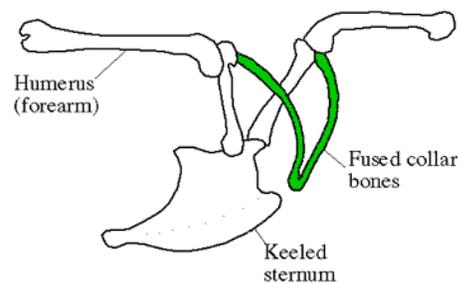




To understand how the ability of birds to fly has evolved we must first understand what birds evolved from. Birds evolved from small theropod dinosaurs. Theropods were bipedal which meant that they used their two back legs for walking. Theropod dinosaurs were very large at first but after 12 separate mutations they became Archaeopteryx. During the Jurassic period, the first bird to be known was the Archaeopteryx. This was discovered by paleontologists in the early 1860's. These birds had thin feathers on their arms, tail, head, neck and body which provided them with insulation. The Archaeopteryx is a close link between reptiles and birds because they had teeth and long bony tails which birds don't have but they were fully covered in feathers like birds and had hollow bones. The feathers had different colours and patterns on them which could've been used for various reasons such as display and camouflage so they could hide from predators or sneak up on their prey.

In theropods, there were many new types of feathers discovered. Some feathers were branched and downy and some theropods evolved a central stalk that had unstructured branches coming out of it and its base. Other theropods had vane like structures and they had well organized barbs, locked together by barbules which is identical to birds now. The function of these feathers was mostly to warm the eggs in their nest and protecting them by shielding them from harm. The oviraptorosaurs' feathers became very long on its arms and hands and its forelimbs were short. The long feathers under their arms helped them when they leaped into the air to catch prey by producing thrust. This is how wings started to form on feathered theropods. They also evolved because theropods began to flap their arms in order to assist them when jumping high. When wings started to get larger, they used them to escape from their predators but to also keep others off their territory.



During the time where theropods were evolving into birds, there were changes in the number of digits they had. Digits represented each finger. So, at first, they had 5 digits. The fourth and fifth digits were smaller than the rest of the digits and the third digit was the longest. The coelophysoids dinosaur lost the fifth digit, so it only had four digits remaining. The second and third digit were similar in height and the fourth was the smallest. The allosaurids lost the fourth digit and the second digit became longer than the third and first. In the tyrannosauroids, the third digit reduced. In the Archaeopteryx the wrist bones beneath the first and second digit merged and became semicircular. This allowed its hand to move sideways and go against the forearm which gave the birds more thrust to fly. Another change that happened to the

archaeopteryx is that the forelimbs became longer than the hind limb which gave them the ability to have a stronger flight stroke.

Over the 65 million years since dinosaurs went extinct, the archaeopteryx continued to evolve in many different ways. Their bones became smaller and hollower which made the size and mass of birds decrease massively but it also helped their flight efficiency. Throughout the years all their teeth were lost and the wishbone became more muscular and complex. All these changes eventually lead to the thousands of different types of birds we have around the world today.