THEORY VERSUS SCIENTIFIC FACT pdf

1: Scientific theory - Wikipedia

Fact vs Theory. The terms fact and theory are words with different meanings. Although both are used in many different fields of studies, they still manage to have their own distinct definitions that separate one from the other.

This section does not cite any sources. Please help improve this section by adding citations to reliable sources. Unsourced material may be challenged and removed. October Learn how and when to remove this template message Typically for any theory to be accepted within most academia there is one simple criterion. The essential criterion is that the theory must be observable and repeatable. The aforementioned criterion is essential to prevent fraud and perpetuate science itself. The tectonic plates of the world were mapped in the second half of the 20th century. Plate tectonic theory successfully explains numerous observations about the Earth, including the distribution of earthquakes, mountains, continents, and oceans. The defining characteristic of all scientific knowledge, including theories, is the ability to make falsifiable or testable predictions. The relevance and specificity of those predictions determine how potentially useful the theory is. A would-be theory that makes no observable predictions is not a scientific theory at all. Predictions not sufficiently specific to be tested are similarly not useful. In both cases, the term "theory" is not applicable. A body of descriptions of knowledge can be called a theory if it fulfills the following criteria: It makes falsifiable predictions with consistent accuracy across a broad area of scientific inquiry such as mechanics. It is well-supported by many independent strands of evidence, rather than a single foundation. It is consistent with preexisting experimental results and at least as accurate in its predictions as are any preexisting theories. Other criteria[edit] In addition, scientists prefer to work with a theory that meets the following qualities: It can be subjected to minor adaptations to account for new data that do not fit it perfectly, as they are discovered, thus increasing its predictive capability over time. This is because for each accepted explanation of a phenomenon, there may be an extremely large, perhaps even incomprehensible, number of possible and more complex alternatives, because one can always burden failing explanations with ad hoc hypotheses to prevent them from being falsified; therefore, simpler theories are preferable to more complex ones because they are more testable. The formal scientific definition of theory is quite different from the everyday meaning of the word. It refers to a comprehensive explanation of some aspect of nature that is supported by a vast body of evidence. Many scientific theories are so well established that no new evidence is likely to alter them substantially. For example, no new evidence will demonstrate that the Earth does not orbit around the sun heliocentric theory , or that living things are not made of cells cell theory , that matter is not composed of atoms, or that the surface of the Earth is not divided into solid plates that have moved over geological timescales the theory of plate tectonics One of the most useful properties of scientific theories is that they can be used to make predictions about natural events or phenomena that have not yet been observed. A scientific theory is a well-substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment. Such fact-supported theories are not "guesses" but reliable accounts of the real world. The theory of biological evolution is more than "just a theory". It is as factual an explanation of the universe as the atomic theory of matter or the germ theory of disease. Our understanding of gravity is still a work in progress. But the phenomenon of gravity, like evolution, is an accepted fact. Note that the term theory would not be appropriate for describing untested but intricate hypotheses or even scientific models. The first observation of cells , by Robert Hooke , using an early microscope. The scientific method involves the proposal and testing of hypotheses , by deriving predictions from the hypotheses about the results of future experiments, then performing those experiments to see whether the predictions are valid. This provides evidence either for or against the hypothesis. When enough experimental results have been gathered in a particular area of inquiry, scientists may propose an explanatory framework that accounts for as many of these as possible. This explanation is also tested, and if it fulfills the necessary criteria see above , then the explanation becomes a theory. This can take many years, as it can be difficult or complicated to gather sufficient evidence. Once all of the criteria have been met, it will be widely accepted by scientists see scientific consensus as the best available explanation of at least some phenomena. It will have made predictions of phenomena that previous theories could not explain or could not predict accurately, and it will have resisted attempts at falsification. The strength of the evidence is evaluated by the scientific community, and the most important experiments will have been replicated by multiple independent groups. Theories do not have to be perfectly accurate to be scientifically useful. For example, the predictions made by classical mechanics are known to be inaccurate in the relatistivic realm, but they are almost exactly correct at the comparatively low velocities of common human experience. For example, certain tests may be unfeasible or technically difficult. As a result, theories may make predictions that have not yet been confirmed or proven incorrect; in this case, the predicted results may be described informally with the term "theoretical". These predictions can be tested at a later time, and if they are incorrect, this may lead to the revision or rejection of the theory. A search for potential improvements to the theory then begins. Since each new version of a theory or a completely new theory must have more predictive and explanatory power than the last, scientific knowledge consistently becomes more accurate over time. If modifications to the theory or other explanations seem to be insufficient to account for the new results, then a new theory may be required. Since scientific knowledge is usually durable, this occurs much less commonly than modification. This is because it is still the best available explanation for many other phenomena, as verified by its predictive power in other contexts. For example, it has been known since that the observed perihelion precession of Mercury violates Newtonian mechanics, [19] but the theory remained the best explanation available until relativity was supported by sufficient evidence. Also, while new theories may be proposed by a single person or by many, the cycle of modifications eventually incorporates contributions from many different scientists. If a theory does not require modification despite repeated tests, this implies that the theory is very accurate. This also means that accepted theories continue to accumulate evidence over time, and the length of time that a theory or any of its principles remains accepted often indicates the strength of its supporting evidence. Unification[edit] In quantum mechanics , the electrons of an atom occupy orbitals around the nucleus. This image shows the orbitals of a hydrogen atom s, p, d at three different energy levels 1, 2, 3. Brighter areas correspond to higher probability density. In some cases, two or more theories may be replaced by a single theory that explains the previous theories as approximations or special cases, analogous to the way a theory is a unifying explanation for many confirmed hypotheses; this is referred to as unification of theories. For example, physical theories in the 19th century implied that the Sun could not have been burning long enough to allow certain geological changes as well as the evolution of life. This was resolved by the discovery of nuclear fusion , the main energy source of the Sun. For example, atomic theory is an approximation of quantum mechanics. Current theories describe three separate fundamental phenomena of which all other theories are approximations; [24] the potential unification of these is sometimes called the Theory of Everything. Relativity[edit] In , Albert Einstein published the principle of special relativity , which soon became a theory. An elegant theory, special relativity yielded its own consequences, [27] such as the equivalence of mass and energy transforming into one another and the resolution of the paradox that an excitation of the electromagnetic field could be viewed in one reference frame as electricity, but in another as magnetism. Einstein sought to generalize the invariance principle to all reference frames, whether inertial or accelerating. Even massless energy exerts gravitational motion on local objects by "curving" the geometrical "surface" of 4D space-time. Yet unless the energy is vast, its relativistic effects of contracting space and slowing time are negligible when merely predicting motion. Scientific law Both scientific laws and scientific theories are produced from the scientific method through the formation and testing of hypotheses, and can predict the behavior of the natural world. Theories are supported by evidence from many different sources, and may contain one or several laws. A theory does not change into a scientific law with the accumulation of new or better evidence. A theory will always remain a theory; a law will always remain a law. Unlike hypotheses, theories and laws may be simply referred to as scientific fact. First-order logic is an example of a formal language. The logical positivists envisaged a similar scientific language. In addition to scientific theories, the language also included observation sentences "the sun rises in the east" , definitions, and mathematical statements. The phenomena explained by the theories, if they could not be directly observed by the senses for example, atoms and radio waves , were treated as theoretical concepts. In this view, theories function as axioms: However, the predictions are then tested against reality to verify the theories, and the "axioms" can be revised as a direct result. The phrase " the received view of theories " is used to describe this approach. Terms commonly associated with it are " linguistic " because theories are components of a language and " syntactic " because a language has rules about how symbols can be strung together. Problems in defining this kind of language precisely, e. Theories as models[edit] Main article: Scientific model The semantic view of theories , which identifies scientific theories with models rather than propositions , has replaced the received view as the dominant position in theory formulation in the philosophy of science. One can use language to describe a model; however, the theory is the model or a collection of similar models , and not the description of the model. A model of the solar system, for example, might consist of abstract objects that represent the sun and the planets. These objects have associated properties, e. The model parameters, e. The word " semantic " refers to the way that a model represents the real world. The representation literally, "re-presentation" describes particular aspects of a phenomenon or the manner of interaction among a set of phenomena. For instance, a scale model of a house or of a solar system is clearly not an actual house or an actual solar system; the aspects of an actual house or an actual solar system represented in a scale model are, only in certain limited ways, representative of the actual entity. A scale model of a house is not a house; but to someone who wants to learn about houses, analogous to a scientist who wants to understand reality, a sufficiently detailed scale model may suffice. Differences between theory and model[edit] Main article: Conceptual model Several commentators [45] have stated that the distinguishing characteristic of theories is that they are explanatory as well as descriptive, while models are only descriptive although still predictive in a more limited sense. Philosopher Stephen Pepper also distinguished between theories and models, and said in that general models and theories are predicated on a "root" metaphor that constrains how scientists theorize and model a phenomenon and thus arrive at testable hypotheses. Engineering practice makes a distinction between "mathematical models" and "physical models"; the cost of fabricating a physical model can be minimized by first creating a mathematical model using a computer software package, such as a computer aided design tool. The component parts are each themselves modelled, and the fabrication tolerances are specified. An exploded view drawing is used to lay out the fabrication sequence. Simulation packages for displaying each of the subassemblies allow the parts to be rotated, magnified, in realistic detail.

