

To: Legislative Council - Panel on Education ("The Panel")
Concern over the Hong Kong Secondary School Biology Curriculum

We are the "Concern Group for Hong Kong Science Education", a group of citizens in Hong Kong who are concerned about the upcoming Biology/Combined Science curriculum for Hong Kong secondary schools to become effective in September 2009.

We have learnt from the news (SCMP, 7/2/09, EDU1) that the new curriculum used for the reformed educational system for senior secondary schools contains statements that have a large loophole to allow teaching of non-scientific alternatives apart from the theory of evolution in middle school biology classes. One related passage is as follows:

"In addition to Darwin's theory, students are encouraged to explore other explanations for evolution and the origins of life, to help illustrate the dynamic nature of scientific knowledge." (p.23, New Senior Secondary Curriculum, Biology S4-6)

In the same article, Dean of HKU Faculty of Science Professor Sun Kwok pointed out that scientific knowledge is based on observable evidence, and not all explanations should be discussed during science classes, guidelines of Education Bureau have misinterpreted the definition of science. We also know from the same report that dozens of schools already made it clear that they will teach viewpoints such as Intelligent Design or other non-scientific notions in biology classes.

We fear this loophole will result in the erosion of our quality education, whereby the quality knowledge of the evolution of life on Earth are being concealed, denied, or confused with ideas or notions not testable by science, and thus contradicts the objectives of science education.

We therefore write to urge the Panel to have the Education Bureau to address this issue and correct the problem in the science curriculum, to avoid Hong Kong to become a world-class laughing stock.

From the news, the Education Bureau turned their back on it and ignored the advice of scientists, without realizing the impact of their decision to our education and students (SCMP, 21/2/09, EDU3). According to the spokeswoman:

"The committee that drafted the guide had considered the views of stakeholders such as academics" and that "the biology curriculum will be under constant review and evaluation in the light of classroom experiences, students' performance and the changing needs of students and society."

However, science education is not about views of stakeholders in business deals – it is about what fits the definition of science and what is good science education, and it is also not satisfying "needs" of the specific beliefs from one part of the society, but to provide quality education up to the international standards to our next generation.

In fact, the majority of the international scientists have clear consensus that the theory of evolution is currently the only robust and established scientific theory regarding biodiversity on Earth, and that pseudo-sciences should not be taught in science classes.

Organizations making similar statements include the Interacademy Panel on international issues (IAP), American Association for the Advancement of Science (AAAS) and the Nobel Prize Laureates from The Elie Wiesel Foundation for Humanity.

Evolutionary theory has stood numerous tests since its publication 150 years ago, supported by overwhelming evidence and is confirmed by other areas of sciences like biochemistry, genetics, anatomy, physics, geology etc.

The other "explanations", such as Creationism or Intelligent Design are inconsistent with the definition of science, and teaching of those ideas undermines our quality education.

The new syllabus has failed to emphasize the current scientific status of the evolution theory and allow unscientific alternatives to be taught, thus cannot keep up with the current international scientific understanding.

On February 29, 2009, the leading international academic journal on science Nature also showed their concern about the case, and described that the position of HKU Faculty of Science is against pseudo-scientific explanations such as Intelligent Design to be spread in schools. Being published in Nature, the news might have bad impact on the image of Hong Kong science education internationally.

We sincerely requests the Panel to urge the Education Bureau to take steps to prevent, instead of to promote, teaching of pseudo-sciences in science classes in order to preserve our quality education system and provide best of knowledge to our young students. A full review of the entire science curriculum for the secondary schools is to be done.

We would also like the Panel to put forward the questions to the Education Bureau on our behalf.

The following questions use the definition of science, scientific theories and scientific methods as follows:

Science, scientific methods and scientific theories ("Science") are defined as follows, and is well understood and accepted by scientific communities worldwide:

- (1) Science is verifiable knowledge built upon theories that are strongly supported by factual evidence and derived by objective scientific methods*
- (2) Scientific methods embody the processes and procedures of finding explanations for natural phenomena which include observation, collecting evidence, logical*

deductions/inferences, making and testing predictions from hypotheses, falsification, and peer-review. Repeated testing ensures that scientific explanations are consistent with current theories, and such theories are modified (or discarded) in the light of new evidence. As a result, mistakes are minimized, or corrected, by an impartial and fair process.

