

| Vertebrate Evolution and Ranges | | | | |
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| Converted to GTS2020 age model; Jan'21 | | | | |
| Pop-up windows include hot-links to external sites for additional information | | | | |
| NOTE: Ranges of different selected fossil vertebrates are defaulted OFF (turn ON from within each directory) | | | | |
| Main published source: Dixon, Dougal, et al. (1988) The Macmillan illustrated encyclopedia of dinosaurs and prehistoric animals. Macmillan New York: 312pp. | | | | |
| | | <i>The publisher granted permission to use these images.</i> | | This compilation is a bit dated, but the main trends/ages are generally schematically okay. |
| Vertebrate Evolutionary Tree Overview | | | | |
| This one-column suite summarizes only the main vertebrate groups | | | | |
| SUPER combined vertebrate evolutionary tree | | | | |
| This is a very-large one-column display that combines ALL of the branching-evolutionary diagrams for the main groups listed below. We recommend using "Priority" and "branch on/off" options to collapse tree portions for exploring; or use the separate ones below: | | | | |
| Fish | | | | |
| Ranges of Fossil Fish (selected) | | | | |
| | | <i>Jawless Fish (Agnathans), Cartilaginous Fish (Chondrichthyans), and Spiny Sharks and Armored Fish (Acanthodians, Placoderms)</i> | | The first vertebrates, jawless fish lacked jaws to catch or manipulate prey. They survived by feeding on food particles from the seabed mud and krill from surface water. Agnathans' bodies had a layer of bone covering as their only protection against predators. Cartilaginous Fish (Chondrichthyans) all have skeletons made of cartilage and gristle, and were among the first vertebrates to develop jaws and bony teeth. |
| | | <i>Primitive (Osteichthyans) and Modern Ray-finned Fish (Teleosts), and Lobe-finned Fish (Sarcopterygians)</i> | | Bony fish account for half of all living vertebrates; the prime success story of vertebrate evolution. Class Osteichthyes are the precursors of amphibians, reptiles, birds, and mammals, and 20,000 species of bony fish are known to exist today. |
| Fish Evolutionary Tree | | | | |
| Amphibians | | | | |
| Ranges of Fossil Amphibians (selected) | | | | |
| | | <i>Labyrinthodonts and Temnospondyls</i> | | Labyrinthodonts were the first amphibians, named for the complex, mazelike pattern of the enamel of their teeth. They are thought to have evolved from lobe-finned fish. |
| | | <i>Lepospondyls</i> | | The insectivorous Lepospondyls were contemporary to the target Labyrinthodonts. They are grouped into 3 major orders, Aistopoda, Nectridea, and Microsauria. |
| Amphibians Evolutionary Tree | | | | |
| Reptiles | | | | |
| Ranges of Fossil Reptiles (selected) | | | | |
| | | <i>Early Reptiles (Anapsids)</i> | | Subclass Anapsida were the first reptiles. They all had heavy box-like skulls with no openings aside from nostril and eye sockets. This limited the jaw muscles in that they were confined to a small space, meaning the mouth couldn't be opened wide or shut with any great force. |
| | | <i>Early Diapsids</i> | | Diapsids are a group of reptiles that developed two holes in each side of their skulls, about 300 million years ago during the late Carboniferous period. Wikipedia |
| | | <i>Marine Reptiles of Mesozoic</i> | | |

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| | | | Placodonts and Nothosaurs | | Many groups of reptiles returned to the sea during the Mesozoic Era. The four distinct types are the Placodonts, Nothosaurs, Plesiosaurs, and Ichthyosaurs. Placodonts were the least specialized swimmers. Many had turtle-like shells protecting their backs. The Nothosoaurs were streamlined, fish-eating animals with long necks, bodies, and tails, and webbed feet. |
| | | | Plesiosaurs | | The marine reptiles of Order Plesiosauroidea dominated the seas for over 100 million years. Superfamily Plesiosauroidea had long necks and short heads, feeding on smaller sea creatures. Superfamily Pliosauroidae had short necks and large heads able to bite and swallow larger prey. They were contemporary and lived in the same place, but their disparate designs likely meant they did not compete. |
| | | | Ichthyosaurs | | Ichthyosaurs were giant marine reptiles that resembled dolphins. (from Wikipedia) |
| | | <i>Turtles, Tortoises, and Terrapins (Chelonians)</i> | | | Turtles, tortoises, and terrapins are the sole survivors of the ancient chelonians. They are unique among reptiles, as their entire bodies aside from their heads are encased in a shell. Many can pull their heads and legs into the shell for total protection. |
| | | <i>Lizards and Snakes</i> | | | |
| | | Reptiles Evolutionary Tree | | | |
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| | | Dinosaurs | | | |
| | | Ranges of Fossil Dinosaurs (selected) | | | |
| | | <i>Thecodontians (Early Ruling Reptiles)</i> | | | |
