as 'Oceanographers in Training' and presented official certificates and mementos from the cruise for their contributions to the science.

"The Galapagos Islands experience was a virtual trip of a lifetime for the students!"

Instead of focusing on one or two TEKS, I worked on building lessons to cover many science TEKS with overlap in language arts, social studies, and mathematics standards. I also designed the inquiry activities to teach introductory scientific concepts that would persistently appear throughout the school year, such as calculating density and using laboratory tools. Therefore, I could always remind the students of a previous lesson or example from earlier in the year and help the students not only learn a concept, but make connections between scientific concepts. Oceanography was the perfect platform to cover almost all the science TEKS as well as from which to introduce land-locked students to science career opportunities beyond the Bryan-College Station area. Besides the impact in the classroom, I noticed improvements in communicating my research and learned how valuable outreach and education are for scientific research. I have had opportunities to present these activities at oceanographic meetings and at the National Science Foundation (NSF). Furthermore, I have brought my enthusiasm for middle school outreach back to my department and am motivating professors to build educational components into their research activities, furthered my educational outreach with different government agencies, including NSF and Texas Sea Grant. All aspects of this program helped me improve as a science communicator and increased general public knowledge about Gulf of Mexico research in my local community. Furthermore, the opportunities to mentor students and watch them grow into young scientists have instilled lifetime memories that I will always cherish! ■

Ruth Mullins's research in the Galapagos was chosen by NSF as an international highlight to showcase products of the NSF GK-12 to the United States Congress..


Students identify species of plankton from the Galapagos.

Undergraduate Fellow, Christopher Prigmore, teaches middle school students about organs and systems in a dog during a weekend presentation.

Behind the Scenes with Undergraduate Fellows

The Making of GK-12 Lesson and Activity Plans

Christopher Prigmore

As I walk around the poster presentation session at the 2010 NSF GK-12 National Conference there is one fact that separates me from any other person at the conference and our program from any other GK-12 program in the country: I am an undergraduate student.

Although other programs across the nation may have previously had undergraduate Fellows, PEER did not let cuts in funding remove such a vital aspect from our program. Instead, PEER secured an alternate source of funding to preserve the continuation of support from the undergraduate Fellows. But what is it exactly that the undergraduate students do and how do other programs function without them?

The undergraduate Fellows have multiple roles in our PEER GK-12 program, the first and foremost being a support system for the graduate Fellows.

We create lesson and activity plans to take into middle school classrooms, search for interesting and engaging websites, help collect materials and set up hands-on teaching activities, and occasionally visit the classroom to serve as positive role models for the middle school students.

For example, my graduate Fellow asked me to create a lesson on probability for 7th grade students that they could complete on their own. I decided to create an interactive game incorporating Macromedia Flash and PowerPoint to provide students with an engaging activity that would provide instant feedback for participatory learning.

I then had the opportunity to go into the classroom with my graduate Fellow, assist with the presentation and observe how the students interacted with the game. Instead of on computers, they played the game on a SMART board, which allowed them to get out of their seats, move around and learn. This experience taught me the importance of making all lessons and activities very engaging, hands-on and fun.

But I did not create this lesson alone; I collaborated with a fellow undergraduate student to produce this innovative activity. Since most of the lesson-creating is done by undergraduate students, the graduate students are, as a result, provided with more time to focus on their research or to be in the classroom and thus, providing a more enjoyable GK-12 experience for everyone.

Another aspect of the PEER program that we serve is the Teacher Requested Resources (TRR) where we are responsible for communicating with and being a resource for teachers in rural areas via the internet. This provides an opportunity for any teacher from any location to request assistance in their personal classroom. We have had requests from teachers wanting help teaching a difficult topic to those just looking for a different approach to a certain subject.

I received a request from a teacher in South Africa wanting "shoestring science" experiments. Since he did not have many available resources, he needed experiments that could be completed with commonly found household items. Undergraduate Fellows respond to many such requests, which provides another dimension to the PEER GK-12 program.

Our program also frequently hosts presentations for minority student groups sent by the Financial Aid Office. Undergraduates assist in the administration of these presentations and with the corresponding activities. These students have the opportunity to learn about college by meeting with both graduate and undergraduate students.

The goal of our program is to enhance interest in learning, to improve academic performance and to enrich education. These objectives may be intended for K-12 students but with the collaboration of graduate and undergraduate students, encouragement for undergraduates to continue to graduate school, to become teachers in STEM fields, or simply to challenge themselves academically has been a result.

Our program strives to encourage student involvement and we have done so at the middle school, high school, undergraduate, and graduate levels. ■

"It is inspiring to know that I enhance classrooms all across the nation through the Teacher Requested Resources."

Rewarding Remarks

Undergraduate Students Benefit from GK-12 Interactions

Brittany Sanchez

The undergraduate Fellows are at the heart of the PEER GK-12 program creating lessons and activities to inspire young scientists and mathematicians. And although they are not necessarily at the forefront of the project's pursuit, their efforts behind the scenes make for a successful program.

PEER collected comments from the undergraduate Fellows about their involvement in the program, from what they do to how they are influenced. By investigating both their qualitative experiences and quantified responses, PEER was able to determine how the GK-12 experience has enhanced undergraduate student skills, knowledge, goals, and opportunities.

Undergraduate Fellow, Brittany Sanchez, teaches about the digestive system with a hands-on approach.

The Voice of the Undergraduates

"As an undergraduate Fellow, I have had the opportunity to assist graduate Fellows in preparing exciting experiments and lessons for middle school science classes. It's rewarding to see my own enthusiasm for science and engineering being put to work to help younger students."

"I had the opportunity to go into the classroom one year right before Halloween to help my graduate student and other teachers put on a themed science show for the kids. We did several demonstrations representing different scientific properties. It was amazing seeing the sixth-graders really get into the presentation and the whole learning process."

"I was offered the chance to present the demonstration of running 110V through a pickle causing it to glow and I found the interest of the students to be very rewarding and encouraging. As a future science teacher, it offered me the chance to get hands-on classroom experience and it affirmed my decision to enter the education profession."

Undergraduate Fellow, Aaron Osborne, assists middle school students with a hands-on adaptation activity.

"I was able to work and interact with the different students and see them truly enjoy learning. Seeing the impact I made on the students is one of my favorite memories in working with the PEER program."

"The lessons I have really enjoyed cre-

(Continued on page 14)

2010 PEER Undergraduate Fellow Survey Results

Question	Percent Agreement
Have you had the opportunity to incorporate your studies into the lessons that you've created?	80
Did you have positive benefits from participation in this GK-12 program?	100
Have you had the opportunity to go into the classroom and interact with the students?	70
Do you feel you have been successful in stimulating student interests in STEM?	100
Do you feel you have had more opportunities as a result of your involvement?	90
Have you had the opportunity of seeing a lesson of yours be implemented successfully?	90
Would you consider your involvement with the program to be rewarding to your college career?	100
Do you think your contribution has made an impact in the schools?	90
Have you had the opportunity to interact with or learn from a graduate student within the program?	100
Have you enjoyed working for the PEER program?	100

"It's rewarding to see that my own enthusiasm for science and engineering helps younger students."

Undergraduate Fellows, Christopher Prigmore and Brittany Sanchez, display their PEER GK-12 Program poster.

PEER PI, Dr. Larry Johnson, takes part in a meeting breakout session.

Graduate Fellow, Ruth Mullins, discusses her poster on bringing the ocean into the classroom.

National NSF GK-12 Annual Meeting

Brittany Sanchez

The 2010 National Science Foundation GK-12 Annual Meeting opened its doors to all GK-12 project members including PIs and CoPIs, graduate Fellows, K-12 educators, project managers, evaluators, research advisors, university and school administrators, and others. The conference was held in Washington D.C. and had numerous objectives: establishing a network among colleagues, sharing ways to invent and assess integrative lessons, summer preparing for successful GK-12 partnerships, implementing international research agendas, and recruiting GK-12 Fellows, but the most important objective was the strengthening of partnerships between K-12 and graduate STEM communities.

The three day meeting, held March 26th – 28th, 2010 focused on collaboration both within a university's own GK-12 project as well as between GK-12 projects. Joining the over 600 attendees at the meeting, participants from PEER included the PI Dr. Larry Johnson, the PEER coordinator, two lead teachers, two undergraduate Fellows, a mentor teacher, and three graduate Fellows. Everyone agreed that having different project members in attendance was beneficial to PEER as a team.

"I do feel that I have developed stronger relationships with those individuals I spent time with at the conference," said Jason Wardlaw, a PEER GK-12 graduate Fellow.

Topics covered during the meeting included a "Birds of a Feather" session for networking, a Plenary Panel on Bringing Research to K-12 classrooms with a Fellow-Teacher-PI Team offering advice, International Research Partnerships, Life after NSF Funding, several poster sessions for individual project presentations, Incorporating Technology into an Urban Middle School Classroom, and closing remarks by Sonia Ortega, Ping Ge, and Mark Hannum.

One goal of the conference was to provide GK-12 programs an opportunity to highlight their successes. By showcasing the successes of the PEER program, the strengths of our program were well recognized. PEER demonstrated success in placing more of an emphasis on classroom participation, particularly on lesson development, than other programs. It was also noted that PEER selects Fellows from an interdisciplinary set of research and backgrounds and is one of the few programs with both a math and science presence. The benefits of having a mentor teacher visit the classrooms and provide encouragement and suggestions in a timely manner were an identified advantage unique to the PEER program. When compared to other projects, PEER is the only GK-12 program that incorporates undergraduate Fellows who add a wealth of creativity, resources, and energy. Another benefit of having undergraduate Fellows is the encouragement they receive for continuing their education at the post-graduate level.

"It was interesting to hear what other GK-12 programs offer and encouraging to realize that our GK-12 program has higher expectations than similar programs at other universities. After listening to presentations from other programs, it will be easy

(Continued on page 11)

Bringing Research to the Classroom

With physics research in the classroom, the students were "very attentive because we were defying gravity, exploding balloons, liquefying air, smashing racquetballs, and spinning on low friction tables, you know... cool physics stuff."
Trey Holik, Physics

Students learned the importance of ratios with a lesson introducing research with integrated circuits. The lesson demonstrated the use of math for predicting probability of error and in designing transducers for specific uses.
Alfredo Perez, Electrical Engineering

To introduce a middle school class to prototyping circuits using breadboards, students were given a kit with different electronic components and were then lead through an activity where they built their own electronic musical instrument. "It has been an extremely rewarding opportunity to help introduce these students to what a real engineer can do."
Jason Wardlaw, Electrical Engineering

Oh What Fun it is!

Carol Tatum

For the past three years, it has been my privilege to visit each middle school classroom where Fellows from the PEER GK-12 program spend ten hours a week enriching the math and science curricula. While the Fellows have not received formal training in the field of education, they have displayed a real knack for reaching the sixth through eighth grade students. Their lessons have addressed some of the most challenging areas of the curriculum. The Fellows are so competent in their own fields of study that they quickly become the “experts” at their schools. Spending from one to three class periods during each visit gives me a perspective of their teaching skills and areas where there’s room for improvement. It’s exciting to see the students grasp the various concepts through the inquiry-based and interactive lessons presented by the Fellows. The Fellows’ computer skills used to create effective PowerPoint presentations greatly enhance many of the lessons. The classroom teachers work with the Fellows to gear the lessons to a level appropriate for the maturity of the students while still allowing the Fellows to challenge and enrich the learning experience. During my visits to the classrooms, I watch for teaching techniques such as attention-grabbing introductions, relationship to real-life situations, statements of lesson objectives, thorough explanations of activities, use of inquiry when appropriate to the lesson, organization of the lesson, interactions between the Fellows and the students, effectiveness of the teachers’ discipline plan to allow for an optimum learning experience during the Fellows’ lessons, fairness in student participation, and closure. Following each classroom visit, I send an email to the Fellow relating all that was observed and making suggestions. The e-mails serve as a positive means of encouraging the Fellows by relating to them all the great learning experiences they provided for their students. I include gentle reminders and suggestions when certain elements have been forgotten. The classroom visits also serve to allow another person to share in some of the frustrations the Fellows experience in the classrooms -- student misbehavior, lack of respect towards the classroom teacher, class periods too short for lab experiences, too much emphasis on the TAKS tests, activities using food as a teaching tool not allowed at some schools, and inadequate lab supplies, just to mention a few. Fortunately the relationships the Fellows develop with their students outweigh any of the frustrations. These relationships are demonstrated when the students enter the classroom and delightedly greet the Fellows and share some of what has gone on in their lives since the last time the Fellows were there. Oh, what fun it is to see all this happening with an age group that is often difficult to reach. ■

Mentor teacher, Carol Tatum, displays her PEER GK-12 poster with “Tips on Maintaining a Positive Classroom” for encouraging the graduate Fellows.

Tips on Maintaining a Positive Classroom

- Use high quality PowerPoint presentations with appealing and appropriate graphics.
- Create an attention grabbing introduction to the lesson or activity.
- Review the skills needed for successful participation
- Show the relationship of the lesson/activity to real life situations.
- Demonstrate a personal interest in students and their lives, for example, attending a sporting event students are participating in or helping with an after-school activity such as the science club.
- Demonstrate fairness in calling on students for responses.
- Allow students a glimpse into one’s own personal life (hobbies, wife/husband, children, research towards degree, special interests).
- Provide clear/concise instructions.
- Recognize that certain days/weeks are not prime times for instruction/learning and gearing the lesson accordingly (for example, days right before holidays and Friday afternoons).
- Plan hands-on lessons that actively involve students.
- Show enthusiasm for the subject and the lesson.
- Monitor activities to ensure success for everyone.
- Practice the activity before having classes do it.
- Have all materials ready before each class period.
- Close the lesson rather than ending abruptly when the bell rings.
- Establish a comfortable rapport and working relationship with the classroom teacher. Students are quick to pick up on any animosity between adults.

(GK-12 Meeting, cont’d from page 10)

to garner the best ideas and tweak ours,” mentioned Carol Tatum, mentor teacher.

PEER also learned from other programs and was able to take notes for future reference. From the PI level, Larry Johnson and other PI’s gained knowledge about how to successfully write a grant. Summer planning was mentioned for developing more inquiry and research-based lessons during uninterrupted time. It was also noted that other programs have a more focused set of goals for their program, which is valuable for making a greater impact in one area rather than several smaller influences. For example, it would be constructive to have a central theme on which all Fellows could focus on, whether that focus is on sustainability, conservation, engineering, or biomedical sciences.

The PEER program participants gained much insight from this conference and deemed it time and money well spent. They concluded that PEER is educationally beneficial yet at the same time found ways to improve. ■

Keeping It Fresh

Brainstorming High School Science Lesson Plans

Kyle Damborsky

At the onset of the PEER Program, I realized that my responsibility to my lead teacher and her students was based around three major objectives: Presenting lessons that: 1. students have never seen before; 2. were better than those that my lead teacher had used last year; and 3. were entertaining. And by the way, I was responsible for at least one lesson every week. No pressure!

The process of designing and implementing these lessons was probably the most challenging part of my experience, but the first time a classroom full of freshman stared back at me with genuine interest and a little bit of awe, the hard work was worthwhile. Admittedly, this did not occur during my first presentation, a slideshow speckled with what I thought was humor but freshmen saw as lame jokes. After that discouraging experience, my lead teacher and I refined our creative process and began anew with exceptional results.

Any good lesson begins with the lead teacher. They are the gatekeepers of the scope and sequence for the course. They have also done this before and have valuable insight into what types of activities work well, which ones are difficult, and when a lesson would be flat out ridiculous. Without some serious guidance from Catherine, my lead teacher, my tenure with the PEER program would have been long and arduous.

My first step in coming up with a lesson was always finding out where I would be most helpful in the coming weeks. If Catherine had a great lesson, why should I reinvent the wheel?

Most weeks, she was more than happy to point out a weakness in her curriculum. Maybe it was an oddball standard that was hard to address, like relating the wavelengths of light to atomic transitions, or coming up with a lab activity demonstrating nuclear reactions. Regardless of the circumstance, a teacher always knows where they have room for improvement. Catherine would also provide valuable advice, including what DID NOT work the year before, and what students struggled with on a particular topic. All of this information would combine to form the basis for the new lesson.

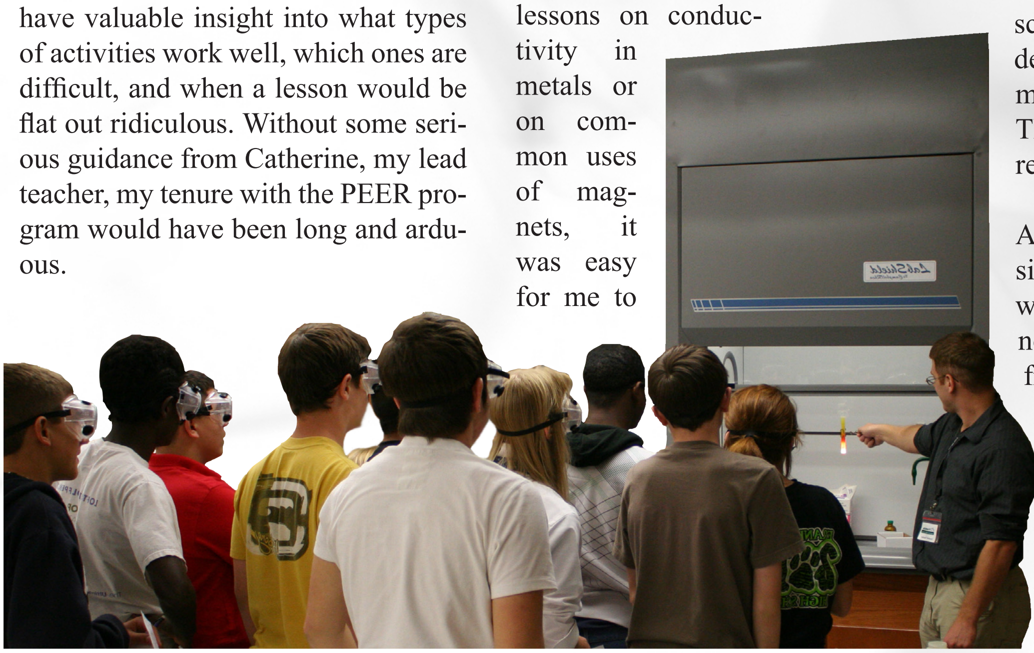
So, at this point, the challenge has been defined and you have a starting point. Now what? I used my own experiences as a foundation for creating my lessons. First, I looked for a way to integrate my research into the topic. Since I work with superconducting accelerator magnets, when Catherine presented me with opportunities to create lessons on conductivity in metals or on common uses of magnets, it was easy for me to

"A good lesson begins with the lead teacher."

grab some of my research tools from lab, bring them to the classroom, and wow the students.

Most of the time, my research was in a completely different field than the topic Catherine suggested. For example, exothermic reactions are not part of my daily lab activities. In these cases, there was little hope for me to integrate my work into the lesson. Now, instead of pulling from research experience, I looked back at my own high school education for inspiration. If a demo or activity still stood out in my mind after that much time (well, not THAT much time), it had to be worth repeating!

Asking friends, classmates, my assigned undergraduate, and even my wife, a graduate student studying neuroscience, for input always led to fruitful options. Everyone has a favorite moment in science, and if you talk to enough people, you'll find something that stood out to each and every one of them. One of my favorite moments from high school chemistry was a video my



teacher showed of sodium reacting with water. Since I had the technical experience and the means to demonstrate this classic reaction to my class, we used this mild explosion as a demonstration of exothermic reactions!

Once I had a firm idea of the lesson I wanted to develop, Catherine would sit down with me during her conference period and I would pitch my idea. Good, bad, or ugly, Catherine delicately let me know her opinion. Most of the time, she would ask me to tone down the lesson so that it would be practical for students to complete in a 48 minute period or cut out some of the math to make the topic more approachable. The entire point of these meetings was to make sure my activity would be realistic. Could it be completed in the allotted time? Would students have enough background knowledge to complete the assignment? Would they find it as exciting as a graduate student and self-proclaimed science nerd? Catherine always knew the answers to these questions and was my inside track to the student's psyche. She always kept me focused on the ultimate goal of teaching the topic with an impact.