(3) Scientific methods circumscribe the realm of what can be taught in the science

(4) Curriculum (4) Scientific theories and data are to be studied with a skeptical, open mind, and critically considered in the light of empirically verified evidence.

Questions:

1. Has and will the Bureau and the committee (responsible for the curriculum) consider(ed) the definition of science/scientific theory/scientific methods in drafting the curriculum for science?
2. Are there any criteria as to what type of explanation(s) apart from evolution teachers can cover according to the new biology curriculum?
3. Are teachers allow to offer alternative explanations that do not fit the definition of science listed above?
4. Many schools made it clear that they will cover Intelligent Design or Creationism, do these fit the definition of science listed above as per current understanding of science community at large (e.g. academia in HK, in leading countries of scientific research like China, USA etc.) ?
5. Has the Education Bureau consulted the Chinese Academy of Science (their persons or materials) on the position of teaching evolution?
6. Will teaching of non-scientific explanations undermine quality of science education in Hong Kong?

Yours Sincerely,

Virginia Yue 虞瑋倩

Spokesperson and convener for "Concern Group for Hong Kong Science Education"

Enclosure:

1. "Scientists urge excluding God from biology Guidelines on creationism criticized". SCMP, 7/2/09, EDU1.
2. "Bureau turns back on creationism concerns." SCMP, 21/2/09, EDU3.
3. Nobel Laureates Initiative On Teaching Of Evolution. 9/9/05
4. Interacademy Panel Statement on the Teaching of Evolution. 21/6/06
5. Common misrepresentations or hoaxes spread by Intelligent Design ("ID")proponents.

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Scientists urge excluding God from biology

Guidelines on creationism criticised

Liz Heron

Updated on *Feb 07, 2009*

Leading Hong Kong scientists have criticised the Education Bureau for tacitly encouraging schools to promote creationism in biology lessons through its guidelines on teaching evolution.

Four senior scientists are calling for guidance on biology teaching in the new senior secondary curriculum launched next September to be upgraded to reflect current scientific thinking.

The University of Hong Kong's dean of science Sun Kwok, science faculty board chairman David Dudgeon, former manager of its Genome Research Centre William Mak and geologist Jason Ali, say that would leave no room for teaching about creationism and intelligent design in biology.

Schools have discretion over how they teach academic subjects under flexible bureau guidelines and at least 30 aided schools teach creationism as an "alternative explanation" for evolution within biology.

Guidelines on the topic in HKCEE and A-level syllabuses require teachers to introduce students to the idea that evolution is a scientific theory supported with evidence.

A bureau spokeswoman said both syllabuses aimed to develop students' "skills, values and attitudes related to scientific thinking" but stipulated that alternative explanations to the theory of natural selection should be discussed.

"Evolution and other explanations should be discussed constructively and impartially against the evidence available, pointing out the limitation

of science to provide a complete answer," she said.

The same objective applied in the senior secondary curriculum and assessment guide for biology classes leading to the new Hong Kong Diploma of Secondary Education.

"In section II, genetics and evolution, students are expected to understand that evolution is a scientific theory supported with evidence and are encouraged to explore other explanations for evolution and the origins of life in addition to Darwin's theory," she said.

Professor Kwok said the advice showed a failure to understand what scientific knowledge was all about. "Science is limited to what we can observe because scientific theories have to be tested by experiment or observation. So, by definition, it is limited, but that doesn't mean that any alternative theory can be discussed in the science class. Certainly, there is no room for creationism and intelligent design. Debates within science classes should be limited to true scientific debates between competing scientific theories."

Professor Dudgeon, a freshwater ecology expert, said: "There are no substantive competing scientific explanations for evolution. Every fossil dig that people go out on essentially produces evidence that supports Darwin's theory. Each one could produce evidence that refutes Darwin's theory but it does not.

"It is ludicrous, if this theory is so important, that we are teaching alternatives. We are not still teaching students that the moon is made of green cheese or the earth is flat."

The bureau had missed a "golden opportunity" to bring the teaching of evolution up to a level that "reflects international best practice and scientific rigour" in the new senior secondary curriculum.

Noted Sars and bird flu researcher Malik Peiris, who is HKU's chair professor of microbiology, said: "In biology, we should confine ourselves to the basic philosophy of the scientific method. Creationism does not fit in that category. However, it may be discussed to illustrate the social context in which science operates."

