

The Scientific Method

The Scientific Method has a long history going back to the second millennium. It perhaps got its biggest boost from Alhazen an Arab physicist who was as influential as Newton in many ways. He was born in Basra, now in Iraq, which was a part of Persia at the time. As an Arab he migrated to Cairo. His work on centered on optics, and motion (he developed the idea of momentum). He died around 1039 about 600 years before Newton was born. It was under Alhazen that the first formal scientific experiments were conducted. He has been called "the first scientist."

The Scientific Method requires that propositions be testable and repeatable. An assertion or explanation is phrased as an hypothesis and then that hypothesis is put to the test. Theories are a wider domain consisting of a system of inter-locking hypotheses. The scientific method itself is characterized by observations (measurements), hypotheses (explanations), reasoning (logic), prediction (expectation), testing and assessing the results of the test. Was our hypothesis correct? Did we get it wrong? Should we do more study?

The output of this process will not yield specific answers, a point that many people seeking "Proof" find endlessly frustrating. The scientific process does not give us proof, but rather, a gathering body of knowledge. This accumulating body of knowledge improves prediction. Source of uncertainty are reduced and understood. As Thomas Kuhn pointed out in "The Structure of Scientific Revolutions", theories may change, but the criterion for the establishment of the new theory is that it explains (predicts) that which the earlier theory explained.

Thus, a method for reducing the uncertainty in prediction is one which consistently produces knowledge. Scientific knowing does that. It is not based on 'gut sense', faith, or personal testimony. It is, rather, a set of methods designed to be unbiased and to lead to increasing valid knowledge on a given subject.

It stands to reason then that scientific thinking be a fundamental building block of managers, engineers and other professionals. Unfortunately often it is not. Many, perhaps even most, of those professionals are not taught the scientific method. PhDs graduate from colleges of chemistry, physics and biology without ever having taken a course in the methods of designing a valid experiment.

Worse, the language of statistics, methods that are useful in all decision making by anyone at any stage of life have, until recently, not been taught in secondary schools at all. Very few high schools offer a course in statistics. Where statistics courses are offered they are for advanced student and offered as Advanced Placement (AP) courses for the most part. Students who take years of science, social science and business courses are never taught the fundamental thought process of

making good decisions in a world of uncertainty.

But, making statistics courses a regular part of the math curriculum for all students at both the secondary and middle school levels does not help managers, scientists and citizens who are currently making decisions. Education is needed for adults as well. Understanding the variation that is all around us in life is fundamental to good decision making. That is, every man, woman and child above (say) age 10. Imagine a world where debate is based on statistics on which people agree, rather than the manipulation of data to make a particular political point. Better policy would be the result.

We live not only in a world of variation, but we also live in a human environment where political forces come into play. People use data to convince other people of the rightness of their arguments. Also, as all of us have often encountered, people mis-use data for the same purpose. Cynical voices talk about 'lies, damned lies, and statistics', but in fact the rules of statistics are quite clear and people educated, even in a rudimentary fashion, in those rules will recognize invalid statements about data and disregard them. Knowledge of statistics reveals the abuse of numbers and measurements.

A person educated in the logic of statistical thinking would also recognize extravagant and invalid claims made by merchants in their advertising. Many advertisements, particularly on television, are intentionally deceptive or misleading. But the educated consumer of these ads can easily see through the incomplete or mis-interpreted data or the excessive but unsubstantiated claims. The monetary benefit of better decision making on the part of the buying public cannot be measured, but one can easily see that the social benefit would be huge.