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2: Difference between Fact and Theory | Difference Between

Definitions of Fact, Theory, and Law in Scientific Work These definitions correspond to the way scientists typically use these terms in the context of their work. Note, especially, that the meaning of "theory" in science is different than the meaning of "theory" in everyday conversation.

These scientific words get bandied about regularly, yet the general public usually gets their meaning wrong. Now, one scientist is arguing that people should do away with these misunderstood words altogether and replace them with the word "model. It means we need better scientific education. Hypothesis The general public so widely misuses the words hypothesis , theory and law that scientists should stop using these terms, writes physicist Rhett Allain of Southeastern Louisiana University, in a blog post on Wired Science. A hypothesis is a proposed explanation for something that can actually be tested. Climate-change deniers and creationists have deployed the word "theory" to cast doubt on climate change and evolution. Part of the problem is that the word "theory" means something very different in lay language than it does in science: A scientific theory is an explanation of some aspect of the natural world that has been substantiated through repeated experiments or testing. The word not only refers to toy cars and runway walkers, but also means different things in different scientific fields. A climate model is very different from a mathematical model, for instance. It has an appearance of solidity in physics right now mainly because of the Standard Model. Instead, true skeptics are open to scientific evidence and are willing to evenly assess it. Genes may influence human beings, but so, too, do epigenetic changes. These modifications alter which genes get turned on, and are both heritable and easily influenced by the environment. The environment that shapes human behavior can be anything from the chemicals a fetus is exposed to in the womb to the block a person grew up on to the type of food they ate as a child, Kruger said. All these factors interact in a messy, unpredictable way. Does it mean statistically significant, or does it mean important? In statistics, something is significant if a difference is unlikely to be due to random chance. But that may not translate into a meaningful difference, in, say, headache symptoms or IQ. Natural "Natural" is another bugaboo for scientists. The term has become synonymous with being virtuous, healthy or good. While organic simply means "carbon-based" to scientists, the term is now used to describe pesticide-free peaches and high-end cotton sheets, as well.