Schools that offer creationism as an alternative to evolution in biology include 27 run by the Church of Christ in China Association.

A spokeswoman for the Hong Kong Examinations and Assessment Authority said there were no questions on creationism or intelligent

design in existing exam papers for science subjects and no plans to introduce such questions.

The big divide: fact or faith

Chan Yau-chi, principal of United Christian College in Shek Kip Mei:

"When we teach about Darwin we treat it as one part of the subject. We teach students creationism as a counterbalancing theory."

Wong Shiu-hung, principal of Kwai Chung Methodist College, said:

"Our religious belief does not approve of evolution. We organise schools upholding Christian faith. If teachers have such a religious background, we encourage them to integrate their faith into lessons."

Siu Sze-chuen, headmaster of Newman Catholic School:

There was no space for creationism because examiners did not accept it. If exam pressure was reduced, "it surely would be a good thing" to introduce creationism as an alternative.

Biology teacher Chan Hiu-ki, Yuen Long Lutheran Secondary School:

stages class debates on the subject. "One side supports the idea that evolution is the theory of the origin of living organisms and the other argues all organisms were created by God."

Amy Nip and Liz Heron

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Search Result**Saturday February 21 2009****Bureau turns back on creationism concerns**

Liz Heron

Guidance for biology teachers will not be reviewed to address concerns that it encourages creationism before the new secondary diploma is launched, the Education Bureau has indicated.

Four scientists, including the University of Hong Kong's dean of science Sun Kwok and science faculty board chairman David Dudgeon, have called for a reference to 'alternative explanations' to Darwin's theory of evolution to be removed from the biology curriculum guidance.

The guide drawn up for the Hong Kong Diploma of Secondary Education states: 'In section II, genetics and evolution, students are expected to understand that evolution is a scientific theory supported with evidence and are encouraged to explore other explanations for evolution and the origins of life in addition to Darwin's theory.'

The scientists argue that there are no credible alternative scientific theories to Darwin's theory of evolution and the guidance therefore suggests that students should be encouraged to explore religious explanations, such as creationism and intelligent design. They say such theories have no place in the science curriculum.

A bureau spokeswoman said the committee that drafted the guide had considered the views of stakeholders such as academics.

'The biology curriculum will be under constant review and evaluation in the light of classroom experiences, students' performance and the changing needs of students and society,' she said, adding that all suggestions were welcome.

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THE ELIE WIESEL FOUNDATION FOR HUMANITY

NOBEL LAUREATES INITIATIVE

September 9, 2005

TO: Kansas State Board of Education

We, Nobel Laureates, are writing in defense of science. We reject efforts by the proponents of so-called “intelligent design” to politicize scientific inquiry and urge the Kansas State Board of Education to maintain Darwinian evolution as the sole curriculum and science standard in the State of Kansas.

The United States has come a long way since John T. Scopes was convicted for teaching the theory of evolution 80 years ago. We are, therefore, troubled that Darwinism was described as “dangerous dogma” at one of your hearings. We are also concerned by the Board’s recommendation of August 8, 2005 to allow standards that include greater criticism of evolution.

Logically derived from confirmable evidence, evolution is understood to be the result of an unguided, unplanned process of random variation and natural selection. As the foundation of modern biology, its indispensable role has been further strengthened by the capacity to study DNA. In contrast, intelligent design is fundamentally unscientific; it cannot be tested as scientific theory because its central conclusion is based on belief in the intervention of a supernatural agent.

Differences exist between scientific and spiritual world views, but there is no need to blur the distinction between the two. Nor is there need for conflict between the theory of evolution and religious faith. Science and faith are not mutually exclusive. Neither should feel threatened by the other.

When it meets in October, 2005, we urge the Kansas State Board of Education to vote against the latest draft of standards, which propose including intelligent design in academic curriculum.

