De-Mystifying Inquiry: Developed by Lee Meadows, Ph.D.

These thoughts are from *Inquiry and the National Science Education Standards,* page 29, Table 2.6. The table can be used to indicate the range of inquiry from open-ended inquiry to guided inquiry to cookbook labs. This whole document depends on you having a working knowledge of the 5 Essential Features of Inquiry from page 24 through page 28 of Inquiry and the NSES. You might want to skim through those pages for a quick review before going further here. Setting the stage for this analysis are the levels on inquiry as reported in "Simplify Inquiry" from the October, 2005, issue of *The Science Teacher.*

Levels of Inquiry in an Effervescent Antacid Tablet Activity

by Rezba, Auldridge, and Rhea's (1999)

Inquiry level	Description and Examples
1	**Confirmation**: Students confirm a principle through an activity in which **the results are known in advance**. "In this investigation you will confirm that the rate of a chemical reaction increases as the temperature of the reacting materials increases. You will use effervescent and antacid tablets to verify this principle. Using the following procedure, record the results as indicated, and answer the questions at the end of the activity."
2	**Structured Inquiry**: Students investigate **a teacher-presented question through a prescribed procedure**. "In this investigation, you will determine the relationship between temperature and the reaction rate of effervescent antacid tablets and water. You will use effervescent antacid tablets and water of varying temperatures. Using the following procedure, record the results as indicated, and answer the questions at the end of the activity."
3	**Guided Inquiry**: Students investigate **a teacher-presented question using student designated/selected procedures**. "Design an investigation to answer the question: What effect will water temperature have on the rate at which an effervescent antacid tablet will react? Develop each component of the investigation including a hypothesis, procedures, data analysis, and conclusions. Implement your procedure only *when it has been approved by your teacher.*"
4	**Open inquiry**: Students investigate topic-related **questions that are student formulated through student designed/selected procedures**. "Design an investigation to explore and research a chemistry topic related to the concepts we have been studying during the current unit of chemical reactions. Implement your procedure only *when it has been approved by your teacher.*"

(As printed in "Simplifying Inquiry"; *The Science Teacher*: October, 2005; p. 30-33)

Confirmation Labs: Verification or Cookbook Labs

In these labs, student abilities would fall on the right side of the table, as the red boxes show below. Students are being directly strongly in what they're doing, and they won't develop many thinking and problem solving skills because they're doing as they are told.

Table 2-6.Essential Features of Classroom Inquiry and their variations

Essential Feature	More.....**Amount of Learner Self-direction**.....Less Less.....**Amount of Direction from Teacher or Material**.....More			
1. Learners engage in scientifically oriented **questions**	Learner poses a question	Learner selects among questions, poses new questions	Learner sharpens or clarifies questions provided by teacher, materials, or other sources	**Learner engages in questions provided by teacher, materials, or other sources**
2. Learners give priority to **evidence** in responding to questions	Learner determines what constitutes evidence and collects it	Learner directed to collect certain data	Learner given data and asked to analyze	**Learner given data and told how to analyze**
3. Learners formulates **explanations** from evidence	Learner formulates explanation after summarizing evidence	Learner guided in the process of formulating explanations from evidence	Learner given possible ways to use evidence to formulate explanation	**Learner provided with evidence and how to use evidence to formulate explanations**
4. Learners **evaluate their explanations** in light of alternative explanations…[1]	Learner independently examines other resources and forms the link to explanations	Learner directed toward areas and sources of scientific knowledge	**Learner given possible connections**	
5. Learner **communicates and justifies** explanations	Learner forms reasonable and logical argument to communicate explanations	Learner coached in development of communication	Learner provided broad guidelines to sharpen communication	**Learner given steps and procedures for communication**

[1] The language from the original table has been replaced with the description of the essential feature given in the text on p. 27.

Confirmation Labs: Dry Lab Data

Sometimes, it's difficult or impossible to let students collect data. The process is too time consuming, too dangerous, or it requires materials and equipment teachers don't have on hand. Teachers still can do inquiry, though, by providing students with data from another sources. The table below shows, however, that these labs can be opened up by requiring more learner self-direction in Essential Features 3 and 4.

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Structured Inquiry: Beginning Inquiry

As with all of the levels of inquiry, several different versions of guided inquiry can be formulated by different combinations of scaffolding. In this example, the teacher eases the student into inquiry by maintaining clear direction throughout the inquiry.

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Structured Inquiry: Day-to-Day Inquiry

This example gives the routine level that high school students should perform at when they are familiar with inquiry and have most of the process skills in place that they need for thinking about inquiry. Day-to-day inquiry balances teachers' responsibilities to cover essential scientific content with their responsibility to develop in their students the thinking and process skills that students need for life in a modern society and work in a global economy. The teacher is still focusing the students through providing most of the question and directing the students experimentation, but the students really have to take the lead in thinking through the data and writing it up.

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Guided-Inquiry: Focusing Students on Investigations.

In this example, the teacher directs the students in the question, but then asks them to figure out how they'll get data. This will take time and coaching; so, the teacher guides more strongly the end of the process to move forward in the curriculum.

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Open-Inquiry Labs: Guiding Students to Question and Solve Problems

In these labs, student abilities would fall mostly on the left side of the table. The advantage to these inquiries is that students have to think of good questions to ask and how then to attack the problem of finding an answer. The disadvantage is that they're so unstructured that students often struggle with direction.
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