AESOP

After-school Experiential Science Outreach Program
High Point University

The best test of whether or not you really understand a concept is trying to teach it to someone else. *-**Richard Rusczyk***

Abstract

This grant proposes the establishment of a science outreach program. High Point University students will develop portable laboratory demonstrations, mini lectures, and hands-on experiments and then take these packaged shows to our partner elementary and middle schools to present in their after-school programs. Through this program, we will engage children in science at an earlier age, thereby offering more opportunity for them to develop an interest in and pursue science as a career. Additionally, by exposing our High Point University students (both education and chemistry majors) to teaching science, we hope to better equip them for their careers in teaching, or to persuade them to consider teaching.

Introduction

It is common knowledge that nationally there exists a shortage of adequately-trained science teachers. Since 2003, there has been a need for chemistry and general science teachers in grades 9-12, and there was an overall shortage of science teachers in grades 6-9 from 2003 to 2005 in North Carolina (US Department of Education website). Additionally, many school systems are faced with budget cuts making it difficult to purchase standard school supplies, much less afford the luxury of purchasing laboratory supplies and doing science demonstrations. Consequently, our children are not getting the exposure and stimulation necessary to spark their interest in science, making it increasingly likely that these vacant teaching positions will not be filled in the future.

A Chinese proverb states: "Tell me and I forget. Show me and I remember. Involve me and I understand." With this in mind, we believe that by engaging elementary and middle-school students in hands-on, learn-by-discovery activities, their interest in science will pique, and they will be more inclined to pursue science courses in the future. Many of our best chemistry majors at High Point University tell us that they are chemistry majors because they had excellent chemistry teachers in high school. We hope to introduce this experience earlier in the child's education so as to cultivate an interest in science at a much younger age. It is these same students that, if engaged early on, have the potential to be excellent scientists and/or science teachers.

In order to gain maximum benefit from this endeavor, we will be recruiting chemistry majors (and minors) and education majors to compile the demonstrations, accompanying lessons, and experiments and to present them to the children. Aristotle summed it up best in his statement, "Teaching is the highest form of understanding". Thus, by requiring our students to present the material, they have to know it well enough to convey it in a manner that is understood by young children. There is also the opportunity for these demonstration shows to seed further innovative ideas for research projects. Our students will have the option of pursuing these interests in their senior seminar in chemistry. As a result of this experience, our university will graduate better scientists and better science teachers. Of course there is always the hope that by exposing

our chemistry majors to the area of teaching, some of them will become intrigued by the possibility of a career in science education.

This type of structured science outreach program, while not uncommon, is sparse throughout North Carolina, and to the best of our knowledge, non-existent in Guilford County. A parent interested in after school activities for their children might perform an internet search. At this point, an internet search only yields Duke University and North Carolina State University in North Carolina as having similar outreach programs, so there is a defined need within our immediate community. In creating this progam, we would be establishing another outlet for our students to fulfill the commitments of High Point University's mission, more specifically, "To contribute to the educational and cultural life of the broader community by offering cultural activities of regional and national interest, and by devoting the resources of the University, the professional skills of the faculty and the talents of students to local charities, businesses and other civic groups".

Program Plan for After-school Experiential Science Outreach Program (AESOP)

Much as its name implies, AESOP, through its packaged shows centered about engaging themes, will seek to weave an experiential yarn that will bring the world of science to life in the minds and imaginations of children in local elementary and middle schools. While serving and reaching out to the community through this project, we also hope to connect our target audience with the next generation of storytellers --- our own HPU students. Through this synergistic arrangement, we hope that young minds will be inspired to explore science and that some of our student volunteers might find their passion in teaching science.

