What does the fossil record show?

Fossils provide a unique view into the history of life by showing the forms and features of life in the past. Fossils tell us how species have changed across long periods of the Earth’s history. For instance, in 1998, scientists found a fossil showing an animal at the transition from sea creature to land creature. This tetrapod (animal with four limbs) had a hand-like fin, confirming a prediction of evolutionary biology. Though the fossil record does not include every plant and animal that ever lived, it provides substantial evidence for the common descent of life via evolution. The fossil record is a remarkable gift for the study of nature.

Evidence of Gradual Change

Organisms have changed significantly over time. In rocks more than 1 billion years old, only fossils of single-celled organisms are found. Moving to rocks that are about 550 million years old, fossils of simple, multicellular animals can be found. At 500 million years ago, ancient fish without jawbones surface; and at 400 million years ago, fish with jaws are found. Gradually, new animals appear: amphibians at 350 million years ago, reptiles at 300 million years ago, mammals at 230 million years ago, and birds at 150 million years ago.1 As the rocks become more and more recent, the fossils look increasingly like the animals we observe today.

The Transition to Land: Sea Creatures to Land Animals

Fossils of land animals, or tetrapods, first appear in rocks that are about 370 million years old. In older rocks, only sea creatures are found. But in 1998, scientists found a fossilized fin, 370 million years old, with eight digits similar to the five fingers humans have on their hands, as shown in Figure 1. However, the fin was undoubtedly that of a fish, which means this fossil is strong evidence of a transitional form.

One of the great success stories in the examination of the fossil record was the finding of a near-perfect fossilized transition between a vertebrate (animal with a backbone) adapted for water and one adapted for land. Evolutionary biologist Neal Shubin set out to find a more complete transitional specimen than the 1998 fin. He determined the exact age of rock that he expected would yield a transitional land/water animal, and then he and his team spent four summers in the Arctic scouring rocks of that age to find one. The results (see Figure 2 below) were spectacular.
From Reptiles to Mammals
Mammals first appeared in the fossil record about 230 million years ago, nearly 70 million years after reptiles first appeared. One group of reptiles, the cynodonts, first appeared about 260 million years ago and became increasingly mammal-like in more recent fossils—about 245 million years ago. This change can be seen most clearly in the bone structure of the ear, as illustrated in Figure 3.

Figure 3: As shown in the image above, transitional fossils of cynodonts had two jaw hinges. These fossils date from a time when the dentary and squamosal bones were beginning to take over the role of jaw hinge (hinge #2). This allowed the articular and quadrate bones to evolve into the second and third bones of the mammalian ear, as shown on the right. Source: Image used by permission from Falk, Coming to Peace, 119. Originally from F. H. Pough, J. B. Heiser, and W. N. McFarland, Vertebrate Life, 4th ed. (Upper Saddle River, NJ: Prentice Hall, 1996), 607.
Scientists found a species of cynodonts, dating to just before the emergence of mammals that had a double jaw hinge like that of a mammal. A pair of bones found in even earlier cynodont fossils seems to have transitioned slowly into the ear. No other fossils have been found that share a similar structure to the transitional cynodonts and date back before the time of mammals. Likewise, soon after mammals appeared, these cynodonts became extinct. This timing implies that the cynodont fossils record the transition from reptiles to mammals.

Transitional Forms: Few and Far Between
Transitional forms occur just when one might expect to see a change from one body type to another. However, a common objection is that few transitional fossils have been discovered; thus many lineages cannot be traced smoothly.

There are several reason for these gaps in the fossil record. First, fossilization is a very rare event. Plus, transitional species tend to appear in small populations, where rapid changes in the environment can provide a stronger evolutionary drive. Finally, because fossilization itself is a rare event, smaller populations are sure to produce fewer fossils. The fact that transitional species have been found at all is remarkable, and it offers further support of gradual, evolutionary change.

Questions –

1. Between this article and the foldable completed at the beginning of this unit you have seen multiple examples of fossil evidence of evolution, give one example and explain what key features were discovered through those fossils.

2. Why are fossils so rare, and why is it difficult to find an evolutionary trail of fossil species leading from a common ancestor?

Video – Watch the video at this link, http://goo.gl/CgaezT.

On your Evidence for Evolution worksheet, write a 3 – 5 sentence summary explaining how fossils are considered evidence for evolution.