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3: 5 facts about evolution and religion | Pew Research Center

Words like "fact," "theory," and "law," get thrown around a lot. When it comes to science, however, they mean something very specific; and knowing the difference between them can help.

Consciousness, intelligence and thoughts are not an accident. Sight, hearing, taste, smell and feeling are not accidents. Cell division into different components of plants and animals is not an accident. Acid rain was pre-planned and has purpose. Climate of the earth is not an accident. Rapid decay of radioactive isotopes at the time of the flood and the time of creation proves that the earth is young. The complexity of cells and DNA molecules is not an accident. The moon is not an accident. The Ten Commandments are valid guidelines for conduct. And so, in the argument of creation vs. For this reason, it seems that those who believe in creation are happier, have more stable marriages, live longer and healthier and have much less conflict in their lives. Intelligent people know that the universe was created by an infinitely intelligent being, but many fail to realize that Jesus Christ rose from the dead, proving that He is the Messiah and the only way to get to heaven. And so, they embrace false religions and still fail to please the Infinite Holy Creator. This same Nebo-Sarsekim is mentioned in Jeremiah The unbelievable concept of Big Bang is disproved and the fact that all attempts to change one species into another have failed. The theory of evolution is not credible and has no scientific basis. The theory that the universe is not an accident and was created by Intelligent Design is based on sound science. Evolution should not be taught in schools as a fact, but only that no proof of evolution change of species has yet been discovered. Intelligent Design should be taught in all schools, not as religion, but by all the scientific facts that confirm it. In the battle of creation vs. It is up to evolutionists to disprove any of the many scientificclaims that are known about Intelligent Design. Subjects that should be topics of discussion in creation vs. At the same time, why were these fruits and vegetables absolutely essential for the lives of the animals? Was that also an accident? Ask our teachers to please explain. Evolution in Secular Schools In creation vs. How many billions of years it would take for each to develop by accident and how could everything that exists possibly exist with all components and functioning organs operating simultaneously while these components accidentally came into existence millions of years apart? In the meantime; where is the fossil evidence? For teachers to teach these things, they surely must know the answers or should not be allowed to teach it. In credibility of creation vs. These can be changes in size, shape or colour of any parts of the plant or animal, but it never has and never will change one species into another species. Evolutionists claim the change in species comes from mutations. Somewhere around millions of laboratory mutations by evolutionists have failed to produce a single change of species. These mutations have only produced freaks like extra legs or missing legs or organs. The offspring of these freaks either vanish or return back to the original species. All plants and animals reproduce after their own kind, as the Bible says in Genesis 1: Copyright C Robert L.

4: Definitions of Fact, Theory, and Law in Scientific Work | NCSE

According to the theory of science you cannot prove a theory finally, but you can disprove a theory if you have a better one, a theory with a higher grade of evidence. Creationism was the theory.