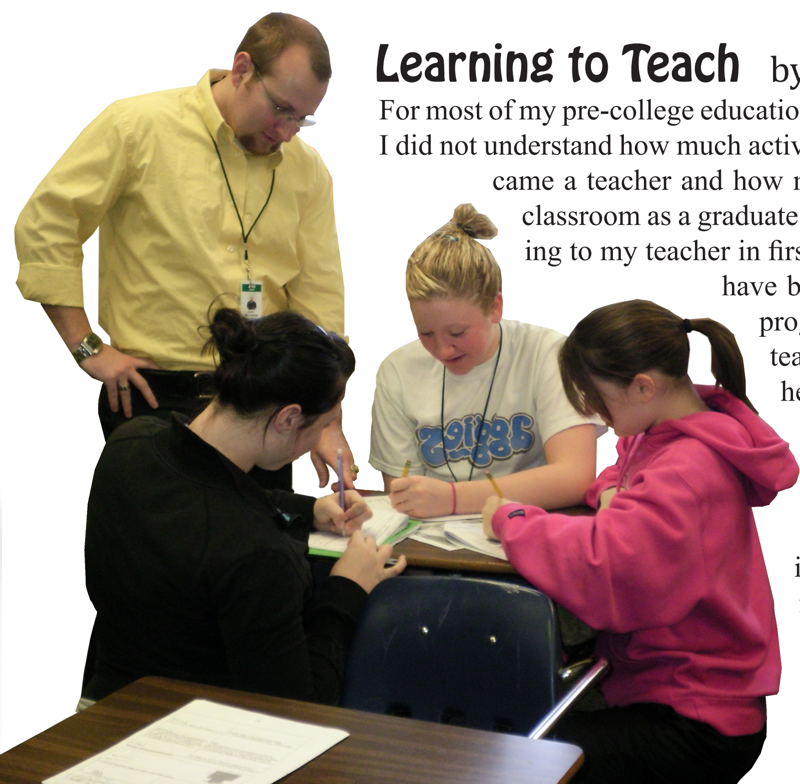
After a few misfires and some trial and error, I came to enjoy the challenge of coming up with new and exciting lessons. Pushing the envelope with exploding pumpkins, flames in the classroom (intentional only, of course), and liquid nitrogen, let the students experience the rewards of our creativity. I can only hope these experiments and demonstrations will be as memorable for the students as the time we spent together was for me. ■

Fellow Advice

Tips for communication:

- Collaborate! Work with your teacher. He or she may have ideas of their own.
- Incorporate common characters in pop culture and TV media as well as real-life applications in every lesson.
- Make sure to acknowledge varying learning styles within the same classroom.
- Be flexible. Sometimes things change and you have to be able to adjust accordingly.
- Initiate conversations with students on career choices. An interest in them will spark an interest in you.
- Do not be afraid to learn from the students. Enhance your communication and organizational skills and your ability to think fast!
- Make friends. With the time before and after class, talk to the students, find out who they are so that you can teach to them personally.
- Get the most out of your students. Try to get even the shy ones to speak up and answer questions.

"I have begun to understand the concept of clear definitions, leading others, and transferring my own knowledge to others so they can apply it to new and great tasks."



Learning to Teach by Jason Wardlaw

For most of my pre-college education, I was unaware of how much effort went into being a good teacher. I did not understand how much activity went into teaching and I was unaware of how a teacher even became a teacher and how much effort that entailed. Needless to say, when I first entered the classroom as a graduate Fellow, it was as if I was practicing my vocabulary words and reading to my teacher in first grade all over again… I had no idea what I was doing! Luckily, I have been paired with two teachers during my tenure as a Fellow in the program who have been more than willing to share, discuss, listen, and teach me what it actually takes to teach and shape young minds. They helped me understand how to deal with students who don't want to learn and to challenge every student in their own way. I have begun to understand the concept of clear definitions, leading others, and transferring my own knowledge to others so they can apply it to new and great tasks. I did not realize so much went into explaining integers and polynomials. At least now, though, I can look back at my own time in school and remember how the teachers I had were able to do what I have struggled with and shape me into who I am today. ■

(Rewarding Remarks, cont'd from page 9)

ating were made using non-traditional ways of teaching. My favorite lesson was interactive and on the computer allowing the students to type answers and get feedback. Kids love computers and interactive lessons so I thought this was a great fusion of both."

"Integerland was a game I created that incorporated a mathematics lesson on integers. The point of the game was to travel from start to finish first, moving forward only on spaces that had integers on them. I was able to go into the classroom the day the kids played Integerland and it was so touching. I was able to see them learn a lot about integers and do it with a smile on their faces!"

"Working with PEER, I am able to coordinate with fellow students to create hands-on learning activities, but I am also able to go into the classrooms and watch my lessons be implemented. It is very rewarding to me to see the work we put forth actually influencing the way students learn. I know that without the resources that the PEER program provides, many students would not have the opportunity to take part in these experiences." ■

The Mathematics of Music

Trey Holik

Graduate Fellow, Trey Holik, takes music into the classroom to teach patterns and fractions.

Teachers today face challenging obstacles. To overcome these barriers, we must get to the heart and motivations of the students. We must show how math is ever-present around them and in all aspects of life that are important to them. Music is influential and is a priority among most youth. Music, when broken down to its basic forms, can teach principals of both math and science.

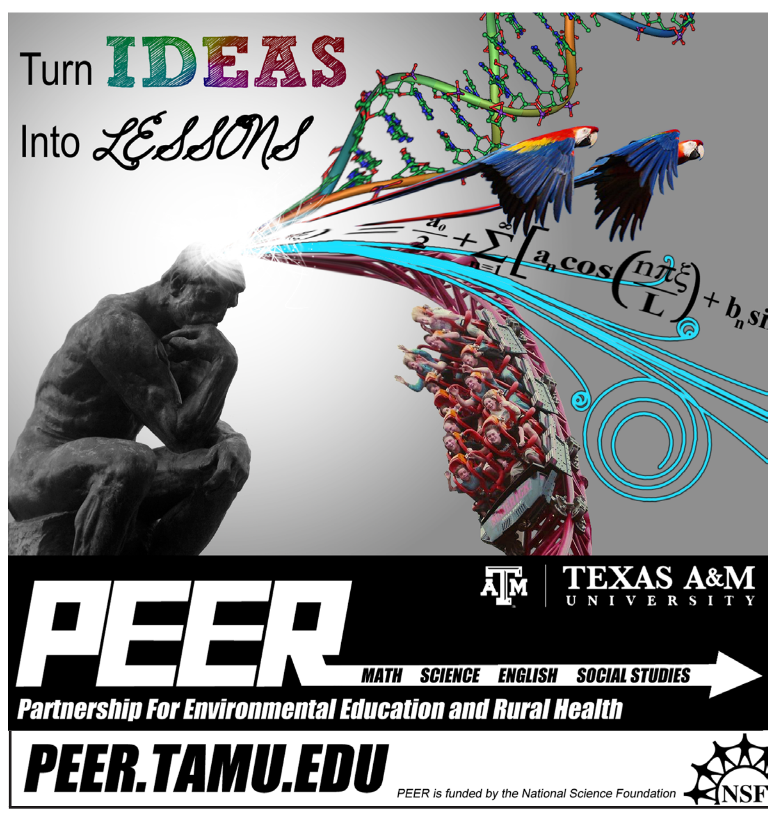
Music is largely the art of combining frequencies of sound in a systematic and mathematical way. For example, the beginning of Beethoven's 5th symphony is arguably the most well known motif of any score of music written. It begins with 3 short G's followed by a long Eb. With this simple 3-short then 1-long pattern, he composed the whole 1st movement. He created his masterpiece by following and repeating this pattern in brilliant new ways.

Patterns and repetition are very popular in modern music. The 1-5-6-4 (C,G,Am,F) chord progression is currently used in no less than 150 pop songs. An Internet search for 1-5-6-4 chord progression will give you a taste for what mathematical repetition exists in between songs.

Our own spirits can testify to the innate rhythm of some music. Why is it that when we hear some songs for the first time, we can almost guess what the next sound or note will be? Perhaps our ears have picked up the mathematical pattern of the music and are following it to our own enjoyment. Perhaps we have caught ourselves singing in the shower or tapping out a rhythm on our thigh or with our feet. Dancers even count to the beat so that they can remember the math pattern of the song. Maybe we have caught our students "beatboxing" a tune. These activities may be described by mathematical musical formulae.

In addition to patterns, fractions may also be taught with music. The types of notes (quarter, eighth, half, whole), the meter and tempo (beats per measure and beats per minute), triplets (3 notes played in 2 beats) and tuplets, and the ratios of frequency between notes of a chord (1/1, 5/4, 3/2, 2/1) may each be used in tandem to introduce fractions to a class.

There is much to learn and teach regarding the math in music. Numbers can and have been appropriately assigned to almost every aspect of music. Perhaps this is why the front two rows at Texas A&M University symphony concerts are often taken by professors in the department of mathematics and physics. Enjoy the lesson (page 45) and enjoy the music! ■



Advancing Knowledge and Attitudes through NSF GK-12 Fellow Involvement

Rebecca V. Rowntree and Brittany Sanchez

Recently, concern for science and math education has risen as the United States struggles to keep up with other countries in its performance on international mathematics and science assessments. In response, the National Council of Teachers of Mathematics (NCTM) calls for: classrooms to incorporate relevant material, teachers to have adequate access to professional development, a curriculum that allows students to learn and understand mathematical concepts and procedures, the incorporation of technologies that will enhance mathematics understanding, and the encouragement of more students to pursue further education in mathematics.

The National Science Foundation (NSF) has responded by providing funds to universities as part of the GK-12 program to send graduate students in science, technology, engineering, and mathematics (STEM) fields into K-12 classrooms to "integrate research and teaching, as well as enhance teaching and curriculum selection/development skills for all participants through collaboration" (in Knapp, 2006).

At Texas A&M, the Partnerships for Education Enhancement Resources (PEER) program includes a GK-12 component that sends Fellows in STEM disciplines into 6-8th grade classrooms in rural and suburban areas of Central Texas. The rationale for targeting these specific grades lies in research indicating that it is during these pivotal years in students' education that they tend to lose interest in mathematics and science. "An initial step to increase student performance in an area of study is to first develop an increased interest in the subject and potentially develop an understanding of the usefulness of the subject" (Hulett, et al., pg. 4). The PEER program introduces graduate Fellows into the classroom as this initial step -- a way to encourage interest in and positive attitudes toward STEM subjects through engaging and entertaining lessons and activities that highlight the usefulness and importance of STEM in the everyday world.

Methodology

Students (n = 725 science students; n = 176 math students) in classrooms of eleven graduate Fellows contributed to this study. Each Fellow taught in the same classroom throughout the year. One Fellow taught two different groups of students over the course of two years. While the PEER program has had more than 11 graduate Fellows in the program between Fall 2006 and Spring 2009, data was only used if the Fellow provided students with the opportunity to take both a pre- and post-test. Students were from five different middle schools in Texas, all of which can be classified as being in suburban or rural communities and which were located within ten miles of the Bryan/College Station area where Texas A&M University is located. All students were in grades 6th through 8th.

Graduate Fellow, Sunny Scobell, assists a middle school student with a hands-on activity involving the digestive system.

Eight middle school teachers (n = 8) active in the 2009-2010 PEER GK12 program were given surveys regarding their experiences in the program. The number of years of teaching ranged from 2 to 26 with a median of 16 years. All teachers taught middle school math or science in a suburban or rural school within ten miles of Texas A&M University and spent the past school year interacting on a weekly basis with a GK-12 graduate Fellow both in and out of the classroom.

Students were given a survey specific to the subject their graduate Fellow was responsible for teaching -- either science or mathematics. Each survey asked students to identify whether they strongly disagreed, disagreed, were uncertain about, agreed, or strongly agreed with a given statement. Each student was assigned a unique ID number to use on both the pre- and post-survey so that his or her identity could remain anonymous.

Teachers with graduate Fellows during the 2009-2010 schools year were given surveys regarding the effect having a Fellow in their class had on their teaching practices, content knowledge, and students. The survey consisted of 10 questions to which teachers were instructed to record a number from one to five indicating their level of agreement, 1 being strongly disagree and 5 being strongly agree. Teachers were also instructed to answer at least one of five free-response questions about their experiences in the GK-12 PEER program.

Results and Analysis

On the science student survey, students indicated a strong agreement and increased their agreement from pre- to post-test with the statement "I get to do experiments in my science class." The students' responses on the post-test were expected as one of the goals of the PEER GK-12 Fellows is to introduce engaging, hands-on lessons into science classrooms.

(Continued on page 16)

Lead teacher, Catherine Johnston, assists a group of middle school students with an assignment on conducting research.

(Advancing Know..., cont'd from page 15)

The Fellows typically try to avoid "book-work" or use of the text without a complementary demonstration or activity. This might explain science students' decrease in their levels of agreement from pre- to post-test regarding their enjoyment of using the science book to learn science and math students' decreased agreement with the statement "I like to use math books to learn math." When presented with the alternative of getting to actually perform experiments and learn from demonstrations rather than reading texts, it is possible that students would be less inclined to enjoy the science or math textbooks. Similarly, Fellows' use of hands-on teaching methods may also explain students' increased agreement with the statements "I like to use science equipment to study science" and "I like to use math equipment to study math."

The science students' increased agreement with wanting to take more science classes could have been sparked by the Fellows' descriptions of their own research, possible careers in science, and the importance of taking higher courses in science to the students' future educational opportunities. Math students' increased agreement with "I like being in school" might also have been influenced by increased opportunities to be fully engaged in activities and to have the relevance of math truly explained in the context of the Fellows' own research.

Results of the teacher survey were mostly as expected. The Fellows' task is to bring new and engaging activities for math and science into the classroom to help students better understand and enjoy the subjects.

Because of this goal, it makes sense that teachers would be able to incorporate the Fellows' lessons easily into their own plans. One teacher verified this by writing, "[The Fellow] has given me fresh ideas and inspired me to create my own lessons that utilize self-discovery methods."

Because of the extent of engagement that is required, the Fellows undoubtedly establish a close relationship with their students leading to a liking and approval of the Fellow in the classroom. One teacher wrote about her students' relationship with the Fellow, "Students are always upbeat when the Fellow visits. They are positive and anxious to see what activity he has planned!"

Fellows are also encouraged to bring their current research into the classroom and to share their university experiences with the students. Most Fellows within the PEER GK-12 program play a video at the beginning of the school year which shows the Fellow at his or her lab, enjoying extracurricular activities, and engaging in after school activities. These videos and the Fellows' presence in general, provide the opportunity for discussions by the teacher with his or her students about college. When asked what has been the most rewarding part of having a Fellow in the classroom, one teacher responded, "Seeing the students really talk about college and get excited by thinking about their future."

The majority of PEER GK-12 Fellows have never been in a classroom setting as an instructor before. This means that they often require guidance by the teacher about what types of lessons are appropriate for the students. By the end of the year, most Fellows indicate that they feel that they have learned how to communicate their lessons and research in an organized, clear way that middle school students, and even the general public, can understand. On the open-ended questions of the teacher survey, one teacher indicated increased content knowledge as a result of the Fellow's presence; "My bank of content knowledge and lesson ideas has been nurtured, and my ability to think outside the box and challenge my students has grown." From this, it follows that teachers' job satisfaction increased as a result of their participation in PEER.

Conclusion

The middle school students obviously held more positive attitudes toward STEM areas in classrooms where Fellows were present. The teachers' survey results were helpful in that they indicated the strengths and weaknesses of the program, and confirmed areas of improvement for both the teachers and the Fellows because of their collaborative workings. ■

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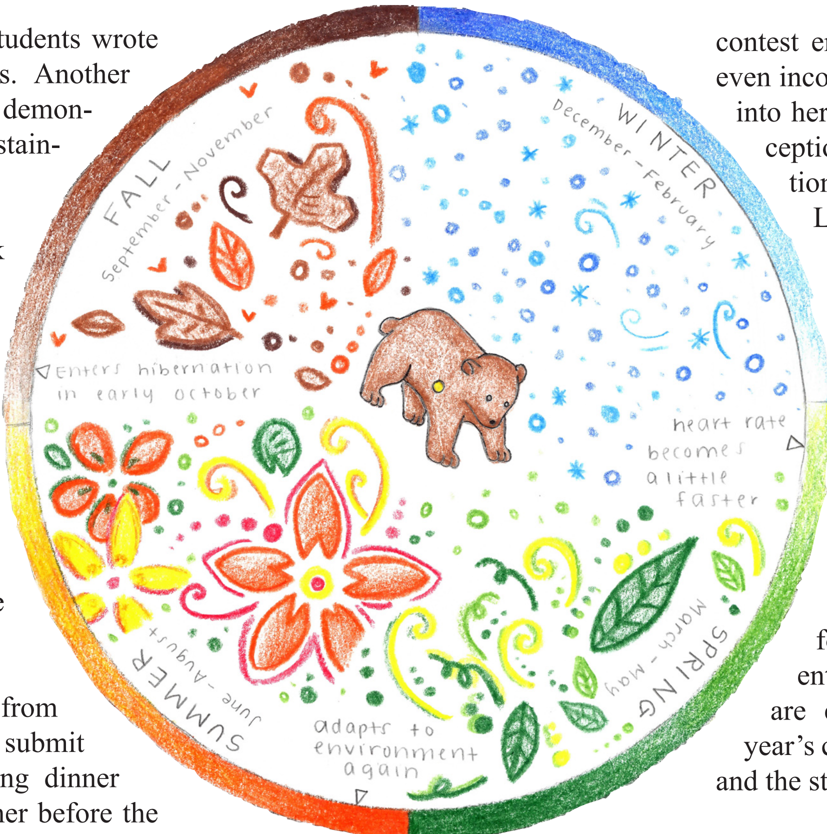
Only Time Will Tell

Transforming a University Lecture Series into an Adventure

Brittany Sanchez



One year, middle school students wrote about undersea adventures. Another year, they drew pictures demonstrating their ideas for sustainable housing materials.

But, this year, students took science into their own hands.

For several years now, PEER has participated in the Texas A&M University Distinguished Lecture Series by conducting drawing and essay contests related to one of the lecture topics.

Middle school students from around the state of Texas submit entries in hopes of winning dinner with their family and teacher before the lecture as well as a token of appreciation and congratulations from the University. This year's contest featured a topic based on research conducted by Dr. Deborah Bell-Pedersen, a member of the Faculty of Genetics, the Program in Microbial Genetics and Genomics, the Program for the Biology of Filamentous Fungi, and the Biological Clocks Program. Her lecture was entitled, "How Organisms Tell Time." Students could enter a drawing, essay, or, new this year, a science experiment.

Sigma Xi, the Research Society, sponsored the contest and PEER coordinated the judging and contest submissions. The contest goal was to promote research among youth.

The drawing competition allows students to be both creative and accurate in their endeavors to illustrate the scientific topic of the Lecture Series with room for student imaginations to take their course.

The essay contest gives students the opportunity to be both scientifically accurate and innovative in their descriptions of current scientific findings and possibilities for their own future research accomplishments.

Dr. Bell-Pedersen said, "Once students begin to understand a little bit about the topic and become engaged, they will want to learn more and more. This is where they get introduced to research."

With this year's challenging and research-oriented Lecture Series topic on biological clocks, the PEER program decided to challenge students to create an experiment pertaining to the subject matter.

Over the course of five days, students chose an area outside of their homes to make observations about nature both in the morning and again in the evening.

This allowed the students to come to their own conclusions about how time of day affects the natural environment and contributed to student understanding of a scientifically rigorous topic.

Dr. Bell-Pedersen helped to judge the contest entries prior to her lecture and even incorporated the winning drawings into her presentation. This was an exceptional expression of the interaction between student winners and Lecture Series scholars.

"I was excited to see the drawings and the types of experiments the students would come up with. I believe that challenged young minds can do amazing, creative things," said Bell-Pedersen about judging.

Dr. Bell-Pedersen's enthusiasm for the contest and the over 400 entries from 28 different schools are evidence of the success this year's contest had for both the lecturer and the students alike.

