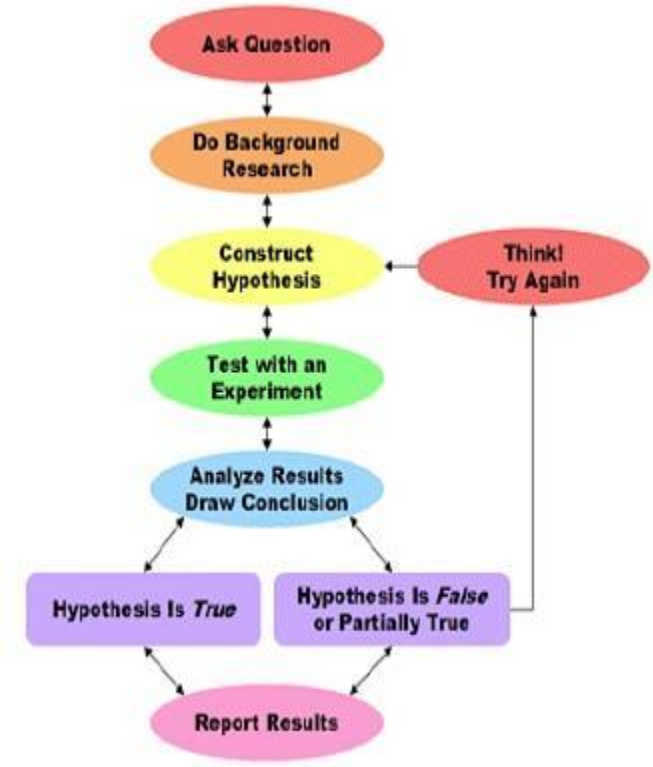
# DOVETAIL COMMENTARY
## Give Me Something to Believe In
## September 2012

Figure 1. Scientific Method




*Source:* http://www.sciencebuddies.org/science-fair-projects/project_scientific_method.shtml

In a recent conversation with a friend, we were discussing the environment and the types of tools and research that are used to evaluate environmental impacts. As we talked, my friend said to me, "Oh, I don't believe in that." I asked, "What don't you believe in?" and he said, "I don't believe in science." Although I was a bit taken aback by this statement, it got me thinking about what it means when a person says, "I don't trust scientific information," or "data can prove anything someone wants it to." This led to consideration of the question, "what does science give us to believe in?" The "scientific method" is commonly described as a cornerstone of science. The scientific method can provide a key insight into how the scientific process works, and why people might have a love-hate relationship with it!

The general steps of the scientific method are to:
- Ask a Question,
- Do Background Research,
- Construct a Hypothesis,

- Test Your Hypothesis by Doing an Experiment or Making Observations,
- Analyze Results to Draw a Conclusion, and
- Communicate Your Results[1]

These steps are illustrated in Figure 1, and as shown, the steps are not linear! The diagram shows that nearly all of the arrows go both ways! At almost any step in the process, new information can be used to go back and revise the previous steps. There is also more formalized feedback built in during the stage of analyzing results and drawing conclusions (i.e., extensive external review and defending your thesis!).

Some people are surprised to realize the scientific method isn't just a lofty tool used by graduate students and in laboratories. All of us use it naturally in every day life! For example, when a child starts crying, a parent will immediately wonder why and begin evaluating different potential causes (hunger, diaper change, tired, etc.) based on previous experience and training. Each potential hypothesis will then be tested and results analyzed in order to reach a final result that informs the parent's actions (and hopefully a happy resolution!).

Some of the common concerns about the validity of scientific findings are that conclusions are always changing and that there is disagreement between scientists (or between parents trying to figure out how to stop the crying!) over the interpretation of results. While this kind of situation can be unsettling, these conditions also provide evidence of the scientific method at work. Changing conclusions and debates about results generate new hypotheses and further testing. New findings often lead to new insights --- scientific progress! Disagreements provide an opportunity for new questions to be asked and new possibilities to be discovered --- the pathway forward to more scientific progress!

The challenge to understanding scientific information is often in the reporting of it (that last – but not least - step in the method!). The scientific method strives to limit variables, focus on the details, and determine the probability that the results could be repeated. A good scientific report indicates, "under these specific conditions and utilizing this specific process it is x% probable that the same results would occur again." For scientists this conclusion is sufficient as it represents a further step in the understanding of a potentially more complex issue. However, for other audiences there is often a need to draw broader and more general conclusions from these details. It is often these generalizations that are in conflict.

At its worst, science can appear frustrating and confusing. It can seem to overlook important considerations that are not easily quantified and end up alienating some people or communities. Specific scientific data can even be used to push an individual or organizational agenda forward. Yet, at its best, the scientific method can be empowering. It can provide for thoughtful exploration of tough questions, evaluating complex challenges, and charting a course of action. It can offer a light to illuminate the path of future opportunity.

The global environment offers a clear example of the need to use the scientific method in evaluating alternatives and informing decision-making. Finding creative and effective ways to meet the needs of a growing global population, while still protecting the earth's natural assets, requires an increasingly sophisticated understanding of incredibly complex systems. The scientific method offers a systematic and inclusive way to understand complexity, to frame issues that need to be addressed, and to inform development of potential solutions.

The successful application of science and rational thought to address current and emerging challenges may depend upon people's willingness to trust the scientific information they are provided. That trust will be based on both their ability to truly hear the information and to understand it. To achieve this, there is clearly a role for educators to facilitate understanding of the scientific method. There is also a role for journalists to ensure the results of scientific research are communicated in a manner that reduces confusion and supports further insights. Finally, it is important that scientists consider and address all aspects of an issue, including emotional and intuitive elements potentially linked to the interpretation of results. These elements often underlie how studies, data, and results will be valued in the long run and whether or not science is going to be "believed."

- Jeff Howe, Ph.D.

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