

Two Proposed Student Expectations

The Biology TEKS

- (2) **Scientific processes.** The student uses scientific methods and equipment during field and laboratory investigations: The student is expected to:
- A. *know the definition of science and understand its limitations;*
 - B. know that hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power which have been tested over a wide variety of conditions are incorporated into theories;
 - C. know scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well-established and highly reliable explanations, but they may be subject to change as new areas of science and new technologies are developed;
 - D. distinguish between scientific hypotheses and scientific theories;
- (7) **Science concepts.** The student knows evolutionary theory is a scientific explanation for the unity and diversity of life. The student is expected to:
- A. identify how evidence of common ancestry among groups is provided by the fossil record, biogeography, and homologies including anatomical, molecular, and developmental;
 - B. describe the sufficiency or insufficiency of common ancestry to explain the sudden appearance, stasis and sequential nature of groups in the fossil record;
 - C. recognize that natural selection produces change in populations, not individuals;
 - D. describe the elements of natural selection including inherited variation, the potential of a population to produce more offspring than can survive, and a finite supply of environmental resources resulting in differential reproductive success;
 - E. recognize the relationship of natural selection to adaptation, and to the development of diversity in and among species; and
 - F. recognize the effects of other evolutionary mechanisms including genetic drift, gene flow, mutation, and recombination.

Supporting documentation

1. New Zealand's "living dinosaur"-- the Tuatara--is surprisingly the fastest evolving animal. It is unchanged in 200 million years ScienceDaily, March 23,2008 [**Stasis**]
2. "...natural selection operates essentially to enable the organisms to maintain their state of adaptation rather than to improve it." Lewontin, Richard C., *Adaptation*, Scientific American (and Scientific American book Evolution), September 1978 [**Stasis**]
3. "The hardest substance in your body is your teeth. The varieties of teeth among vertebrates is astounding, from the tiny incisors in a mole to the bone-crushing scimitars on a *T. rex*. Many fossils are known only from their teeth. One would think teeth are the best-studied objects in evolutionary theory, but a recent paper uncovers a near absence of explanation about how they arose." Koentges, Georgy, "Developmental Biology: Teeth In Double Trouble", Nature, , Oct 14, 2008

1. What Evolution Is, Ernst Mayr, 2001

- "The earliest fossil prokaryotes (3.5 billion years ago) were cyanobacteria ... [which] are morphologically [body type] indistinguishable from [the] still living species and nearly all of them can be placed in modern genera". Page 47 [**Stasis**]
- The fossil record, in spite of its many gaps, is the most irrefutable evidence for the occurrence of evolution. However, continuous fossil sequences are still the exception; the fossil record remains woefully inadequate." Page 69 [**How can that which is "woefully inadequate", and which lacks "continuous fossil sequences" be "irrefutable"?**]
- "a localized population suddenly appear(s) on the scene and then continue(s) essentially unchanged until [they] become(s) extinct." Page 63; also page 196 [This related to horses and whales.] [**Sudden appearance**]
- "stasis of a widespread populous species is widely observed in the fossil record." Page 193 [**Stasis**]
- "The complete standstill or stasis of an evolutionary lineage for scores, if not hundreds, of millions of years is very puzzling." Page 195 [**Stasis**]
- "[These] living fossils have hardly changed for hundreds of millions of years." Page 279 [These are long lived species that remain in *stasis*. For some reason these have not become extinct, so are called "living fossils".] [**Stasis**]
- "Bats have hardly changed in basic body plan in the ensuing 40 million years." Page 196 [**Stasis**]

