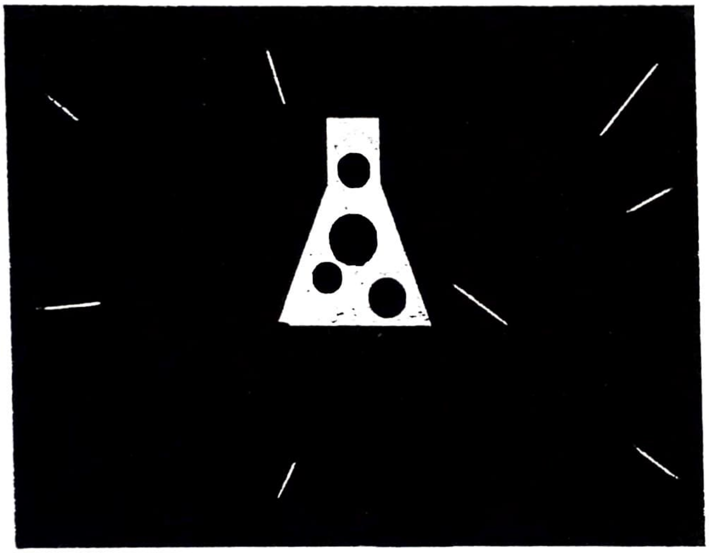
For several decades, there has been an extensive and organized campaign intended to generate distrust in science, funded by regulated industries and libertarian think tanks whose interests and ideologies are threatened by the findings of modern science. In response, scientists have tended to stress the success of science. After all, scientists have been right about most things, from the structure of the universe (the earth does revolve around the sun) to the relativity of time and space (relativistic corrections are needed to make global positioning systems work).

Citing successes isn't wrong, but for many people it's not persuasive. An alternative answer to the question "Why trust science?" is that scientists use the so-called scientific method. If you've got a high school science textbook lying around, you'll probably find that answer in it. But what is typically asserted to be the scientific method—develop a hypothesis, then design an experiment to test it—isn't what scientists actually do. Science is dynamic: new methods get invented; old ones get abandoned; and at any particular juncture, scientists can be found doing many different things. That's good, because the scientific method doesn't work. False theories can yield true results, so even if an experiment works, it doesn't prove that the theory it was designed to test is true.



If there is no identifiable scientific method, then what is the warrant for trust in science? How can we justify using scientific knowledge in making difficult decisions?

The answer is the methods by which those claims are evaluated. The common element in modern science, regardless of the specific field or the particular methods being used, is the critical scrutiny of claims. It's this process—of tough, sustained scrutiny—that works to ensure that faulty claims are rejected.

A scientific claim is never accepted as true until it has gone through a lengthy process of examination by fellow scientists. This process begins when scientists discuss their data and preliminary conclusions. Then the claim is shopped around at conferences and workshops. This may result in the collection of additional data or revision of the preliminary interpretation. Then the scientist writes up the results and sends the preliminary write-up to colleagues.

Until this point, scientific feedback is typically fairly friendly. But the next step is different: once the paper is ready, it is submitted to a scientific journal, where things get a whole lot tougher. Editors deliberately send scientific papers to people who are not friends or colleagues of the authors, and the job of the reviewer is to find errors or other inadequacies. We call this process "peer review" because the reviewers are scientific peers—experts in the same field—but they act in the role of a superior who has both the right and the obligation to find fault. It is only after the reviewers and the editor are satisfied that any problems have been fixed that the paper is accepted for publication and enters the body of "science."

A KEY ASPECT of scientific judgment is that it is done collectively. It's a cliché that two heads are better than one: in modern science, no claim gets accepted until it has been vetted by dozens, if not hundreds, of heads. In areas that have been contested, like climate science and vaccine safety, it's thousands. This is why we are generally justified in not worrying too much if a single scientist, even a very famous one, dissents from the consensus. The odds that the lone dissenter is right, and everyone else is wrong, are probably in most cases close to zero. This is why diversity in science—the more people looking at a claim from different angles—is important.

In a way, science is like a trial, in which both sides get to ask tough questions in the hope that the truth becomes clear, and it is the jury that makes that call. But there are important differences: one, the jurors are not common citizens but experts who have the specialized training required to evaluate technical claims; two, the judges are all the other members of the expert community; three, double jeopardy is allowed, because there is always the possibility of reopening the case on the basis of new evidence.

Does this process ever go wrong? Of course. Scientists are human. But if we look carefully at historical cases where science went awry, typically there was no consensus.

Some people argue that we should not trust science because scientists are "always changing their minds." While examples of truly settled science being overturned are far fewer than is sometimes claimed, they do exist. But the beauty of this scientific process is that it explains what might otherwise appear paradoxical: that science produces both novelty and stability. New observations, ideas, interpretations and attempts to reconcile competing claims introduce novelty; transformative interrogation leads to collective decisions and the stability of scientific knowledge. Scientists do change their minds in the face of new evidence, but this is a strength of science, not a weakness.

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Evolution of Scientic Method

Method	Era	Teaching	Automation Need	Social Machinery	Research/ Education
a) Deductive reasoning (Plato) b)Observation and logic (Aristotle)	Platonic/ Aristotelian	Primarily based on authority and regurgitation	Minimal	Plato's Academy Aristotle's Lyceum	Ad Hoc
Experimentation (Descartes)	Cartesian-Mechanistic	Primarily based on instruction	Increased	Universities	Primarily disciplinary
Meta-fusion (systematic knowledge generation)	Combinatorics/ integration	Primarily based on facilitation	An integral part of the method	Integrated universities and polytechs guided by institutes of technosciences in the technopolices of the next century	Primarily Transdisciplinary