

## On the scientific method, scientific process and scientific filter...

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After spending about 20 years in electromagnetic engineering studies, I also got interested in philosophical questions, especially when I face interesting questions in my undergraduate lecture, "Science, Technology & Society" in the Dogus University. During the first couple of weeks of the lecture of each term we discuss questions like

- What is the difference/similarity between
  - a research and scientific research,
  - a method and scientific method,
  - a fact and scientific fact,
  - an answer and scientific answer, etc.?
- What makes science currently more credible than anything else?
- Why is it scientific to speculate about ozone hole in the atmosphere, but not scientific to predict what will happen next year by looking at playing cards, etc.?

We take a dictionary definition of science, discuss some characteristic keywords in detail and try to draw a flowchart related to scientific method, process and filter. A flowchart is pictured in the Figure.

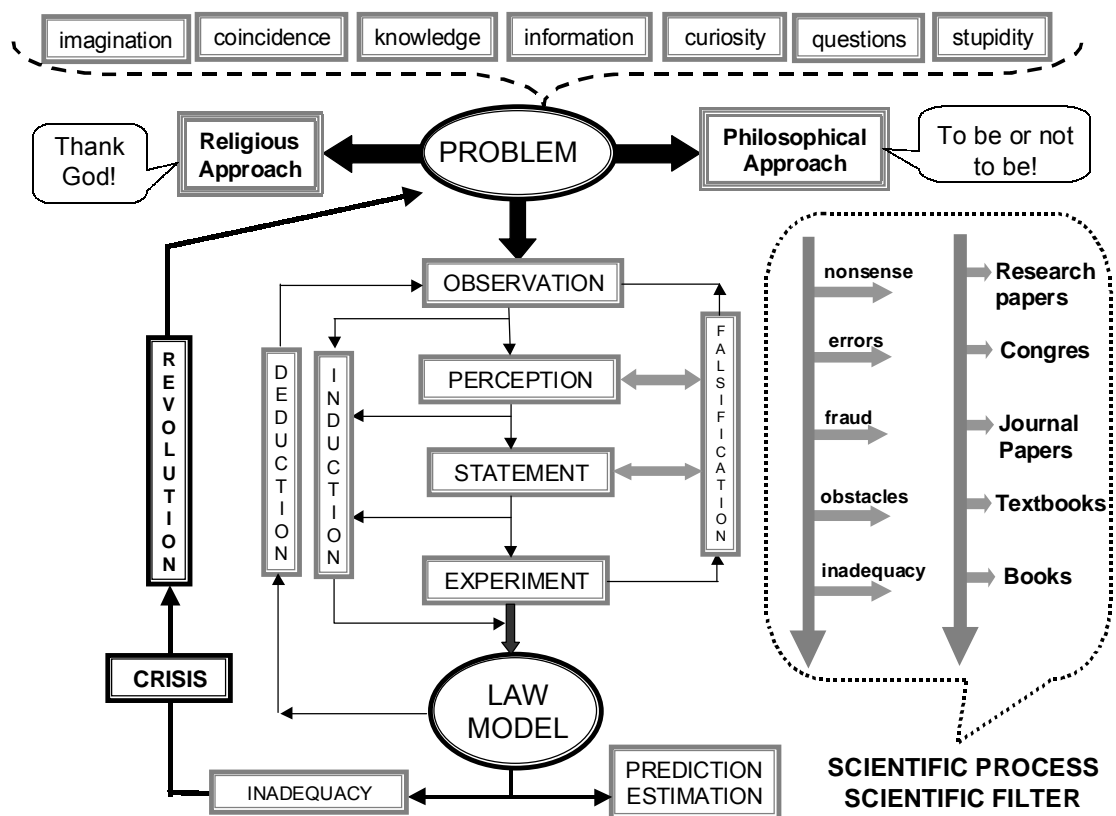


Figure: A flow-chart of scientific process

A dictionary definition of science is "The study through observation and experimentation of the structure and behavior of the physical and natural world and society including a particular area of this such as the science of engineering, medical science, computer science, etc."

How compact, complete and useful this definition is questionable and debatable, but one thing that can not be deniable about science is its specialty in the society, because of its achievements on changing our lives in the past century.

Let's explain the flow chart to initiate a discussion in the IEEE AP community. Related to the physical and natural world including society, science starts with a clear definition of a *problem*, no matter how and where it comes from (the questions, curiosity, imagination, stupid ideas, previous knowledge, chance, etc.) and ends up with general solutions as laws. It deals with studies towards building models to simulate, test and predict behaviors under different parameters, and to estimate future events. Within the historical progress there have been, in general, three different solution approaches; religious approach, philosophical approach and the scientific approach. From the third century BC till XVII - XVII. centuries science had been trapped inside religious and philosophical approaches due to initial efforts of Platon and his student Aristoteles. XVI and XVII centuries are the scientific evolution period, when science freed itself and became independent first with Galileos, Newtons, Bernoullies, Faradays, Clausiuses, and then Ensteins and Feynmans (the aim here is not to discuss and/or criticize religious and philosophical approaches, which are related to believes and thoughts, respectively. They are not the subject of this paper).

Science, scientific study and scientific process start with the definition of the problem, progress with independent, unbiased observations, perceptions, statements, intensive experiments and tests, finally reaching general solutions, after a long period of falsifications, tides, and rephrasing among these steps. In this process, first nonsense, errors, then fraud are eliminated. Obstacles and inadequacies are also discovered during this period. The socialization of the problem and the scientific progress is achieved first by public debate, research proposals, followed by meetings, congress and symposium papers and journal articles, and finally by tutorials, textbooks and books, in a process which is called *scientific filter*. After this process and filtration the solution of a well-defined problem is publicized as a scientific law with its accuracy, resolution and range of validity. Falsification or failure of a law in explaining new phenomena in scientific progress is a serious crisis in science, often results in a revolutionary change and may cause totally re-phrasing (or definition) of the problem.

Let's stop here (for now) by giving two examples. First one is "the apple and Newton" example, which results in one of the fundamental laws and triggers the idea and realization of journey to moon. The other one is the claim of an earthquake prediction model in a region (for example, in Marmara region in Turkey) by just taking the two strong hits in the last 500 years of billions years of Earth's history.

What do you say, isn't it interesting to take a short break (also a deep breath) and think about it?