Sincerely,

Alexei A. Abrikosov
Nobel Prize, Physics (2003)

Linda B. Buck
Nobel Prize, Medicine (2004)

Richard Axel
Nobel Prize, Medicine (2004)

Aaron Ciechanover
Nobel Prize, Chemistry (2004)

Günter Blobel
Nobel Prize, Medicine (1999)

Mairead Corrigan Maguire
Nobel Prize, Peace (1976)

Robert F. Curl, Jr.
Nobel Prize, Chemistry (1996)

John B. Fenn
Nobel Prize, Chemistry (2002)

Clive W.J. Granger
Nobel Prize, Economics (2003)

David J. Gross
Nobel Prize, Physics (2004)

Leland H. Hartwell
Nobel Prize, Medicine (2001)

Herbert A. Hauptman
Nobel Prize, Chemistry (1985)

Dudley R. Herschbach
Nobel Prize, Chemistry (1986)

Avram Hershko
Nobel Prize, Chemistry (2004)

Roald Hoffmann
Nobel Prize, Chemistry (1981)

H. Robert Horvitz
Nobel Prize, Medicine (2002)

Eric R. Kandel
Nobel Prize, Medicine (2000)

Wolfgang Ketterle
Nobel Prize, Physics (2001)

Aaron Klug
Nobel Prize, Chemistry (1982)

Sir Harold Kroto
Nobel Prize, Chemistry (1996)

Anthony J. Leggett
Nobel Prize, Physics (2003)

Jean-Marie Lehn
Nobel Prize, Chemistry (1987)

Ferid Murad
Nobel Prize, Medicine (1998)

Erwin Neher
Nobel Prize, Medicine (1991)

Sir Paul Nurse
Nobel Prize, Medicine (2001)

Stanley B. Prusiner
Nobel Prize, Medicine (1997)

Irwin Rose
Nobel Prize, Chemistry (2004)

K. Barry Sharpless
Nobel Prize, Chemistry (2001)

Horst L. Störmer
Nobel Prize, Physics (1998)

Gerardus 't Hooft
Nobel Prize, Physics (1999)

Daniel C. Tsui
Nobel Prize, Physics (1998)

Harold E. Varmus
Nobel Prize, Medicine (1989)

John E. Walker
Nobel Prize, Chemistry (1997)

Carl E. Wieman
Nobel Prize, Physics (2001)

Elie Wiesel
Nobel Prize, Peace (1986)

Frank Wilczek
Nobel Prize, Physics (2004)

Jody Williams
Nobel Prize, Peace (1997)

Betty Williams
Nobel Prize, Peace (1976)

IAP STATEMENT ON THE TEACHING OF EVOLUTION

We, the undersigned Academies of Sciences, have learned that in various parts of the world, within science courses taught in certain public systems of education, scientific evidence, data, and testable theories about the origins and evolution of life on Earth are being concealed, denied, or confused with theories not testable by science. We urge decision makers, teachers, and parents to educate all children about the methods and discoveries of science and to foster an understanding of the science of nature. Knowledge of the natural world in which they live empowers people to meet human needs and protect the planet.

We agree that the following *evidence-based* facts about the origins and evolution of the Earth and of life on this planet have been established by numerous observations and independently derived experimental results from a multitude of scientific disciplines. Even if there are still many open questions about the precise details of evolutionary change, scientific evidence has never contradicted these results:

1. In a universe that has evolved towards its present configuration for some 11 to 15 billion years, our Earth formed approximately 4.5 billion years ago.
2. Since its formation, the Earth – its geology and its environments – has changed under the effect of numerous physical and chemical forces and continues to do so.
3. Life appeared on Earth at least 2.5 billion years ago. The evolution, soon after, of photosynthetic organisms enabled, from at least 2 billion years ago, the slow transformation of the atmosphere to one containing substantial quantities of oxygen. In addition to the release of the oxygen that we breathe, the process of photosynthesis is the ultimate source of fixed energy and food upon which human life on the planet depends.
4. Since its first appearance on Earth, life has taken many forms, all of which continue to evolve, in ways which palaeontology and the modern biological and biochemical sciences are describing and independently confirming with increasing precision. Commonalities in the structure of the genetic code of all organisms living today, including humans, clearly indicate their common primordial origin.

We also subscribe to the following statement regarding the nature of science in relation to the teaching of evolution and, more generally, of any field of scientific knowledge :

Scientific knowledge derives from a mode of inquiry into the nature of the universe that has been successful and of great consequence. Science focuses on (i) observing the natural world and (ii) formulating *testable* and *refutable* hypotheses to derive deeper explanations for observable phenomena. When evidence is sufficiently compelling, scientific theories are developed that account for and explain that evidence, and predict the likely structure or process of still unobserved phenomena.