Advertisement In Brief Despite definitive legal cases that have established the unconstitutionality of teaching intelligent design or creationist ideology in science class, the theory of evolution remains consistently under attack. Creationist arguments are notoriously errant or based on a misunderstanding of evolutionary science and evidence. Hundreds of studies verify the facts of evolution, at both the microevolutionary and macroevolutionary scaleâ€"from the origin of new traits and new species to the underpinnings of the complexity we see in life and the statistical probability of such complexity arising. Today that battle has been won everywhereâ€"except in the public imagination. Embarrassingly, in the 21st century, in the most scientifically advanced nation the world has ever known, creationists can still persuade politicians, judges and ordinary citizens that evolution is a flawed, poorly supported fantasy. When this article first went to press in , the Ohio Board of Education was debating whether to mandate such a change. Prominent antievolutionists of the day, such as Philip E. The good news is that in the landmark legal case Kitzmiller v. Dover in Harrisburg, Pa. The bad news is that in response, creationists have reinvented their movement and pressed on. Consequently, besieged teachers and others are still likely to find themselves on the spot to defend evolution and refute creationism, by whatever name. Nevertheless, even if their objections are flimsy, the number and diversity of the objections can put even well-informed people at a disadvantage. It also directs readers to further sources for information and explains why creation science has no place in the classroom. These answers by themselves probably will not change the minds of those set against evolution. But they may help inform those who are genuinely open to argument, and they can aid anyone who wants to engage constructively in this important struggle for the scientific integrity of our civilization. Evolution is only a theory. It is not a fact or a scientific law. Many people learned in elementary school that a theory falls in the middle of a hierarchy of certaintyâ€"above a mere hypothesis but below a law. Scientists do not use the terms that way, however. So when scientists talk about the theory of evolutionâ€"or the atomic theory or the theory of relativity, for that matterâ€"they are not expressing reservations about its truth. In addition to the theory of evolution, meaning the idea of descent with modification, one may also speak of the fact of evolution. Although no one observed those transformations, the indirect evidence is clear, unambiguous and compelling. All sciences frequently rely on indirect evidence. Physicists cannot see subatomic particles directly, for instance, so they verify their existence by watching for telltale tracks that the particles leave in cloud chambers. Natural selection is based on circular reasoning: That is, rather than labeling species as more or less fit, one can describe how many offspring they are likely to leave under given circumstances. Drop a fast-breeding pair of small-beaked finches and a slower-breeding pair of large-beaked finches onto an island full of food seeds. Within a few generations the fast breeders may control more of the food resources. Yet if large beaks more easily crush seeds, the advantage may tip to the slow breeders. In pioneering studies of finches on the Galpagos Islands, Peter Grant and Rosemary Grant of Princeton University observed these kinds of population shifts in the wild. The key is that adaptive fitness can be defined without reference to survival: Evolution is unscientific because it is not testable or falsifiable. It makes claims about events that were not observed and can never be re-created. This blanket dismissal of evolution ignores important distinctions that divide the field into at least two broad areas: Microevolution looks at changes within species over timeâ€"changes that may be preludes to speciation, the origin of new species. Macroevolution studies how taxonomic groups above the level of species change. Its evidence draws frequently from the fossil record and DNA comparisons to reconstruct how various organisms may be related. Natural selection and other mechanismsâ€"such as chromosomal changes, symbiosis and hybridizationâ€"can drive profound changes in populations over time. The historical nature of macroevolutionary study involves inference from fossils and DNA rather than direct observation. Yet in the historical sciences which include astronomy, geology and archaeology, as well as evolutionary biology , hypotheses can still be tested by checking whether they accord with physical evidence and whether they lead to verifiable predictions about future discoveries. For instance, evolution implies that between the earliest known ancestors of humans roughly five million years old and the appearance of anatomically modern humans about , years ago , one should find a succession of hominin creatures with features progressively less apelike and more modern, which is indeed what the fossil record shows. But one should notâ€”and does notâ€”find modern human fossils embedded in strata from the Jurassic period 65 million years ago. Evolutionary biology routinely makes predictions far more refined and precise than this, and researchers test them constantly. Evolution could be disproved in other ways, too. If we could document the spontaneous generation of just one complex life-form from inanimate matter, then at least a few creatures seen in the fossil record might have originated this way. If superintelligent aliens appeared and claimed credit for creating life on Earth or even particular species , the purely evolutionary explanation would be cast in doubt. But no one has yet produced such evidence. It should be noted that the idea of falsifiability as the defining characteristic of science originated with philosopher Karl Popper in the s. More recent elaborations on his thinking have expanded the narrowest interpretation of his principle precisely because it would eliminate too many branches of clearly scientific endeavor. Increasingly, scientists doubt the truth of evolution. No evidence suggests that evolution is losing adherents. Pick up any issue of a peer-reviewed biological journal, and you will find articles that support and extend evolutionary studies or that embrace evolution as a fundamental concept. Conversely, serious scientific publications disputing evolution are all but nonexistent. In the mids George W. Gilchrist, then at the University of Washington, surveyed thousands of journals in the primary literature, seeking articles on intelligent design or creation science. Among those hundreds of thousands of scientific reports, he found none. Krauss, now at Arizona State University, were similarly fruitless. Creationists retort that a closed-minded scientific community rejects their evidence. Yet according to the editors of Nature, Science and other leading journals, few antievolution manuscripts are even submitted. Some antievolution authors have published papers in serious journals. Those papers, however, rarely attack evolution directly or advance creationist arguments; at best, they identify certain evolutionary problems as unsolved and difficult which no one disputes. In short, creationists are not giving the scientific world good reason to take them seriously. The disagreements among even evolutionary biologists show how little solid science supports evolution. Evolutionary biologists passionately debate diverse topics: These disputes are like those found in all other branches of science. Acceptance of evolution as a factual occurrence and a guiding principle is nonetheless universal in biology. Anyone acquainted with the works of paleontologist Stephen Jay Gould of Harvard University knows that in addition to co-authoring the punctuated-equilibrium model, Gould was one of the most eloquent defenders and articulators of evolution. Punctuated equilibrium explains patterns in the fossil record by suggesting that most evolutionary changes occur within geologically brief intervalsâ€”which may nonetheless amount to hundreds of generations. When confronted with a quotation from a scientific authority that seems to question evolution, insist on seeing the statement in context. Almost invariably, the attack on evolution will prove illusory. If humans descended from monkeys, why are there still monkeys? This surprisingly common argument reflects several levels of ignorance about evolution. The first mistake is that evolution does not teach that humans descended from monkeys; it states that both have a common ancestor. The parent species may survive indefinitely thereafter, or it may become extinct. Evolution cannot explain how life first appeared on Earth. The origin of life remains very much a mystery, but biochemists have learned about how primitive nucleic acids, amino acids and other building blocks of life could have formed and organized themselves into self-replicating, self-sustaining units, laying the foundation for cellular biochemistry. Astrochemical analyses hint that quantities of these compounds might have originated in space and fallen to Earth in comets, a scenario that may solve the problem of how those constituents arose under the conditions that prevailed when our planet was young. But even if life on Earth turned out to have a nonevolutionary origin for instance, if aliens introduced the first cells billions of years ago , evolution since then would be robustly confirmed by countless microevolutionary and macroevolutionary studies. Mathematically, it is inconceivable that anything as complex as a protein, let alone a living cell or a human, could spring up by chance. Chance plays a part in evolution for example, in the random mutations that can give rise to new traits , but evolution does not depend on chance to create organisms, proteins or other entities. As long as the forces of selection stay constant, natural selection can push evolution in one direction and produce sophisticated structures in surprisingly short times. On average, the program re-created the phrase in just iterations, less than 90 seconds. The Second Law of Thermodynamics says that systems must become more disordered over time. Living cells therefore could not have evolved from inanimate chemicals, and multicellular life could not have evolved from protozoa. This argument derives from a misunderstanding of the Second Law. If it were valid, mineral crystals and snowflakes would also be impossible, because they, too, are complex structures that form spontaneously from disordered parts. The Second Law actually states that the total entropy of a closed system one that no energy or matter leaves or enters cannot decrease. Entropy is a physical concept often casually described as disorder, but it differs significantly from the conversational use of the word. More important, however, the Second Law permits parts of a system to decrease in entropy as long as other parts experience an offsetting increase. Simple organisms can fuel their rise toward complexity by consuming other forms of life and nonliving materials. Mutations are essential to evolution theory, but mutations can only eliminate traits. They cannot produce new features. Mutations that arise in the homeobox Hox family of development-regulating genes in animals can also have complex effects. Hox genes direct where legs, wings, antennae and body segments should grow. In fruit flies, for instance, the mutation called Antennapedia causes legs to sprout where antennae should grow. These abnormal limbs are not functional, but their existence demonstrates that genetic mistakes can produce complex structures, which natural selection can then test for possible uses. Moreover, molecular biology has discovered mechanisms for genetic change that go beyond point mutations, and these expand the ways in which new traits can appear. Functional modules within genes can be spliced together in novel ways. Comparisons of the DNA from a wide variety of organisms indicate that this is how the globin family of blood proteins evolved over millions of years.

