A Content Secondary Science Newsletter from the
Southern Nevada Regional Professional Development Program

Science Dissected

Converting Labs from Verification to Inquiry - Part 2

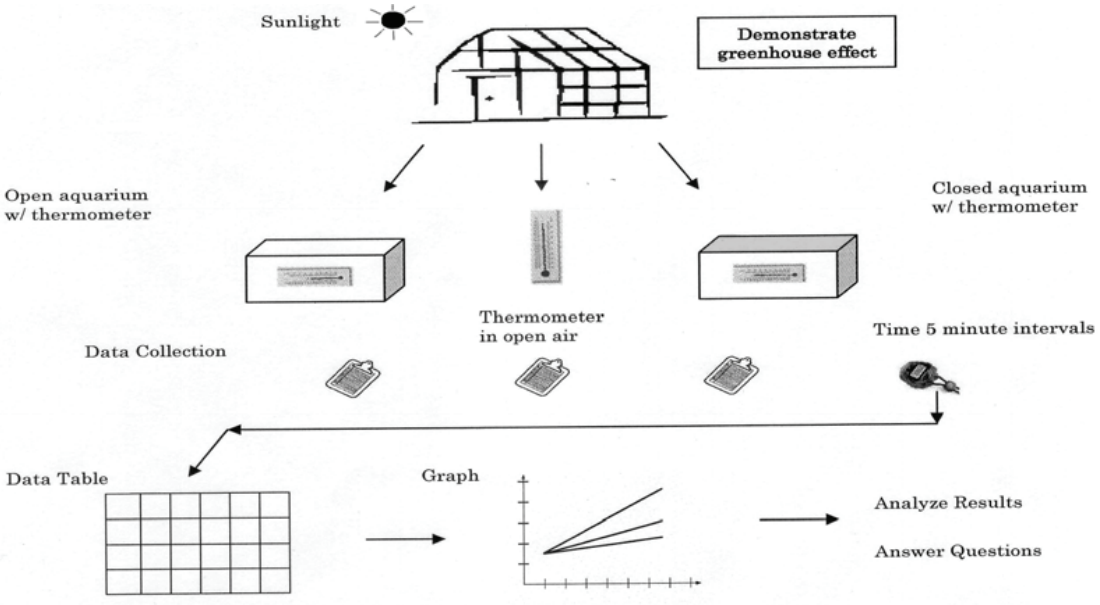
When working on "Science Fair" type projects, have you ever had students have difficulty identifying a problem to investigate, or who feel that projects on volcanoes or "How 'stars' determine a person's destiny?" are viable Science Fair topics. If so, it may be that the students' experience with inquiry has been concentrated on the verification end of the inquiry continuum. Students with limited inquiry experience often have difficulty in identifying projects/ questions that are scientific in nature.

In Science Dissected ***Converting Labs from Verification to Inquiry Part 1***, we covered some fairly simple ways to convert verification labs to inquiry labs. Those methods take a verification lab and begin to march it down the inquiry continuum toward open inquiry, or to the traditional Science Fair type project. In the second installment of Verification to Inquiry we will move much closer to open inquiry, leaving verification far behind. I would caution that if your students are not accustom to working in an inquiry-based environment then using these more "advanced" suggestions may induce some anxiety in both you and your students.

Continuing from where we left off in Part 1: The next method on the inquiry continuum would be to provide the students with the problem statement and **procedures only** for the lab. After the students read over the procedures they are to identify what data they are to collect and develop the data table. This process requires the students to become more connected with what they are expected to do to be successful with the investigation. Students are challenged to anticipate the outcomes in order to organize the data to be collected and analyze the relationship between the variables.

Remove the step by step instructions from a traditional lab and give the students only the **data table**. Based on the information required to complete this graphic organizer the students must "work backwards" to design the experiment and write the procedures. Students who tend to skip the procedures and jump straight to the data table tend to do very well with this modification.

Concept Map – Students convert the step by step instructions found in most labs to a flowchart with pictures rather than text. When the concept map or flow chart is interpreted by the students they internalize the process and begin to see the overall intent of the lab activity. Students may need to be guided through the process of flow charting, until they are comfortable with it.



NSTA blog: Switching from cookbook labs to full inquiry, http://nstacommunities.org/blog/2011/03/24/switching-from-cookbook-labs-to-full-inquiry/

Archived Issues of Science Dissected, http://www.rpdp.net/link.news.php?type=sciencedis

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Converting Labs from Verification to Inquiry - Part 2 continued...

If you desire to give the students a bit of guidance, provide them with just the problem statement and the **first few steps** of the procedure. From this point the students must finish the experimental procedures and the data table. This method requires the students to think through the problem and how it will progress so that in the end they can address the problem statement that they were given.

Scientists routinely report their experimental results in **paragraph form** when they share their findings in peer reviewed journals. Provide students with a paragraph description of the experimental results. Based on the information in that paragraph the students work backwards to recreate the experiment, problem, procedures, and data table in an attempt to verify / repeat the results.

Further on the continuum would be to provide the students with **only the independent and dependent variables**. From this point the students would be expected to recreate the experimental procedures, identify the magnitude of the independent variables and conduct the experiment. For example they could be provided with the question "How is energy absorbed when matter changes state?" They would be told that the independent variable would be time in minutes and the dependent variable would be the temperature of water in degrees Celsius. Students would determine the cause and effect relationship between these two variables based on the experiment they design. This method is very similar to what students would do in a "science fair" type project and provides the students the opportunity to explore open ended problems.

The final method and the furthest on the inquiry continuum, just before open inquiry/Science Fair, that still has some teacher direction would be to provide the students with the **problem statement only**. In this method the students are required to plan the experiment, design the data table, collect and evaluate these results to the problem provided. This method also known as "bounded inquiry" provides the students with the least amount of guidance, however the teacher may still want to provide the student with the experimental materials that "may" be used to investigate the given problem.

The progression from verification to inquiry is inversely proportional to the amount of *teacher direction* provided during a lab. This in no way implies that in an inquiry activity the teacher is not involved. In fact, the opposite is true, the teacher is highly involved, but their involvement shifts from the director of the action, as in Simon of "Simon, Says!" to one more akin to a drivers ed. instructor. Despite all the book "learning" that the student does, when it comes time for them to sit behind the wheel with the instructor at their side, they will be making the decisions and the mistakes. The instructor offers suggestions, warnings and encouragement but they cannot drive the car for the student. After the driving lesson, the instruct takes time to discuss what happened during the behind the wheel experience, pointing out mistakes and helping the student identify possible correction, and discussing what went well. Being the teacher in an inquiry classroom environment is much like teaching someone to drive, sometimes you have to hang on and watch them make some decisions that may not be the best choice, and sometimes you have them pull over in a safe spot so you can pry your fingers out of the dash board, for example when safety is an issue you ***always*** say something. After a lab (or a trip to the store) it is critical that you take the time to "debrief" the experience and help the student correct mistakes, strengthen the positive portion of the experience and draw attention to the key things that just slipped right past them. The ultimate goal in drivers ed. and inquiry is to enable the student to become independent of the instructor, able to apply their new found skills to unique situations and be successful in so doing.

Special points of interest:

- Build student and teacher confidence in inquiry by starting with limited inquiry and progressing to more open inquiry once students are successful.
- A goal of inquiry is to help the students become independent problem solvers and thinkers.
- Inquiry is one tool in a teacher's tool chest, although it is much like duct tape in its versatility.

Reference: Peters, E. (2005). Reforming Cookbook Labs. *Science Scope* November/December, 16-21