The PEER program continues to strive for excellence in outreach, and, as such, will continue to enhance the contest to provide more opportunities for hands-on, inquiry-based learning. ■

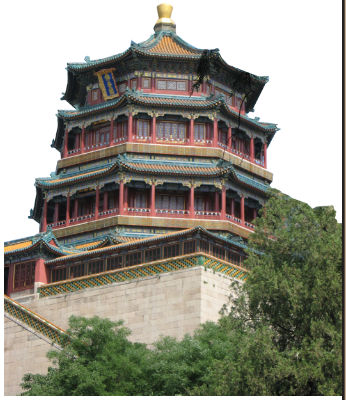
Expanding Outreach

PEER is considering additional ideas for future Lecture Series:

- Holding question and answer sessions for students who want to learn more about the topic
- Additional prizes for particularly motivated students that might want to shadow a professor or tour the University
- Creating new variations of the science experiment such as an engineering contest (where students submit drawings of their invention) or a research journal describing their investigations
- Providing more opportunities for the professor conducting the lecture (and his/her graduate students) to interact with students via the web or other media

The GK-12 Meets China

Natalie Johnson



The opportunity to travel to Beijing and Shanghai in the fall of 2009 as an NSF Fellow afforded me the chance to experience a new culture and interact with peers and mentors at the international level. Attending the China-U.S. relations conference set the theme for our trip of strengthening partnerships between individuals in both countries, which have become intimately linked over the past decades. Here, we celebrated the past 30 years of U.S.-Chinese relations and discussed problems which we still face together, particularly environmental health issues. Interactions with fellow graduate students at the conference and at the two universities we visited set this trip apart from other conferences I had attended. Here we engaged in conversations about our research, families, and unique experiences within our own cultures. For instance, as we climbed the Great Wall with two students from Beijing Normal University, we exchanged thoughts and shared a unifying experience by touching a special stone for good luck. We were welcomed to Shanghai at a classic 'hot pot' restaurant where we tried new foods from the very spicy to the quite bizarre. At Fudan School of Public Health the next day, we discussed some of the similarities and differences of our countries' educational systems from grade school to the advanced level and prospered from understanding the strengths and weaknesses of both. Ultimately, this journey to China greatly enhanced my graduate education and prepared me for work in the international arena. In a time when collaboration in scientific research is vital and global issues abound, this unique educational opportunity expanded my skills in teamwork and communication with partners abroad. ■

Graduate Fellows expand outreach via international collaboration.

Texas A&M professor Barbara Gastel has presented science-communication workshops in more than 10 countries. Here, after a workshop in Kenya, she feeds an inhabitant of a giraffe sanctuary.

10 Tips for Presenting Science to the Public

Barbara Gastel

Science can interest and help many members of the public. But how can it be presented effectively to groups without technical backgrounds? The following are 10 top tips. Many of the approaches may be familiar to science teachers.

1. Tie the subject to the audience's interests. For example, show how the science applies to audience members' concerns.

2. Build on the audience's existing knowledge. Use analogies to familiar objects or processes. Relate new ideas to concepts familiar to the audience.

3. Provide overviews before details. Orient the audience by presenting the "big picture" before specifics.

4. In general, use simple, familiar language. Avoid most technical jargon. And keep other wording brief and easy-to understand. For example, say "basic," not "fundamental."

5. Present the concept before the technical term. Some technical terms can be helpful for members of the public to know. But consider introducing them gently by presenting the concept first.

6. Present numbers and sizes effectively. Use familiar units. Compare sizes to those of familiar objects.

7. Include human—or animal—interest. Talk about the people involved with the science. If animals are involved, talk about them, too.

8. Use narrative. People like stories and tend to remember them. So tell (true) stories about the science and its use.

9. Use the visual element well. If feasible, include graphics that both inform and attract. Use headings and white space to help show the structure of what you are presenting.

10. Note sources of further information. Especially if you've followed tips above, audience members might well want to know more. Therefore identify sources of additional information.

These tips can help communicate science clearly, engagingly, and informatively to general audiences. Whether you're giving a talk, writing an article, or preparing material for the web, consider using them. ■

The PEER Graduate Student Educational Outreach Team

Bill Klemm

Each year, our PEER management team makes it a point to select graduate students for our NSF GK-12 program who have the motivation, personality, and scientific expertise to be effective ambassadors and science consultants to middle schools in our area. We call these graduate students Resident Scientists or Mathematicians or Fellows. Every year we pick a new "class" of 8-12 graduate students because we want to spread the experience widely among many. To preserve some corporate memory, each class has a few holdovers from the previous year who were especially outstanding, and serve as important role models for the new Fellows.

In May, before school starts in the Fall, Fellows actually visit the classroom of their assigned teacher. Then in the summer, we conduct a week-long training where they learn about the environment in our local schools, standards for dress and behavior, and pedagogical theory. Part of that time is also spent in all-day sessions with the assigned teacher, so that they get better acquainted and can begin the planning for the upcoming fall semester.

We select Fellows from multiple disciplines, such as math, engineering, biology, physics, and geosciences. Though each Fellow is assigned to work with a particular teacher in a specific school, the Fellows work as a team when it comes to planning their school visits and sharing experiences. PEER has an on-staff retired teacher, Carol Tatum, who makes periodic visits to evaluate Fellows as they make presentations and conduct demos in their assigned classes. Her many years of experience help the Fellows in ways they cannot gather in any other form.

Each Fellow records their weekly activities in an online journal which includes open-ended questions for guidance. In addition, there are seven survey items for Fellows to indicate how they judged their effectiveness in stimulating inquiry, explaining real-world connections, in promoting understanding of research, and their comfort level in interaction with students and teachers. Our evaluation team analyzes these surveys to track the growth in Fellow impact across the academic year.

At our weekly meetings, I share the highlights from each Fellow's latest report. I try to get answers to questions that Fellows raise and summarize reports of their experiences with student attitudes and behavior, teaching issues, and specifics of some of their classroom activities. On the many occasions when great events happen, I make a "Golden Nugget Award" (well, actually it is a gold-painted rock) for experiences that have exceptional impact on a class and on the teacher. Some Fellows have an impressive "trophy case." Awards are based on eliciting student enthusiasm and motivation, as well as effectively engaging students in academically rigorous ways.

A major purpose of the weekly meetings is to encourage Fellows to share insights on their experiences and help each other with suggested improvements and ideas for future classroom visits. The academic diversity of our Fellows proves invaluable for helping everyone with ideas and information from fields about which they may not know a lot.

Fellows also use this meeting time to invite each other to classes in another school and to participate in special out-of-class events, such as science clubs and fairs. Sometimes they jointly conduct activities in a school. Some of our meetings also include the undergraduate assistants who work for PEER directly with our graduate Fellows.

Weekly meetings are chaired by the Fellows, who rotate the assignment. At each meeting, the Chairperson gives a demo and explanation of some special class activity that was conducted or is planned for the near future. Other Fellows join in with evaluation and suggestions. Frequently, they use each other's presentation and demo materials in their own classes.

For some organizations, weekly meetings can be drudgery. That is not the case for our GK-12 meetings. Everyone is glad to have the meetings because we all gain so much from them. ■

Lead teacher, Kathy Polzer, mentor teacher, Carol Tatum, and graduate Fellow, Kyle Damborsky, gather at the National NSF GK-12 Meeting to discuss ways to improve team collaboration.

Teacher Tips

Working with your Fellow:

- Be clear with your expectations.
- Fellows are in the program to learn and gain experience; they are looking for instruction from you as an experienced teacher.
- Be involved in the making of your Fellow's lessons to create a lesson that suits your classroom and your students.
- Let the Fellow completely have the class from time to time. You facilitate while getting other important tasks completed.
- Be willing to try lessons that seem a little too challenging for your students – they may just rise to the challenge and surprise you!
- Have lunch together! Talk about life, hobbies, and interests.

NSF Graduate STEM Fellows in K12 (GK12): Program Directives and a Possible Plan for Meeting Them

Larry Johnson and Brittany Sanchez

Directives: The NSF GK-12 program provides funding to universities to send graduate students in NSF-supported science, technology, engineering, and mathematics (STEM) disciplines and their specific research practices and findings into K-12 classrooms. The goal of this initiative is to enhance K-12 education in STEM areas of learning and career interest for students.

However, the benefits of the program extend beyond GK-12 students. Through collaborations with other graduate Fellows and faculty from STEM fields, with teachers and students in the K-12 setting, and with various team members of the GK-12 program, graduate students learn how to communicate their research to both technical and non-technical audiences. The graduate students also gain leadership, team building, organizational, and teaching capabilities, skills that are transportable to other areas of study, research, and work.

With the provided benefits of the program, the NSF has expectations of performance from the GK-12 program, the graduate fellows, for K-12 education, and for the institutions of higher education as a whole. Fellows are to take coursework/preparation to receive training in collaboration and team building, effective time and task management, developing leadership skills, and in pedagogy.

Lead teachers are also encouraged to train both with and without their Fellows to develop mentoring skills, increase their science content knowledge, learn to produce multimedia materials and cyber-enabled tools for teaching/learning, and in professional skills development. The teacher-Fellow team must coordinate to engage in joint research and educational efforts to enhance learning and STEM career interest for students creating the desired K-12 experience for the students.

But building relationships within a GK-12 program is only the first step. Programs must learn to collaborate and build relationships with faculty and programs at other academic institutions and NSF-funded programs to extend knowledge banks and broaden participation of women and underrepresented minorities in STEM.

GK-12 graduate Fellow, Alfredo Perez, meets with NSF Program Directors Sonia Ortega and Ping Ge at a GK-12 conference.

Teachers and Fellows can use university resources, including academic development programs, offices for campus diversity, or minority and women student groups, and professional associations, organizations, or committees that promote STEM. It is important to the NSF that recruitment of graduate Fellows is a result of partnerships to continue the collaborative efforts of the GK-12 program by sustaining and building upon its foundation.

Plan to Meet: One plan is to direct efforts at professional development of graduate Fellows with new courses developed and workshops on energy and environment and incorporation of successful aspects of the GK-12 projects into the university graduate program. The STEM content knowledge and K-12 student interest in STEM would be

From the GK-12 Program Director

"GK-12 prepares a unique and different kind of science and engineering professional, one who in addition to being capable of conducting leading-edge research is also prepared to function well in a global community. We are preparing professionals who will be engaged in their communities, who will know about the scholarship of teaching and learning, and who will be able to bring science and engineering issues to the public. The GK-12 provides an opportunity for graduate students to bring their research to K-12 classrooms and make science and engineering relevant to students' lives as they serve as role models to those students"

Sonia Ortega
GK-12 Program Director, NSF

Graduate Fellow opportunities are on the horizon with research and teaching of green technologies and energies.

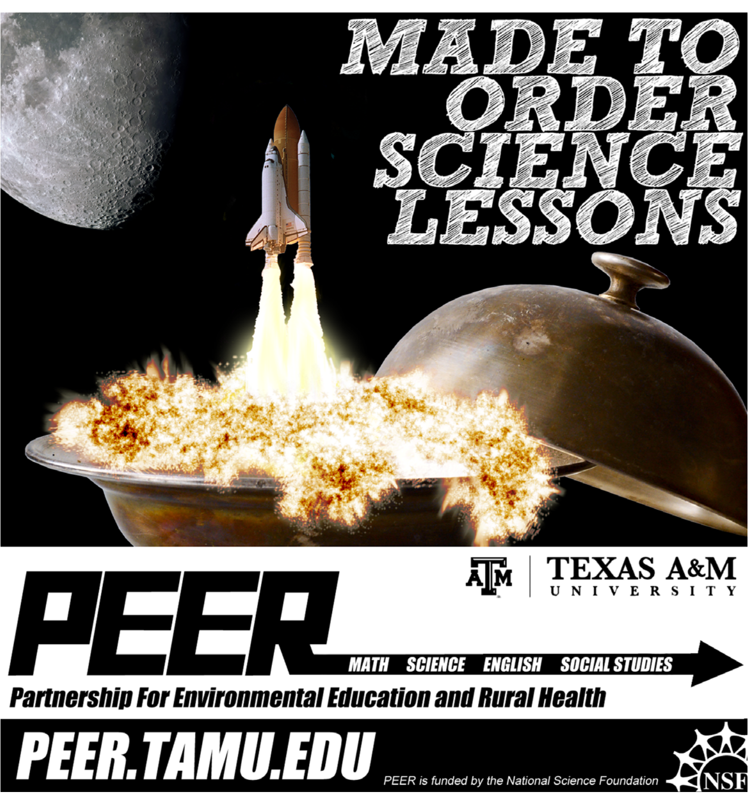
enhanced through teacher workshops, Fellows in class (face-to-face), or via cyber-enabled tools. A week-long summit with Fellows presenting energy/environment research, a keynote speaker, teacher-Fellow planning, curricular development, and experiments involving K-12 students would help unify the project and would likely be sustained beyond the GK-12 activity. Fellows are instructed on pedagogy and successful approaches and allows them to reach out to rural Texas where resources and travel are prohibited and a large minority population resides. Fellows would be trained to be successful in their profession as college professors and industry STEM scientists. ■

GK-12: A Life-Changing Experience

Alfredo Perez

I am a very fortunate person; fortunate in the sense that life tends to lead me into life-changing experiences at the perfect times and places. A great example of that has been my involvement in the GK-12 program for the past two years while a doctoral student at Texas A&M University. This opportunity came at a moment when I was nearly prepared to leave graduate school due to economic reasons. The financial support that came through a GK-12 teaching fellowship was instrumental in allowing me to continue the advancement of my studies. In terms of life impact, my experience in this program has been such that I am convinced I am a better scholar and a better engineer, as well as a more educated person overall.

The GK-12 program has presented me with numerous opportunities to grow both as a scholar and as an engineer. For instance, stimulating the interest of middle school students and teachers in the STEM fields has required me to learn to communicate advanced knowledge in a way that can be understood by audiences with no background on the subject. Also, developing math or research-related lessons and hands-on activities has improved my ability to work in an interdisciplinary context where engineering, design, and teaching concepts and skills have had to be applied. Furthermore, working with other graduate students and professors involved with the program has expanded my network of contacts and has even granted me the opportunity to present my research work and promote myself professionally at the NSF headquarters in Washington, D.C.



Working as a GK-12 teaching Fellow has also given me an early start toward becoming a competent instructor, acquainting me with a wide range of pedagogical techniques and different learning styles. As well, it has allowed me to enhance my mentoring and managing skills through working and coordinating with undergraduate students and multiple teachers on a weekly basis. Spending a significant amount of time at a public intermediate school every week has helped me gain familiarity with some of the common problems that burden our education system. This has heightened my sensitivity to the needs of teachers, students, and the community in general. My main motivation for getting a doctoral degree has been to become a model professor and researcher at a university and make a difference in the careers of my students and my community. In that sense, the GK-12 program has already begun preparing me for that purpose.

There are too many positive aspects to highlight about the GK-12 program. I really feel fortunate to be part of it. Speaking of it being a life-changing experience, some day one of my former students may come up to me to share that building that blinker circuit during math class was the precise moment that sparked his or her interest in engineering. ■

A PEER Perspective: From Science Fair to Dissertation

Natalie Johnson

It is probably rare for a graduate student to write her dissertation on almost the same topics as her high school science fair project, but for me this happens to be the case. I was a junior at Navasota High School when Dr. Tim Phillips from Texas A&M University gave a seminar to our chemistry class on the effects of environmental compounds, specifically aflatoxin. His role in K-12 outreach was spurred by the PEER program and allowed us, as high school students, to learn about this advanced topic focusing on environmental health problems. Although I did not expect him to be my graduate advisor one day, I asked to come see his lab and work on a small science fair project. He welcomed me into the lab and his senior researcher Dr. Kittane Mayura taught me how to extract and measure aflatoxins in peanut butter. I eventually presented this work at the International Science and Engineering Fair in San Jose, CA, which was quite an experience for me as a high school student. This hands-on experiment sparked my interest in scientific research. Nearly ten years later, I am graduating with a Ph.D. in toxicology under the guidance of Dr. Phillips. I joined his lab as a graduate student after completing my bachelor's degree in biology from Texas A&M in 2006. While this exact path may be uncommon, I believe many people can attribute their interest in a subject or field to a dedicated teacher or professor who spent the time to help develop and foster one's interest. The importance of K-12 outreach from research institutions and the PEER program are largely responsible for introducing me to the world of research. ■

20 Tips for Better Grades, Less Effort

Dr. Bill Klemm, a Professor of Neuroscience and a PEER Co-PI, is a distinguished speaker with over 40 years of university teaching and research experience. Additionally, he has given numerous memory improvement talks to audiences in clubs and schools and at regional and national meetings. Bill visits schools to conduct all-day workshops on memory for teachers. He has also given talks about science in public schools to students in grades ranging from the second to the eighth grade. Other public speaking experiences include completion of the Dale Carnegie course in leadership and public speaking and, during an eight-year period as a Colonel in the Air Force Reserves, he gave frequent briefings to staff and commanders at the Headquarters of Air Force Human Systems Division. For over 40 years, he has given five or six talks each year in locations ranging from schools to cruise ships. Today, Dr. Bill's research has helped scientists understand how the brain works, specifically memory.

He has developed the tips to improve learning efficiency:

1. Commit the time
2. Improve your reading skills
3. Get motivated
4. Bring your "A-game" to class
5. Think! – it's the best rehearsal
6. Memorize only what you can't figure out
7. Organize learning material
8. Don't memorize by rote
9. Make associations
10. Use lots of cues
11. Use mental pictures
12. Improve working memory span
13. Reduce interferences
14. Don't multi-task; learn to focus
15. Reduce stress; calm emotions
16. Have a healthy life-style
17. Get enough sleep
18. Recall cues to remove "tip-of-the-tongue" blocks
19. Test yourself often
20. Believe in your ability

Dr. Bill Klemm, "Memory Medic" (left). The "Memory Medic" on his way to help students with their memory (right).

Visit thankyoubrain.com for memory tips and a blog on current topics in neuroscience, or read Dr. Bill's book, "Thank You Brain For All You Remember: What You Forgot Was My Fault." ■

Scientific Method Used to Study Behavior

Louise C. Abbott

What is a hypothesis? Why do scientists create hypotheses? Why are hypotheses useful in science? What do we mean by the scientific method? These are just some of the questions that are raised in this unit. When reviewing the basic tenets of the scientific method, a group of students were given a real experimental question to deal with: Do old mice behave differently than young mice? Students discussed if there might actually be any differences between old and young mice with respect to how they acted when placed in a novel open space and if there might be any differences in coordination. Students developed theories of mouse behavior and developed a consensus about how they expected the mice to behave and developed testable hypotheses. They worked with groups of 5 - 6 old and 5 - 6 young mice and test specific behaviors using different scientific apparatuses actually used in a research laboratory. Each student wore nitrile gloves and was instructed how to correctly pick up and hold a mouse and the students took turns putting the mice into each behavioral test and then back into the cages.

Dr. Louise Abbott engages students in an experiment involving the scientific method, allowing them to get hands-on laboratory experience.

The first test that the students carried out was the open field test. This is a standard behavior test that assesses how mice deal with a novel open space. Mice are placed in a box with a floor, sides, and open top. Researches record the distance traveled and the number of times each mouse rears up on its hind legs. Each mouse spends two minutes in the box, and then the box is thoroughly cleaned before the next trial. Students used their math skills to average the distance traveled for the old mice and for the young mice. The same was true for average number of times the old and the young mice reared. The students took turns placing one mouse at a time into the open field box, taking it out, timing the events, and counting distance and numbers of times the mouse reared up.

The second test was the vertical pole test. This test uses a 1.5-inch diameter plastic pipe, wrapped in tape that the mouse is placed on when the pole is horizontal. When the pole is shifted to a vertical position over the course of 15 seconds, the students observe whether the mouse can stay on the rod. Beneath the rod there is a box with soft padding in the bottom so if the mouse falls, it is not hurt. The students hold the pole a foot above the padding so the mouse is not tempted to just jump from the pole to the bedding. This test determines if mice can coordinate their movements and how they are gripping the pole so that they can stay on the pole as its orientation changes from horizontal to vertical. Mice with impaired coordination cannot stay on the pole as it nears the vertical position. Again, students calculate the average for each group of mice, young and old.

"The students were able to put the scientific method into practice in a fun, yet realistic way."

At the end of the experiments, the students determined whether they proved their hypotheses – some hypotheses were true and some were not. The students then discussed what might have influenced the results. The students were very enthusiastic about developing hypotheses that they could actually test with live animals. They learned that there could be a difference of opinion at the beginning about what they might observe, they realized that they did not know how the experiment would turn out and then they had the satisfaction of seeing a complete experiment from beginning to end that answered the questions that they raised. The students were able to put the scientific method into practice in a fun, yet realistic way. Being able to actually run the experiments themselves helped the students engage in the learning process in a way that is not possible when experiments are only discussed or demonstrated. These students also learned about research that is really carried out in the scientific community. These two behavior tests are ones that I actually used in my research when I studied how low dose exposure to methylmercury would affect mouse behavior. ■

PEER Integrated Middle School Curriculum

Bill Klemm

http://peer.tamu.edu/MiniMods.asp

Science and math are too important in everyday life to be dismissed as too hard or boring. This curriculum helps motivate students by showing just how relevant and interesting science and math can be by integrating science and math with social studies (mainly history and geography) and language arts.