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5: 10 Scientific Laws and Theories You Really Should Know | HowStuffWorks

Fact vs Theory vs Law vs Hypothesis vs Proof There is a reasonable amount of jargon across all scientific disciplines and it is absolutely not surprising that the general public does not keep up to date on all of them, nor should they be expected to.

Although both are used in many different fields of studies, they still manage to have their own distinct definitions that separate one from the other. One particular field, wherein both terms are commonly used is in Science. In the scientific world, facts or scientific facts are what one can readily observe. It can pertain to any objective and real phenomenon may it be the falling of the ball after being thrown upwards or other simple observable occurrences. In this regard, the fact is that the ball will fall. More so, if this test is being done repeatedly under a controlled environment that cancels all unnecessary variables the phenomenon would have become a very obvious and undeniable fact. It is considered a fact because it will remain as true even after several centuries unless there is a more rigid and precise way of measuring a certain phenomenon. On the contrary, theories in science are likened to the explanations to what has been observed. It is relatively greater in weight to what a hypothesis is. If a hypothesis an intelligent guess is the first base of formulating a scientific law then t heories are placed at the second base. These are the statements that are assumed to be true because they seem so even if there are no hundred percent concrete evidences. Nevertheless, theories are always presented to be true even if the claims in the said theories are mere speculations or a general agreement between a significant numbers of experts. Moreover, theories are the statements that often undergo a series of tests to nullify the claims maid by those who propose them. To display the difference between fact and theory , a good example is when a report will state that a certain hurricane killed thousands in a particular state in America yesterday because of the reckless mass evacuation spearheaded by the local officials. In this aspect, the fact is that many were killed by the hurricane while the theory is the reason behind the death of these people. Was it only because of the haphazard evacuation plan or was it also because of the intensity of the hurricane among many other reasons? Hence, facts are really the real deal while theories are still unclear although presumed to be true. Facts are observations whereas theories are the explanations to those observations. Theories are vague truths or unclear facts whereas facts are really facts. If you like this article or our site. Please spread the word.

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6: Theory and Fact | NCSE

A scientific theory is "a well-substantiated explanation of some aspect of the natural world that can incorporate facts, laws, inferences, and tested hypotheses." [22] Theories are formed from hypotheses that have been subjected repeatedly to tests of evidence which attempt to disprove or falsify them.

