Scientific Elements

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Whilst there can be slight variations between the exact structure and type of study between the various scientific disciplines, there are certain key scientific elements that all must possess to some degree.

These elements have evolved over the centuries, and they have become accepted by both scientists and philosophers of science as sound basic principles.

Observations and Review

The initial scientific element is to evaluate and observe possible subjects for experiment [1].

This can be through direct observation or by reviewing literature [2], and other sources, building upon earlier research.

For example, Thomson knew a little about the properties of 'cathode rays [3]', but wanted to delve further. Darwin's observation of Galapagos Finches [4] led to his groundbreaking theory and further investigation by later scientists.

Hypothesis

Ideally, any research must begin with a testable hypothesis [5], which can be proved or

disproved.

This hypothesis [6] should be realistic and consider the technology and methods available. Generating a hypothesis should involve looking for the simplest possible explanation for a natural occurrence or phenomena.

Despite the slight differences between the various research techniques, this is the most fundamental of the scientific elements [7].

All scientific methods rely on a hypothesis as the main underlying principle and tool for establishing recognized proofs.

Predictions

This stage is where a researcher attempts to predict the expected results [8] of their experiment [1].

The prediction should be an extension of the hypothesis and express a degree of opinion about what the findings should uncover.

Ideally, the prediction should also set out ways in which the results can be analyzed and tested statistically [9].

Experiment and Measurement

True science requires some type of numerical measurement, which provides quantifiable and analyzable data.

This analysis takes into account the uncertainty and inherent errors [10] built into any scientific methodology.

This is the final stage because, if the experiment has been well constructed, a valid answer will have been generated. Using the basic scientific elements ensures that usable knowledge about a process emerges from the initial observations of phenomena.

Whether the prediction is proved or not, further experiments feed back into this process, by refining the initial hypothesis or by generating more accurate predictions.

Variations

There are many variations on these elements, covering the broad range of science, with this rigid structure tending to be more strongly adhered to by life and natural sciences.

Social sciences may place more emphasis upon the observation and prediction stage, whilst physicists may observe and predict without experimental proof, relying upon pure mathematics to provide answers.

However, all science relies upon this basic formula for theory and hypothesis to be accepted as ultimate proof, separating science from pure philosophy.

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