Students often ask: "Why do we need to know this?" By integrating science and math content with environmental health, social studies, and language arts, we believe the relevance of science and math is made self-evident. Students see science and math in a new light.

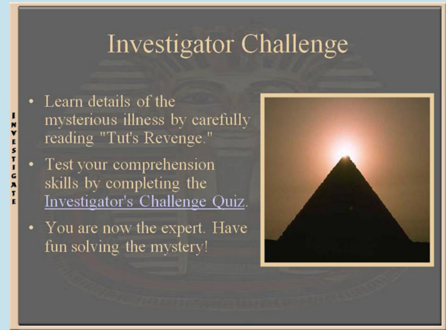
An adventure story is the basis for language arts instruction, and at the same time creates the setting for spawning academic content in social studies, science, and math. A recurring cast of characters, the "Back Pack club," has a time-travel pocket digital assistant that allows them to travel to different parts of the world at different historical periods.

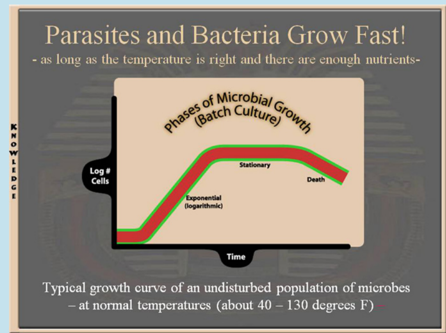
Time travel visits are driven by state-mandated social studies standards: in Texas, 6th graders learn about world history, 7th graders learn Texas history, and 8th graders learn U.S. history prior to the Civil War. Adventure stories are created in these historical settings.

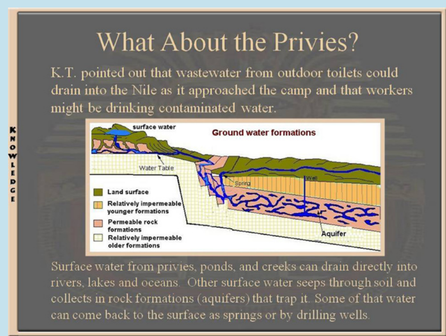
We add to the relevance by including environmental health problem for students to solve. Children can relate curriculum concepts to environmental health issues, because they have either confronted similar issues or know someone who has. Common conditions include allergies and asthma, poisoning from food, water, or air; exposure to chemical hazards and carcinogens; nutritional disorders and assorted infectious diseases. All of these themes appear in our modules.

Benefits for Teaching and Learning

• FREE Instructional materials downloadable from the PEER website







• Content shows real-world relevance of science and math

• Written by real experts: Texas A&M professors in each subject and education professionals. Seven years in the making.

• Adventure story written by profession children's book author … The story setting makes science and math fun.

• Adventure stories available in audio and in written Spanish

• State knowledge and skills standards-based.

• Content provided as engaging PowerPoint slides in which the notes section of the slides provides information for the teacher.

• Each module has a problem for students to solve. Encourages critical and creative thinking and use of scientific method.

• Content in all four subjects is more interesting since it is embedded in real-world context that emphasizes how academic subjects inter-relate.

• Flexible to use. Modules available in two forms: 1) a complete set of ~ 120 slides with notes that teachers can team-teach as an integrated unit. The content is intermixed to create a logical flow that is related to flow of events in the story, or 2) slides divided into "mini-modules" that focus only on a given subject (science, math, social studies, or language arts).

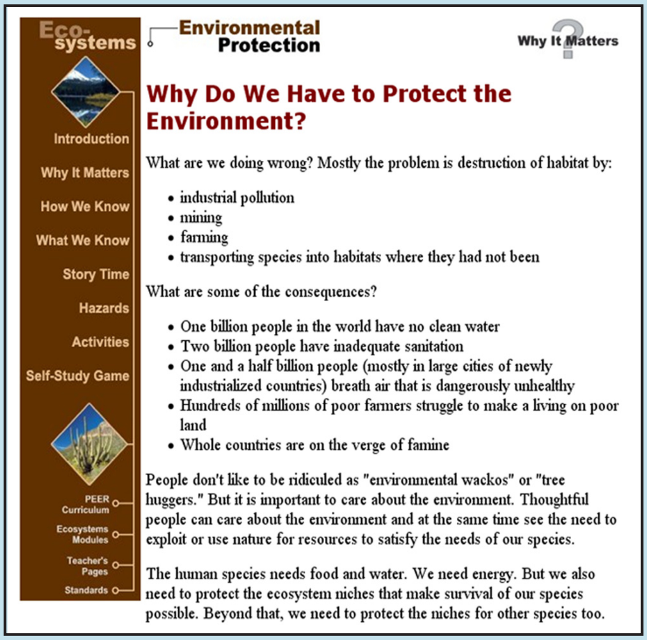
• Numerous hands-on and lab activities.

• Important supplemental material. Science: combating infections, scientific method, tobacco and nicotine addiction, water purification. Math: area/volume calculations, circumference, geometric shapes, length conversions, metric multiplication factors, percents/decimals/fractions, perimeter, probability, ratios, statistics, temperature conversion, time measurement, volume and weight, conversions.

• Teachers can take ownership by modifying slide shows.

• Pre- and post-tests in each academic area. ■

Units of instruction begin with explanation of "Why It Matters":


Eco-systems
Environmental Protection
Why It Matters

Introduction
Why It Matters
How We Know
What We Know
Story Time
Hazards
Activities
Self-Study Game
PEER Curriculum
Ecosystems Modules
Teacher's Pages
Standards

Why Do We Have to Protect the Environment?

What are we doing wrong? Mostly the problem is destruction of habitat by:

- industrial pollution
- mining
- farming
- transporting species into habitats where they had not been

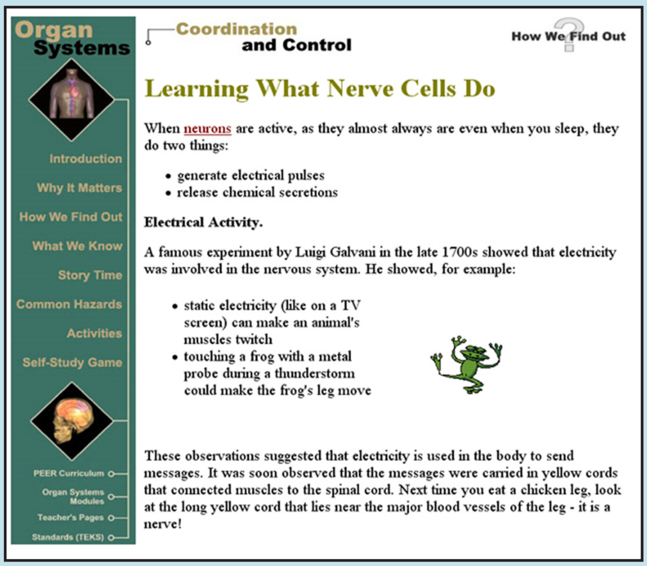
What are some of the consequences?

- One billion people in the world have no clean water
- Two billion people have inadequate sanitation
- One and a half billion people (mostly in large cities of newly industrialized countries) breath air that is dangerously unhealthy
- Hundreds of millions of poor farmers struggle to make a living on poor land
- Whole countries are on the verge of famine

People don't like to be ridiculed as "environmental wackos" or "tree huggers." But it is important to care about the environment. Thoughtful people can care about the environment and at the same time see the need to exploit or use nature for resources to satisfy the needs of our species.

The human species needs food and water. We need energy. But we also need to protect the ecosystem niches that make survival of our species possible. Beyond that, we need to protect the niches for other species too.

Units show how some of the information was discovered:


Organ Systems
Coordination and Control
How We Find Out

Introduction
Why It Matters
How We Find Out
What We Know
Story Time
Common Hazards
Activities
Self-Study Game
PEER Curriculum
Organ Systems Modules
Teacher's Pages
Standards (TEKS)

Learning What Nerve Cells Do

When neurons are active, as they almost always are even when you sleep, they do two things:

- generate electrical pulses
- release chemical secretions

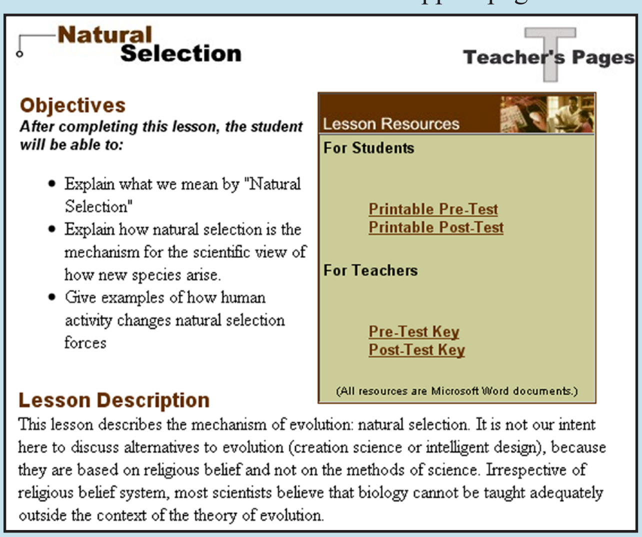
Electrical Activity.

A famous experiment by Luigi Galvani in the late 1700s showed that electricity was involved in the nervous system. He showed, for example:

- static electricity (like on a TV screen) can make an animal's muscles twitch
- touching a frog with a metal probe during a thunderstorm could make the frog's leg move

These observations suggested that electricity is used in the body to send messages. It was soon observed that the messages were carried in yellow cords that connected muscles to the spinal cord. Next time you eat a chicken leg, look at the long yellow cord that lies near the major blood vessels of the leg - it is a nerve!

Units of instruction have a teacher-support page:


Natural Selection
Teacher's Pages

Objectives

After completing this lesson, the student will be able to:

- Explain what we mean by "Natural Selection"
- Explain how natural selection is the mechanism for the scientific view of how new species arise.
- Give examples of how human activity changes natural selection forces

Lesson Resources

For Students

Printable Pre-Test
Printable Post-Test

For Teachers

Pre-Test Key
Post-Test Key

(All resources are Microsoft Word documents.)

Lesson Description

This lesson describes the mechanism of evolution: natural selection. It is not our intent here to discuss alternatives to evolution (creation science or intelligent design), because they are based on religious belief and not on the methods of science. Irrespective of religious belief system, most scientists believe that biology cannot be taught adequately outside the context of the theory of evolution.

Bill Klemm

http://peer.tamu.edu/curriculum_modules/

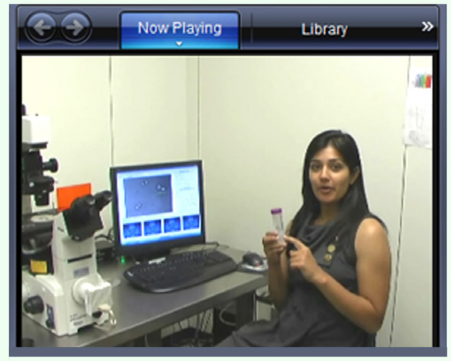
There is talk that someday, maybe soon, traditional textbooks will be replaced with e-books. Well, we don't know about that, but we have a biological science e-book. And you don't have to read it all scrunched up on the tiny screen of a Kindle-like device. You read it full featured on a website.

This e-book covers the full span of middle-school science (cell systems, organ systems, and ecosystems) and in addition has features you won't find in other textbooks. We provide explanations and activities not only for traditional biology content but also for a multitude of common environmental toxins. The section on water quality even has a lot of standards-based math instruction.

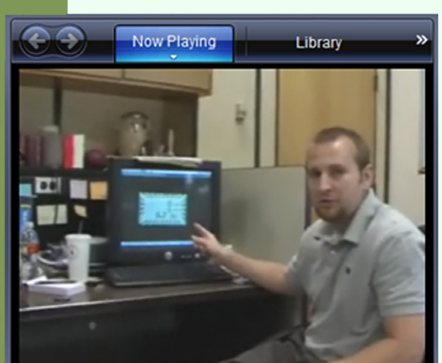
Benefits for Teaching and Learning

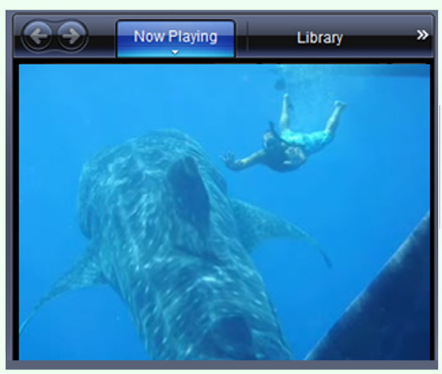
- Applicable to vast majority of state standards for middle-school life science.
- Broad and cohesive web curricula for middle schools.
- Modularized. Pick and choose what you want or need to learn.
- Convenient to use: electronic searching, webpage format for easy surfing, hyperlinking within the curriculum and to outside sites.
- Written by real experts: biological scientists and education professionals.
- Four or more hands-on activities or experiments in every unit.
- Emphasizes functions to encourage students to think, as opposed to just memorizing dry facts.
- Covers all the major areas: cell systems, organ systems, ecosystems.
- Covers important environmental issues: water quality, pollution from industry, mining, farming.
- Explains ~ 50 common environmental hazards: from insecticides to global warming … http://peer.tamu.edu/curriculum_modules/Hazards_index/environmental_hazards_index.htm
- A "Story Time" in each unit gives a child-oriented biosketch of a famous scientist who made some of the discoveries presented in the content section (http://peer.tamu.edu/curriculum_modules/storytime/storytimeindex.htm).
- Each unit has two sections not found in books: 1) "Why It Matters," shows students why they should care about the content, and 2) "How We Know" shows what strategies, methods, and instruments are used in discovery.
- Teacher-support pages for each unit provide overview, pre- and post tests, applicable state standards, resources. ■

Do you wonder what the life of a scientist is like or how to become a scientist??



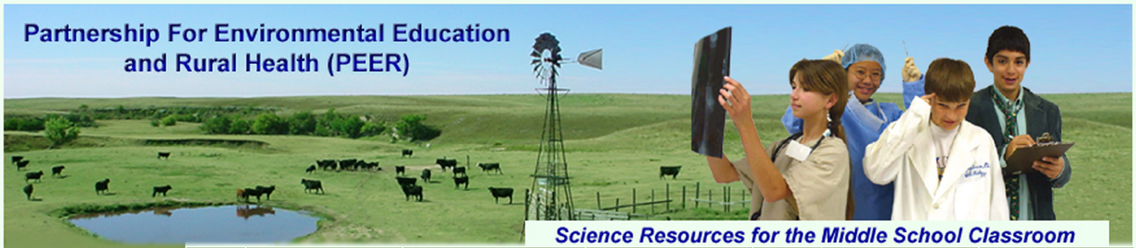
The PEER program has worked with many types of scientists and mathematicians across Texas A&M University. Videos can be found on the homepage that detail the research and personal lives of many resident scientists and mathematicians involved throughout the program. Teachers and students can watch and interact with these scientists, including learning about how to become a successful scientist and the possibility of career options available at Texas A&M University. Videos range from talking to biologists, veterinarians, oceanographers, engineers, and physicists!





http://peer.tamu.edu/NSFPages/NSF_Interviews.asp

Visit peer.tamu.edu and find out!



Home | Teacher Resources | Request a Lesson Plan | Teacher Workshops | Videos | NSF GK-12 Program | For Veterinarians

Contact Us

Other Links ....

Public School Collaborations

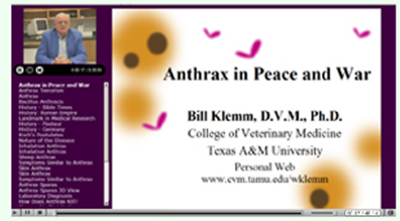
Southwest Regional GK-12 Site

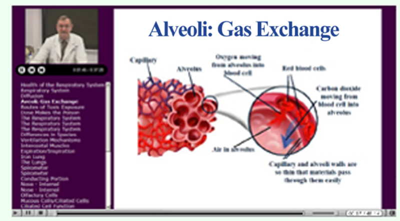
Search

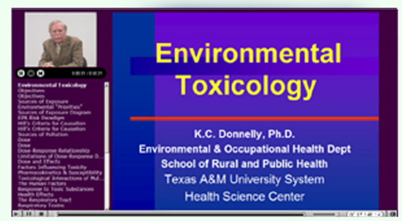
Virtual Scientists' Presentations

Select from the list below the environmental health presentation you would like to view. The "High Bandwidth" option on the health presentations has a video with an integrated PowerPoint presentation and the "Low Bandwidth" is video only. If you have problems viewing the "High Bandwidth" presentation, please select "Low Bandwidth."

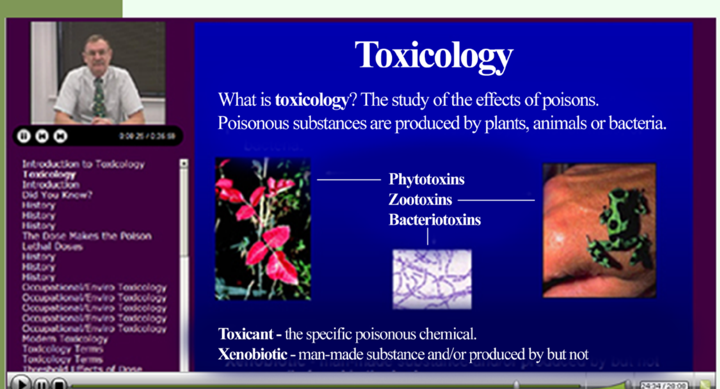
Environmental Health Presentations	Description of Presentations
African Wildlife Conservation By Dr. James Derr (18 minutes) Variable Bandwidth	The presentation provides information on African Wildlife Conservation efforts.
Anatomy and Physiology By Dr. Larry Johnson (48 minutes) Variable Bandwidth	The presentation provides an overview of anatomy and physiology. The different kinds of tissues and systems and their structures and functions in the human body and other living organisms are discussed.
Anthrax in War and Peace By Dr. William Klemm (28 min.) High Bandwidth Low Bandwidth	History of anthrax discovery, effects, locations affected in the world, routes of exposure for humans, historical and current value in medicine and in war.
Drug Toxicology By Dr. K. C. Donnelly (37 minutes) Variable Bandwidth	Dr. Donnelly discusses drug toxicology associated with substance abuse including exposure and toxic effects of those drugs on the body.
Energy By Dr. Mark Holtzapple (28 minutes) High Bandwidth	Energy is the possible solution for reducing various problems such as water, food, environment, poverty, war, disease, education, democracy, and population.
Environmental Toxicology By Dr. K. C. Donnelly (51 minutes) High Bandwidth Low Bandwidth	Toxicology as it relates to the exposure to substances in our daily environment. Includes sources of pollution and exposure, the factors that affect a person's susceptibility to toxins, and the effects of environmental toxins on various body systems such as the kidneys and central nervous system.
Health of the Respiratory System By Dr. Larry Johnson (38 minutes) High Bandwidth Low Bandwidth	Anatomy and function of the respiratory system, how we breathe, the function of conducting (plumbing to outside environment) and respiratory (site O_2 and CO_2 gases exchange), and the effect of smoking on cell function, appearance and condition of the lung and its possible role in causing lung cancer.
Introduction to Toxicology By Dr. Larry Johnson (36 minutes) High Bandwidth Low Bandwidth	History of toxicological events leading to current studies and current regulatory agencies, toxicology terms and concepts from a fun approach, major effects of toxicants and organ damage, routes and sources of toxicant, and careers in toxicology.
Scientific Method By Dr. William Klemm (21 min.) Variable Bandwidth	Discussion of scientific method including hypotheses, experimental design, interpretation of results, and the drawing of conclusions.