Science and Tech Fact vs Theory vs Law vs Hypothesis vs Proof There is a reasonable amount of jargon across all scientific disciplines and it is absolutely not surprising that the general public does not keep up to date on all of them, nor should they be expected to. First, lets take a look at what science actually is. That is pretty straightforward. Science is a framework, or a methodology, for looking at the world around us and putting forth our best efforts to understand this crazy universe we find ourselves in. This framework can be laid out in a few simple steps outlined in this nifty little flow chart: Needless to say, it works pretty well. Now lets dive into the headline of the article. The words listed in the title, fact, theory, law, hypothesis, and proof are words that find themselves with slightly different meanings in the common vernacular when compared to how they are used within the context of science. This leads to much confusion in science reporting and in communicating science to the general public. Please, please, please, keep in mind that when you are reading and listening to scientific discussion of any kind these words must be understood within the proper context and not as they are typically used by the general public in day to day conversation. A scientific hypothesis is a testable explanation about some phenomenon. As long as it attempts to explain something and it is testable it is a scientific hypothesis. The key difference between a hypothesis as used in day to day discord and a scientific hypothesis is that a scientific hypothesis is necessarily testable. Hypothesis testing is a whole other issue that I may tackle in the future but for now lets leave it at that. A fact, within the context of science, is very basic. It is a fact that when standing on the surface of earth if one were to release an object from their outstretched hand that the released object will fall towards the ground. This is an objective reality that anyone can go and test at any time. Facts are collected when we repeatedly fail to reject a hypothesis during experimental testing. Here comes one of the big problems. In general conversation when someone uses the word theory they are using the word the same way a scientist might use hypothesis. The person most likely means that they have some kind of guess or hunch. When a scientist uses the worth theory they mean something entirely different. Within the context of science a theory is a well-substantiated explanation of some aspect of the natural world, based on a body of facts that have been repeatedly confirmed through observation and experiment. Further, a scientific theory must be able to be used to make predictions about natural events and phenomena that are consistently accurate. A simple way of thinking about a theory is that is is what we use to explain the facts we observe in the world. The theory of gravity is an attempt to explain how and why when you release that object from your hand it falls. While a scientific theory may help us to explain the world around us a scientific law is something entirely different. A law, within the context of science, is a statement that is based on repeated experimental observation that describes some aspect of natural phenomenon. While the theory of gravity may strive to explain why things fall when you release them the a law of gravity will describe the falling. As such, laws are often expressed using mathematics. That is simply not how it works. Continued use of the scientific method builds supporting evidence or refuting evidence for existing theories and laws and is used in the construction of new theories and laws. That is all there is. If you were reading closely earlier you may have noticed a curious way of describing the outcome of an experiment. This is significant and important to understand. An experiment in science does not prove the hypothesis, is either rejects the hypothesis or fails to reject it. Because of this we can never know with certainty that the outcome was not caused by some unaccounted for variable, some bias, or some mistake. I hope this brings some clarity to the discussion of science and that those who stumble across this find it interesting and useful.

7: Evolution Resources from the National Academies

A scientific theory is a specific type of theory used in the scientific method. The term "theory" can mean something different, depending on whom you ask. "The way that scientists use the word.

Evolutionary theories continue to generate testable predictions and explanations about living and fossilized organisms. It is based on the evolutionary premise of an ancestral descendant sequence of genes, populations, or species. Individuals that evolve are linked together through historical and genealogical ties. Evolutionary trees are hypotheses that are inferred through the practice of phylogenetic theory. They depict relations among individuals that can speciate and diverge from one another. The evolutionary process of speciation creates groups that are linked by a common ancestor and all its descendants. Species inherit traits, which are then passed on to descendants. Evolutionary biologists use systematic methods and test phylogenetic theory to observe and explain changes in and among species over time. These methods include the collection, measurement, observation, and mapping of traits onto evolutionary trees. Phylogenetic theory is used to test the independent distributions of traits and their various forms to provide explanations of observed patterns in relation to their evolutionary history and biology. Evolution as theory and fact in the literature[edit] The following sections provide specific quotable references from evolutionary biologists and philosophers of science demonstrating some of the different perspectives on evolution as fact and theory. Evolution as fact[edit] American zoologist and paleontologist George Gaylord Simpson stated that "Darwin If you like, then, I will grant you that in an absolute sense evolution is not a fact, or rather, that it is no more a fact than that you are hearing or reading these words. Miller writes, "evolution is as much a fact as anything we know in science. How else except by the word evolution can we designate the sequence of faunas and floras in precisely dated geological strata? And evolutionary change is also simply a fact owing to the changes in the content of gene pools from generation to generation. Writing in , biologist Julian Huxley entitled the third book of the wide-ranging series The Science of Life , which dealt with the fossil record and the evidence of plant and animal structures, The Incontrovertible Fact of Evolution. He also says "Natural Selection There we come to speculative matter, to theories. Stephen Jay Gould writes, " It is also a fact. And facts and theories are different things, not rungs in a hierarchy of increasing certainty. Theories are structures of ideas that explain and interpret facts. Facts do not go away when scientists debate rival theories to explain them. Evolution, in this context, is both a fact and a theory. It is an incontrovertible fact that organisms have changed, or evolved, during the history of life on Earth. And biologists have identified and investigated mechanisms that can explain the major patterns of change. That evolution is a theory in the proper scientific sense means that there is both a fact of evolution to be explained and a well-supported mechanistic framework to account for it. Richard Lewontin wrote, "It is time for students of the evolutionary process, especially those who have been misquoted and used by the creationists, to state clearly that evolution is fact, not theory. Futuyma writes in Evolutionary Biology , "The statement that organisms have descended with modifications from common ancestorsâ€”the historical reality of evolutionâ€”is not a theory. It is a fact that we are cousins of gorillas, kangaroos, starfish, and bacteria. Evolution is as much a fact as the heat of the sun. Evolution is a fact. The term theory is no longer appropriate except when referring to the various models that attempt to explain how life evolves Fitzhugh [39] writes that scientists must be cautious to "carefully and correctly" describe the nature of scientific investigation at a time when evolutionary biology is under attack from creationists and proponents of intelligent design. Fitzhugh writes that while facts are states of being in nature, theories represent efforts to connect those states of being by causal relationships: Theories are concepts stating causeâ€”effect relations. He nevertheless contends that referring to evolution as a "fact" is technically incorrect and distracts from the primary "goal of science, which is to continually acquire causal understanding through the critical evaluation of our theories and hypotheses. Robertson writing for National Science Teachers Association writes, "I have heard too many scientists claim that evolution is a fact, often in retort to the claim that it is just a theory. Rather than claiming so, I think scientists would be better served to agree that evolution is a theory and then proceed to explain what a theory is -- a coherent explanation that undergoes constant testing and often revision over a period of time. To explain means to identify a mechanism that causes evolution and to demonstrate the consequences of its operation. These consequences are then the general laws of evolution, of which any given system or organism is a particular outcome. Graham Bell , Selection: The Mechanism of Evolution [42] "Proof" of a theory has different meanings in science. Proof exists in formal sciences , such as a mathematical proof where symbolic expressions can represent infinite sets and scientific laws having precise definitions and outcomes of the terms. Proof has other meanings as it descends from its Latin roots provable, probable, probare L. In this way natural selection and common ancestry has been proven. To remain consistent with the philosophy of science, however, advancement of theory is only achieved through disproofs of hypotheses. Model-based science uses idealized structures or mathematical expressions to strategically create simpler representations of complex worldly systems. Models are designed to resemble the relevant aspects of hypothetical relations in the target systems under investigation. For example, evolutionary phylogeneticists run simulations to model the tree like branching process of lineages over time. In turn, this is used to understand the theory of phylogenetics and the methods used to test for relations among genes, species, or other evolutionary units.

