Harwood on scientific inquiry 10 Nov 2008:
http://pubs.acs.org/isubscribe/journals/cen/86/i45/html/8645letters.html#6

http://ptonline.aip.org/journals/doc/PHTOAD-ft/vol_62/iss_7/8_1.shtml
What is science? Physics Today, July 2009

"To oversimplify, scientists think of science both as a process for discovering properties of nature and as the resulting body of knowledge, whereas most people seem to think of science, or perhaps scientists, as an authority that provides some information"

"science is a process, based on interpretation of experimental or observational data using models and theories, within a tightly constrained logical structure. The constraints arise from needing a logically self-consistent explanation of multiple phenomena. Any apparent contradiction between different theories or models, between evidence and theory, or between different sources of evidence must be examined and resolved. Asking questions is a big part of doing science, and choosing to pursue answers to the more compelling and productive ones helps shape a given field. Eventually, something resembling an answer might emerge, only to be tested against further observations, models, or theories, a process that often leads to further questions. The work continues, iteratively refining both the theory or model and the questions being examined. Iterations are essential because the process is inherently messy. There are many false starts, with misinterpretations and incomplete information sometimes sending science off on a wild goose chase for a while. We scientists could well be more forthright about the fits and starts of research; after all, clearing up the inconsistencies is what confers much of the authority on the results.

Much of science seeks to explain observations of the current state of the natural world by developing an evidence-based history of how that situation arose, much as a detective reconstructs a crime. Computer programs that can simulate the progression of the system—or some aspects of it—over time are important tools in such science and can be powerful means to predict outcomes. The developed history must be consistent not only with all that is known about the system in question but also with all that is understood about processes that occur within the system. Geoscience, climate science, astrophysics, cosmology, and evolutionary biology all use that important history-building approach to develop major parts of their theories.

Theories and models develop over time. Based on data, they undergo a long-term process of testing and refinement before becoming accepted scientific explanations or tools in a given domain. Contrast that with the usual description of the scientific method, which reduces continuous and iterative theory building to the idea that one makes and tests hypotheses. The use of a broad theoretical framework within which each hypothesis must fit, and that gets refined by each test, is generally lacking in the textbook account.

Scientific theories, even when generally accepted after much testing and refinement, are still never complete. Each can be safely applied in some limited domain, some range of situations or conditions for which it has been well tested. Each might also apply in some extended regime where it has yet to be tested, and may have little or nothing to offer in still more distant domains. That is the sense in which no theory can be proven to be true; truth is too complete a notion. We need to emphasize that the incompleteness of theory in no way compromises the stability over time of well-established understanding in science—an important notion that is seldom made explicit."