| | | <i>Crocodyles</i> | | | Order Crocodylia are the only survivors of the Archosaurs; and have changed very little from their Triassic forms. However, the earliest Triassic ancestors were mainly land-living carnivores including types that could run on two legs. |
| | | <i>Saurischians</i> | | | Suborder Saurischia ("lizard-hipped" dinosaurs) can be divided into 2 main groups on the basis of what they ate: the flesh-eating Theropods that walked upright on 2 legs, and the plant-eating Sauropods that moved about on all four legs. |
| | | | Theropods (carnivores) | | Suborder Theropoda (flesh-eating dinosaurs) are subdivided into 3 "infraorders" according to size: small, light weight as Infraorder Coelurosauria (meaning "hollow-tailed lizards" referring to the thin-walled hollow bones that made up their tails and most of their bodies), medium with killing claws on hind feet as Infraorder Deinonychosauria (meaning "terrible-clawed lizards"), and large massive Infraorder Carnosauria (meaning "flesh-eating lizards") |
| | | | | <i>Carnivorous dinosaurs -- small (Coelurosaurians)</i> | |
| | | | | <i>Carnivorous dinosaurs -- medium-sized (Deinonychosaurians)</i> | |
| | | | | <i>Carnivorous dinosaurs -- large (Carnosaurs)</i> | |
| | | | Sauropods (herbivores) | | Suborder Sauropodomorpha is largely made up of 4-legged herbivores, and is divided into "infraorders" according to size. "Prosauropoda" ("Before the Sauropods") consists of the smaller types, while "Sauropoda" consists of the more well-known, gigantic, plant eating dinosaurs. |
| | | | | <i>Early herbivorous dinosaurs (Prosauropods)</i> | |
| | | | | <i>Long-necked browsing dinosaurs (Sauropods)</i> | |
| | | <i>Ornithischians</i> | | | Order Ornithischia ("bird-hipped" were exclusively plant-eaters. They can be divided into 4 distant suborders: Ornithomimids ("bird feet") that walked on 2 legs, and the three 4-legged suborders of Stegosauria (with great bony plates on their back), Ankylosauria (with armor-plated skins), and Ceratopsians (with horns on their heads) |
| | | | Ornithomimids (bird-hipped plant-eaters) | | Suborder Ornithomimids "Bird Feet" consists of animals that walked on 2 legs, and may have been Ancestral to other ornithischian dinosaurs. |
| | | | | <i>Fabrosauria, Heterodontosauria, Pachycephalosauria</i> | |
| | | | | <i>Hypsilophodonts</i> | |
| | | | | <i>Iguanodonts</i> | |

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| | | | Hadrosaurs (duck-billed dinosaurs) | | This family of the plant-eating bird-hipped dinosaurs (Ornithopods) were the crowning group of Late Cretaceous from Asia-Europe to North America. Their common feature is an elongated, broad, flattened snout with a toothless beak; hence the name "Duck-billed". |
| | | | Stegosaurs (armored dinosaurs) | | Suborder Stegosauria was characterized by massive bodies with bony plates lining the back. These heavy quadrupeds also possessed spiked tails for defense. Suborder Ankylosauria were more heavily armored, with plates covering their entire backs and flanks, and used massive, bony tail clubs for defense. |
| | | | Ankylosaurs (armored dinosaurs) | | Suborder Ankylosauria, with their armor of flat, bony plates embedded in leatherly skin, eventually replaced the Stegosaurs. The two main groups were Nodosuurs with long spikes projecting from their flanks and Ankylosaurs themselves with a heavy "club" of solid bone at the ends of their tails. |
| | | | Ceratopians (horned dinosaurs) | | Suborder Ceratopia were the last ornithischian dinosaurs to survive before the Late Cretaceous Mass Extinction. They were well-armored by a bony frill at the backs of their skulls and many possessed massive horns for defense. |
| | | <i>Flying reptiles (Pterosaurs)</i> | | | Order Pterosauria ("winged dinosaurs") evolved in Late Triassic, thrived in Jurassic and Early Cretaceous to include the largest flying creatures of all time. Suborder Rhamphorhynchoidea became extinct at end-Jurassic; Suborder Pterodactyloidea overlapped in Late Jurassic and only a few types survived to end-Cretaceous. |
| Dinosaurs Evolutionary Tree | | | | | |
| Birds | | | | | |
| Ranges of Fossil Birds (selected) | | | | | |
| | | <i>Early and Flightless Birds</i> | | | This group contains Subclass Archaeornithes, of which Archaeopteryx lithographica is the only known member, Subclass Odontornithes ("Toothed Birds") which were quite similar to modern birds, except for the small, pointed teeth that gave them their name, and Neornithes ("New Birds") which includes all recent species. |
| | | <i>Water and Land Birds</i> | | | Within Subclass Neornithes, Order Ciconiiformes (modern shorebirds), Order Gruiformes (the ancestors of modern cranes, rails, moorhens, coots, etc.), and Order Anseriformes (ancestors of modern waterfowl such as ducks, geese, etc.) dominated the evolution of birds, and their descendants make up the vast majority of modern birds. |
