



Like the theory of gravity, the theory of evolution is an explanation of a particular aspect of God's creation. While the theory of gravity explains the relative motion of physical bodies with respect to each other—for instance the falling of an apple to the earth or the orbit of a planet around the Sun—the theory of evolution explains the history, diversity, and relationships of all living things with respect to each other, not only of those that are extant, *i.e.*, still found in the world today, but also of those that have become extinct.

In brief, according to the theory of evolution, the history, diversity, and relationships among all living beings that have ever lived on our planet can be explained as follows. Life on our planet diversified gradually beginning with one primitive living thing that lived more than 3.5 billion years ago. Over time, this one living thing generated many more living species via a mechanism that can be explained primarily (but not completely) by genetic change and natural selection. All living beings on our planet, human beings included, are descendants of a common ancestor.

What is the evidence for this explanation? Some believe that there is one definitive experiment that “proves” that evolution is true. However, like the theory of gravity, the theory of evolution is not based on any single observation. Rather it is supported by numerous observations from different areas of biological and paleontological research. Thus, the theory of evolution is justified by a web of evidence that together supports the claim that all life on our planet has evolved from a common ancestor.

This web of evidence is comparable to the web of evidence presented at a jury trial. It is not this piece of evidence alone—say the fingerprint of the suspect on the stolen item—but this piece of evidence along with all the other pieces of evidence—the video footage taken by the camera

in the supermarket and the eyewitness account by another customer, for example—that convicts the suspect in an open-and-shut case. It is all the evidence taken together and the likelihood that they explain the crime better than any other alternative account that justifies the verdict.

**The Fossil Record:** First, the theory of evolution explains the fossil record well. It explains why the deepest and thus the oldest rocks in the fossil record contain the simplest fossils. It explains why later species in the fossil record—the

## *The Web of Evidence for Evolution / Part I*

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fossils in younger rocks—have characteristics that make them look like the descendants of earlier ones. Lastly, it explains why transitional fossils—fossils of species that have characteristics that are typical of an older species and those that are typical of a later one—exist and existed at this particular place and time rather than at that particular place or time.

One of the most spectacular transitional fossils is the species, *Tiktaalik roseae*, which was discovered in 2004 on Ellesmere Island in Nunavut, Canada. Until 390 million years ago (mya), the only vertebrates were fish. However, 30 million years later (360 mya), the earth had become populated by four-footed vertebrates that walked on land called tetrapods. These early tetrapods resembled modern amphibians like frogs and salamanders in that they had flat heads and bodies, a distinct neck, and well-developed legs and limb girdles. However, they also resembled the earlier fishes in that they had scales, limb bones, and head bones.



## BEGINNING

The available evidence suggested that a transitional species—an extinct species that would have had both fish-like and amphibian-like characteristics—would be found in rocks formed 375 mya between the 390 mya fish-only and the 360 mya amphibian-only rocks. This prediction was confirmed with the discovery of *Tiktaalik roseae* in rocks formed 375 mya, and not in rocks formed 400 mya or 350 mya.

*Tiktaalik* was an animal that had gills, scales, and fins that allowed it to live in water. In this way, it was fish-like. However, it also had amphibian-like traits including sturdy ribs that helped the animal to pump air into both its lungs and its gills. Interestingly, it also had limbs that are part fin, part leg, that allowed it to push itself up. It also had a neck, which fish do not have: Their skulls are linked directly to their shoulders. Together, these traits suggested that *Tiktaalik* was adapted to live and to crawl in shallow waters, and to peer above the water surface and to breathe air.

The theory of evolution is the best explanation we have for the characteristics and the timing of the fossils found in the rocks of our planet.

**Objection:** Critics of evolutionary theory often raise several objections when confronted by the fossil record. Most prominently, they point to instances in the fossil record where new species appear “instantaneously” in the rocks.

The most striking example of this is the Cambrian explosion which began around 540 mya. Prior to the Cambrian explosion, most organisms were simple cell-like creatures that may have been organized into colonies. After the Cambrian explosion—a relatively short period of 70 or 80 million years—numerous complex multi-cellular organisms that are representative of all the major animal kinds today were found in the fossil record. Critics argue that evolutionary theory cannot explain the rapid and apparently unprecedented appearance of these animal kinds.

It is clear that we still do not understand the Cambrian explosion completely. However, in response to this objection, I would observe that animal fossils from before the Cambrian, called the Ediacarans, have been found suggesting that the animals of the Cambrian did not appear without precedent. Moreover, a study of the Cambrian fossils of the arthropods, the animal kinds that include insects, spiders, and lobsters, shows that the Cambrian rates of evolution were within the boundaries of normal evolutionary processes. In sum, this suggests that the Cambrian explosion is not beyond the explanatory power of the theory of evolution. **T&E**

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