Education is not the filling of a pail, but the lighting of a fire.

W.B. Yeats

Shell Lab Challenge Exemplar Narrative 2013

Science Instructional Strategies

I believe that each child is one-of-a-kind, who needs and deserves a safe learning environment in which to grow at all levels of development—cognitively, socially, emotionally, and physically. As an educator, it is my goal to enable every student to achieve his or her greatest potential by providing an environment that is equitable, invites inquiry, and supports risk-taking. The key elements that I believe contribute to such an environment are the teacher functioning as a guide, and invoking the student's natural curiosity to direct it toward learning.

When the teacher's role is to guide, providing access to information rather than acting as the primary source of information, the students' search for knowledge is achieved as they learn to find answers to their questions. For students to construct knowledge, they need the opportunity to feel secure in an atmosphere of inquiry and practice skills in authentic situations. Providing students access to hands-on activities and allowing adequate time and space to use materials that reinforce the lesson being studied creates an opportunity for individual discovery and construction of knowledge to occur.

Equally important to self-discovery is having the opportunity to study things that are meaningful and relevant to one's life and interests. Developing a curriculum around local and student interests fosters intrinsic motivation and stimulates the passion to learn. One way to take learning in a direction relevant to student interest is to find ways to teach science concepts using the local environment—whether it is by using the surrounding schoolyard, a local estuary, or natural features unique to the region. When students connect with what they are learning and sense relevancy, they are motivated to work hard and master the skills necessary to reach their goals.

As an instructor, I differentiate my instruction so that I can meet the learning styles of my students and design interdisciplinary lessons that are built around hands-on inquiry and student-driven projects. Employing only Mexican jumping beans and chart paper, my Life Science students (many of whom are Hispanic) learn how to perform a controlled experiment, to find out what makes jumping beans jump more. A simple, but very engaging way of challenging students to keep their experiment controlled, with very few materials required. Without a science lab, or much space to keep supplies, keeping it simple is key. After planning their experiment and running their tests, students then do research about the life cycle of the jumping bean moth, integrating multiple subjects while investigating the ecosystem where the moths come from in Mexico. All information curated by the students during their investigation—from their initial question about the jumping beans, to the data from their tests, to the research generated about the species and their environment—is presented in a peer-collaborated poster session.

One of the many things I treasure about teaching is the ability to be creative, resourceful, and innovative—to teach science in a way that captivates and challenges my students. To ensure students understand science concepts, and not merely memorize them, I assess formally on a daily basis by utilizing interactive science notebooks, higher-level questioning, setting learning goals, regularly eliciting and addressing science misconceptions, requiring in-depth written responses to essential unit concepts and frequently provide project-based assessments that measure comprehensive learning. These methods provide deep interaction and engagement with science material that has shown demonstrated learning gains in pre-and post-test assessments.

Current and Desired Lab Resources

At my school, Sebastian Charter Junior High, we currently have no lab facilities for teaching science. In the past, if I have had the need to use a sink for a lab, or to set up and utilize stations in a lesson, I have moved lab materials to the cafeteria. Although I do have my own classroom, with some storage (a closet and some cabinets), I am limited by space and funding for science equipment. I do not have lab tables, but regular desks that I keep in groups to facilitate collaborative learning. Being a charter school in our district means being exempt from school improvement funding, upgrades in equipment, and resources available to the traditional public schools in our area. Supplies are basic—graduated cylinders, elementary-level plastic beam balances, fading microscopic slides, and eight-year old lab manuals. Most of my existing storage space is taken up with materials that I have asked students and parents to bring in to recycle for lab activities, such as 2-liter bottles, old 35mm film canisters, or paper towel tubes. As for teacher resources, I have spent hundreds of dollars of my own money on books and regularly seek professional development opportunities to inject new ideas into the science curriculum.

Due to staff and student expansion--as a result in great part of being the highest academically performing middle school in our district--this year I no longer have access to the cafeteria for labs that require more space or the use of a sink. Minus that option, I will not be performing quite a few labs that have now become a tried and true part of the curriculum. It would greatly benefit my science classroom to have additional resources available for improving existing science lab supplies. Under present conditions, I find myself “going virtual” more and more in teaching science concepts. Although the use of technology in the classroom can be a wonderful and effective tool, my Earth Science students would learn more about weathering and erosion if our lab equipment included a stream table and a rock tumbler, so that students could experience those processes first hand, instead of only on a screen. Conversely, my Life Science students would gain a greater understanding of the Protista, Eukaryotic, and Prokaryotic Kingdoms with microscopic slides that provided them with several examples of each type of organism.