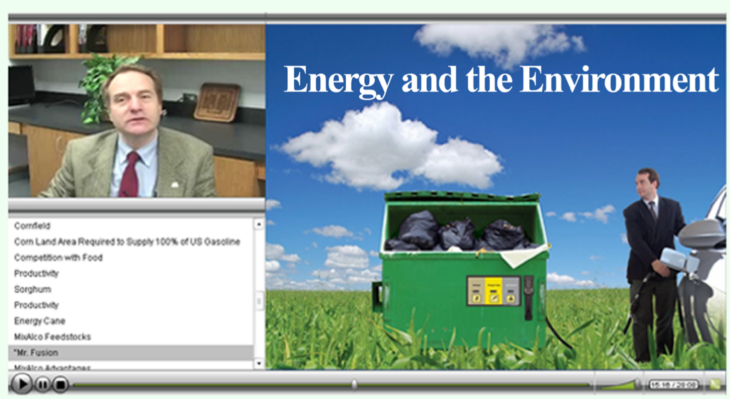






Need more information? Teachers can find more presentations from scientists about environmental health and veterinarian science. Under 'Virtual Scientists' Presentations', teachers can access videos ranging from toxicology to African wildlife to bioterrorism threats complete with discussions from real-life scientists and lesson plans to engage students' interest and participation. So visit peer.tamu.edu and see what you can find for your classroom!





http://peer.tamu.edu/presentations.asp

EXPLODING Pumpkins

Kyle Damborsky

Target Grade Level: 8th

TEKS Objectives: 6.5 (D): Identify the formation of a new substance by using the evidence of a possible chemical change, 7.6 Matter has physical and chemical properties and can undergo physical and chemical changes, 8.5 (D): Recognize that chemical formulas are used to identify substances and determine the number of atoms of each element in chemical formulas containing subscripts.

Materials:
- Pumpkin(s), full sized
- Calcium carbide, 2 g per demo
- Water, 10 ml per demo
- Matches
- Meter stick (or another long, rigid object to which you feel comfortable taping a wooden splint)
- Wooden splints
- Masking tape
- Aluminum foil
- Fire extinguisher

Activity Summary:

This demo is an example of the power of exothermic chemical reactions that is still suitable for a classroom. Calcium carbide reacts with water to form the volatile gas, acetylene. With the flick of a match, this powerful gas can turn a pumpkin into a jack-o-lantern with knife-like precision. Or so it seems...

Chemical Concepts:

This activity is a demonstration of chemical changes, exothermic reactions, and provides an opportunity to explain balancing chemical equations. The instructor should be familiar with these concepts before the demo. There are two chemical reactions in this demo with which the instructor should be familiar:

1. The formation of acetylene from calcium carbide and water.
2. The combustion of acetylene and oxygen. Since following fire is always arduous, it is recommended that this demo be used as a wrap up for a lesson on chemical reactions, exothermic reactions, or balancing chemical equations.

Activity Plan:

1.) Before the demo, carve out the pumpkin(s) with a jack-o-lantern face, removing all “guts”. Reserve all carved pieces, and make sure they can be inserted back into the jack-o-lantern with ease. Note: The jack-o-lantern should be as air tight as possible. Also, the face pieces and top should be cut with a taper so that they easily slide in and out of their positions, but will stay in place when left alone.

2.) Carve a small, triangular opening in the back of the pumpkin. This opening is for the ignition of the gas and should be on the lower half of the pumpkin (the lower the better).

3.) Make a small boat out of the aluminum foil large enough to hold the 10 ml of water.

4.) Measure out the 2 g of calcium carbide and 10 ml of water you will use for the demo. Make sure you keep them separate so the reaction does not begin prematurely.

5.) Place the carved pumpkin, with all carved pieces returned to their openings, at the front of the class. The students should just see what appears to be a pumpkin. The small triangle at the back of the pumpkin should be easily accessible to the demonstrator.

6.) Removing the top of the pumpkin, insert the aluminum boat and fill it with the water. Pick a volunteer to assist you from this point on. The next steps must be timed since from this point on, gas will be accumulating in the pumpkin.

7.) Have your volunteer pour the calcium carbide into the water filled boat, then gently return the lid to the pumpkin. Gas should begin evolving from the liquid immediately.

8.) At the same time, light the wooden splint taped to the end of your meter stick.

9.) Allow between 15 and 30 seconds for the gas to accumulate inside the pumpkin and the reaction to complete. The longer you wait, the more gas builds inside the pumpkin and the more dramatic the effect.

10.) Insert the lit splint into the back of the pumpkin and watch the reaction!

11.) Some pieces of the pumpkin interior may become scorched or catch on fire. Using water to put out the fire is not a good idea since some calcium carbide may remain. Instead, try blowing or smothering the flames.

Troubleshooting Tips:

1.) A less than dramatic explosion. This may be fixed by adding more calcium carbide, and/or allowing more time for the pumpkin fill with gas.

2.) Only a few pieces of the pumpkin face came out. Again, allow more time for the gas to accumulate, and if necessary, add more calcium carbide. Also, try using a thin knife to make sure the pieces can freely slide out of the face.

3.) No pumpkins available at this time of year? Try a watermelon or other large, gourd type fruit or vegetable. Note: Watermelons make a decent substitute, but they are much less rugged than pumpkins. After one demo, they will most likely shatter. ■

To find this lesson search for “Pumpkin” at http://peer.tamu.edu/DLC/NSF_Resources.asp

Skittle ex-plosion

Betsy Childs

Activity Summary:

This activity is designed to provide students with a visual and hands-on way of discovering the tremendous effects of exponents. The activity uses Skittles as the main visual aid. They are added to a large bucket at different exponential increments. The students, and even adults, will be amazed at how quickly the container fills with Skittles! Along with the experiment, students graph the data at hand and actually discover an exponential relationship.

The activity is designed to introduce students to exponential relationships and make conjectures about how changing the base of a number with an exponent can change the steepness of the curve.

Activity Plan:

• Get the students' attention through an introduction involving exponential growth and something applicable to the real world (like the spread of the Black Plague).
• Place the clear bucket where all the students can see it and ask the students how many rounds they think we would have to go in order to fill the bucket with Skittles if we double the number of Skittles we add each round.
• Demonstrate by having the baggies labeled with the correct round number (n) and number of Skittles being added that round, t(n). For example, on round 0, have a baggie with one Skittle labeled round 0, and add the Skittle. For round 1, have a baggie labeled round 1 that has 2 Skittles in it, and add the Skittles. For round 2, have a baggie labeled round 2 that has 4 Skittles in it, and add the Skittles etc…
• After a few rounds, the instructor may want to ask the student's if they would like to change their guess. They will probably guess a higher number of rounds than they did previously.
• Finish the demonstration.
• Work through the first table and graph on the Skittle ex-plosion Worksheet
• Next, change the base from 2 to 4 and have students hypothesize if the bucket will fill up more quickly or more slowly if we quadruple the number of Skittles we add each round instead of doubling and by how much.
• Next, proceed with the demonstration while simultaneously going through the worksheet and filling out the table and graph with the students. After a few rounds, have the students do the recording on their own.
• Ask students about different conclusions they drew from this experiment.
• Have them proceed with answering the Review Questions on the worksheet and then discuss their findings as a group.
• Conclude the lesson by going back to your attention-grasping example, like the Black Plague, and explain to the students the effect that exponential growth has in these real world situations.

Lesson Extension:

• Obtain a set of graphing calculators for the students, or use an overhead graphing calculator, to simulate graphs as the students are working through this experiment. This will help students to get a better grasp about what exponential curves look like and the drastic effect that increasing or decreasing the base of the number changes the shape of the graph.
• For higher grades, a geometry lesson could be involved by measuring and estimating the volume of an individual Skittle, the volume of the bucket, and then hypothesizing as to how many Skittles will be needed to fill the bucket. A good science lesson could also be introduced here involving the air pockets between the Skittles.
• For advanced students, it would be a great idea to show the relationship of the number of Skittles that are being collected in the bucket to exponents.

This is actually a geometric sequence that the students could quite easily figure out! ■

Target Grade Level: 6th

Time Required: 45 to 60 minutes

TEKS Objectives: 6.1 (D): Write prime factorizations using exponents, 6.10 (D) : Solve problems by collecting, organizing, displaying, and interpreting data, 6.11 (C): Select or develop an appropriate problem-solving strategy from a variety of different types, including drawing a picture, looking for a pattern, making a table, and working a simpler problem, 6.12 (A): Communicate mathematical ideas using language, efficient tools, appropriate units, and graphical, numerical, physical, or algebraic mathematical models, 6.13 (A): Make conjectures from patterns or sets of examples and non-examples, 6.13 (B): Validate his/her conclusions using mathematical properties and relationships.

Materials:
• 7 to 10 large bags of Skittles
• 1 large transparent bucket
• 1 box of quart-size Ziploc baggies
• 1 box of gallon-size Ziploc baggies
• Marker (to write on the baggies)
• Worksheet

Cost per classroom: Approximately $50.00 if using Skittles. This activity can be done for a much lower cost if the instructor uses water instead.

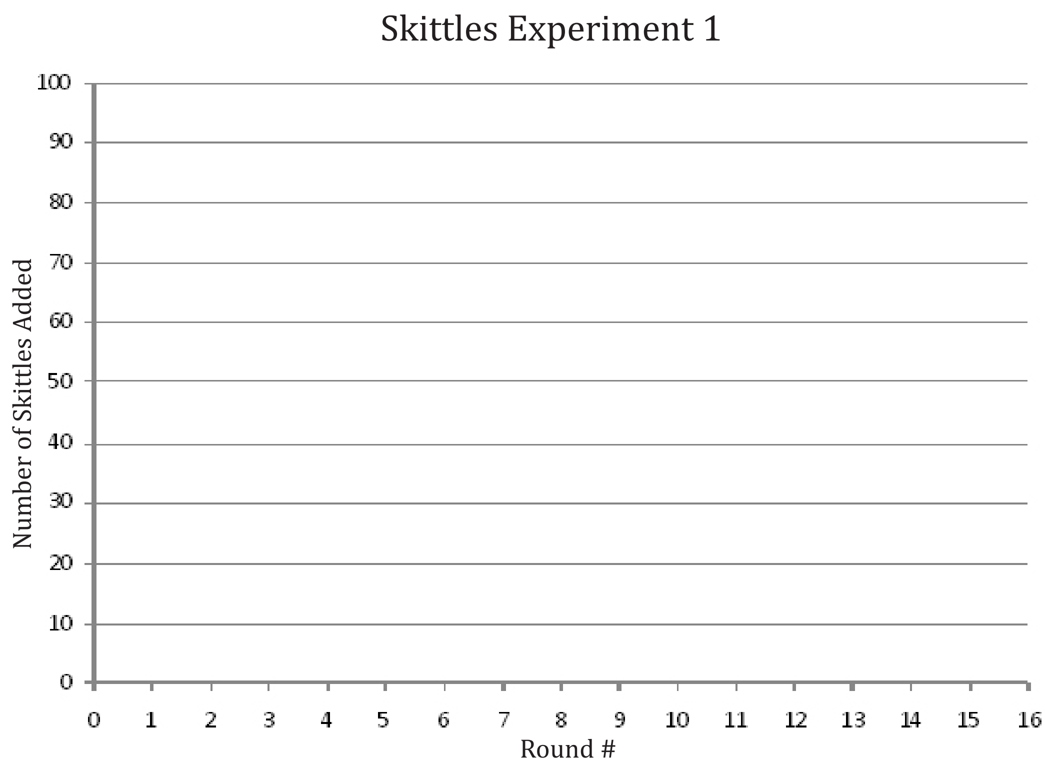
Name: Date: Class period:

Skittle e^{x}-plosion

Directions: Fill in the following tables and graphs with information you gather from the activity.

Experiment #1

Round #	0											
Number of Skittles Added this Round	1											
	$2^{\square}$	$2^{\square}$	$2^{\square}$	$2^{\square}$	$2^{\square}$	$2^{\square}$	$2^{\square}$	$2^{\square}$	$2^{\square}$	$2^{\square}$	$2^{\square}$	$2^{\square}$

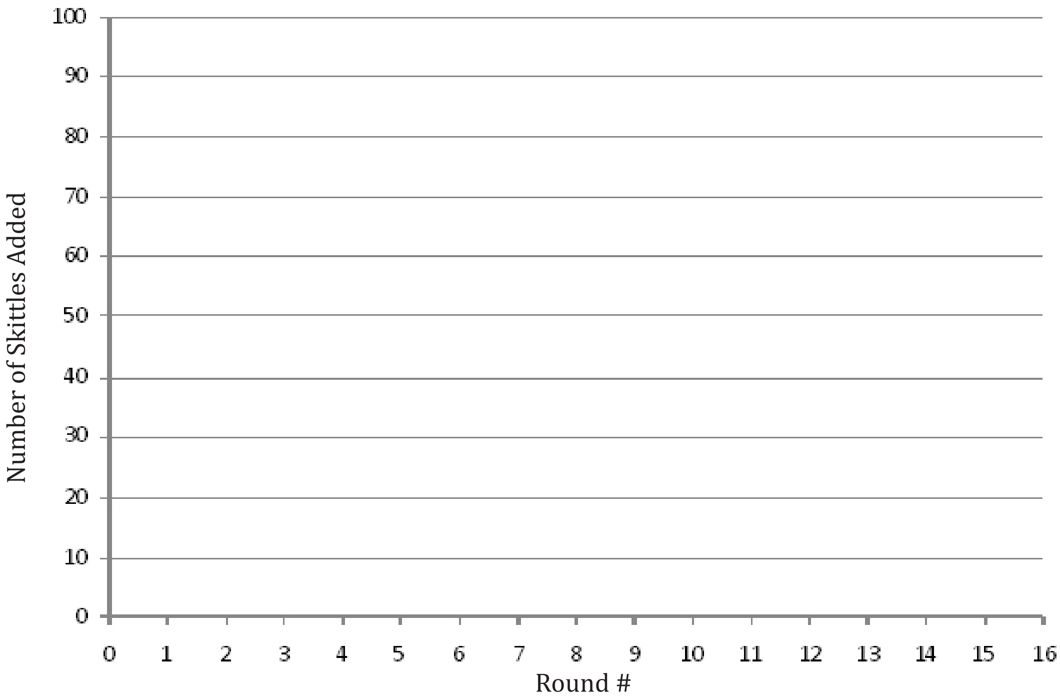


Experiment #2

Round #	0											
Number of Skittles Added this Round	1											
	$4^{\square}$	$4^{\square}$	$4^{\square}$	$4^{\square}$	$4^{\square}$	$4^{\square}$	$4^{\square}$	$4^{\square}$	$4^{\square}$	$4^{\square}$	$4^{\square}$	$4^{\square}$

To find this lesson search for "Skittle E-xplosion"

Skittles Experiment 2



Review Questions

Answer the following review questions based on what you learned from the activity.

1. How does the graph of Skittles Experiment 1 differ from the graph of Skittles Experiment 2?

2. What might have caused this difference?

3. Why did changing the base from 2 to 4 make such a huge difference in how quickly the bucket filled up?

4. What do you suppose would happen if we changed the base to 3?

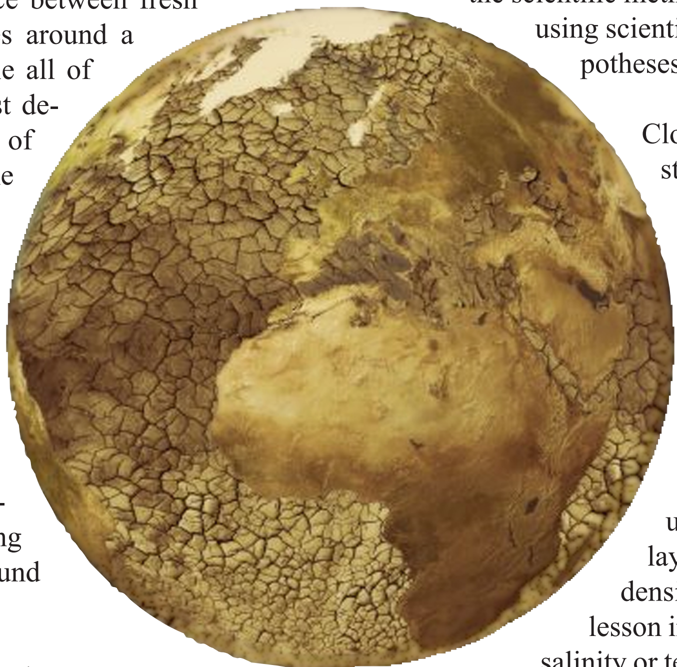
Mystery Water

Disappearing Hydrosphere – A Mystery Experiment

Ruth Mullins

Activity Summary:

This activity focuses on the hydrologic cycle by applying an investigative approach to determine the difference between fresh and salt water. The experiment revolves around a scientific mystery: An evil madman stole all of the earth's water, and now students must determine the proper locations of samples of the stolen water sources to rebalance the hydrosphere. The activity applies previous knowledge of density, temperature, and use of scientific tools to solve the mystery of the stolen hydrosphere.



Activity Plan:

Start the lesson with an introduction of the water cycle. Focus on what percentage of water is salt and what percentage is fresh in the hydrosphere, including where the freshwater is distributed around the globe.

After the introductory lesson, move into the mystery story where students investigate the differences between salt and fresh water. Have fun with adapting the story to fit your classroom and add dramatic effects by including music, laboratory coats, safety glasses, spyware, etc. to interest the students.

1st Day: Water is one of the earth's most valuable resources and is nonrenewable. The earth's water supply forms the hydrosphere and covers 70% of the earth's surface. However, very little of the hydrosphere is fresh water (~3%) and much of that is frozen in the polar icecaps. The hydrologic cycle is the force constantly renewing the earth's water supply and is driven entirely by solar energy. There are three main steps in the hydrologic cycle: 1. sun provides energy causing evaporation 2. water vapor condensates in the troposphere 3. precipitation occurs as water droplets become too heavy to stay in the troposphere.

There are three basic types of fresh water sources on the earth's surface: frozen, flowing, and standing. Frozen sources include glaciers, which can form in valleys, on continents, or in the oceans (icebergs). Flowing waters are rivers and streams, occurring around in the world in different sizes. Standing water sources are areas where water enters a region and remains there. Lakes, ponds, and reservoirs are standing water sources.

After providing the basic information, have students construct models of the hydrologic cycle with examples of the types of water in a particular step.

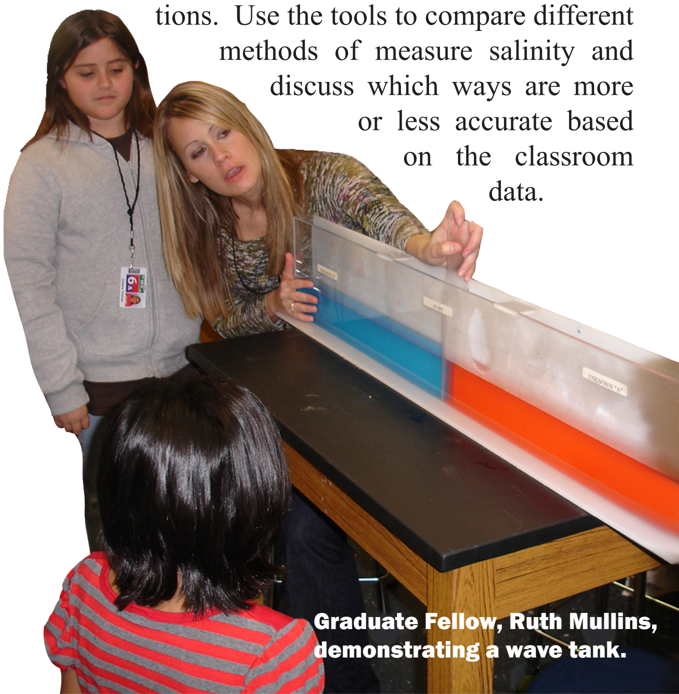
2nd Day: Explain to the students that someone has removed the earth's hydrosphere and now they must decide how to return the water back to its appropriate location in order to restore the hydrologic cycle. From here, give the students three samples of mystery water and a set of equipments to start measuring and determining which sources of water they have. Also, be creative with the samples. Depending on the equipment available and your location, you can collect river water, pond water, add sediment to water, etc. The purpose of the lab is for students to practice the scientific method and improve their skills with using scientific instruments, formulating hypotheses, and explaining conclusions.

Close the lesson by asking for the students' predictions on what type of water they have from which location on earth. Extend this discussion into precision and accuracy in scientific procedures.

End the lesson by demonstrating the differences between water sources in the hydrosphere using a wave tank to show how layers will form based on different densities. If time remains, lead the lesson into a discussion on how to test if salinity or temperature has more of an effect on density in the hydrosphere.

