**TEACHER NOTES**

Westminster College

**INQUIRY EXPERIMENTS OVERVIEW**

From *Vernier Investigating Chemistry through Inquiry*

**DOING INQUIRY EXPERIMENTS**

These experiments can be used in an open or guided inquiry setting. Open inquiry is sometimes called student-initiated inquiry, in which students create their own research questions. Guided inquiry is sometimes called teacher-initiated inquiry, with the instructor providing the researchable questions.

Each of the experiments have a list of possible researchable questions listed in the teacher notes. The instructor can choose from the list or use modifications to create their own. We recommend the simultaneous use of multiple researchable questions in the guided inquiry setting.

The sensors and other materials that you have available will, of course, play an important role in determining the nature of the inquiry experiments in your classes. Knowledge of your resources will help you to guide your students through the first phases of inquiry. Use this knowledge to align the student investigations with your course objectives, to help generate good researchable questions and keep your preparation time within reasonable bounds.

**INQUIRY PHASES**

1. **Preliminary Activity**

In the guided inquiry approach, the Preliminary activity serves three major purposes:

* To aquaint students with the sensor(s) and software used.
* To familiarize students with technique (such as titration technique or the production of the Beer’s law standard curve).
* To initiate or advance the study of a subject in line with the instructor’s objectives.

During the Preliminary Activity in the guided inquiry approach

* Students should record observations.
* After completing the hands-on part of the experiment, studnets should use reference sources to find out more about the subject being studied before moving on to the planning phase.
* You should circulate among the student groups asking questions, helping students make observations, offering help for answering questions on the student handout, and making suggestions.

Preceding the Preliminary Activity, you may choose to assess prior knowledge of the topic following a procedure such as this:

* Have students individually record what they know about the topic.
* Have them “pair and share” what they wrote with a partner
* Have some students share their responses with the entire class.
* Display the responses and organize students throughts into concept map.
1. **Planning**

Each student group should prepare a plan that includes the following:

* The question to be investigated
* The hypothesis to be tested (if appropriate)
* The manipulated, responding, and controlled variables
* A materials list
* Detailed list of safety concerns
* A procedure
* Data tables (if appropriate) Often printed data tables and printed graphs are more appropriate

Circluate among the student groups asking questions and making helpful suggestions, while being mindful of the resources available. Some instructors choose to provide a blank “Inqiury Plan” to help students with planning durin ghte first inquiry experiments of the course. We have provided one on the website. You can provide a sheet to your students as a handout or electronically. You may choose to collect and approve inquiry plans before investigations can begin. You will need the student materials lists to prepare in advance for the student investigations.

You will need to decide how you want to make your students aware of the materials available for each experiment. Some options include: inserting a Materials list into the student handout, announcing items aloud, or telling students on an as-needed-to-know basis during the first three phases of the inquiry process.

It is very important for your students to prepare a detailed description of the safety concerns they will address as they begin to investigate a researchable question. There are many options within each lab topic, thus there will be different safety issues. An Inquiry Plan should not be approved with a a carefully written section on safety. Your students will find the Flinn website especially useful because it includes MSDS (Materials Safety Data Sheets) documents for solution concentrations they will be using in their investigations.

1. **Carrying Out the Plan**

During this phase, students use their plan to carry out the experiment and collect data. Circlate among the student groups asking questions and making helpful suggestions.

Student experiments will not always work out as hypothesiszed. Be ready to help when things “don’t work”. Unexpected results present learning opportunities and often lead to new researchable questions.

1. **Organizing the Data**

Groups shold prepare to communicate their results with presentatoins and reports using graphs, tables, and/or charts. They can prepare to communicate their results ot the class using Logger *Pro,* Powerpoint, posterboard, or a combination of these. Handheld results can be transferred to a computer for this purpose. Later, the results can be moved to the presentation computer by LAN or memory stick.

The student groups should also work on reports to be submitted to you and fitting your guidelines. Consider using Logger *Pro* and the Page feature as a tool for producing such hardcopy and electronic reports.

Circulate among the student groups asking questions and offering assistance as they organize their data.

1. **Communicating the Results**

During this important and exciting phase of the inquiry process, student groups present their research using tools such as those listed above. Interaction among groups is important during this phase and leads to better understanding by all involved.

You may find it desirable to have a student recorder and record a list of new researchable questions that are generated during the session. Make opportunities available for the investigation of such questions.

Record information that you will be able to utilize during the Conclusion phase.

1. **Conclusion**

Using your notes recording during the Communicating the Results phase, summarize the group results for the experiment and tell how they will fit into the upcoming instruction.

1. **Assessment**

Scientific inquiry assessment may take on many forms. It determines students’ abilities to form a question or hypothesis, design an investigation, collect and present data, and analyze and interpret results. A scoring rubic, such as the one provided on the following pages allows instructors to be more objective in grading complex student performances. They also help students understand more clearly what is expected of them in an inquiry investigation.

These guidelines are extensively based on the content of the books available form NSTA and other sources:

*Inquiry Within: Implementing Inquiry-Based Science Standards*

Douglas Llewellyn

Corwin Press ISBN# 978-0761977452

*Teaching High School Science through Inquiry*

Douglas Llewellyn

Corwin Press and NSTA Press ISBN# 978-0761939382