Science Outreach in the K-12 Classroom: Opportunities and Challenges

Alex Chapin, Lindsay N. Roland and Dr. Ami L. Wangeline
Department of Biology, Laramie County Community College, Cheyenne, WY 82007

Introduction

According to the research of Sternberg and Frensch (1991) "the way in which academic subjects are typically isolated from each other, and from any real-world use, does not encourage a mental set for transfer." Thus to teach students concepts that they can relate to other situations requires applying the material to a real-world use (Detterman, 1993). Research has shown that it is beneficial for students to employ a exploration-explanation technique as this helps children test their ideas to learn how they work in the real world and to apply their knowledge to other situations (Brown & Brown, 2010). Research published in the *Journal of College Science Teaching* focused on elementary education majors ability to translate their knowledge of basic scientific concepts from two different classes to answer questions about the topics as they relate to each other and explain their answers; what the research found was a disconnect between the knowledge and the ability of the teachers to implement that knowledge in a relative way (Johnson & Rutherford, 2010). This may in part be because most elementary education programs do not focus on science, confounded by a higher chance of a teacher not being able to translate what they have learned into a hands on, real-world lesson for their class.

There is frequently a disconnect between textbook learning and hands on activities in the classroom (Howes, 2008). No where is this disconnect more apparent than in the field of science in the USA where we are simultaneously cutting funding to science curriculum in the elementary years while bemoaning the fact that we are rapidly falling behind science curve compared to our international counterparts.

The goal of this project was to help fill the gap by providing resources in the form of supplies, ideas and background knowledge to the science curriculum in a 4th grade classroom. The goal was to provide a hands on experience to correlate with the classes science lessons.

Based on research it is clear that demonstrations, that do not allow class participation, do not engage the class as readily as group interaction (Howe et al., 2007). Thus anytime that we had a demonstration in our plan for the day we also had a hands on activity to help engage the children in the topic they were learning. To help the children fully understand the topic we used multiple teaching modalities, as well as only doing experiments on what was discussed in class. By doing this we believe that the children had the best chance of fully understanding the material.

Through the use of worksheets we had the children record what they observed in their experiments which is an important step in the development of the children's science skills (Howes, 2008).

Methods

A group of 4-6 college students, went to a local elementary school 4 times over the last 6 months in an attempt to supplement the science curriculum and enhance the children's experience and feelings about science by providing access to equipment and increased individual attention in a small group setting. Our trips covered topics such as the cell, geography, weather, circuits and tectonics. Utilizing the student's classroom science text book (Badders et al., 2007) combined with other sources, we designed science lessons, experiments, and demonstrations to help teach these concepts. The science textbooks included instructions for a number of experiments and demonstrations that were specific to what they learned though not all were stimulating or feasible for a single instructor with a class of 25. Our group allowed for the class to be in groups of around 5 allowing for each student to have one on one attention and help with the experiments and worksheet.

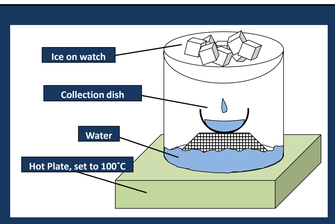
Results

This program has had huge successes. Based on an anonymous survey of the students, all students showed that they felt same or better about their science class with the college student visits. Also, all students commented that they enjoyed the interaction and looked forward to the activities. These experiences support that the more hands on activities that these children can engage in the more excited they will be about the subject, we also believe that experiments are an vital part of the learning process for children in regards to science.

Classroom Activities

#1 – The Water Cycle

In this demonstration a pair of college students separated salt in water and water by evaporation and condensation, using a hot plate, beaker, watch glass, and ice. This demonstration allowed the children to observe the water cycle first hand by seeing evaporation, condensation and precipitation.



#2 – The Microscope & Cells

The college students went over the differences between a plant cell and an animal cell with the students, and then allowed the students to examine samples of these cells under a microscope. This one was a success in terms of student engagement. Once the 4th graders realized what was visible under a microscope, they initiated an investigation into what everyday classroom items looked like under the microscope.