Acquiring Tools:

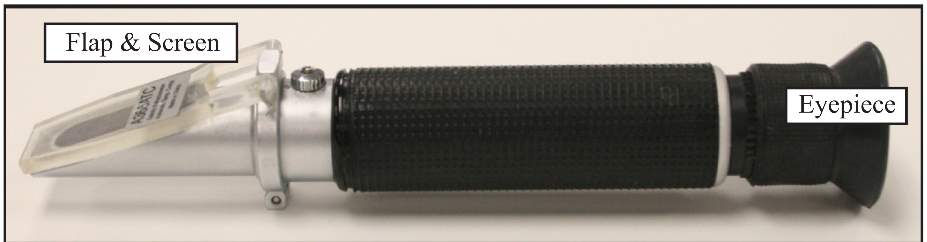
The only difficulty may be acquiring advanced tools for measuring salinity. These tools can be purchased from various websites or borrowed from universities, state departments, or companies that monitor water sources. The optional tools are a good way to introduce students to new scientific measuring tools and serve as improvements to accuracy in addition to their density calculations. Use the tools to compare different methods of measure salinity and discuss which ways are more or less accurate based on the classroom data.



Graduate Fellow, Ruth Mullins, demonstrating a wave tank.

Experimental Set-Up

Salinity by Refractometer
Materials: eyedropper, samples of mystery water, refractometers
Procedures:
1. Open the flap and clean the blue screen of the refractometer with a soft cloth
2. Use the eye dropper to place ONE drop of sample on the blue screen
3. Close the screen and hold the refractometer into the light
4. Look through the eyepiece to calculate the salinity
5. Read and record the salinity of your sample (Use the diagram below)
6. Wipe off the screen and repeat with the other samples.



Salinity by Evaporation
Materials: hot plate, aluminum foil or boats, small samples of mystery waters (5 ml), triple beam balance
Procedures:
1. Using your pencil, mark each aluminum dish with the name of the sample (i.e. A, B, C)
2. Weigh and record the dry weight of each sample dish in the table
3. Add 5 ml of each sample to the appropriate dish
4. Weigh and record the wet weight of each sample dish in the table
5. Place the dishes on the hot plate and wait for the water to evaporate
6. Weigh and record the evaporated weight of each sample dish in the table
7. Calculate the salinity of each sample using the following ratio:
Study the following example. Then determine the salinity of each of your samples using the information in Table 1.

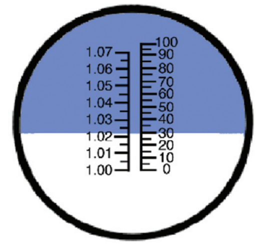
sample	dish #	empty wt.	dish + water	wt. of water	dish + salt	wt. of salt
known	16	.95	6.08	5.13	1.08	.13

To get the % salt = $\frac{\text{weight of salt}}{\text{weight of water}} \times 100 = \frac{.13}{5.13} \times 100 = 2.5\%$

To get the ppt salt = $\frac{\text{weight of salt}}{\text{weight of water}} \times 1000 = \frac{.13}{5.13} \times 1000 = 25$ ppt

Salinity by Density:
Equipment: triple beam balance, graduated cylinder, calculator
Procedures:
1. Weigh your empty graduated cylinder
2. Add 50 ml of sample to your cylinder and weigh
3. Determine the weight of your sample and the volume
4. Calculate the density of your sample
5. Repeat for the other two samples

Salinity by Buoyancy:
Equipment: floating object (block, cork, etc.), sample, ruler
Procedures:
1. Place the object into your sample
2. Measure the height of the object ABOVE the water level
3. Record your measurement and repeat for the other two samples



Read the value on the right side of the window where the blue and white line meets. This sample has a salinity of 30 ppt.

Target Grade Level: 6th, 7th

Time Required: Two 45-minute class periods

Lesson Objectives: Understand the hydrologic cycle and how water circulates around the globe. Learn the difference between fresh and salt water. Investigate the differences in physical characteristics between fresh and salt water. Improve skills in measuring and calculating density. Apply measurement results to the balance of water in the hydrosphere and be able to explain why fresh and salt water remains constant on earth. Construct a working model of the hydrologic cycle.

Materials:
- Rectangular water tank with partitions to divide it into chambers
- Food coloring
- 100 ml beakers or Erlenmeyer flasks to hold mystery samples (each group will need 3)
- Aluminum foil
- Hot plates
- Graduated cylinders (10 ml) (one per group)
- Triple beam balance (one per group)
- Salt water (35 ppt: 30-35 grams per 1000 grams of water best made with sea salt)
- Distilled water
- Fresh tap water
- Refractometers
- Thermometers
- Conductivity meters (if available)
- Hydrometers (if available)
- Light-weight blocks (or something similar that will float)
- Calculator

Cost per classroom: Approximately $10.00

Safety First:

The method of evaporation requires using hot plates and aluminum dishes. The hot plates can be dangerous and hot. Depending on the maturity level of the students, either have a hot plate per table or monitor the evaporation plates. ■

Name: Date: Class period:

Disappearing Hydrosphere

A Mystery Experiment

EVAPORATION METHOD:
Fill in the following table according to the procedures.
Do NOT forget to use appropriate scientific UNITS (ex. g, cm, m, g/cm3) Wt. = weight

dish #	empty wt.	dish + water	wt. of water	dish + salt	wt. of salt
A					
B					
C					

Calculate the salinities of each sample based on the formula in the procedures:

A = ________ ppt B = ________ ppt C = ________ ppt

REFRACTION METHOD:
Using the refractometer, measure the salinity of each sample.
A = ________ ppt B = ________ ppt C = ________ ppt

SAMPLE DENSITIES:
Using your mass balance, calculate the density of each sample. Remember mass and volume are important AND do not include the weight of your graduate cylinder. DO NOT FORGET UNITS!

A = ________ B = ________ C = ________

SOLVE THE MYSTERY! Based on your sleuth expertise and great scientific measuring abilities, solve the mystery of the disappearing hydrosphere. Accurately predict below by labeling what would happen if we mix the three layers in a wave tank and identify the location of each layer in the hydrosphere (fresh water, river water, ocean water)!

A = ________
B = ________
C = ________

To find this lesson search for "Disappearing" at
http://peer.tamu.edu/DLC/NSF_Resources.asp

Chemistry in a Bag

Saniya Ali

Lead teacher, Naveen Cunha, carefully distributes chemicals for the experiment in his Stephen F. Austin Middle School classroom.

Target Grade Level: 8th

Time Required: One class period

TEKS Objectives: 8.8 (A) Describe the structure and parts of an atom, 8.8 (B) Identify the properties of an atom including mass and electrical charge, 8.9 (A) Demonstrate that substances may react chemically to form new ones, 8.9 (B) Show how an element's properties affect its position on the periodic table, 8.9 (C) Recognize the importance of formulas and equations to express reactions, 8.9 (D) Identify that physical and chemical properties are in everyday materials.

Materials:
- Plastic bags
- Sodium bicarbonate
- Calcium chloride
- Test tubes
- Universal indicator (phenol red)

Cost per student: $0.10

Activity Summary:

Physical and chemical changes happen all around us all the time. In this activity students will observe and identify the types of changes taking place to gain an understanding of chemical reactions and how they work. The students will see a reaction between calcium chloride and sodium bicarbonate and each separately mixed with a universal indicator. They will make observations of both physical and chemical changes.

Activity Plan:

1. Place scoop of the calcium chloride and scoop of the sodium bicarbonate in the Ziploc bag A. Mix the dry ingredients. Stop and observe any changes.
2. Place scoop of calcium chloride in another Ziploc bag labeled B with 30 mL of 'universal indicator' mixture.
3. Place scoop of sodium bicarbonate in the Ziploc bag labeled C. Mix in 30 mL of 'universal indicator' mixture.
4. Add 30 mL of 'universal indicator' mixture to Ziploc bag A. Carefully and calmly observe as many changes as you can. Some changes may take a few minutes to occur. Keep observing.

Chemistry Concepts:

In a chemical change, elements combine to form new chemical compounds with new and different properties. There are some distinct signs that a chemical change has taken place. These signs include: formation of a gas, an odor, color change, precipitate, and a change in temperature. Some examples of a chemical change are: food spoiling, burning paper, digestion of food, baking a cake, and a candle burning.

In a physical change, the form of a substance or some if its physical properties may change, but its chemical composition stays unchanged. The elements or compounds involved in the change keep their identity. Some examples of physical changes are: cutting paper, changes of state, melting, and dissolving.

Chemical Availability:

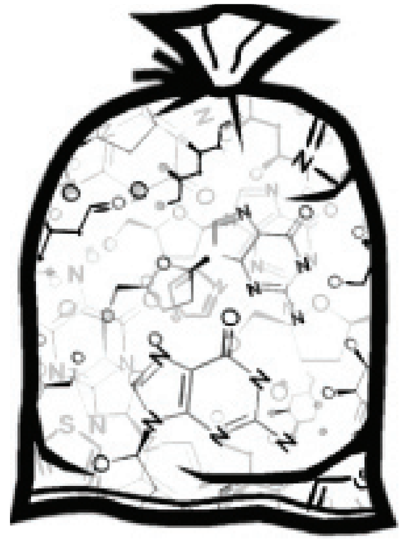
Calcium chloride: available from builder supply stores as a drying agent and sold under the name Damp Rid.
Sodium bicarbonate: available from grocery store, Arm & hammer $2.50 for a 48 oz. Box
Phenol red: available in 1.0 oz. bottle from swimming pool supply stores (and some department store garden departments). This can be highly diluted (we use 1 part phenol red to 10-15 parts isopropyl alcohol). A 1 oz. phenol red diluted to 16 oz. will be enough.
Baggies: try the smaller size Ziploc snack bags. They run less than 5 cents per bag.
Disposal/cleanup: this can be washed down the drain with plenty of water.

Safety First:

- Students must wear goggles at all times during this lab activity.
- Make sure all participants read the activity before starting the investigation.
- The plastic bag must be sealed fully so that the contents do not spill out during the reaction. ■

Name: Date: Class period:

Chemistry in a Bag



OBJECTIVE: To observe and recognize chemical reactions.

MATERIALS:
- Plastic bags
- Sodium bicarbonate
- Calcium chloride
- Test tubes
- Universal indicator

SAFETY NOTE
- You must wear goggles at all times during this lab activity.
- Read the activity before starting the investigation.
- The plastic bag must be sealed fully so that the contents do not fly out during the reaction.

PROCEDURE:

1. Place scoop of the calcium chloride and scoop of the sodium bicarbonate in the Ziploc bag “A”. Mix the dry ingredients. Stop and observe any changes.

RECORD OBSERVATIONS: ____

2. Place scoop of calcium chloride in another Ziploc bag labeled “B” with 30 mL of ‘universal indicator’ mixture.

RECORD OBSERVATIONS: ____

3. Place scoop of sodium bicarbonate in the Ziploc bag labeled “C”. Mix in 30 mL of ‘universal indicator’ mixture.

RECORD OBSERVATIONS: ____

4. Add 30 mL of ‘universal indicator’ mixture to Ziploc bag “A”. Carefully and calmly observe as many changes as you can. Some changes may take a few minutes to occur. Keep observing.

RECORD OBSERVATIONS: ____

To find this lesson search for “Chemical/Physical”

ANALYSIS QUESTIONS:

1. Describe the appearance of each chemical: These observations should include color, smell, texture, etc…
- Calcium chloride -
- Sodium bicarbonate -
- Indicator -
- Water -

2. What changes occurred when the calcium chloride was mixed with the sodium bicarbonate? Was this a physical change or was it a chemical change?

3. What changes occurred when the ‘indicator’ was mixed with the calcium chloride? Was this a physical change or was it a chemical change?

4. What changes occurred when the ‘indicator’ was mixed with the sodium bicarbonate? Was this a physical change or was it a chemical change?

5. When the ‘indicator’ mixture was combined with calcium chloride and sodium bicarbonate:

    A. What changes occurred immediately and a few minutes later?

    B. Was this a physical change or was it a chemical change?

6. Use a periodic table to find the symbol, atomic mass, atomic number for each of the following elements.

Element	Symbol	Atomic Number	Atomic Mass
Calcium			
Sodium			
Carbon			
Hydrogen			
Oxygen			

7. Investigate which chemical caused the color change and why.

8. Which chemical caused the bag to heat up?

9. Using the internet, conduct some research on the uses of calcium chloride.

Chex Mix Taxonomy

Lauren Schilling

Target Grade Level: 6th

Time Required: One class period

TEKS Objectives: 6.12 Organisms and environments. Students will gain an understanding of the broadest taxonomic classifications of organisms and how characteristics determine their classification. The other major topics developed in this strand include the interdependence between organisms and their environments and the levels of organization within an ecosystem.

Materials:
- Chex mix
- Cheerios
- Dried fruit mix
- Raisins
- M&Ms
- All of the above combined into a large mix and then divided out into 1/3 cup portions and placed into snack-size baggies.
- Classified PowerPoint and worksheet

Cost per classroom: Approximately $10.00

Activity Summary:

In order to teach sixth graders about taxonomy, the concept is broken down to the simplest level: give the students food and have them sort it into taxonomic groups of their own design.

Ultimately this activity shows students how difficult it can be to agree upon designations (groups) and why scientists sometimes have trouble classifying an organism.

This activity is started off by showing students the short "Taxonomy" PowerPoint located at peer.tamu.edu and conducting a brief discussion on what the word "taxonomy" means and how scientists use this to classify organisms. Then students are given a small bag of Chex mix and told to classify their bag of "organisms" into the best taxonomic classification system they can think of. Usually this results in a wide variety of "best" taxonomic classification systems and this can lead into a discussion on how to classify difficult organisms - like a sponge or a virus.

The students have a worksheet to fill out after completion of their taxonomic charts. These sheets can be turned in to judge comprehension of the material.

Activity Plan:

This activity is a creative way to introduce students to the concept of classifying organisms, and why it is important to do so. It can be used to discuss the work done by scientists who are actually involved in classifying organisms.

After discussing the "Taxonomy" PowerPoint, students are handed bags of food mixture and then allowed to work on their own to come up with taxonomic trees to classify their pieces. It is recommended that the students have their trees checked for completion/comprehension of the idea before allowing them to eat their mix. Allow the students time to complete the questions on their worksheet. The remainder of the class can be spent discussing organisms that are difficult to classify.

Taxonomy Concepts:

Taxonomy is how scientists classify organisms. It is extremely important, especially in the world of science, so that scientists (and your average person) know exactly what animal or plant someone is referring to. For example, there are over 1,500 species of fruit fly (a common model organism in the study of genetics). Knowing exactly which type of fruit fly someone is talking about could be crucial for scientific studies. This is why plants and animals are classified all the way down to the species (or sub-species) level. Additionally, taxonomy is important because the gradually narrowing groups (Kingdom, Phylum, Class, Order, Family, Genus, and Species) allow scientists to compare organisms within both broad and narrow groups. This allows them to find similarities within common species (such as the wolf, dog, and fox) or differences between them. This is of particular use in the study of plants - for example, for identifying poisonous or beneficial plants. ■

To find this lesson search for "Taxonomy"

Name: Date: Class period:

Classifying Chex Mix

Directions:
Use what you learned today to answer the following questions:

1. What is taxonomy?

2. Into how many groups did your group divide your Chex Mix?

3. What are some other things that could be classified this way?

4. Why is it important that we can classify things?

Use this table to answer the next 3 questions

	Human	Panda Bear	Raccoon	Emperor Penguin	Red Oak Tree
Kingdom	Animalia	Animalia	Animalia	Animalia	Plantae
Phylum	Chordata	Chordata	Chordata	Chordata	Anthophyta
Class	Mammalia	Mammalia	Mammalia	Aves	Dicotyledones
Order	Primates	Carnivora	Carnivora	Sphenisciformes	Fagales
Family	Hominidae	Ursidae	Procyonidae	Spheniscidae	Fagaceae
Genus	Homo	Ailuropoda	Procyon	Aptenodytes	Quercus
Species	sapiens	melanoleuca	p. lotor	forsteri	rubra

5. Based on the table, which two species are the most closely related?

6. Which organism is the least like the other four?

7. At which level do all of the organisms start to differ?

Hypertensive Statistics ♥

Ryan Pedrigi

Target Grade Level: 8th

Time Required: One class period

TEKS Objectives: Math: (B) Draw conclusions and make predictions about analyzing a scatter plot, 8.12 (C) Construct bar and line graphs, 8.13 (A) Evaluate methods of sampling for validity of inferences form the data set, 8.14 (A) Identify and apply mathematics to everyday experiences, 8.15 (A) Communicate mathematical ideas using language, tools, and models. Science: 8.6 (A) Describe interactions among systems in the human organism.

Materials:
- Computer with PowerPoint
- Connected projector
- Worksheet

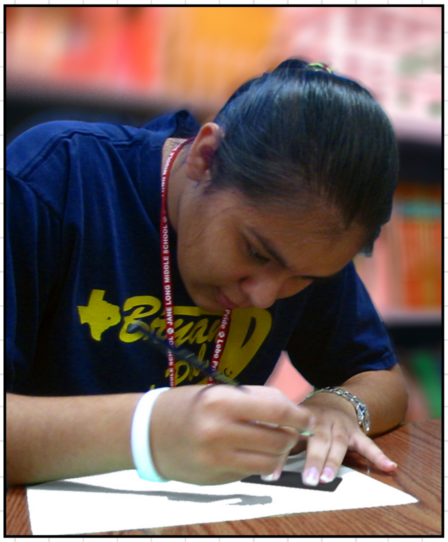
Cost per classroom: None

Activity Summary:

The purpose of this activity is to have students calculate the mean, median, mode, and range of sample systolic blood pressure data and then graph the results. Because of the extent of knowledge on the cardiovascular system, a short presentation should be given in order to introduce to the students the basic function of the heart, vasculature, and the meaning, measurement, and consequences of high blood pressure. This will help illustrate to students the application of mathematics in science and showing that these two disciplines often work in collaboration.

Activity Plan:

- Give a presentation on the cardiovascular system (~10 minutes).
- Distribute the worksheet and a double-sided piece of graph paper.
- Provide the students with the remainder of the class period to work out the problems.
- Have the students hand in the assignment for assessment.



A middle school student connects the points on her line graph to analyze blood pressure.

Statistics Concepts:

Mean: The average of a set of numbers.
Median: For odd numbered sets, it is the number that appears in the middle of the set, arranged in numerical order. For even numbered sets, it is the average of the middle two numbers.
Mode: The number that appears most frequently in a set. If no number appears more than once than the answer is 'not applicable (NA).' Be careful not to allow your students to give the answer as 0 because this is a real number that could represent the mode of a number set.
Range: Can be represented as the actual range given by the smallest number to the largest number (i.e. 2-57) of a data set, or as the difference between the smallest and largest numbers.

Cardiovascular System Concepts: The heart is a pump that circulates blood from the right ventricle into the pulmonary vasculature to exchange gases (eliminates CO2 and gains O2). Then it enters into the left ventricle where it is pumped throughout the systemic vasculature nourishing the different tissues of the body.

Blood vessels are composed of three layers (intima – inner layer, media – middle layer, and adventitia – outer layer) that prevent intravascular blood clotting and allow for the vessel to dilate and contract in response to the demands of the tissue. Blood pressure is the pressure exerted on the vessel walls as blood passes through, and is measured in both the contractile phase of the heart (systole) and the passive phase (diastole).

The means of measurement is often a sphygmomanometer, which is a cuff placed around the bicep of the patient. As the cuff is inflated, this cuts off the blood passing through the brachial artery. This artery can be felt by placing two fingers on the inside of the middle bicep and sliding them down underneath this muscle applying a little pressure. The cuff is then slowly released as the doctor listens (via stethoscope) for the noise of the blood pushing through the slowly opening vessel. When the doctor hears the first noise, he reads the current cuff pressure. This number represents the patient's systolic blood pressure (120 mmHg is considered normal), and the point of no noise (the point at which the blood is passing through the vessel unobstructed, signaling that the vessel is no longer compressed) is the diastolic pressure.

Hypertension (defined as systolic BP>140 mmHg and diastolic>90 mmHg) is prevalent in 33% of the US adult population and is the number one risk factor for a variety of cardiovascular diseases. The most important of these is coronary artery disease (heart disease). Heart disease is the development of fatty plaque (atherosclerosis) on the inner wall of these vessels that causes obstruction of blood flow, which ultimately leads to myocardial infarction (heart attack). ■

To find this lesson search for "Hypertensive"

Name: Date: Class period:

Analyzing Blood Pressure

Data:

Systolic Blood Pressure, BP (mmHg, Persons > 40 years of age):

Person	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
BP	171	134	115	138	125	110	149	126	157	122	143	131	189	139	127

Systolic Blood Pressure (mmHg, lowest → highest):

Calculations:

Mean: _____________ mmHg Median: _____________ mmHg

Mode: _____________ mmHg Range: _______ mmHg to ______ mmHg

Size of interval: ___________ mmHg

Graphs:

On graph paper, draw both a bar graph and a line graph of the blood pressures (y-axis) vs. person in which it was measured (x-axis).

