SCIENCE INSTRUCTIONAL STRATEGIES (2 pages maximum; double spaced)

Science teaching philosophy: The middle school science program at ACCESS Academy is inquiry driven, with the goal of inspiring students to actively question, research, analyze and form their own logical conclusions. My aim is to empower students to experiment with the scientific method itself, to approach a hypothesis from any angle rather than being restricted to a defined, linear pathway. I believe this approach replicates the actual working scientific environment, in which scientists observe or informally collect data before embarking on a formal experiment.

Middle school students sometimes find it difficult to articulate a hypothesis and develop a relevant experiment. However, when given the opportunity to handle different tools and equipment, as well as a broad conceptual framework, students see the capabilities at their fingertips and begin generating questions of their own that can be transformed into scientific experiments. Their own natural curiosity strongly motivates them to seek further, deeper learning and understanding, setting them on the path to become scientifically literate lifelong learners.

Strategies currently used: I use multiple teaching strategies in my classes to develop each student's process of inquiry. Modeling, role playing, simulations, laboratory activities and other techniques ensure that students are presented concepts in various ways to suit their different learning styles.

Although my laboratory resources are limited, I provide hands-on experimentation with equipment to pique students' curiosity and inspire them to test hypotheses. Whenever possible, I integrate available technology to replicate the current scientific environment. In addition, I incorporate current events into lessons, experiments, and classroom discussions to reinforce the relevancy of science to each student's life.

Working toward student understanding: I cultivate student understanding of scientific concepts by finding ways to develop meaningful, real-world connections to abstract ideas. For example, when discussing the effects of drugs and alcohol on human beings, we began from a neuroscience point of view: we dissected sheep's brains, an activity that provided students with a tangible experience illustrating cause

and effect. In another instance, I used a game in biology class, Fish Banks, to simulate the relationship between industry and natural resources. Students analyzed various data and used it to make decisions with far-reaching impacts. Creating these firsthand experiences motivates students to go deeper, build connections, and develop higher-level understanding.

Science inquiry in lab activities with current facilities: ACCESS Academy has had limited access to equipment, space and resources since its inception, and it has faced deep budget cuts like other public schools. Working within the constraints of ACCESS Academy's facility and funding environment has required creativity and resourcefulness. Laboratory activities and experiences often must rely on common, inexpensive materials, but I find that simple, carefully curated experiments can provide the basis for a wealth of instruction. A DNA experiment, for instance, can be carried out with wheat germ, clear shampoo, isopropyl alcohol and water.

I have been able to enrich the scientific learning environment by tapping into a supportive parent community and forming partnerships with local and regional universities. For example, a parent's donation of plastic pedometers was used to spur inquiry into biomedical research. A partnership with Portland State University is bringing a scanning electron microscope into the classroom for two weeks this fall. At the same time, another parent effort has produced a collaborative relationship with Oregon State University's Honey Bee Lab, which is delivering hundreds of dead bee samples. Students will view the OSU bee samples under PSU's microscope, looking for indications of parasites or disease and testing hypotheses. Their results will be shared with researchers assessing the health of Oregon's hives. In addition, students will photograph the samples, and there is potential for their images to be used in further research or even publication. Despite their youth ACCESS Academy science students will have an opportunity to make a real contribution to the scientific world. This type of real-world connection provides students with a sense of achievement and encourages further inquiry.

CURRENT AND DESIRED LAB RESOURCES (2 pages maximum, double spaced)

Current lab facilities, equipment and/or resources: ACCESS Academy's middle school science classes are taught in a 1,000-square-foot classroom designed for science instruction 100 years ago. We have learned to work within our facility and equipment constraints to ensure the safety of our future scientists. We have protective eyewear for each student and use goggle sanitizer between uses to reduce the spread of germs. Due to limited ventilation in our sub-basement classroom, I select experiments that avoid the use of any noxious chemicals. Rather than compromise safety, such lab work simply isn't pursued as it may be in other district schools, and ACCESS students are placed at a disadvantage.

ACCESS Academy's lab comprises three sinks with small counter space between each one, filled with equipment. At our disposal are microscopes, incubators, glassware, and a limited number of Vernier data collection sensors. These tools, particularly the data sensors, have proven valuable in science inquiry during lab activities. However, equipment has been purchased through small grants, which have not been sufficient to acquire complete classroom sets.

Why laboratory upgrade support is needed: Existing equipment and facilities are limiting how science inquiry can be utilized in the classroom. The structure of the building and the space cannot be changed without serious investment, but sufficient laboratory equipment would make a significant difference to ACCESS Academy students. Currently, if I want to provide each student with an opportunity to conduct experiments and collect data, laboratory work is either split or shared. For instance, half the class may be engaged in conducting experiments while the other half may be working from textbooks. Or, small groups of four or five students may work together on one experiment, not always ensuring that each team member gets an equitable amount of time with the equipment or subject matter. This rotation through equipment is extremely inefficient, slowing the discovery process and placing undue emphasis on gaining equipment time rather than on collecting and analyzing data. In addition, technology is becoming more

intertwined with science education, and students are hungry for tools that automate data gathering and leave more time for analysis and discovery.

