What is Science?

Dr. Syed Arif Kamal

Department of Mathematics, University of Karachi, Karachi 75270, Pakistan

Homepage: https://www.ngds-ku.org/kamal• *e-mail*: profdrakamal@gmail.com

Science and its study occupy most important part in today's education. But how many people know what really science is and what is not. Can science answer all of the questions faced by the mankind? Certainly science has its limitations. It can only deal with what can be observed or felt. It cannot male value judgments. There are also limitations of time to find the answer as well as lack of absolute certainty in the answers. Even well-accepted theories have a dead end somewhere. Consider big bang theory of creation of the universe. What was there before the big bang? How was there such huge energy concentrated in a small volume? These questions and others shall continue to haunt the mind of the inquiring and the seeker of the truth.

Time and again persons from outside the mainstream of science claim that they have made a breakthrough. They seem to have proved one of the established theories to be false. Are they always wrong? Beware that people who did not hold a degree in physics made some of the major contributions in Physics. Eugene P. Wigner, a *Nobel Laureate* in Physics and contributor in nuclear, particle and solid-state physics held an engineering degree. Can anyone overlook his contributions in physics? What should, then, be the criterion to judge a theory to be seriously considered? Let us find out if there are some established rules to seriously consider a theory. To do so we must first determine what science really is all about.

One of the schools of thought claims that all scientific studies start with doubts and conflicts. Somewhere along a line a conflict starts between a *theory* and the available *observations*. A theorist tries to understand nature and builds an idea (*hypothesis*) on the basis of available knowledge and then suggests to an observer to look for certain predictions. Examples of a few hypotheses are**:**

- Heavier bodies fall towards earth with larger acceleration.
- Moon does not have its own light but glows because of the reflection from sun.

The following are *not* scientific hypotheses (why?)**:**

- Arshad is a good boy.
- War is bad for mankind.
- The reward for paying in congregation is twenty-five times as compared to praying individually.

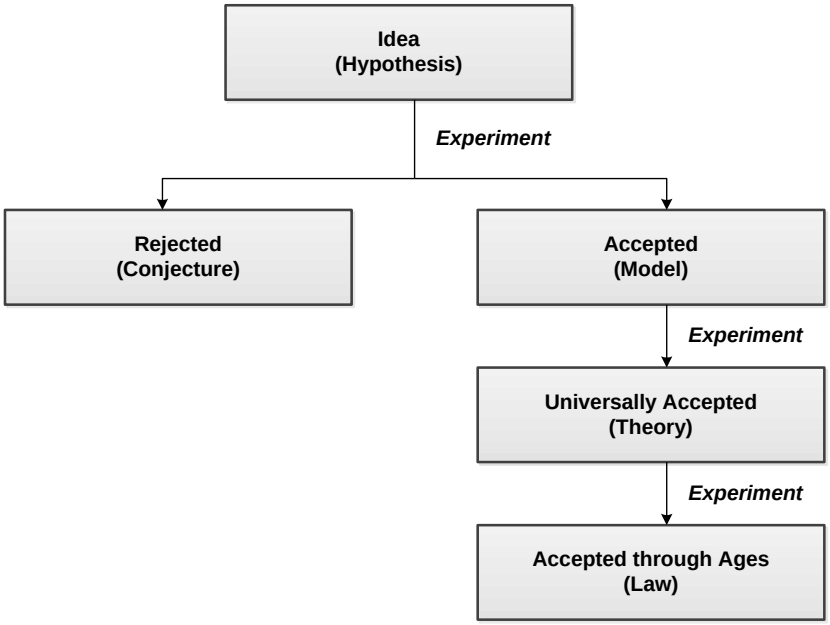

Fig. 1. Development of a scientific theory

An observer, then goes out and sees if the theorist's idea is true. If an idea matches the reality becomes a *model* of the real world (Fig. 1). If an idea does not match with the real world it becomes a *conjecture.* If an idea becomes a model many people along the globe check this idea in different circumstances.

If the idea matches the real world in all situations it becomes a *theory.* For example, it took 12 years (1967-1979) for the model of electroweak interaction to become the Glashow-Weinberg-Salam Theory. If a theory predicts correctly and it can be found on a larger time scale then it becomes a *natural law.* Examples may be cited from classical mechanics. Everyone is familiar with the 'Newton's Laws of Motion' and the 'Law of Universal Gravitation'. It implies that a natural law depends on the available information of the physical world and the basic axioms of the mathematics used. A theorist goes on modeling in this way and always works for a better understanding of the natural world. There is always a possibility of change in basic physical information or in the basic axioms of mathematics. Whenever this happens a theorist searches for a new idea to revolutionize the understanding of the real world.

In the next article, we shall see basics of the *scientific method*. Children must be taught to think scientifically. The logic of science is not automatically built in the human mind. It must be inculcated. To see this point ask ten children of class five or six the following question:

Drop two balls. One directly towards the ground; the other given a small horizontal velocity. Which of the balls reaches the ground first?

One would be surprised to learn that most of the children give the answer: *The first ball reaches the ground earlier.* Their perception is that the first ball travels a shorter distance.

Next, ask them to perform the actual experiment. They will, immediately, realize that their answers were incorrect. Both the balls would reach the ground at the same time because the *downward velocity is independent of the horizontal velocity*. Children must be taught science in such a way to develop qualities of creative thinking and critical analysis, which are essential for a student of science. Creative thinking may be developed if the students are encouraged to develop alternative explanations of the topics discussed in the class and persuaded to check the validity of their assumptions. The students can, critically, analyze a situation if they have a thorough understanding of the principles involved. Critical analyses also require an awareness of the validity and the limitations of assumptions made for the solution of a problem.

Web address of this document (*author's homepage*)**:** https**:**//www.ngds-ku.org/Articles/A15.pdf
*HTML version***:** https**:**//www.ngds-ku.org/drak_articles/dra1.htm