Published on *Explorable.com* (https://explorable.com)



# Definition of the Scientific Method

Martyn Shuttleworth, Lyndsay T Wilson83.9K reads

Due the vast number of scientific disciplines and subtypes, it's not easy to whittle down a simple definition of the scientific method. There are a few fundamentals that are common to all, however.



## Scientific Definitions

Various dictionaries and online resources give a strict definition of the scientific method, explaining the scientific process [1] from beginning to end. Whilst these definitions are useful, they can be very specific and give the false impression that science is infallible [2], and that scientists are always right.

Here, we will try to break down some of these barriers and find a more moderate definition of the scientific method.

Consider these dictionary definitions:

> ***"The principles and empirical processes of discovery and demonstration considered characteristic of or necessary for scientific investigation, generally involving the observation of phenomena, the formulation of a hypothesis concerning the phenomena, experimentation to demonstrate the truth or falseness of the hypothesis, and a conclusion that validates or modifies the hypothesis."***
>
> From: answers.com [3]
>
> ***"Sciences: Rigorous, systematic approach, designed to eliminate bias and other subjective influences in the search, identification, and measurement or validation of facts and cause-effect relationships, and from which scientific laws may be deduced."***
>
> From: businessdictionary.com [4]

# The Scientific Method – Not a Holy Grail of Ultimate Proof

The scientific process [1], even amongst many scientists, can sometimes be seen as a holy grail, or as a clean, logical path to achieving absolute and undeniable proof. For this misconception we can thank popular media portrayals of science as the ultimate trump card.

Lawyers and advertisers appropriate the language of science to bolster their claims, and TV shows like CSI glorify the power forensic scientists have to find the truth of the matter and convict the bad guy, no questions asked.

Unfortunately, science in the real world is not quite so glamorous. Good scientists will take great pains to make sure their research [5] is the best it can be, but they are well aware of the inbuilt limitations to their work.

Hollywood encourages the idea that science and scientists are infallible by presenting the scientific process as though it were taking place in a courtroom, where the evidence to convict a criminal must be “beyond reasonable doubt.”

But in science, there is plenty of doubt. Even the most established theory can later be challenged and falsified [2] as part of the scientific process [1].

Another problem with the scientific method is that many disciplines don’t actually follow it, especially social and behavioral sciences and, most notoriously, psychology.

In 2011, the so-called “replication crisis” brought awareness to just how flawed the accumulated body of published scientific research was. One poll found that half the published scientists in *Nature* had failed to replicate any of their own experiments, and 70% had never replicated any other scientist’s experiment. A shocking 2% had admitted to falsifying data and 14% said they knew someone who did.

So, in contrast to the common understanding, experimental research can and is affected by human bias, error, manipulation, and the pressures of the academic world.

## Doubt: The Scientist’s Friend

There is a lot of publicity about the application and authority of the scientific method, taking up many inches of newsprint and thousands of webpages.

For example, creationists attempt to debunk evolution [6] by claiming that it’s an incomplete and flawed theory. And many injustices revolve around the fact that juries took the testimony of 'expert scientific witnesses' to be true beyond question, resulting in heinous consequences for the wrongly accused.

Ultimately, these misapplications of the scientific process reflect back on our own misunderstanding of what it means to do science. The onus is on scientists to explain that they do not deal in absolutes.

The scientific method as a concept is an ideal to strive towards. Real life can be messy though – budgets for experiments can be cut midway, the “publish or perish” dogma can put pressure on the most ethical researcher, and bias can creep in undetected even despite the best intentions.

It is not a problem that science produces conclusions that are shown to be wrong. Refining and updating theory in time is not evidence that the scientific process is not working, but proof that it is. Good research begins with a solid understanding of the logic behind the research, thorough and ego-free consideration of every element of the research design, and patience.

People who are charmed by online “pop science” or TV show content may enjoy the aura of superiority and certainty the scientific process conveys, believing that “it’s science!” is the same as, “I’m right! I win!” But a competent scientist is perfectly able to admit when they are wrong – in fact, they recognize that falsifiability and the ability to refine theories is at the very core of good science.

## The Definition of Pseudoscience

The scientific method is a strict protocol dictating the underlying philosophy behind scientific research. It is not itself a fixed dogma, but a *process* that produces ever-improving models of the world we live in, not to confirm our bias and preconception, but despite those biases.

However, many researchers cannot follow the scientific method exactly, due to the difficulty of defining reliability and validity [7]. Practical limitations are always present. But scientists strive, nevertheless, towards ironing these out over time to arrive at something we feel confident calling reality. The intention is always to tweak at models and theories and work towards only those statements that are supported by solid evidence, even if the steps towards those models are small at first.

A “scientific” claim that is made without the appropriate evidence to back it up, however, is called pseudoscience. Research becomes pseudoscience when it attempts to clothe itself in the legitimacy of scientific rigor without actually subscribing to the scientific method. Pseudoscience can be deliberately deceptive or merely misguided. The problem is presenting statements as 100% true when the methodology doesn’t allow that certainty.

While the border between science and pseudoscience is hotly contested, scientific literacy and high research standards are tools to ensure the quality of any research outcome, regardless of our shifting definitions of science and its methods.

---



**Links**
[1] https://explorable.com/steps-of-the-scientific-method
[2] https://explorable.com/falsifiability
[3] http://www.answers.com/topic/scientific-method
[4] http://www.businessdictionary.com/definition/scientific-method
[5] https://explorable.com/what-is-research
[6] https://explorable.com/when-science-meets-religion
[7] https://explorable.com/validity-and-reliability