The centerpiece of the program is the packaged show format that will be developed and delivered by HPU student volunteers. A typical packaged show will consist of 1-1.5 hours of interactive hands-on demonstrations and experiments with young students in after-school programs at HPU-partnered local elementary and middle schools (e.g., 3rd.- through 8th.-graders). We anticipate that our target audience would consist of a maximum of 30 young students. Each packaged show will have a unifying theme that will vary with either the calendar or a particular scientific topic (e.g., late October might be an opportune time for a Halloween-themed show or a particular show might focus on the topic of electricity). After presenting a coherent set of demonstrations and lessons on the chosen theme (30-40 minutes), student volunteers will lead the young students in hands-on experiments. Young students will be broken down into manageable groups (6-8 students per group), and one or more HPU student volunteers will then help students with hands-on science experiments. After completing hands-on experiments, the packaged show will end with an energetic wrap-up and a parting gift or favor for the young students to enjoy. (An example of a sample packaged show is detailed in the Appendix.)

In order to prepare for the program, we will need to spend a significant amount of time during the summer before the launch identifying and developing major themes around which to focus the packaged shows. For each packaged show, we will come up

with possible demonstrations and hands-on activities to accompany the chosen topic and vet the ideas for their appropriateness in working with younger students. We will also write or assemble procedures for demonstrations and experiments, with the intention that they will likely need to be modified by student volunteers to adapt to their lesson plans. For each packaged show, we will come up with a tentative budget and list of supplies and suppliers so that we will be prepared to order items as needed in the coming year. Finally, in preparation for recruiting student volunteers for the program, we will develop a prototype packaged show as a primer for this format of interactive learning.

Once the school year is underway, we will proceed to recruit student volunteers from among interested students. We will form two teams of student volunteers, with 6-8 students per team, each headed by a faculty mentor. As faculty mentors to the student volunteers, we will help them to formulate reasonable itineraries for packaged shows and give them helpful feedback on ideas and presentations; however the student volunteers will ultimately be responsible for writing and implementing their own lesson plans. With each packaged show consisting of 3-4 short demonstrations and 1-2 hands-on activities, students will often work in groups of two or three to practice and present various segments of the show.

Student volunteers will meet on Friday afternoons for 1-3 hours each week to plan and practice experiments; create learning aids (posters, handouts, multimedia presentations, etc.); collaborate to ensure continuity and smooth transition of content; and rehearse delivery of packaged shows. Each student on the team must be competent in teaching and presenting all experiments in a packaged show so that the team will be able to cover for any team member who is absent on a presentation day. Before presenting to younger students, each show will be thoroughly rehearsed from start to finish. Each team will present about three times during a semester (on Friday afternoons), with a goal of presenting ten to twelve shows over the course of the first year of the program. Along the way, we will make minor adjustments to the presentation format and content to meet the needs and interests of the younger students. We anticipate some student volunteer turnover after the first semester, as student schedules may change from one semester to the next, or students may wish to take a break from the commitment.

During the second summer of the program, it is our intention to assess the success of the program and make adjustments based on feedback from student volunteers as well as our community partners and younger students. In addition, we will attend a science education meeting to present a poster or talk on the AESOP program and gain fresh perspectives and ideas from other educators attempting similar outreach programs. Over the summer we will also prepare a presentation to be given to the faculty in the fall of 2010. The remainder of the summer will be spent refurbishing our supplies and pursuing new ideas for packaged shows.

As the second year of the program unfolds, we will continue to take our packaged shows to local after-school programs while exploring options for making AESOP a sustainable volunteering opportunity for motivated students at HPU, possibly through its incorporation into the curriculum as a separate academic course. After producing two-

year's worth of inquiry-based interactive lessons on a variety of scientific topics, we would also like to share these lessons with local teachers and science education majors at HPU who could benefit from using them in their classrooms. This would be done through the production of a booklet of successful packaged programs which teachers could use as a series of in-class hands-on learning experiences on particular topics. These booklets will be disseminated at a workshop in the spring of 2011 that will feature the presentation of a packaged show by HPU student volunteers as well as discussions on modeling and teaching science to young students.

It is our hope that through the AESOP program that we will be able to foster a sense of excitement about learning and discovery in young students, while providing a sense of stewardship as well as teaching and leadership opportunities for HPU student volunteers. The program should provide a synergistic relationship between science and education departments at HPU and hopefully have a positive impact on local after-school programs and teachers. (A letter of support for the AESOP program has been written by Dr. Barbara Leonard, Associate Dean of the School of Education.)