On both of the graphs, draw a line representing the threshold between normal and high blood pressure (remember that high systolic blood pressure is anything greater than or equal to 140 mmHg)

Questions:

1. Were the mean and median different for your blood pressure data? _______________________________

____

____

____

2. Which of the two diagrams do you feel is the best choice to represent the data that you collected? Why?

____

____

____

3. According to your plots, how many people in this study have hypertension (high blood pressure)? What percentage is this of the total number of people in this study?

Number of people in this study with hypertension: _______________________

Percentage of the people in this study with hypertension: __________________

Worksheet

Partnership for Environmental Education and Rural Health

at http://peer.tamu.edu/DLC/NSF_Resources.asp

Beak Business

Candace Seeve

Activity Summary:

This activity involves the entire class participating in a hands-on activity where they will represent different kinds of birds with different beaks designed to gather food in different habitats. This activity has students up and moving around and competing for resources based on their specific bird beak adaptations. Students will learn to record data, create graphs, and draw conclusions.

Target Grade Level: 7th

Time Required: One to two class periods

TEKS Objectives: 7.11 (B): Explain variation within a population or species by comparing physiology of organisms that enhance their survival, 7.11 (C): Identify some changes in genetic traits that have occurred over several generations through natural selection and selective breeding, 7.12 (A): Investigate and explain how internal structures of organisms have adaptations that allow specific functions, 7.13 (A): Investigate how organisms respond to external stimuli found in the environment, 7.14 (A): Define heredity as the passage of genetic instructions from one generation to the next generation.

Materials:
- 7 pairs of scissors
- 7 plastic spoons
- 7 tweezers
- 7 large binder clips
- 4-5 boxes of large paper clips
- 200 large rubber bands
- 4-5 boxes of toothpicks
- 2 cups of macaroni
- 6 cups of various food items (Cheerios, rice, lucky charms, raisins, marshmallows, birdseed)
- 28 plastic cups (best if clear)
- 28 worksheets
- Graph paper

Cost per classroom: Approximately $20.00

Activity Plan:

First Part:

1. Have students select a plastic cup and a tool: a spoon, tweezers, binder clip, or pair of scissors
2. All students should stand or sit in circle around a table or area where food will be dispersed.
3. Explain to them that they are now HUNGRY birds. They can only eat by picking up food with their selected tool, which represents their type of beak! The cup represents their stomach.
4. The cup must remain upright at all times and they must hold their beak in one hand and cup in the other hand at all times.
5. Explain to them that one type of food at a time will be spread out evenly in the middle of the circle in all directions. When you say "GO," you will allow the birds to feed for 1-2 minutes or until all food is gone.

   NOTE depending on your students you may need to monitor behavior very closely. This activity can induce a very competitive and excited reaction among the students. Just as in nature!!! SAFETY MUST COME FIRST!!!! Anyone found injuring another bird or being aggressive with their beak should have to sit out. Those sitting out can observe and take notes on other birds' behavior.
6. Once you have said "STOP," or all food is gone, have students count the items in their stomachs and record their data on the worksheet found at end of this activity.
7. After students have recorded on their sheets the number of food items they collected, have them hand it back to you or place it to the side.
8. Tell them to prepare for the next type of food item. Spread out a different item and say "GO." Again, allow students 1-2 minutes to collect food items. Follow the above steps until all birds have had an opportunity to try gathering all types of food items and recorded their results on their worksheets.
9. CLASS DISCUSSION BREAK. Ask the following:

   a. What did you notice about your ability to grasp the food items based on your beak type?

   b. Did everyone with your type of beak have your same difficulties or successes?

   c. What did you notice about your behavior and the behavior of those around you?
10. Tally up the class totals for each of the beak types in a grid on the board. Have students create bar graphs that represent the class total for each of the beaks and food types. This can be started in class and finished as homework if necessary.

Second Part:

1. When all graphs have been completed, have students pick up their beaks and stomachs again and return to the feeding area. Tell them that normal ecosystems do not have just one type of food available at a time. Ask them “What will you do if all the food types are available?”
2. Spread out all of the food materials and allow 4 minutes for feeding. Again monitor student behavior for competitive and possible aggressive actions. Tell students they are not to cause injury or act inappropriately.
3. After 4 minutes are up or one all food is gone, have students count and record data again on their worksheets indicating how many of each type of food they were able to gather.
4. Have students give you their food items when done recording data.
5. CLASS DISCUSSION BREAK.

Ask the following:

a. What were your strategies to gather food this time? If different from your previous times, how was it different?

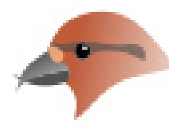
b. Ask students which beak type would be most successful if all these types of birds flew to an island together and the only food there was the macaroni. Which bird beak would be most successful? Explain why.

Adaptation Concepts:

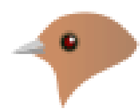
In any habitat, food is limited and the types of foods available may vary. Animals that are better adapted to take advantage of available foods will fare better than those that are less well adapted and thus live to pass on their genes to the next generation. While this concept seems rather obvious, it is essential that each student fully grasps its significance. Understanding the idea of adaptive advantage opens the door to understanding populations in ecosystems as well as the process of evolution.

A group of middle school students use various tools representing different bird beak types to pick up food in this hands-on activity.

The following is a chart of some types of birds. Their beaks are adapted according to the types of food they eat. The beak of a bird can tell you about behavior of the bird based on what it eats and where the bird might live. ■



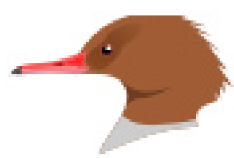
A cone shaped beak is found in many birds such as finches. It is a strong beak used for cracking seeds.



Thick, slender pointed beaks are found mainly in insect eaters. They are used to pick insects off leaves, twigs, and bark. The warbler is a good example of this.

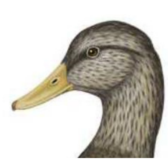
Woodpeckers have strong beaks that taper at the tip forming a chisel for pecking holes in trees for food or nests. Most feed on insects which live under the bark.

Hummingbirds have long tubular bills that resemble straws. They are used for sipping nectar from flowers.



Mergansers are specialized for eating fish and have sharp tooth-like structures on the edge of their beak designed to hold the fish tightly.

Hawks, owls, and other birds of prey catch and kill live prey. They have sharp hooked beaks that are used to bite and tear.



The edges of a ducks bill and other birds that scoop up water have slits that allow the water and mud to drain out without losing the plants, seeds, or small organisms that they may have scooped up.

Name: Date: Class period:

Beak Business

First Part Data

	Paper Clips	Macaroni	Rubber Bands	Toothpicks
Scissors				
Spoons				
Tweezers				
Binder Clips				

Second Part Data

	Paper Clips	Macaroni	Rubber Bands	Toothpicks
Scissors				
Spoons				
Tweezers				
Binder Clips				

To find this lesson look under "Animal Behavior" at http://peer.tamu.edu/VBB/ScienceTeacherResources.asp

The Mathematics of Music

Trey Holik

Target Grade Level: 7th

Time Required: One class period

TEKS Objectives: 7.1 (A) Compare and order integers and positive rational numbers, 7.3 (B) Estimate and find solutions to application problems involving proportional relationships, 7.4 (C) Describe the relationship between the terms in a sequence and their positions in the sequence, 7.13 (A) Identify and apply mathematics to everyday, to activities in and outside of school, with other disciplines, and with other mathematical topics.

Materials: Ask your music director if you may borrow any instruments.
Recommended:
- Keyboard
- Guitar
- Tuning forks

Optional:
- Aluminum solid rod
- Harmonica
- Accordion
- Computer

Cost per group: $15.00

Activity Summary:

Music is a popular passion among youth. Though often difficult to delineate, music is highly mathematical. Rhythmically tapping your foot at repetitive intervals to a song testifies to its mathematical nature of patterns and sequences. This activity will teach the students about the simple mechanics of sound, relate, mathematically, the vibrating of an instrument to the pitch or frequency of sound, and demonstrate the use of instruments to make music in terms of sequences or patterns. The students will use their own tools to make sense out of the sound we hear, the music we feel, and the math that connects it all.

Activity Plan:

Follow the worksheet as closely as possible. If you do not have one or two of the instruments, ask your band director for help. Also if you are not musically inclined, you could ask your choir or band director to help play the instruments. It will add to the experience.

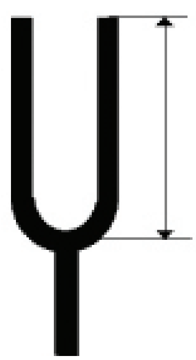
Guitar:

To play the specific value on the bass E string on the guitar, lightly hold your finger over a node and pluck the string. For 2 nodes, the two ends of the string are the node. For 3 nodes, hold your finger directly in the middle. For 4 nodes, hold your finger at either 1/3 or 2/3 of the length of the string. For 5 nodes, place your finger at either ¼ or ¾ the length of the string. Any stringed instrument like a violin, cello, or banjo will work. This may take a little practice.

Tuning Forks:

- The formula is frequency = constant/length^2
- The length is measured from the tip of the fork to the middle of the bend.
- For stainless steel the constant is 3,200 in^2/sec

Pitch	Frequency	Length
C	261.6	3.50
D	293.7	3.30
E	329.7	3.12
F	349.2	3.03
G	392	2.86
A	440	2.70
B	493.9	2.55
C	523.3	2.47
A	880	1.91



- These numbers are for round stainless steel. Expect to get slightly different numbers, depending on the type of material.

Aluminum Rods:

The rod can be made out of solid aluminum and roughly 1/2inch diameter and 1 yard length. To vibrate the rod, first use rubbing alcohol to remove the oils from your hands and the aluminum rod. Then apply violin rosin to your fingers and to the rod. For one node, hold the rod in the middle and rub the rod with your rosin coated fingers. This should produce a high pitched sound at 4000Hertz and a wavelength of 2 yards. You may also hold the rod at 1/4th of the length of the rod and the frequency will double and the wavelength will be cut in half to 1 yard. The pattern can continue.

Access to computers would allow the students to make their own pattern of music. Several computer keyboard programs are available online and can be found using “virtual piano” as keywords.

Vocabulary/Definitions:

1. Wavelength – Distance between peaks or troughs of a wave
2. Node – The point on a standing wave with minimal amplitude
3. Peak – The point with the highest amplitude
4. Trough – The point with the lowest amplitude
5. Frequency – The number of times a wave oscillates per second
6. Pattern – A set of numbers or objects that are related by a rule
7. Sequence – An ordered set of quantities ■

Name: Date: Class period:

Patterns in Music

1. What is Sound? Music? ____
____

2. What makes music…… music? ____
____

3. Define:
a. Wavelength: ____
b. Frequency: ____
c. Node: ____
d. Peak: ____
e. Trough: ____

4. Screaming Rods:

Nodes					
Wavelength					
Frequency					

Patterns:
Sequences:

5. Acoustic Guitar:

Nodes					
Wavelength					
Frequency					

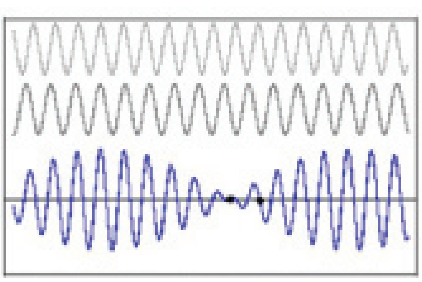
Patterns:
Sequences:

6. Electric Guitar:

Nodes					
Wavelength					
Frequency					

Patterns:
Sequences:

Can you feel the BEAT?



Partnership for Environmental Education and Rural Health

Worksheet

To find this lesson search for "Music"

The Cute C Chord: C,E,G,C (1,5,8,13)

7. If C,C#,D,D#,E,F,F#,G,G#,A,A#,B,C… corresponds to 1,2,3,4,5,6,7,8,9,10,11,12,13… then:

a. What is the sequence of a C chord?

b. What are the first 12 numbers of the sequence of a G chord?

c. What are the first 12 numbers of the sequence of an F chord?

d. If A-minor chord is (A,C,E,A), what are the first 6 numbers of its sequence?

e. How is the minor chord pattern/sequence different from the major chord?

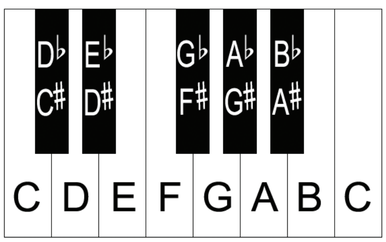
The Cuddly C Chord Progression: C,F,G,C

8. The Accordion:

What scale is the middle row of Mr. Holik's accordion? Top Row? Bottom Row?
What patterns can you hear in a waltz?
What patterns can you hear in a polka?
What patterns can you hear in a two-step?

The Pretty Pentatonic Scale: C,D,E,G,A,C

9. The Piano:



a. If C,D,E,G,A,C is the pattern in the key of C, what is the pattern in the key of F# (F sharp)?

b. If C,C#,D,D#,E,F,F#,G,G#,A,A#,B,C corresponds to 1,2,3,4,5,6,7,8,9,10,11,12,13 then what is the pentatonic scale/pattern in numbers in the key of C?

c. If the pattern was to continue to the next octave, what would the numbers be in the second octave?

d. If the frequency of the note A in octave 4 is 440hz, what is the frequency in octave 3? Octave 5?

e. Write a sequence for N=octave number where the output is the frequency.

N				4			
Frequency (hertz)				440			

f. Make your own song with Garage Band!

i. Your song can be in any key.
ii. Your song can be with any virtual instrument.
iii. Some Hints:

1. Use the Pentatonic Scale for individual notes.
2. If you desire to change scale/key, use the chord progression patterns.

Introduction to Evolution & Natural Selection

By Undergraduate Fellow, Kelly Bowen, in Response to a Teacher's Request

Activity Summary: One of the Teacher Requested Resources that the PEER team received was the controversial topic of Evolution. An informative PowerPoint presentation and an activity to accompany it was created in response to the request The PowerPoint covers topics such as Darwin's theory of natural selection, an overview of Darwin's finches, convergent, divergent, and co-evolution, extinction, camouflage, and even real-world application of natural selection and evolution. The objective of the activity is to recreate the peppered moth experiment, which took place in England during the Industrial Revolution. It demonstrates the importance of coloration in avoiding predation, relates environmental change to changes in organisms, and explains how natural selection causes populations to change.

Target Grade Level: 7th, 8th

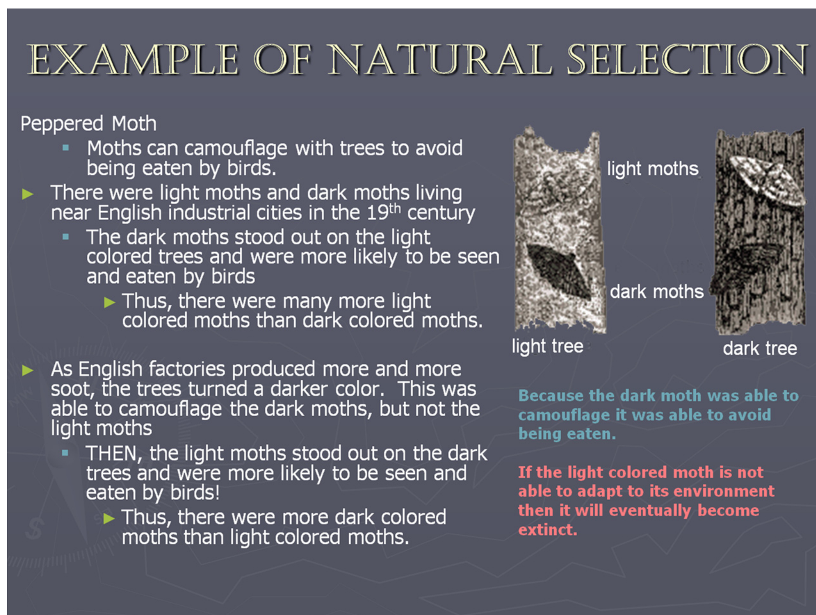
Time Required: 40-50 minutes

TEKS Objectives: 8.2 (B) Collect data by observing and measuring, (C) Organize, analyze, evaluate, make inferences, and predict trends from direct and indirect evidence, (E) Construct graphs, tables, maps, and charts using tools to organize, examine, and evaluate data, 8.3 (C) Represent the natural world using models and identify their limitations.

Materials:
- Sheet of white paper
- Newspaper
- Forceps
- Colored Pencils
- Timer
- 30 newspaper circles (made with hole punch)
- 30 white circles (made with hole punch)

Cost per group: $2.00

Activity Preparation: Before the activity takes place, show the students the PowerPoint on evolution, which can be found at peer.tamu.edu. As an introduction to the presentation, ask students what comes to mind when they hear the word "evolution." A discussion can then accompany the second slide of the PowerPoint. After the presentation, the students should have a basic understanding of what natural selection is and how it works in nature. The teacher should have the newspaper and white paper, and if possible, the holes should be pre-punched before class and the pieces stored in Ziploc bags. Make room on the floor, tables, or desks for the students to work. Keep in mind this activity is interactive. This activity can be completed in groups of 2 or more depending on the supplies available.

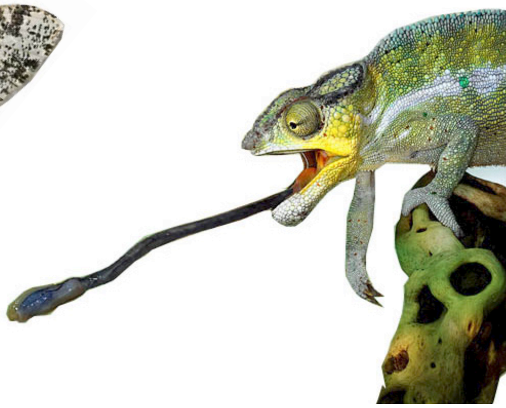


Activity Plan:

Each student should receive a copy of the "Peppered Moth Predators" worksheet.

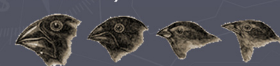
1. Place a sheet of white paper on the table and have one person spread 30 white circles and 30 newspaper circles over the surface while the other person is not looking.
2. The person looking away, or the "predator" will then use forceps to pick up as many of the circles as he or she can in 15 seconds
3. This trial will be repeated with white circles on a newspaper background, newspaper circles on a white background, and newspaper circles on a newspaper background.

The students should record their observations on the worksheet and answer the questions. Each student should get a chance to be the predator for each combination and collect their own data. The students should then complete the graph and answer the corresponding questions. ■

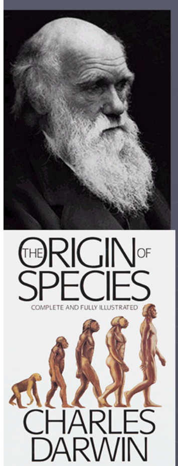


DARWIN'S FINCHES

- These are some of the finches that Darwin studied on his voyage
- Though they are all finches, their beaks distinguish them from one another
- Some finches developed short, strong beaks that made it possible for them to crack nuts
- Some developed long, fine beaks to reach insect larvae in tiny holes
- This is an example of how these finches adapted to their environment to survive (natural selection)



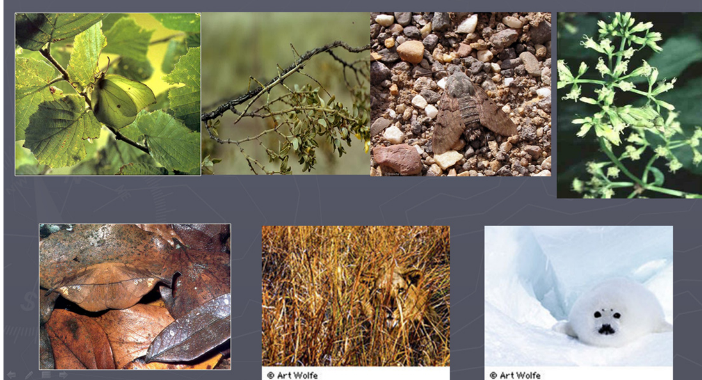
CHARLES DARWIN, THE FATHER OF EVOLUTION (1809-1882)

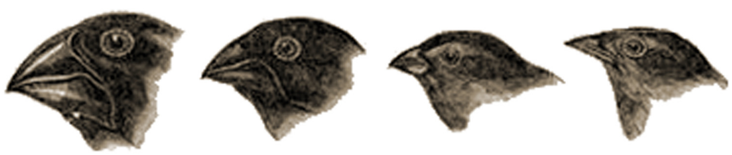


- He was an English Naturalist
- He traveled around the world on his ship, the *Beagle*
- Studied species and fossils in the Galapagos Islands and around the world
- Why did some species survive while others became extinct?
- Natural selection
- Published The Origin of Species in 1859

CAMOUFLAGE

- Many animals have evolved to resemble the environment around them.
- This makes it very difficult for predators to find them and eat them, thus increasing their chance of survival.
- Can you spot them?





