SQER^3 : An FAU GK-12 Innovative Model for a Student-Driven, Teacher-Guided Science Demonstration

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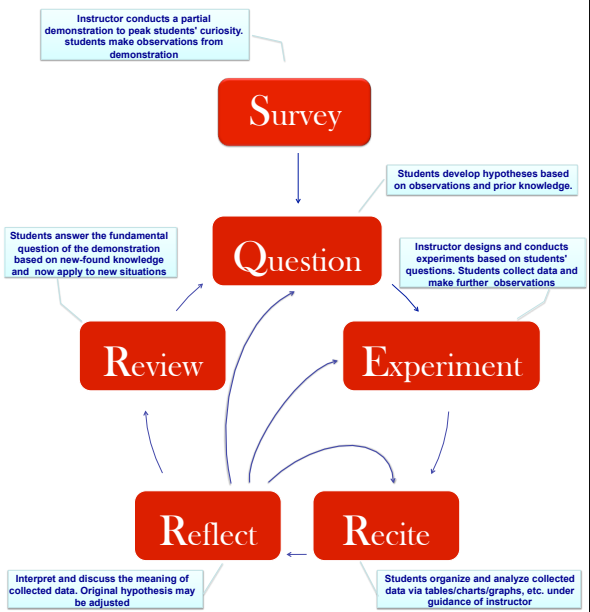
Abstract

Improving the effectiveness of classroom demonstrations and increasing student participation has been a long-lived challenge in science education. While scientific demonstrations can assist in explaining concepts, students tend to be on the sidelines watching as opposed to being directly involved. Studies have shown that success in science education comes from students' ability to be involved in the thought process leading to the demonstration. In the following study, an interactive, question-driven framework for demonstrations that draws clear parallels to science practices has been developed and implemented. The framework, defined as SQER^3 (Survey, Question, Experiment, Recite, Reflect, and Review), allows for a departure from a one-sided demonstration to a cyclic questioning process that lets students extend their investigations. Because of its flexibility and adaptability to all levels of science, this SQER^3 model has proven to be effective so far in high school chemistry classrooms, where it has been implemented at the regular, honors and advanced placement chemistry levels. The study of a demonstration utilizing the SQER^3 framework will be presented along with a discussion of its effectiveness in the high school classroom.

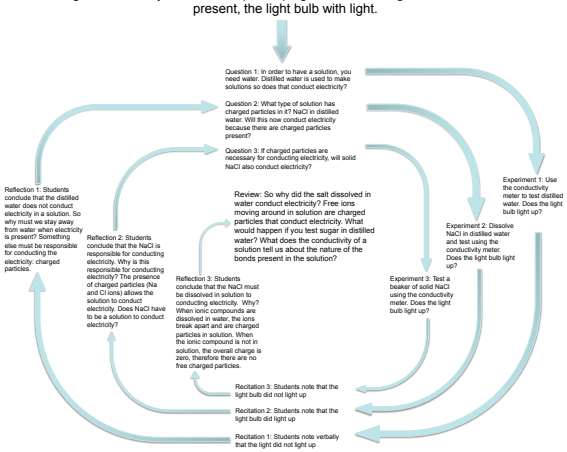
SQER^3 Defined



Examples of SQER^3 and Well-Known Demonstrations

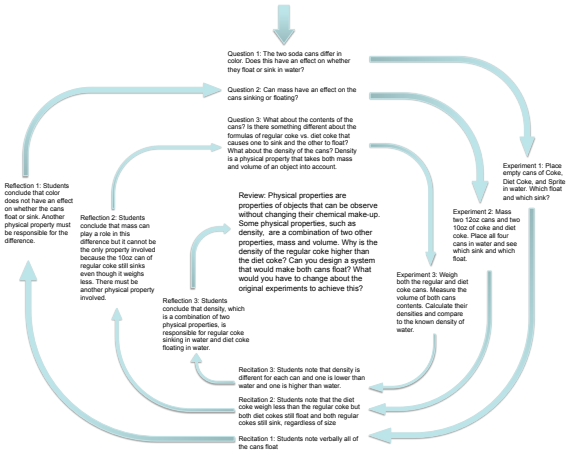
Electrical Conductivity

Survey: What is responsible for conducting electricity in solution? Electric conductivity is the flow of charged particles so what types of solutions might conduct electricity? This can be tested using a conductivity meter with a power plug attached to a light bulb. If electric current is present, the light bulb with light.



Density

Survey: What is a physical property of an object? It is defined as a property that can be observed about an object without changing its chemical make-up, such as color. What sort of physical properties can we observe from two cans of soda: coke and diet coke? When submerged in water, the can of coke sinks while the can of diet coke floats. What physical properties are different between these two cans of soda? Are they responsible for the difference between sinking and floating in water?



FAU GK-12 Program

Ionic Bonding Activity:
This activity introduced the nature of ionic bonds. Students were assigned an ion and asked to attach the correct number of valence electrons (balloons) to their ion. They also formed ionic bonds with other ions by transferring electrons to one another.

Crystallization of super saturated sodium acetate Lab:
Students built a sodium acetate tower by performing super saturation and exothermic processes. Students made a super saturated solution of sodium acetate by boiling together vinegar and baking soda which was then cooled over night. When the liquid is disturbed by pouring, crystallization occurs so quickly that towers were able to be made.

Elephant Toothpaste Lab:
In this activity, the decomposition reaction was introduced and demonstrated. Students added potassium iodide catalyst to speed up the decomposition of hydrogen peroxide into water and oxygen gas. Soap was used to capture the oxygen bubbles. The result – Elephant Toothpaste!

Flame Test Lab:
This activity introduces a reaction of Mg with heat. The students analyze the difference in mass and calculate the amount of the byproduct through balancing equations.