Essential vocabulary of academic culture

Theories and laws

In science and other academic fields, when we refer to something as a theory (e.g., "Theory A, X Theory, the theory of Y"), we do not mean theory in the sense of conjecture, guess, or something that has not been proven (which is the colloquial meaning of 'theory'). A theory is not necessarily something that is not true, or that is not yet proven. Many times we work with theories that are considered proven, true, and scientific fact (especially in the sciences and social sciences). It is not true that a theory is unproven, and becomes a "law" after being proven true.

Theory

Definition	A theory is an explanatory conceptual framework, that is, a complex concept that is designed to explain something.
Character-istics	A theory may consist of several components, propositions, or even laws, which together form a coherent concept that explains something. In the pure sciences, many theories have been proven true. For other theories, scientists are in the process of trying to verify or disprove them. In the humanities or social sciences, one may use a certain theory simply because it scholars find it useful for analyzing things (e.g., in literature, poetry, music), without necessarily trying to prove it first.
Examples	The theory of evolution consists of several components or propositions, e.g.: [1] living organisms have descended with modifications from species that lived before them [2] Changes arise through genetic mutation (change); [3] Successful traits allow members of a species to better adapt to their environments, and [4] these successful traits are passed down to descendants (natural selection). This theory has been proven and accepted as scientific fact. The special theory of relativity deals with how matter and energy are related; the special theory of relativity explains the relationship between space and time, including gravity. Both have been proven and accepted as factual. String theory in physics attempts to go beyond the Standard Model better explain the various types of matter (particles) and forces in the universe. Scientists are attempting to verify several different forms of string theory; it may be many decades before any one form of string theory is confirmed. Inflation theory attempts to explain how the Big Bang happened; cosmologists and astrophysicists are currently trying to verify it.

In linguistics, different theories exist regarding the syntax (abstract grammatical structure) of human languages; how humans learn a first language (as children); how humans learn a second language as adults; or how we interpret language in real contexts. Most of these have not yet been "proven," but linguists use them as useful tools for research and analysis.

Law

Definition	A single, simple statement, that is universal (always or generally true).
Characteristics	A law can be in the form of a formula or equation (as in physics), or a single sentence-like statement. It is generally true, at least for its intended domain. For example, Newton never thought about black holes or traveling at light speed when he formulated his laws of motion; his laws apply to the "normal" world. In the social sciences and humanities, the term 'law' may be used more loosely for something that is generally true (though maybe not always).
Examples	Newton's law of gravity; this is always true in the "normal" world or universe. Likewise, Newton's laws of motion (such as F=ma) always hold true in the "normal" world. $F = G\frac{m_1 m_2}{r^2}$ Various other laws in physics and chemistry: the laws of thermodynamics, Ohm's Law, Kirchoff's Law, Coulomb's Law, Avrogado's Law, Boyle's Law, law of conservation of mass, law of conservation of energy, Dalton's Law, Faraday's Law, ideal gas law (PV=nRT), and many others. Economics laws, e.g., laws of supply and demand, Hotelling's Law, laws of returns (diminishing returns, increasing returns) If it is not always true, or has not quite been proven, other terms may be used such as 'rule', e.g., L'Hôpital's rule in calculus.

Model

Definition	A description of some complex phenomena, but not a complete explanation or theory.
Characteristics	This term may be used differently in different fields, but a model generally attempts to describe complex relationships or phenomena, by [1] organizing and categorizing things, or [2] by providing a simplified representation, e.g., in the form of a graphical model or a metaphorical description.
Examples	In physics, the Standard Model of quantum physics describes the relationships and categories among the various forces, particles and parameters that make up the universe. It is an incomplete description (e.g., gravity and dark matter are not included), and does not fully explain why things are they way they are. Various models are used in psychology to explain how human behavior or human cognition work. Those in research psychology or counseling psychology find them useful frameworks for their work (without necessarily trying to prove them).

Hypothesis

Definition	A proposed explanation, that consists of a single statement.
Character-istics	A hypothesis consists of one specific statement, which can be tested and thereby confirmed or disconfirmed (disproven). It is often a prediction from an existing theory or model about a specific case or phenomenon, e.g., theory X predicts that Y should happen is situation Z. Scholars and scientists often work within an existing theory that they accept, or want to prove. In an accepted theory, one wants to see what happens in a specific case; theory X leads to some prediction for situation Z (theory X predicts that in situation Z, Y should happen). In other cases, people want to prove theory X by testing various hypotheses that come from theory X for situations B, C, D... Occasionally, one might develop and test hypotheses, and from those, construct a new theory. Most academic and scientific research, though, is about applying or extending an existing theory through hypothesis testing, or doing hypothesis testing to prove an unconfirmed theory.
Examples	The Standard Model in physics predicted the existence of a particle (the Higgs boson) that is responsible for mass; this particle was discovered in 2012. Evolutionary theory leads to many hypotheses about how particular animals have developed, and much evidence in the fossil record confirms this. Evolutionary theory also leads to predictions about patterns that we would expect to see in the human genome (DNA), and in fact, the strongest evidence for evolution comes from genetics. Inflation theory (in cosmology) predicts that certain patterns should be seen in the cosmic background radiation (CMB) that reflect how the Big Bang happened; these are currently being tests. Particular linguistic theories predict that children will learn their first language in certain ways but not others, and many of these hypotheses have been confirmed by studying how children's language abilities develop.