| Birds Evolutionary Tree | | | | | |
| Mammal-like Reptiles | | | | | |
| Ranges of Fossil Mammal-like Reptiles (selected) | | | | | |
| | | <i>Pelycosaurs</i> | | | Order Pelycosauria were the earliest synapsid, or mammal-like, reptiles. They began as small, lizard-like animals, but quickly adapted to heavier builds, stronger jaws, variegated teeth, and various sizes. |
| | | <i>Therapsids</i> | | | The therapsids were more advanced synapsid reptiles; direct ascestors of mammals. They branched off from the pelycosaurs sometime around the Early Permian. |
| Mammal-like Reptiles Evolutionary Tree | | | | | |
| Mammals | | | | | |
| Ranges of Fossil Mammals (selected) | | | | | |
| | | <i>Primitive Mammals</i> | | | Subclass Prototheria make up the most primitive of the first mammals, directly descended from synapsid reptiles. Subclass Theria represent the majority of fossil mammals and their living relatives. |
| | | <i>Marsupials</i> | | | Order Marsupialia evolved during the Late Cretaceous. They give birth to very small and immature young, which are suckled in a pouch and mature outside the mother's body, unlike most other mammals. |
| | | <i>Glyptodonts - sloths - armadillos - anteaters (cohort Edenta)</i> | | | The mammals of Cohort Edenta ("No Teeth") are represented today by antaters, tree sloths, and armadillos. Despite what their name suggests, only anteaters are truly toothless. The orogin of the edentates, as well as their relationship with other mammals, remains unknown. |
| | | <i>Insectivores and Creodonts</i> | | | Insectivores include a wide variety of orders, including Anagalida (rabbit-like, digging mammals), Dermoptera (gliding mammals related to bats and primates), Chiroptera (bats), Leptictida (primitive shrewlike mammals), and Lipotyphla (hedgehogs, moles, solendons). Order Creodonta represent early flesh-eating mammals. |

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| | | <i>Order Carnivora</i> | | | Order Carnivora includes cats, civets, and mongooses, dogs, bears, and pandas, stoats, weasels, and otters, seals, sealions, and walruses. Carnivores have a specially adapted pair of carnassial teeth for slicing and tearing flesh, sharp incisors for holding prey, and large, pointed canines to deliver the killing bite. The 2 major suborders are Fissipeda ("Split Feet") and Pinnipedia ("Fin Feet") |
| | | <i>Early Rooters and Browsers</i> | | | The early rooters and browsers were a diverse group of ungulates (hoofed animals), most of which ate leaves, shoots, and roots. |
| | | <i>Oreodonts and Early Horned Browsers</i> | | | The even toed ungulates of Suborder Tylopoda stand midway between suines (pigs, peccaries, and hippopotamuses) and pecorans (giraffes, deer, and cattle). Their only surviving relatives are camels, llamas, and their close relatives. |
| | | <i>Elephants and Mastodonts and Mammoths</i> | | | African and Indian elephants are the only surviving members of Order Proboscidea, a once widespread and diverse group. Their evolution had them grow progressively more massive, developing specialized pillar-like legs to bear their enormous weight. Their trademark trunks were originally an adaptation to allow a tall, short-necked animal to reach high vegetation. |
| | | <i>South American Hoofed Mammals</i> | | | South America during the Tertiary period was home to a diverse and strange collection of mammals, much as Australia is today, and for many of the same tectonic and ecological reasons. These specialized creatures were descendants of marsupials, primitive edentates, and some early rooting and browsing ungulates. |
| | | <i>Odd-toed Ungulates (horses, tapirs, etc.)</i> | | | The first of the two main groups of ungulates aside from primitive rooters and browsers are Perissodactyla ("odd-toed") ungulates, which are represented today by horses, rhinoceroses, and tapirs. |
| | | <i>Even-toed Ungulates (pigs, sheep, camels, etc.) and Whales</i> | | | The second main groups of ungulates are the even-toed Artiodactyla, which include modern deer, sheep, goats, cattle, pigs, giraffes, hippopotamuses, camels, and llamas. |
| | | <i>Primates</i> | | | Order Primates is divided into Suborders Prosimii and Anthropeida. Prosimians form a group that includes early insectivore-like creatures, fossil and modern leumurs, lorises, and tarsiers. |
| Mammals Evolutionary Tree | | | | | |
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| Humans | | | | | Main sources = Primate Fossil Record (Cambridge Univ Press; 2002); Tattersall & Schwartz (Evolution of Genus Homo; Ann. Rev. Earth & Planet. Sci., 2009); Australian Museum website; NOVA Human evolution website; Smithsonian website |
| | | Tool intervals (3 Ma, generalized) | | | |
| | | <i>Paleo-Neolithic</i> | | | |
| | | <i>Tool cultures</i> | | | |
| | | <i>Europe tool cultures (Late Paleolithic)</i> | | | |
| Main Homo and Australopithecus species ranges (6 Ma) | | | | | |