How a lab upgrade impacts teaching and content knowledge: Giving ACCESS Academy a laboratory upgrade would involve procuring enough equipment to allow each student, or even each pair of students, to have regular, hands-on experiences in the classroom. ACCESS Academy students represent the next generation of scientists, and in order to prepare them for the future, they must gain experience with the appropriate tools and in the appropriate environment. A lab that integrates technology and collaboration is critical. By introducing electronic data collection, students can invest less time in mundane data gathering and instead direct their energies toward analyzing and interpreting data and drawing conclusions. With electronic data collection, students have capabilities to share data with their cohorts, using the opportunity to discuss their hypotheses and collaborate to explore new avenues. Such a classroom laboratory more closely resembles a science research environment and should enable students to make new connections and discoveries that develop a deeper understanding of and passion for scientific concepts.

Putting electronic data collection and more advanced scientific equipment in the hands of all students would increase the efficiency of experiments, providing more time for data analysis and increasing collaboration among students. As a teacher, I could focus more on developing student skills in data analysis and engaging all of my students in higher level scientific research. Ultimately, equipping each student with the appropriate tools will allow me to help students reach their fullest potential.

ACCESS Academy students are capable of, ready for, and eager for higher level scientific research. Despite many obstacles in terms of our facilities and resources, the middle-school science students have not only excelled, but have garnered some of the region's highest science honors. Three ACCESS Academy teams have won first prize at the nation's largest regional science bowl competition, the Bonneville Power Administration Regional Science Bowl, and in the 2012-13 school year, five students were nominated to attend the prestigious national Broadcom MASTERS Competition.

LABORATORY ACTIVITY (2 pages maximum, double spaced)

Describe an innovative, replicable lab activity that you have implemented using limited school lab resources with assessments.

- **Purpose and outcome with materials needed.**

I engage my middle school students in innovative lab activities that explore the nature of scientific inquiry in biomedical research. One such activity is part of a genetics unit and involves extracting DNA from wheat germ. The purpose of the activity is threefold:

1. It provides students with hands-on laboratory experience.
2. It introduces students to the research process and guides them through independent research design.
3. It creates an opportunity to expand classroom discussion to address genetic engineering and consider ethical implications of this field.

The activity relies on common household items, including: fruits, vegetables, seeds, water, clear shampoo or other detergent, salt, meat tenderizer and rubbing alcohol. Despite the apparent simplicity of materials, the exercise replicates the same fundamental components of more advanced laboratory DNA extraction procedures. Students use clear shampoo or detergent to break up the cell walls through mechanical and thermal methods. Using ethanol (rubbing alcohol), students release and precipitate the DNA. The final result for observation is a glob of material that contains millions of DNA strands clumped together. This material is not pure DNA; other cell proteins associated with DNA also precipitate into the ethanol.

With additional laboratory equipment, it would be possible and edifying to extend this activity. For example, with access to a spectrophotometer, students could measure the absorption spectrum of the sample. DNA exhibits maximal absorbance at approximately 260 nm, while a typical protein shows peak absorbance at 280 nm. This difference can be used to distinguish the two types of molecules. Students could analyze their data further to determine if a sample contained DNA and how much contaminating protein

was present. In addition, students could design research questions that investigate extracting DNA from other fruits and vegetables and compare yields or the use of different extraction procedures.

For middle school students, science fair projects are a requirement, but can be met with some trepidation. The process of generating research questions is often the biggest obstacle in developing compelling projects. By working through this lab activity, students are introduced to the research process in a fun and engaging way. They have an opportunity to take their inquiry in several directions and learn to overcome the challenge of independent research design.

Finally, as part of the genetics unit, this lab activity presents numerous ancillary topics for discussion and debate. Introducing the field of genetic engineering and the ethical dilemmas associated with it provides an opportunity to explore current advances and potential implications.

Use of state and/or national standards.

The activity meets Oregon and national education standards by teaching students the skills needed to successfully conduct, analyze, and report an experiment. It is a rewarding, easily replicable learning opportunity that can be pursued as deeply and in as many different directions as student interest and ability allows.

List of safety issues and how you address them.

The safety issues associated with this activity are negligible. The required materials are common household items, and no hazardous chemicals or burners are necessary. It is a simple activity to replicate, as the materials are easily found around a household or procured at little cost from a supermarket. For science programs with limited resources, equipment and safety features, an activity of extracting DNA from wheat germ can launch students into a complex world of scientific discovery.