Human understanding of value and purpose are outside of natural science's scope. However, a number of components – scientific, social, philosophical, religious, cultural and political –

contribute to it. These different fields owe each other mutual consideration, while being fully aware of their own areas of action and their limitations.

While acknowledging current limitations, science is open ended, and subject to correction and expansion as new theoretical and empirical understanding emerges.



1. Albanian Academy of Sciences
2. National Academy of Exact, Physical and Natural Sciences, Argentina
3. Australian Academy of Science
4. Austrian Academy of Sciences
5. Bangladesh Academy of Sciences
6. The Royal Academies for Science and the Arts of Belgium
7. Academy of Sciences and Arts of Bosnia and Herzegovina
8. Brazilian Academy of Sciences
9. Bulgarian Academy of Sciences
10. RSC: The Academies of Arts, Humanities and Sciences of Canada
11. Academia Chilena de Ciencias
12. Chinese Academy of Sciences
13. Academia Sinica, China, Taiwan
14. Colombian Academy of Exact, Physical and Natural Sciences
15. Croatian Academy of Arts and Sciences
16. Cuban Academy of Sciences
17. Academy of Sciences of the Czech Republic
18. Royal Danish Academy of Sciences and Letters
19. Academy of Scientific Research and Technology, Egypt
20. Académie des Sciences, France
21. Union of German Academies of Sciences and Humanities
22. The Academy of Athens, Greece
23. Hungarian Academy of Sciences
24. Indian National Science Academy
25. Indonesian Academy of Sciences
26. Academy of Sciences of the Islamic Republic of Iran
27. Royal Irish Academy
28. Israel Academy of Sciences and Humanities
29. Accademia Nazionale dei Lincei, Italy
30. Science Council of Japan
31. Kenya National Academy of Sciences
32. National Academy of Sciences of the Kyrgyz Republic
33. Latvian Academy of Sciences
34. Lithuanian Academy of Sciences
35. Macedonian Academy of Sciences and Arts
36. Academia Mexicana de Ciencias
37. Mongolian Academy of Sciences
38. Academy of the Kingdom of Morocco
39. The Royal Netherlands Academy of Arts and Sciences
40. Academy Council of the Royal Society of New Zealand
41. Nigerian Academy of Sciences
42. Pakistan Academy of Sciences
43. Palestine Academy for Science and Technology
44. Academia Nacional de Ciencias del Peru
45. National Academy of Science and Technology, The Philippines
46. Polish Academy of Sciences
47. Académie des Sciences et Techniques du Sénégal
48. Serbian Academy of Sciences and Arts
49. Singapore National Academy of Sciences
50. Slovak Academy of Sciences
51. Slovenian Academy of Sciences and Arts
52. Academy of Science of South Africa
53. Royal Academy of Exact, Physical and Natural Sciences of Spain
54. National Academy of Sciences, Sri Lanka
55. Royal Swedish Academy of Sciences
56. Council of the Swiss Scientific Academies
57. Academy of Sciences, Republic of Tajikistan
58. The Caribbean Academy of Sciences
59. Turkish Academy of Sciences
60. The Uganda National Academy of Sciences
61. The Royal Society, UK
62. US National Academy of Sciences
63. Uzbekistan Academy of Sciences
64. Academia de Ciencias Físicas, Matemáticas y Naturales de Venezuela
65. Zimbabwe Academy of Sciences
66. African Academy of Sciences
67. The Academy of Sciences for the Developing World (TWAS)
68. The Executive Board of the International Council for Science (ICSU)

Common misrepresentations or hoaxes spread by Creationism/Intelligent Design ("CID") proponents

The “teach the controversy” hoax. The CID movement employs a tactic that appeals to the layman’s idea of “fairness and balance.” CID advocates argue that since there is a controversy over evolution, we should “teach the controversy” in school science classrooms.

The “controversy” is manufactured. Evolutionary biology draws strength from a supporting scientific literature extending across 150 years that includes literally hundreds of thousands of individual papers, all are result of rigorous research based on the scientific methods. CID proponents offer no science. In some cases, they have misrepresented science in their efforts to debunk it. In the Kitzmiller Vs. Dover District School Board et al trial, microbiologist Dr. Behe (an ID proponent) stretched the definition of science such that even astrology could be called “science”.