DIVERGENT EVOLUTION

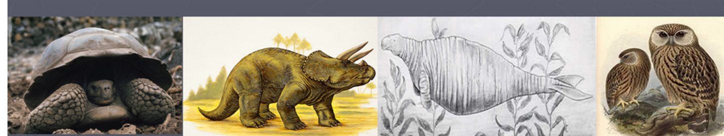
Red Fox

Kit Fox

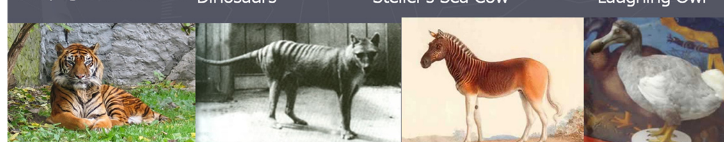
- Divergent evolution is the process of two or more related species becoming more and more dissimilar.
- Example: The red fox and the kit fox
  - The red fox lives in mixed farmlands and forests, where its red color helps it blend in with surrounding trees.
  - The kit fox lives on the plains and in the deserts, where its sandy color helps conceal it from prey and predators. The ears of the kit fox are larger than those of the red fox. The kit fox's large ears are an adaptation to its desert environment
- Similarities in structure indicate that the red fox and the kit fox had a common ancestor. As they adapted to different environments, the appearance of the two species diverged, or became more and more different.

EXTINCTION

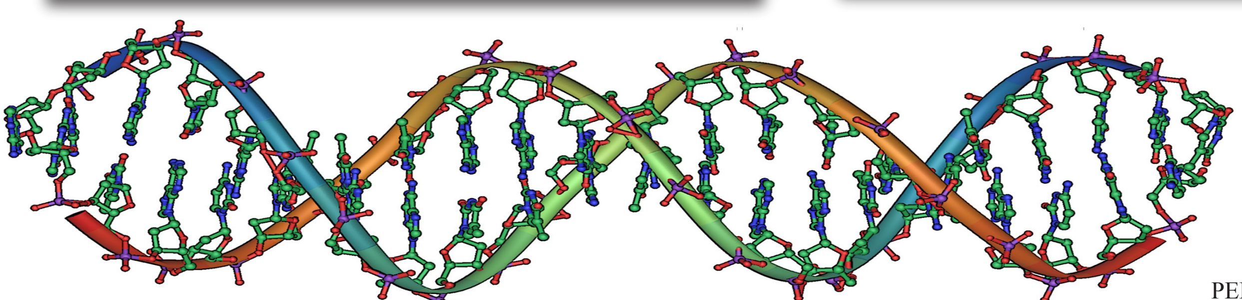
- Extinction is the disappearance of an entire species
- If a species does not have the genetic traits to survive in its environment, then the species will eventually become extinct forever
- Some examples of extinct animals are:



Galapagos Tortoise | Dinosaurs | Steller's Sea Cow | Laughing Owl



Bali Tiger | Thylacine | Quagga | Dodo Bird



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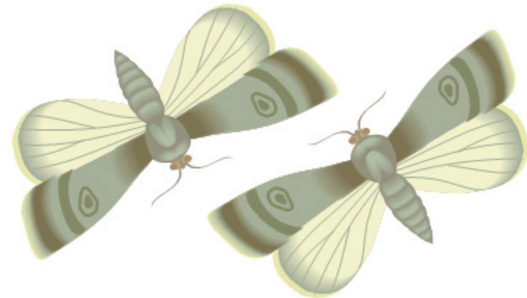


Peppered Moth Predators

1. Place a sheet of white paper on the table and have one person spread 30 white circles and 30 newspaper circles over the surface while the other person isn't looking.
2. The "predator" will then use forceps to pick up as many of the circles as he can in 15 seconds.
3. This trial will be repeated with white circles on a newspaper background, newspaper circles on a white background, and newspaper circles on a newspaper background. Record the data in chart below.

		Starting Population		Number Picked Up	
Trial	Background	Newspaper	White	White	Newspaper
1	White	30	30		
2	White	30	30		
3	Newspaper	30	30		
4	Newspaper	30	30		

Analysis
1. What did the experiment show about how prey are selected by predators?

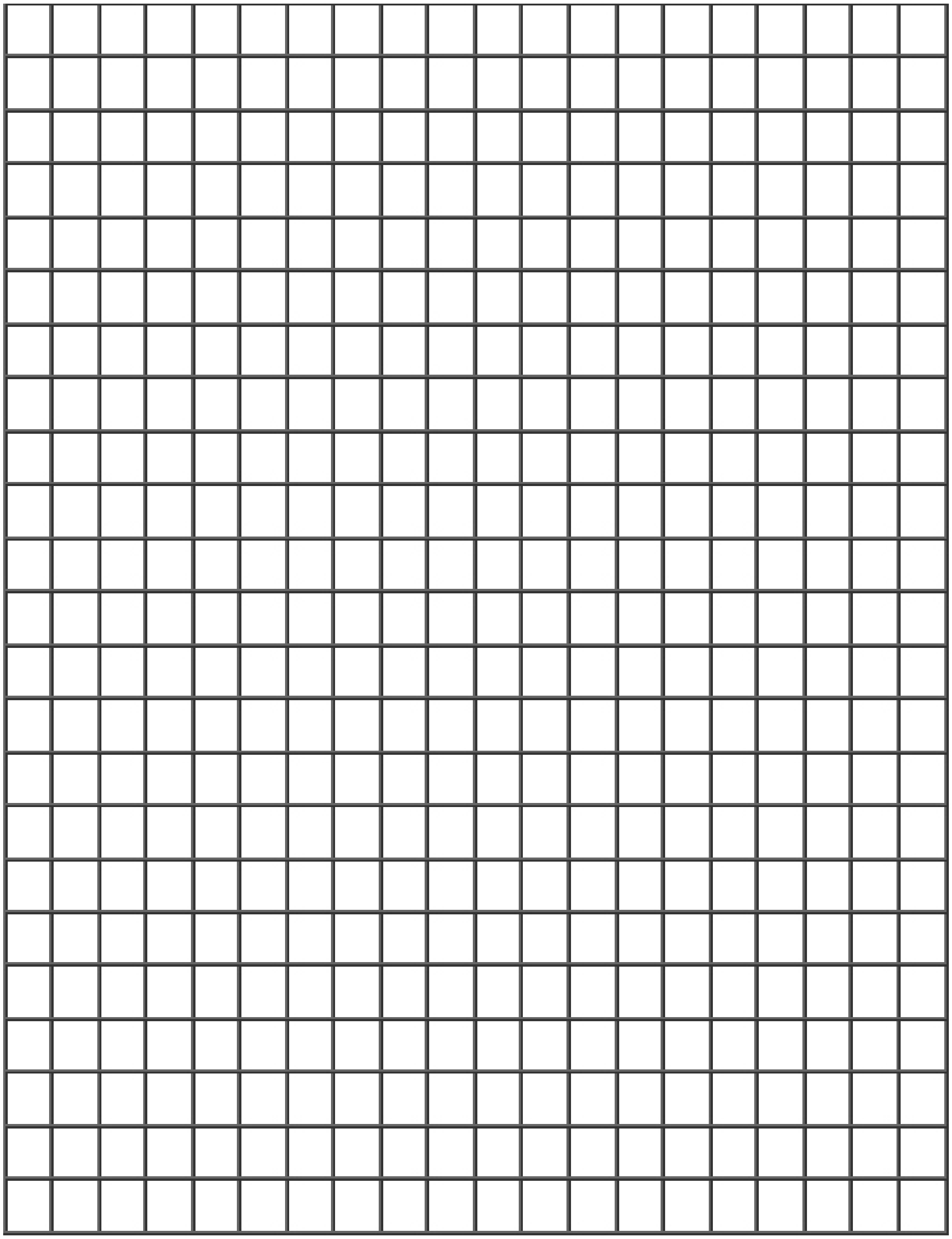
2. What moth coloration is the best adaptation for a dark (newspaper) background? How do you know?

3. What would you expect the next generation of moths to look like after trial 1? What about the next generation after trial 3?

4. How does the simulation model natural selection?

5. Examine the table and construct a graph. Plot the years of the study on the X-axis, and the number of moths captured on the Y axis. You should have 2 lines on your graph - one for light moths, and one for dark moths.

To find this lesson search for "Peppered



Year	# of Light Moths Captured	# of Dark Moths Captured
2	537	112
3	484	193
4	392	210
5	246	281
6	225	337
7	193	412
8	147	503
9	84	550
10	56	599

6. Explain in your own words what the graph shows.

7. Describe a situation where this type of selection might occur.

Moth” at http://peer.tamu.edu/DLC/NSF_Resources.asp

Shape Up with the Scientific Method

Alfredo Perez

Activity Summary:

In this activity, students will explore the relationships between different shape dimensions and shape volumes. Prior to calculating the volume of all six shapes, each student will have the opportunity to make an educated guess about which shapes have the largest volume. Divide the class into groups. Each group will view a set-up of the three dimensional figures, each filled half-way with water. Have students rank which objects they think hold the most liquid. They will then use their knowledge of measuring and mathematics to compute the volume of each figure and rank them according to the actual volume capacity. The students will then compare their initial observations and their actual rankings.

A student measures the dimensions of a shape to calculate the volume and test his hypothesis.

Activity Preparation:

To prepare for this activity, fill one set of the EAI plastic shapes half-way with water. The volumes of water to be used are listed below:

- Cube: 515ml
- Rectangular Prism: 255ml
- Sphere: 251ml
- Cone: 133ml
- Cylinder: 404ml
- Pyramid: 164ml

It is suggested that this step be completed before the students come to class so they cannot see into which shape you poured the most water. There is also the option of making the activity slightly more fun by giving the liquid more definition and adding food coloring to the water.

Target Grade Level: 8th

Time Required: One class period

TEKS Objectives: 8.8. Measurement of Solids (B) Connect models to formulas for volumes of different 3-D shapes, (C) Estimate answers and use formulas to find surface area and volume.

Materials:
- Volumetric shapes by EAI education
- Beakers
- Graduated cylinders 200ml capacity
- Food coloring
- Copy of the worksheet for each team
- Tape measure

Cost per group: Approximately $15.00

Activity Plan:

1. Once all of the shapes are filled and set up, pass out the worksheets (one per group). Explain that this activity will guide them through the scientific method of discovering the actual volumes of shapes.
2. Ask the students to view the filled shapes and rank them from the one containing the largest volume to the one containing the least volume, based on their observations. Based on these observations, each group will create a hypothesis, which will be tested.
3. Next, the students will measure the dimensions of the shapes and calculate the volumes based on their measurements. The volume equations as well as how to calculate each value is included on the worksheet. This is the testing or experimental part of the scientific method.
4. Next, the students will compare their results with their hypothesis and initial observations. This represents the conclusion part of the scientific method.

Collect the worksheets and discuss with the class the different volumes of the shapes. Give a prize to the group that initially guessed the correct order. Explain to the class how they just followed the scientific method in order to discover something that was initially unknown. ■

Name: Date: Class period:

Shape Up with the Scientific Method

Step 1: Observations
Go to the front of the classroom and observe the shapes. All containers are filled half-way with liquid. Consider which shape has the most liquid. Write down your observations in the space below.

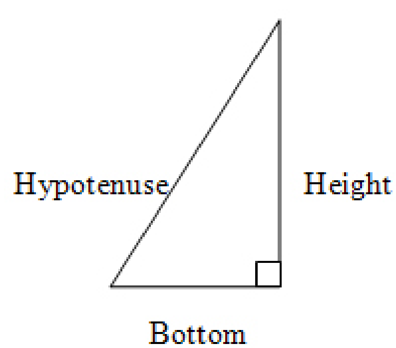
Step 2: Hypothesis
With all of these observations in your head, don't you wonder which shape actually has the greatest volume? Rank the shapes according to which ones you think contain the most liquid. We will test your hypothesis.

Shapes: Rectangular Prism, Sphere, Cube, Pyramid, Cone, Cylinder

Most Volume: ____________________
____
____
____
____
Least Volume: ____________________

Step 3: Test the Hypothesis
Now that we have a hypothesis, we are going to test it by computing the volumes of all the shapes to discover which shapes have the greatest volume.

Pyramid: Volume = 1/3 Base x Height
Base area = ______cm x ______cm = ______ cm^2
Pyramid height = ______cm
For hypotenuse, measure from the middle of one of the sides to the top of the pyramid.
The bottom is 1/2 of the length of the base.

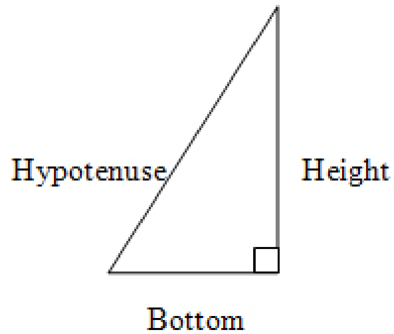


V = 1/3* ______ cm^2 x ______cm = ______cm^3

Cube:
Volume = $side^3$ = (______cm)^3 = ______ cm^3

Rectangular prism: Volume = Base Area x Height
Base area= ______cm x ______cm = ______cm^2
Height = ______cm
Volume = ______cm^2 x______cm = ______ cm^3

Cylinder: Volume = Base Area x Height
Height: ______cm
Diameter of base: ______cm
Base Area = $\pi r^2 = \pi/4 \times D^2 = \pi/4 \times$ ______^{2} = ______cm^2
Volume = ______cm^2 x ______cm = ______ cm^3



Cone: Volume = $\frac{\pi \times D^2 \times Height}{12}$
Diameter = ______cm
Cone height = H = $(Hypotenuse^2 - Bottom^2)^{1/2}$ =______cm
The bottom length will be ½ of the diameter.
V = $\pi/12$ x______cm^2 x ______cm =______cm3

Sphere: Volume = $\frac{4\pi \times r^3}{3} = \frac{\pi \times D^3}{6}$
Circumference =______cm
Diameter = Circumference/π = ______/π = ______cm
Volume = $\pi/6$ x ______^{3} = ______ cm^3

Step 4: Conclusion
Now that all of the volumes are computed, a conclusion can be reached. Now rank all of the shape volumes based on your calculations instead of just your observations.

Most Volume: ____________________
____
____
____
____
Least Volume: ____________________

Write about the results in the space below. How was your hypothesis different or the same from what you actually computed?

____
____
____
____
____
____
____

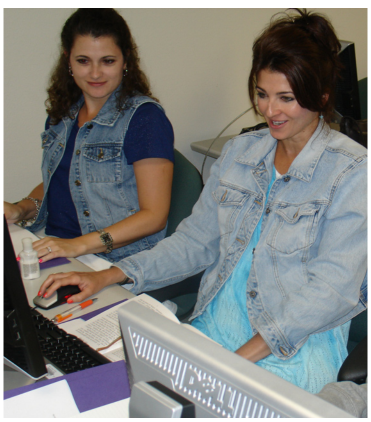
Novice Teacher Corner

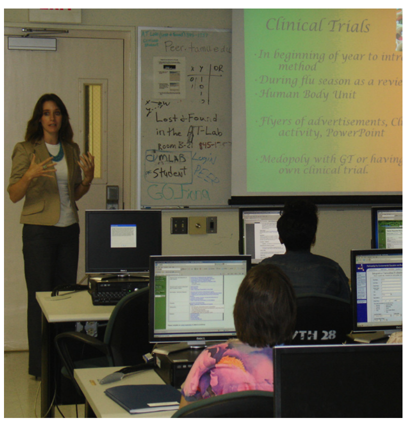
Michele Ward

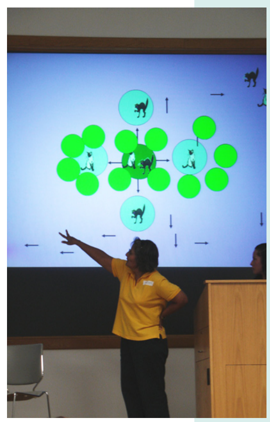
You are ready for your first year of teaching. You've got your classroom ready. You are feeling that excitement and are prepared for the diverse group of students that will soon be coming through your classroom door. One thing that you are not sure of is how you can possibly help all of the different students that you will teach to be successful in learning all of the materials that you will need to teach them. Every day you will need to plan a lesson that challenges students and excites them about the subject you teach. How can you possibly do that?

Researchers at Mid-Continent Research for Education and Learning have identified nine instructional strategies to improve student achievement across all content areas and grade levels. These strategies stem from the book, "Classroom Instruction That Works" by Robert Marzano, Debra Pickering, and Jane Pollock.

1. Identifying similarities and differences: Basically, compare and contrast. You can do this in a Venn diagram, a written paragraph, or by drawing pictures.
2. Summarizing and note taking: Whether it is having the students tell a partner what they learned, paraphrase something they heard, or make a poster to describe the main concept, summarizing is a way to help them process and remember information.
3. Reinforcing effort and providing recognition: Everyone appreciates being recognized. Even a thumbs up or a smile can be the key to keeping the students excited and motivated.







4. Homework and practice: Not everyone likes it, but the old saying "practice makes perfect" seems to be true.
5. Nonlinguistic representations: A picture is worth a thousand words in education. Showing the students a picture of a concept before having them find the definition can make connections that help them remember the concept.
6. Cooperative learning: Cooperative learning motivates students and can play on their strengths. It can foster a sense of interdependence and unity in a classroom.
7. Setting objectives and providing feedback: Set expectations high and students will rise up to meet them. Make sure to give the students feedback and benchmarks for progress along the way.
8. Generating and testing hypotheses: Not just for science! Ask them to predict what will happen next in a story. Ask them what might happen in an equation if the numbers were changed. Again, thinking and analyzing helps stimulate learning.
9. Cues, questions, and advance organizers: This is a great way of stimulating the students to think about what they already know about a subject and about what more they are going to learn.

Just remember, you are a huge influence on your students' lives and learning. Make every day and every lesson count, but don't forget to enjoy yourself and your students along the way! ■

TEACHERS! Are you in a bind with your lesson development? Let PEER create lessons for you!

Ruth Mullins

The PEER website can help you with providing full curriculum modules or daily lessons for any 6th-8th TEK standard in science, math, language arts, and the social sciences. In addition to lessons already developed, teachers can request lessons or activities for any standard for your classroom. So, check out the site and follow these easy steps to find and/or request lessons.

• Visit PEER at peer.tamu.edu. Follow these specific steps to find lessons or request lessons.
• To find lessons, click 'Teacher Resources' at the top of the webpage.
  - Under this link, you can find entire curriculums or search for individual lessons.
  - To search the lessons, select 'Lessons: Teacher Requested Resources' from the drop-down menu.
  - To search specific topics, click the blue link, 'Browse' in the upper left corner. On this page, you can search by topic, grade level, or subject. For maximum results, keep the search topic simple, such as 'chemistry' instead of 'exothermic and endothermic reactions'.
  - If you cannot find lessons for a topic, click on the red link, 'Submit Request', to fill in a personalized lesson request to be created by students in the PEER program.
• To request lessons, click 'Request a Lesson Plan' at the top of the homepage.
  - Choosing this link takes you directly to the 'Teacher Request Submission Form'.
  - Fill out the form as requested. Help us build you a great activity by being as specific as possible!
  - Lesson completion takes about 2 to 4 weeks depending on the level of activities requested. All lessons are developed by undergraduate and graduate students at TAMU with varying specialties in the STEM disciplines. Lessons undergo final approval and are reviewed to meet TEK standard by TAMU faculty and Texas certified teachers.

The PEER website offers resources for Middle School Teachers:

- Mini-modules (one-class, self-contained lessons)
- Free CDs containing all of PEER's curricula
- Adventure-based health science story lessons that incorporate math, science, social studies, and language arts
- Veterinarians' Black Bag curricula
- Professional sessions across Texas
- Distance Learning Community
- Web curricula on life science and environmental health
- Visit **http://peer.tamu.edu** to take advantage of these resources!