World of Chemistry
Decision Making, Problem Solving and the Scientific Method
– or –
"following the yellow brick road"

When the cause or causes of an event are not immediately obvious we need to work things out by doing some detective work, an historical study, a scientific experiment, or some other kind of investigation. Unfortunately, we often do nothing of the kind. We do not proceed scientifically, historically, or whatever; in fact, we do not do anything remotely systematic. Instead, we jump to a conclusion and accept the first conclusion that comes to our heads, we do not even entertain any alternative explanations or ideas. Most of us do this sometimes; for example we jump to a conclusion about why the car will not start, instead of considering possible alternatives – could it be out of gas, could it be an electrical fault, could the battery be dead, and so on. Or we hear a TV news report about a car bomb explosion and we immediately jump to a conclusion about the likely perpetrators – without even considering possible alternatives. Sometimes we even just give up and say that we cannot understand something or that it is completely beyond us.

A second weakness we sometimes display when considering the causes of events or the material at hand is that we fail to consider all of the relevant evidence; we take bits of evidence which support our favored explanation and ignore the others – or we do not even look for additional or conflicting evidence.

One of my favorite TV shows (as you may already know or will find out because I will mention it numerous times as the year goes on) is CSI: Crime Scene Investigation. I find this particular one the most – scientifically – interesting, although the CSI: Miami is perhaps a close second in some aspects. Often in a CSI episode, Grissom or another character (often quoting him) will remind someone else that everything is in the data (evidence) and that they cannot get caught up in their own biases or jumping to conclusions without examining and considering ALL the data. Some of the stories revolve around the conflict between the police who want a simple solution and have already made up their minds, and the CSI investigator(s) who wants to get all the evidence. Sometimes the story is left hanging because the evidence is not there to be able to really come to a definite conclusion.

This is quite different than, say, Columbo in which Lieutenant Columbo often decided early in the episode who was guilty and then during the rest of the show he worked to find the proof of that person's guilt. Certainly, sometimes the CSI's also work to find more evidence that they might have missed in order to show someone's likely guilt or innocence. In a couple of episodes that come to mind, however, the continued search leads to identifying a completely different suspect.

So when we do lab experiments in Chemistry, everything is not always immediately there; and sometimes it is. We have to make observations, measurements, decisions, etc. based on what we see. One can design experiments to look for particular things and on other occasions one just looks to find whatever is there. There are methods people have

developed to help use experiments to prove things one way or another. One of the things that often gets my "experimental juices" flowing is the statement that something cannot be done in some particular way. For me this is a bit like waving a red cape in front of a bull.

[For those of you who choose to look at my patents (see the various "extra credit" opportunities at www.thinkchemistry.com), you should find two that, if you actually read them, deal with the result of this challenge. In fact, even some of my co-workers at the time, some other patents and even some text books claimed that what I did could not be done. (Talk about red capes or flags!) OK, so it wasn't easy but it also opened up a wide range of possibilities for doing other things more simply to make certain kinds of compounds. And, yes, I love a challenge of proving people wrong! HA!!!

This works in a similar manner when we look at things like **word problems** – we often immediately give up with the explanation that we "cannot do word problems" without bothering to look at the problem carefully and, simply, follow stepwise through the process of discovering (a) what is asked for, (b) what is given, (c) what we need to do to get to the answer, and (d) the reasonableness of our answer. Sometimes we need to do some investigation in order to solve a problem, any problem – or to just make a decision.