Assessment

The success and validity of the AESOP program will be evaluated primarily through questionnaires given to our student volunteers and to our partner schools' outreach facilitators. Questions such as: "did the students seem to understand the material being presented to them?" and "did the students anticipate the visits by High Point University?" will be asked of the facilitators. Student volunteers will be polled as to what they felt they learned by participating in the program, and whether or not they thought the experience was beneficial in helping them become better ambassadors of science.

After completion of the first year of packaged shows, we will create an assessment based on the content of the developed shows that we will administer to the new HPU volunteers that join the group in the second year. This test will be given at the beginning and again at the completion of the AESOP experience. Primarily, we are interested in determining to what extent teaching the material aids in learning the material. The results of this assessment could also be used in the science education courses such as NSC 111 to help determine the most effective classroom pedagogy.

Dissemination

We plan on disseminating information about the AESOP program and reports of its impact and progress in a few different forums. After the first year of the program, we will present a poster or talk at a local or national meeting for science educators in the summer of 2010. In the fall of the second year of the program (Fall 2010), we will present a faculty forum in which we will describe and review the AESOP program to the HPU community. Both of these opportunities will allow us to get critical and creative feedback on the program while promoting the university and its mission. We will be particularly interested in using both occasions to develop ideas for making AESOP a sustainable volunteering opportunity for students at HPU. This may include finding private and/or public sources of funding for its continuance.

Finally in the spring of 2011, we will culminate the program by presenting a packaged show and workshop for local teachers, in hopes of passing on hand-on experiential lessons and educational ideas for use in area schools. A small fee will be charged to cover the cost of materials for the workshop. At this workshop, local teachers will be treated to a demonstration show put on by HPU student volunteers. Teachers in attendance will receive a booklet of packaged shows that were successfully executed by the AESOP group over the previous two years, with detailed instructions on how to perform the demonstrations and hands-on activities. After the demonstration show, we will have an open group discussion on the opportunities and challenges for interactive hands-on learning in the classroom. This discussion will be followed by a chance for teachers to explore a rotation of hands-on learning exercises set up in chemistry laboratories in Congdon Hall. It is our hope that teachers will come away from this experience refreshed and energized as well as enthusiastic and ready to incorporate what they have learned into valuable classroom experiences for their students.

Timeline

May – July 2009

* Develop themes for packaged shows
* Generate demonstration show and hands-on project ideas for packaged shows
* Prepare ordering lists and budgets for materials needed
* Prepare items for recruiting and guidelines for helping students
* Prepare inquiry-based packaged show as a primer for student volunteers

August 2009 – December 2009

* Present packaged show to recruit student volunteers
* Divide student volunteers into teams
* Direct students in preparing demonstrations and hands-on experiments
* Present six packaged shows to area after-school programs

January 2010 – May 2010

* Student volunteers present packaged show to recruit additional student volunteers for Spring 2010 (if necessary)
* Student volunteers present a packaged show at Piedmont Science Fair for Non-Public Schools (late January 2010 at HPU)
* Present six packaged shows to area after-school programs

May 2010 – August 2010

* Review progress of program and consider changes in format for the upcoming year
* Prepare presentation for science education conference
* Revise current packaged shows and generate new theme ideas for additional packaged shows
* Prepare ordering lists and budgets for materials needed
* Prepare seminar to be given to HPU faculty in Fall 2010

August 2010 – December 2010

* Present packaged show to recruit student volunteers

* Divide student volunteers into teams
* Direct students in preparing demonstrations and hands-on experiments
* Present seminar to HPU faculty
* Present six packaged shows during Fall 2010

January 2011 – May 2011

* Student volunteers present packaged show to recruit additional student volunteers for Spring 2010 (if necessary)
* Student volunteers present a packaged show at Piedmont Science Fair for Non-Public Schools (late January 2010 at HPU)
* Present six packaged shows to area after-school programs
* Prepare booklet for dissemination to local science teachers
* Organize AESOP workshop and advertise event to area schools
* Hold AESOP workshop at HPU – Spring 2011

BUDGET

The budget is shown below, followed by a description of expenses.