- “there is no documentation of the branching event between the *hominid* and the chimpanzee lineages. To make matters worse, most *hominid* fossils are extremely incomplete. They may consist of part of a mandible, or the upper part of a skull without face or teeth, or only part of the extremities. virtually all of them are somewhat controversial.” Page 239
- “the various steps in the history of the change from ape to man is entirely based on inferences and any part of it may be refuted at any time.” Page 240
- “*Australopithecus* populations did not change very much in this whole 1.5 million-year-long period; it was a period of stasis.” Page 243 [Stasis]
- “with *H. erectus* another period of stasis was apparently reached, and changes in the 1.5 million years of its existence were relatively minor.” Page 251 [Stasis]
- “*Cro-Magnons*, were highly successful but did not change appreciably in the nearly 100,000 years of their dominance.” Page 251 [Stasis]
- “the human brain seems not to have changed one bit since the first appearance of *Homo sapiens*, some 150,000 years ago.” Page 252 [Stasis]
- “Only about 35 [structural body types] are now left, none of which has changed drastically (in the basics of their body plan) in the 500 million years since the Cambrian.” Page 267 [Stasis]
- “Once a species has acquired effective isolating mechanisms, it may not materially change for millions of years. *Stasis* apparently indicates the possession of a genotype [genes] that is able to adjust to all changes of the environment without the need for changing its basic phenotype [body].” Page 278 [This is not limited to fish, birds, mammals, insects, or plants: it applies to all living things.] [Stasis]

2. The Structure of Evolutionary Theory, Stephen J. Gould, 2002

- “...Anatomy may fluctuate through time, but the last remnants of a species look pretty much like the first representatives.” (p. 749.) [Stasis]
- “...the greatest and most biologically astute paleontologist of the 20th century...acknowledged the literal appearance of stasis and geologically abrupt origin as the outstanding general fact of the fossil record and as a pattern which would ‘pose one of the most important theoretical problems in the whole history of life.’” (p. 755 quoting George Gaylord Simpson.) [Sudden Appearance, Stasis]
- “...the long term stasis following geologically abrupt origin of most fossil morphospecies, has always been recognized by professional paleontologists.” (p. 752.) [Sudden appearance]
- “The great majority of species do not show any appreciable evolutionary change at all. These species appear in the section (first occurrence) without obvious ancestors in the

underlying beds, are stable once established and disappear higher up without leaving any descendants." (p. 753.) [Sudden appearance] [Stasis]

- "...but stasis is data... Say it ten times before breakfast every day for a week, and the argument will surely seep in by osmosis: 'stasis is data; stasis is data'..." (p. 759.) [Stasis]
- "Indeed proclamations for the supposed 'truth' of gradualism - asserted against every working paleontologist's knowledge of its rarity - emerged largely from such a restriction of attention to exceedingly rare cases under the false belief that they alone provided a record of evolution at all! The falsification of most 'textbook classics' upon restudy only accentuates the fallacy of the 'case study' method and its root in prior expectation rather than objective reading of the fossil record." (p. 773.)

3. Evolution: What the Fossils Say and Why it Matters, Donald R. Prothero, Columbia University Press, 2007,

- As Gould (1980a, 2002) pointed out, the persistence of fossil species through millions of years of intense selection pressure suggests that they are not infinitely malleable by selection, but instead have an integrity or some sort of internal homeostatic mechanism that resists most external selection. This is a radical notion for evolutionary biology, add still hotly controversial. Most paleontologists argue that the fossil record shows things that can't be seen in fruit flies or living populations, but many biologists are unconvinced that the fossil record can't be explained by some Neo-Darwinian mechanism. Page 81 [Stasis]
- This stasis, in turn, is now causing discomfort among many evolutionary biologists, because there is not yet any good mechanism in Neo-Darwinian theory for it, suggesting we still have a lot to learn about evolution and speciation. But this is good thing! If we had all the answers, and paleontology provided no new or interesting facts and ideas, science would be very boring. Page 81 [Stasis]

4. "Once established an average species of animal or plant will not change enough to be regarded as a new species, even after surviving for something like a hundred thousand, or a million, or even ten million generations Something tends to prevent the wholesale restructuring of a species, once it has become well established on earth." M. Stanley, Johns Hopkins Magazine, Page 6, June, 1982 [Stasis]