

## When scientists disagree

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The debate over potential impacts of shale gas development recently heated up with the release of a Duke University study of groundwater chemistry in northeastern Pennsylvania. An early rebuttal by a Penn State geologist has raised questions among the general public about what constitutes scientific fact in the Marcellus debate.

The Duke researchers found that some drinking wells in the region contained dissolved salts with features similar to salts associated with the mile-deep Marcellus shale formation. The researchers interpreted their findings to suggest that brines from the Marcellus found their way to the surface over some undetermined time span – independent of hydrofracking.

Their study, published in the respected journal *Proceedings of the National Academy of Sciences*, challenged conventional wisdom that drinking water sources are insulated from mile-deep hydrofracking. The authors suggested that some water wells risk being contaminated by hydrofracking – even though none of their samples found any direct evidence of such contamination.

In an unusual step, Penn State geologist Terry Engelder publically released a review of the study that he submitted to the authors while their manuscript was being considered for publication. Engelder laid out a detailed, highly technical series of arguments against the Duke team's data interpretations.

Those familiar with the Marcellus shale story know that Dr. Engelder was one of the first scientists to recognize the vast energy potential of Marcellus shale. He is often described as being a champion of the industry.

The day that the Duke study was published, I had a fascinating email exchange with a knowledgeable fellow living in the midst of Marcellus development. He admitted that he could not understand how two scientists could disagree so profoundly. After all, “isn't science black-and-white?”

That question caught me off guard.

Indeed, science can appear black-and-white to those whose science education ended in high school – or with a basic course in college for non-majors. Students are asked to demonstrate their mastery of the facts through exams with questions that have right and wrong answers.

Those of us who become researchers quickly learn that science is much more than a collection of facts. It is a process of discovery that involves rigorous hypothesis testing and data analysis. Eventually, we get to the point where nearly everybody agrees on the answer to a given question – though getting there sometimes takes years. Thanks to the mountain of information collected over the centuries, many of the topics addressed by science are indeed “settled.”

But many topics are far from settled.

During the discovery process, scientists often disagree. Typically, disagreement arises when we try to determine the meaning of a given set of data. Scientists will have different opinions based on their education, research experiences, grasp of scientific literature, and even conversations with colleagues.

Scientific disagreements are typically handled with mutual respect, and often help scientists learn from each other. Scientific debates can lead to consensus about what we know, and what deserves future research. Many grant proposals to government agencies or foundations originate from scientists concluding that more research is needed.

The process goes awry when particular scientists let their biases influence their research, and, more importantly, their ability to find consensus with others who disagree. To that end, Engelder’s review was unnerving because he opened by questioning the motives of the Duke researchers.

When research on some topics -- like the potential impacts of shale gas extraction – is carried out with intense public scrutiny, more complications arise. Studies that find minimal impacts are rejected by those opposed to drilling. Studies that suggest an impact are ridiculed by those favoring development. The debate is made fully public on the Internet, and its ability to display comments made by anyone – regardless of background knowledge or motive. As a result, the discussion becomes even more polarized. Collectively deciding on a reasonable course of action remains elusive.

We need to do better. Scientists must work together to better assess risks surrounding shale gas development, especially compared to other energy sources. Interested stakeholders should view all science objectively and avoid cherry-picking research findings that only support their viewpoint. Finally, we should follow the good example of generations of scientists and find ways to resolve disagreements without resorting to character assassination.

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*Note: this essay was submitted as an Op-Ed to newspapers throughout Pennsylvania in late July 2012. It was published by the Wilkes-Barre Times-Leader and the Wilkes-Barre Citizen’s Voice.*