The “just a theory” hoax. CID proponents purposefully confuse the two meanings of the word “theory.” In common usage, a theory connotes a statement that is tentative or hypothetical, sometimes just a hunch or a ill-conceived notions. This is the meaning implied in the frequent claim of CID advocates that evolution is “*just* a theory.” However, in science the term “theory” is used differently. When substantiated to the degree that evolutionary theory has been, a theory is regarded as a fact. Practicing biologists operate within the rich context of evolutionary theory, and no part of modern biology, including medicine, is completely understandable without it. Scientific arguments are not qualified with clauses that allow for a nonevolutionary scenario.

The word "theory", in science nomenclature is a strong word; a "theory" represents body of knowledge obtained via scientific methods regarding an aspect of the natural world which explains and describes that aspect, with substantial evidences to support those knowledge and experience, and the "theory" is tested and falsified. "Gravity" is a theory, "Electromagnetism" is a theory etc.

The “fair and balanced” hoax. In the name of “fairness and balance,” the public relationship effort by CID advocates has so much influence that in USA, the media

have decided to present “two sides” of this story. For example, a day after the Dover decision in 2005, National Public Radio aired a commentary by a Heritage Foundation fellow comparing ID to the Big Bang Theory, predicting that eventually it will be widely accepted by scientists¹. By giving uncritical treatment to “both sides,” the media convey to the public the false impression that this is a genuine scientific controversy and that each has a substantial body of evidence and convincing argumentation. Journalists, educators, teachers, education policy makers and legislators should be mindful of the fact that no science supports creationism/ID; 150 years of biological, geological, and physical science supports the modern synthesis of Darwin’s theory. The individuals with scientific credentials who support ideas such as ID actually constitute a rather small group, as recently described in a New York Times article. ²

The “persecuted scientist against the establishment” hoax. Another plea often articulated by CID proponents is the idea that there is a community of CID scientists undergoing “persecution” by the science establishment for their revolutionary scientific ideas. A search through PubMed³ fails to find evidence of their scholarship within the peer-reviewed scientific literature. No substantial or serious scientific research work was done for CID.

From the booklet "Science, Evolution and Creationism" (can be downloaded free-of-charge in PDF format from www.nap.edu/catalog/11876.html)

Is Evolution a Theory or a Fact? (emphasis added)

It is both. But that answer requires looking more deeply at the meanings of the words “theory” and “fact.”

In everyday usage, “theory” often refers to a hunch or a speculation. When people say, “I have a theory about why that happened,” they are often drawing a conclusion based on fragmentary or inconclusive evidence.

¹ Loconte, J. 2005. December 21. Intelligent design has a place in the classroom

² Chang, K. 2006. February 21. Few biologists but many evangelicals sign anti-evolution petition. The New York Times. F2

³ PubMed is a resource on the Internet that allows science researchers to find peer-reviewed digital archive of biomedical and life sciences journal literature.

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).

Like these other foundational scientific theories, the theory of evolution is supported by so many observations and confirming experiments that scientists are confident that the basic components of the theory will not be overturned by new evidence. However, like all scientific theories, the theory of evolution is subject to continuing refinement as new areas of science emerge or as new technologies enable observations and experiments that were not possible previously.

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.

For example, the theory of gravitation predicted the behavior of objects on the Moon and other planets long before the activities of spacecraft and astronauts confirmed them. The evolutionary biologist who discovered Tiktaalik (in local speak at which the fossil was discovered, it means "big shallow water fish" -- a big, Devonian shallow water animal, which is part fish, part amphibian, with scales but features of an amphibian, and primitive front legs) predicted that they would find fossils intermediate between fish and limbed terrestrial animals in sediments that were about 375 million years old. Their discovery confirmed the prediction made on the basis of evolutionary theory. In turn, confirmation of a prediction increases confidence in that theory. In science, a "fact" typically refers to an observation, measurement, or other form of evidence that can be expected to occur the same way under similar circumstances. However, scientists also use the term "fact" to refer to a scientific explanation that has been tested and confirmed so many times that there is no longer a compelling reason to keep testing it or looking for additional examples. In that respect, the past and continuing occurrence of evolution is a scientific fact. Because the

evidence supporting it is so strong, scientists no longer question whether biological evolution has occurred and is continuing to occur. Instead, they investigate the mechanisms of evolution, how rapidly evolution can take place, and related questions.