8: 15 Answers to Creationist Nonsense - Scientific American

It's time we learn the difference between a fact, a theory, a hypothesis, and a scientific law. Have an idea for an episode or an amazing science question you want answered? Leave a comment or.

Astronomy Home Page It is extremely important to distinguish between facts and theories in science, and in every other subject also, because facts usually remain the same and theories often change. They are not always easy to differentiate, and even scientists forget to do it. And the people who write science textbooks nearly always forget to do it. For example, the universe has doubled in age since I was a boy, which gives you an idea of just how old I am. When some people see a scientific theory disproven and replaced by another, they lose confidence in all of science, which is a big mistake. That is how science progresses, and it is a wonderful way to learn about our world. The Scientific Method There are essentially three steps to the scientific Method, although some authors break it in to more. These steps are to observe something, then to try to explain it, and then use your explanation to predict future observations. Suppose that in the early morning light, you are walking with two friends and notice that there is a halo around your shadow, glowing in the dew on the grass. You notice also that there is no such halo around the shadow of your friends. Being curious about the world, you ask yourself, "What causes the halo? The man who first wrote up this observation, proposed the theory that it was because of his superior intelligence. Before reading on, do you think he is right? If not, pause for a moment and try thinking of your own theory. How could you test either his theory or your own theory to see if it might be right? Use the Theory to Predict Future Observations. The heart of science lies in this third step. Having your theory, use it to predict the outcome of a future observation. This is the "testing" part of science. In the current example, you could ask your friends if they see anything unusual about any of the shadows. Suppose they both answer that each sees a glow around her own shadow. What does this tell you about your theory? An important point here is that if the prediction fails then the theory must be discarded or changed. If it was really his superior intelligence, then the prediction would be that the two friends would either agree that only his shadow had the aura, or perhaps they would see no aura at all because of their inferior intelligence! The simple observation that each sees his own aura falsifies his theory because not all three can have an intelligence superior to both the others. These three steps are usually repeated over and over, often refining the theory after each set of new observations or experiments, with increasingly difficult testing hurdles for the theory to overcome. The most valuable theories are those which make precise and risky predictions, which could easily disprove the theory if they failed. Repeat the Three Steps Until Satisfied. If your theory passes the first falsification test, then think of another experiment to test another aspect of the theory. The idea of science is to repeat the three steps over and over until you are convinced you have a theory good enough to correctly predict the outcome of experiments in a wide variety of situations. To do this, scientists like to use "controlled" experiments when only one thing changes each time. In this example, you might try looking for a halo at a different time of day, or without the dew, or on something besides grass. Each time your theory should make a measurable prediction. If your theory makes no prediction, then it cannot be tested and hence it is not scientific. It still might be the correct explanation, it is just not scientific because the scientific method cannot be used to falsify it. There are many theories out there which cannot be tested, masquerading as scientific theories in order to have credibility. Be on the lookout for them. Note that you cannot prove any theory to be true. You might think up a thousand totally different tests to try to disprove the theory, and it might pass every one. Does that mean it is "true"? No, because the 1,st test could prove it false. While scientific theories are never supposed to be considered to be absolute truth, some have passed so many tests that they are called "laws. A scientific law is like a theory that has been inducted into the "Science Hall of Fame. You probably use the scientific method everyday more than you might have suspected. If your car stops, you first think it might be out of gas, but the fact is, the gauge says you have plenty. After you try several things which fail falsifying those theories , you replace the gas filter and suddenly it works again. TV commercials are filled with suggestions for you. You observe that the guy who uses this toothpaste has a brighter smile and the girls all chase him. But even if your date-acceptance-rate does measurably pick up, it may still be hard to trace it to the toothpaste; it might be simply that you are smiling more! But at least we can think about what we are doing anyway in a more scientific way. A lot of times we just do the first two steps of the scientific method. We observe something, form a theory, and then simply assume the speculation is true. Or maybe she got caller ID. Before "jumping to conclusions," try thinking of ways to test your explanations of observations. It is the predictive power of science that is so powerful, and which has led to much of the marvelous technology we now enjoy. When we know the law of gravity, we can build bridges and even send rockets to the moon. Without the ability to predict future results, we do not have science, we have only speculation about what happened in the past. Perhaps the greatest achievement in chemistry was the periodic table, which predicted the existence and properties of several elements before they were discovered. Science is truly wonderful in what it has given us, and the rock on which it is founded is the scientific method. The "Rest of the Story. That explains why it is only seen around the shadow of the observer, because it is directed back toward the sun. Finally someone asked, "Well, is the light green? Facts The word fact can be used several ways, but in general in science, "facts" refer to the observations. They are best when they are repeatable observations under controlled conditions, such as "It is a fact that the speed of light is constant in a vacuum. Theories The theories are the explanations proposed in step two of the scientific method. Usually the word "theory" is reserved for more than a first attempt, which might be called a "hypothesis. Thus, by separating facts from theories, I mean distinguishing between observations and explanations. When you hear the news, "The Dow Jones took a plunge today because of fears about the Asian crisis," is that fact or theory? It was half and half. The fact is that the market went down: But who knows what drives the market? In any case, it remains only a theory. No one will separate the facts from theories for you; the trend is to present everything as truth. If science can never prove a theory "true," then truth really has no place at all in science. By "truth" I mean what is "really" going on. Truth has to do with ultimate causes, which are nearly always extremely elusive and beyond the realm of science. Science deals with theories, usually mathematical, which predict outcomes of experiments. For example, if we drop a rock off a cliff, the law of gravity combined with theories of air resistance and other forces can be used to calculate just how long it will take to hit the ground, and how fast it will go, etc. But science does not answer the question of just exactly what gravity is, or why things fall. It just states that given certain conditions, they will fall. In general, science answers questions like "how," "when," "where", but never "why" in the ultimate sense. As an example of the interplay of the three concepts of observations, theories and truth, consider the courtroom. The observations may be that a man was seen shooting a gun and that the person hit by the bullet died. The theory may be that it was cold-blooded murder, but the truth may be that it was self-defense. Courts are very interested in truth, where the motive the ultimate cause for actions is given considerable weight. The distinction between first-degree and second degree murder is based on intent. Motives are not as yet observable in science, and hence are beyond science. Try Replacing the Word "Fact" The word "fact" has several meanings, which can be very confusing. In popular useage it can mean either "observation," "theory," or "truth. Finally, if one so thoroughly believes that the theory of gravity is really "true," he could replace "a fact" with "true," which would take the meaning beyond science into the realm of his personal convictions. This confusion can often be avoided by always replacing the word "fact" with "observation," "theory" or "truth," whichever seems to convey the intended meaning best. Remember that if the meaning is "observation," then it is as fallible as the observer. If it is a "theory," then it also could be disproven someday. If it is claimed to be "truth," then it is a statement of the personal conviction of the speaker, which is outside the domain of science. Use the Scientific Method Daily. First, try making a practice of using the scientific method on a daily basis. You already formulate explanations of things you notice. The main step to add is some test with predicted results to test your theory. I do programming for a living.