Budget Worksheet				
			Instructional Technology and Program Supplies	
Quantity		**Item Description**		**Total Cost**
1		ELMO TT-02S Digital Visual Presenter		$700.00
1		Epson PowerLite W6 Multimedia Projector		$800.00
1		Xerox Phaser 6180 N Color Laser Printer		$515.00
1		Da-Lite 45” x 80” Picture King HDTV Format Projector Screen		$300.00
1		Buhl Industries Plastic AV Cart		$150.00
1		Dell Laptop		$1,500.00
1		Initial Start Up Costs (construction supplies)		$100.00
1		Vernier Computer Interface Hardware and Software		$1,500.00
1		Portable Amplifier and Microphone		$200.00
12		Portable Plastic Storage Containers		$240.00
24		Chemicals for Show Demonstrations and Experiments		$2,400.00
				$8,405.00
			Salary	
1		Elizabeth McCorquodale, 2009 Summer		$4,000.00
1		AESOP student leader, 2009 Summer stipend		$3,000.00
1		Harold Goldston, 2009 Summer		$4,000.00
1		AESOP student leader, 2009 Summer stipend		$3,000.00
1		Elizabeth McCorquodale, 2009 Summer (3 hr course)		$3,500.00
1		Harold Goldston, 2009 Summer (3 hr course)		$3,500.00
				$21,000.00
			Travel	
2			Science Education Conferences	$3,060.00
				$3,060.00

Instructional Technology and Supplies

The above listed equipment and supplies will be necessary to support the production and delivery of packaged shows.

Salary

Summer salary for two months in 2009 and two months in 2010 will be necessary in order to research and purchase supplies and instrumentation, and to organize the shows to be implemented during the school year. Payment will be the equivalent of a 6 contact hour summer science course (4 credit hours) with at least 9 students enrolled for the summer of 2009, and the equivalent of a 3 contact hour course (3 credit hours) for the summer of 2010. The salary budget for 2009 will be divided between the PI's and two summer student team leaders. The total budget expense for salaries and student stipends is thus $21,000.00.

Travel

Travel will constitute each co-PI attending a conference on chemical education. Such conferences could be, but are not limited to, a Gordon Research Conference on Chemistry Education Research and Practice, the Biennial Conference on Chemical Education (BCCE), or a ChemEd conference. Approximate expenses for registration ($300), airfare ($500), hotel for 5 nights ($500), food for 6 days ($150), and taxi ($80) could be $1530 each. This is a total estimated expense of $3060.

Conclusion

In summary, the AESOP program is an interdisciplinary program that will build new bridges between departments within the university, provide HPU students with an opportunity to better master scientific principles and the art and craft of teaching, and impact the community through the service and stewardship of HPU students. The program provides a chance for HPU student volunteers to leave the bubble of university life and venture into the real world to give back to the community by exciting and inspiring the minds of young children. As HPU student volunteers take on the responsibility of preparing and delivering lessons, they will develop leadership and teamwork skills while inspiring the next generation of scientists by sharing their own love of learning. Though the AESOP program is simple in concept, it is likely to be far-reaching in its impact in engaging the imaginations of children at such a formative and impressionable age.

Appendix

A look inside an AESOP packaged show...

The group of HPU student volunteers arrives and sets up as a small group of 4th-graders look on with curiosity and anticipation --- the *really* big kids (college students!) have come to visit them this afternoon. After loading demonstration kits into the front of the multi-purpose room and setting up the computer and projection system, the AESOP troupe is ready to go. After kids quiet down and settle into their places, the show begins...

"What am I drinking?" one of the student volunteers asks as she walks among the children taking a swig from a bottle of water.

"Water," one of the children quietly answers.

"Yes, what was that?" she replies.

"Water!" respond the children, this time a little more loudly.

"That's right --- water. Does anyone know another name for water? Have you ever heard it called anything else?"

The children are quiet, rustling slightly in their seats.

"H...2....," she slowly prompts.

"O," one of the children blurts out proudly.