#3 – Volcanoes and Earthquakes

To illustrate different types of volcano eruptions, we placed effervescent tablets in film canisters with water and snapped the lid on; some of the film canisters quickly erupted (exploded, shooting the cap into the ceiling) while others slowly let out their liquid. We also did a demonstration of a volcano erupting using concentrated Hydrogen Peroxide.

For earthquakes, we used Slinkys to show the movement and differences between S waves and P waves. Finally, to demonstrate how earthquakes affect buildings (and to give them a treat before Thanksgiving) we used Jell-O (as the earth) and Starburst candies (as the buildings). The 4th graders assembled their "cities", and then were allowed to start their eruption, and observe the impact on the structures on the surface.

#4 – Rock Hardness

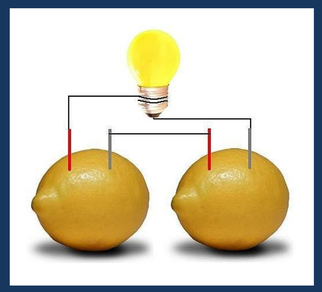
Using fingernails, pennies, and nails, the students tested the 10 rocks for relative hardness and then classified them from least hard to most hard.

Also in this experiment the students tested for the presents of calcium carbonate by submerging each rock into vinegar and looking for signs of a chemical reaction.

#5 – Vegetable Batteries and Circuits

Using copper wire and galvanized steel nails, each group of students created a multi-cell lemon or potato battery which they then used to light an LED light bulb.

In addition to this we used a multi meter to test the conductivity of various fruits and vegetables.



Challenges

We had 30 minutes with each group of twenty five students, therefore setup had to be quick. We never know quite how much time we really need based on how much explanation, or direct support will be needed by the students. We design each lesson with extra time to allow for flexibility in instruction as well as for time to get the students focused.

Another issue that we have experienced finding time to plan and run test experiments with the demands of college academics. On one occasion we went to the school to conduct an experiment and were unsuccessful in completing the experiment because none of the college students were able to practice ahead of time, and right before the time with the students were not able to get it to work, resulting in a reschedule. Scheduling was also very difficult because the students availability frequently differed and the elementary schools have had standardized testing and other school wide activities that conflicted.

Of the two different classes that we have worked with each class has 2 students who need extra attention and assistance in completing and understanding the tasks. Balancing time between these student and other more capable students is a challenge because the other students deserve just as much attention but require less direct assistance. We generally split the classes into groups and the groups who have these students in them tend to take more time completing the experiment. This is obviously an issue that the classroom teacher deals with as well, but in our case, 30 minutes does not allow a lot of flexibility for differentiation.

Student comments

"I felt like a million bucks when I starte siance class with you guys. I hope you guys come every week"
Do you like it in collage? I think it wil be asome if I whet"
"it is really cool to look at science a different way and you guy's have taught me a lot more science and science acts then I expected"
"I loved it it is the best. Also it help me understand even more"
"it help me a lot"
"It helps me in sincene"
"It is really cool when you guys com here. It's the best thing that I think we've done in the class"

Literature Cited

•Badders, W., Carnine, D., Feliciani, J., Jeanpierre, B., Summers, C., & Valentino, C. (2007). *Science*. Boston, MA: Houghton Mifflin.
•Brown, T. M., & Brown, P. L. (2010). Enhancing Elementary Students' Experiences Learning about Circuits Using an Exploration–Explanation Instructional Sequence. *Science Activities, 47*(2), 54-57.
•Detterman, D. K. (1993). *In Transfer on trial: Intelligence, cognition, and instruction*. Norwood, NJ: Ablex .
•Howe, C., Tolmie, A., Thurston, A., Topping, K., Christie, D., Livingston, K., Donaldson, C. et al. (2007). Group work in elementary science: Towards organizational principles for supporting pupil learning. *Learning and Instruction*, 549-563.
•Howes, E. V. (2008). Educative experiences and early childhood science education: A Deweyan perspective on learning to observe. *Teaching and Teacher Education*, 536-549.
•Johnson, A. F., & Rutherford, S. (2010). Transfer of Knowledge in Science Courses for Elementary Education Majors. *Journal of College Science Teaching, 39*(4), 80-88.
•Sternberg, R. J., & Frensch, P. A. (Eds.) (1991). *Complex problem solving: Principles and mechanisms*. Hillsdale, NJ: Erlbaum.