Theory of Everything

Summary

http://quantumspotacademy.org/videos/theory-of-everything/

A theory of everything is a single theory that explains all of our experiences. The idea that all of the complexity in the world can be reduced to simple, underlying foundations is called reductionism. The way in which the complexity of our world emerges from simple underlying laws is called emergence.

In physics, a theory is a tool we can use to make predictions. We test our theories by performing experiments. If an experiment matches a theory's predictions, that does not necessarily mean that the theory is true. It is always possible that future experiments will prove the theory to be false. However, by performing many diverse experiments, we can become very confident in a theory's accuracy.

In addition to being accurate, a theory of everything must explain every single observed phenomenon. Towards this end, physicists unify specialized theories into more general ones. Many physicists desire to find a theory of everything that is simple and elegant. A theory of everything will not be a philosophical statement about the universe.

A current theory that is very close to being a theory of everything is the Standard Model of particle physics, which describes the properties and interactions of the fundamental particles making up everything we see. A theory of everything will unify the Standard Model with our current theory of gravity, General Relativity, in addition to explaining the mysterious nature of dark energy and dark matter.

A leading contender for a theory of everything is String Theory, which postulates that the fundamental particles are composed of tiny vibrating strings. String Theory also predicts the existence of extra spatial dimensions, which some physicists aren't prepared to accept. The theory's mathematics are very difficult to analyze and there are several different versions of String Theory. String Theory currently does not make any testable predictions. Another contender for a theory of everything is loop quantum gravity, which postulates that space and time are composed of a discrete network.

The precision of a theory of everything would be a major hinderance in modeling very complex phenomena because the computational power required would be enormous; we need to develop approximate models to describe those phenomena.