"H_2O --- that's right. H_2O. Ever wonder why we call it H_2O?"

The children are quiet again.

"Well that's what we're here to talk to you about today. It turns out that everything in this room, everything in the world around us --- even the water that I'm drinking --- is made up of little bitty particles called molecules. And those tiny molecules are made up of even tinier things called atoms. [She pulls out a magnifying glass and a construction paper model of H_2O that she has been holding between the water bottle and her hand.] Water is a molecule... [she says, while looking at the bottle of water with her magnifying glass]... we call it H_2O [as she looks through her magnifying glass at the construction paper model] and it's made up of atoms --- H's and O's --- 2 hydrogen atoms and one oxygen atom [she holds up the model for all the children to see]."

Thus begins an interactive session of demonstration and hands-on experiments with the children on the topic of atoms, molecules, and chemical reactions. The first demonstration is the flame ramp, in which heavy flammable vapors are ignited as they are poured down a trough ramp towards a lit candle, showing how even though we can't always "see" molecules, they really are there. Next the group takes a look at H_2O's cousin, H_2O_2, or hydrogen peroxide. After engaging the children in a discussion about some of the uses of hydrogen peroxide in daily life, the student volunteers show how it can be broken down into water and oxygen gas ($2\ H_2O_2\ (aq) \rightarrow 2\ H_2O\ (l) + O_2(g)$). (A soap solution is added to the hydrogen peroxide solution to create a fun, lava-like flowing mass of bubbles.) Other student volunteers using a felt board show the children how this reaction really just involves re-arranging the H's and the O's in H_2O_2 to form H_2O and O_2. In yet another demonstration, a wad of aluminum foil is dropped into a flask containing a solution of hydrochloric acid, and the hydrogen gas generated is collected in a balloon. Again a group of student volunteers show the children that this reaction just involves another re-arrangement of atoms in the reactant molecules to form the product molecules ($2\ Al\ (s) + 6\ HCl\ (aq) \rightarrow 3\ H_2\ (g) + 2\ AlCl_3\ (aq)$).

In the final demonstration, a brave volunteer from among the young children holds a meter stick at the end of which is a candle. The candle is then lit and held against the hydrogen-containing balloon taped to the end of another meter stick. The balloon becomes a small fireball, exploding with a loud pop! Once again, this is yet another chemical reaction, with hydrogen gas reacting with oxygen gas to make water ($2\ H_2\ (g) + O_2\ (g) \rightarrow 2\ H_2O\ (g)$).

Now it is time for the children to do a chemical reaction of their own. Student volunteers hand out card stock reaction templates upon which are drawn reactant and product molecules made up of circular atoms. There are labels under each molecule: sodium bicarbonate ($NaHCO_3$), acetic acid (H_3CCOOH), carbon dioxide (CO_2), water (H_2O), sodium acetate (NaO_2CCH_3). The students are then given "atoms": varying-sized construction paper circles that match the sizes of the atoms on the reaction template. As the students glue the colored atoms onto their templates, the student volunteers interact with the children and engage them in a discussion about atoms, molecules, and chemical reactions. Upon completion of their reaction templates, the children now have a keepsake of the AESOP visit --- but the fun is not over yet!

Working in pairs, the children will now get to do the reaction that they have just mapped out:

$$NaHCO_3\ (aq) + H_3CCOOH\ (aq) \rightarrow CO_2\ (g) + H_2O\ (l) + NaO_2CCH_3\ (aq)$$

With the help of student volunteers, the children spoon a teaspoon of baking soda into an empty party balloon. Then they carefully attach the party balloon to the end of a small soda bottle containing an ounce of vinegar. Once the balloon is attached, the children empty the baking soda from the balloon into the soda bottle and watch as the foaming reaction quickly fills their balloons with carbon dioxide. WOW!

As the children and student volunteers clear away the experiments and clean up any messes, the student volunteers engage the children in a fun question-and-answer session about the things that they learned and enjoyed that afternoon. After saying goodbye to the children, the AESOP troupe heads back to HPU to conjure up more scientific storytelling and fun.