At the beginning of each year, when first introducing students to science process skills, I use the analogy of looking for clues much like a detective does, and this connects very well with each student's natural curiosity in solving a mystery. To be able to actually have students participate in a crime scene investigation and connect scientific methods to real-world applications requires more materials than I currently have available, and would greatly enhance student understanding and knowledge—taking them beyond the analogy into actually solving the mystery--coming full circle in the inquiry cycle.

Additional resources would profoundly impact my ability to teach using hands-on lessons in the classroom and exam scores for Science will be improved in the process. Project 2061 studies show that students participating in hands-on inquiry with relevant phenomena exhibit higher learning outcomes (12% increase on post-tests), a 4% increase in general science content knowledge, and demonstrate accurate use of science terminology 81% of the time. [1] My number one professional goal as a teacher is to increase student understanding of the "doing" of science; having fewer lab resources available presents very real obstacles to teaching in an active learning

---

. [1] The Einstein Project (2005) Cornerstone Study: Results of the Study. http://www.einsteinproject.org/einstein/For+Educators/ Proven+Results/results+2007.asp environment. A lab upgrade would provide much needed materials that would affect many hundreds of students over time, many of which are English language learners and students with exceptional needs who get the most advantage from a hands-on science curriculum.

Laboratory Activity

In our Fresh Water unit, my 6th grade Earth Science students are challenged to create an efficient water filter utilizing three filter materials of their choice. The lesson objectives are: to design and build a water filtering system; to collect data to compare water before and after filtration; to develop a conclusion based on data; to compare individual results to class results to determine the most effective filtering mediums, and how those mediums relate to natural and man-made filtering systems. This lesson addresses the following National Education Standards: Content Standard: NSS-G.K-12.5 Environment and Society. As a result of activities in grades K-12, all students should: understand how human actions modify the physical environment and understand how physical systems affect human systems. Content Standard: NS.5-8.1 Science as Inquiry. As a result of activities in grades 5-8, all students should develop: abilities necessary to do scientific inquiry; understanding about scientific inquiry. Florida Sunshine State Standards addressed in this lesson: <u>SC.6.N.1.4</u>. Discuss, compare, and negotiate methods used, results obtained, and explanations among groups of students conducting the same investigation. <u>SC.6.N.3.4.</u> Identify the role of models in the context of the 6th grade curriculum. <u>SC.7.N.1.C</u>. Scientific argumentation is a necessary part of scientific inquiry and plays an important role in the generation and validation of scientific knowledge. <u>SC.7.E.6.6.</u> Identify the impact that humans have had on Earth, such as deforestation, urbanization, desertification, erosion, air and water quality, changing the flow of water. SC.7.L.17.B. Both human activities and natural events can have major impacts on the environment.

We begin by brainstorming with a K-W-L chart on water recycling and filtration. Students work in groups of four to create a hypothesis that includes their chosen filter media. We discuss and record procedures for data collection, and teams write their predictions of outcomes. I guide students to collect data on odor, appearance, and pH. Before gathering materials and beginning experiment, students put on safety goggles and are instructed on how to waft for smelling odor and not to smell water directly.

Reused 2-liter bottles are used for water containers, cut circumferentially around the bottle about ½ or 1/3 of the way down and inverted into the bottle, creating a self-contained funnel and catchment device. Materials used per group are as follows: safety goggles, 1 2-liter bottle/filtering system structure, screening material, sand, gravel, zeolite, coffee filters, cotton balls, clay, paper towels, 5 litmus paper strips, pH color chart, 1 metric ruler, 1 metric liquid measuring cup, 500 mL clean water, 500mLgray water.

Students collect filtering media of choice and measure filtering materials to a depth of 5-8 cm per layer. Each group collects 350mL of clean water, observes properties of water, wafting to smell water, and measures pH before filtering. Data is collected and recorded. During filtering of water, students sketch and label their filtration system in their lab notes. After filtering, students repeat quantitative and qualitative observations of odor, appearance, and pH level. Students repeat the same procedures with the gray water. Data is then analyzed in groups, and conclusions drawn with guidance from study data questions.

Education is not the filling of a pail, but the lighting of a fire.

W.B. Yeats

Assessment includes completed study data questions, completed K-W-L chart, and student presentation of results in a poster session that is measured by an inquiry investigation rubric that is used for all inquiry labs in class. We share class data and draw conclusions about what materials were the most effective filtering media and discuss as a class what each filtering material might represent in a wetland system as well as in a water filtration plant.