THEORY VERSUS SCIENTIFIC FACT pdf

9: Evolution as fact and theory - Wikipedia

A scientific theory is an explanation of an aspect of the natural world that can be repeatedly tested and verified in accordance with the scientific method.

Theory and Fact Theory and Fact One source of confusion about the status of the science or theory of evolution stems from the difference between the "everyday" meaning of the word "theory" and the scientific meaning the word. Below we list some common misconceptions about the term "theory" and describe a classroom activity that can help students rethink their understanding of this term. The first statement implies that a theory should be interpreted as just a guess or a hunch, whereas in science, the term theory is used very differently. The second statement implies that theories become facts, in some sort of linear progression. In science, theories never become facts. Rather, theories explain facts. The third misconception is that scientific research provides proof in the sense of attaining the absolute truth. Scientific knowledge is always tentative and subject to revision should new evidence come to light. Discuss each example with students, focusing on whether the statement is based on evidence and under what conditions the statement is true. Ask students to organize these statements in some type of relative order, from that which they most readily accept to that which they consider most tentative. Provide students with the definitions of these terms from the National Academy of Sciences1 Fact: Truth in science, however, is never final and what is accepted as a fact today may be modified or even discarded tomorrow. A tentative statement about the natural world leading to deductions that can be tested. If the deductions are verified, the hypothesis is provisionally corroborated. If the deductions are incorrect, the original hypothesis is proved false and must be abandoned or modified. Hypotheses can be used to build more complex inferences and explanations. A descriptive generalization about how some aspect of the natural world behaves under stated circumstances. In science, a well-substantiated explanation of some aspect of the natural world that can incorporate facts, laws, inferences, and tested hypotheses. Ask students to identify each of the original statements as a Fact, Hypothesis, Law, or Theory and to revisit the arrange of statements, from that which they would most readily accept to that which they consider most tentative, and make any changes deemed necessary. Did the order change? If so, how and why?

THEORY VERSUS SCIENTIFIC FACT pdf

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