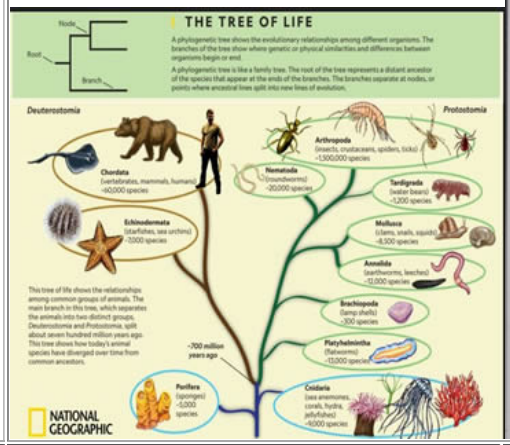
HOME.....

EVOLUTION

This is a page I have put this page together to give me convenient access to information on this subject.

My books on evolution





	Introduction	Evolutionary trees	Evidence for evolution		For expanded view of this Click here
	History of the idea of evolution	Clades	First public announcement		
	Lamarck Lyell Hooker Wallace Darwin		Useful Wikipedia links		

Introduction

The Earliest Life

The age of the Earth is about 4.5 billion years and the earliest life on Earth dates from at least 3.5 billion years ago. Evolution does not attempt to explain the origin of life but it does explain how early lifeforms evolved into the complex life that we see today. Based on the similarities between all present-day organisms, all life is assumed to have originated from a 'last universal ancestor' from which all known species have arisen through evolution.

Evolution

Living creatures reproduce and become more numerous, but predation and

Natural selection is a cornerstone of modern biology. The concept, published by Darwin and Alfred Russel Wallace in a joint presentation of papers in 1858, was elaborated in Darwin's influential 1859 book *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*. He described natural selection as analogous to artificial selection, a process by which animals and plants with traits considered desirable by human breeders are systematically favoured for reproduction. The concept of natural selection originally developed in the absence of a valid theory of heredity; at the time of Darwin's writing, science had yet to develop modern theories of genetics. The union of traditional Darwinian evolution with subsequent discoveries in classical genetics

competition work against the survival of individuals. Individual differs from their parent(s) in minor, random ways due to mutations in their DNA. When these differences (traits) are beneficial, the offspring are more likely to survive and reproduce. If the differences are detrimental there will be less chance of survival.

Natural Selection is the result of this process resulting in changes within the population. When the population of a species is sufficiently different from the parent popultion they will be called a different species, a characteristic of this being that the two ppulations do not interbreed.

Sexual selection occurs when some traits are actively preferred by mating partners. Females may also prefer traits that confer the lowest cost to their reproductive health, which is known as Fecundity selection.

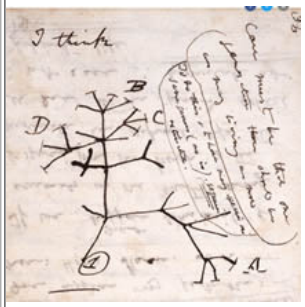
formes the modern synthesis of the mid-20th century.

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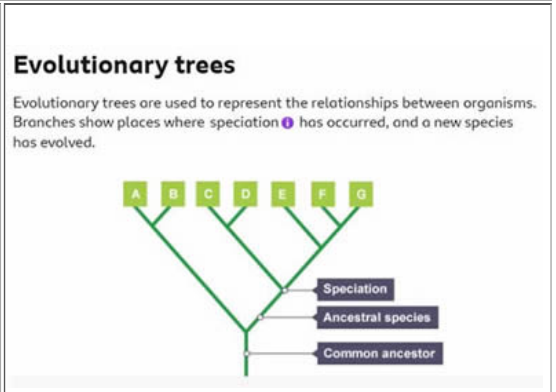
Evolutionary trees (Phylogenetic trees)

The only illustration in Darwin's *Originn of Species* is his 'Tree of Life', first drawn in his account of the *Voyage of the Beagle*. In this evolutionary tree, species A and B share a recent common ancestor. Species A is therefore most similar to species B. Species F and G also share a recent, common ancestor, however this common ancestor is different to the common ancestor of A and B. The common ancestor of F and G shared a common ancestor with species E. All seven species share a common ancestor at the bottom of the tree, probably from the distant past.

Go to more evolutionary trees

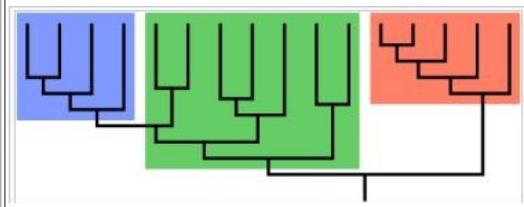


Darwin's Tree of Life



Clades, cladograms and cladistics

An alternative way of representing evolutionay relationships is to use a Cladogram. A clade is a group of organisms that is composed of a common ancestor and all of its descendants. Clades are the fundamental unit of cladistics, a modern approach to taxonomy adopted by most biological fields.



A Cladogram illustrating the relationships of organisms within groups known as clades. The vertical line at the bottom represents the last common ancestor. The blue and red groups are clades, each defined by a common ancestor stem at the base of its subgroup (branch). The green subgroup alone is not a clade; it is a paraphyletic group relative to the blue subgroup because it excludes the blue branch which shares the same common ancestor. Together the blue and green groups form a clade.

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Brief summary of the evidence for evolution

The Fossil Record: There is a chronological progression: deeper rock layers consistently display simpler, ancient organisms, while higher strata show a progression toward modern species. Transitional fossils like Archaeopteryx (dinosaur to bird) and Tiktaalik (fish to tetrapod) indicate the structural transitions between major animal groups.

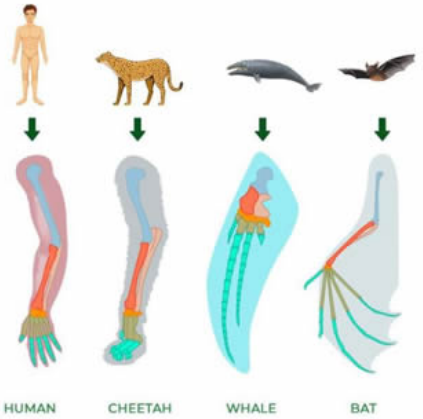
Molecular Biology and Genetics: All organisms share the same DNA, biochemical organisation and genetic code. Organisms that are closer on the family tree share significantly higher degrees of DNA sequence and protein similarity. The chronology created by this method matches the chronolgy by other methods. The presence of inactive "junk" DNA fragments that are shared between related species, undergoing gradual mutation and degeneration, points to shared ancestors.

Comparative Anatomy and Embryology: Different species share homologous structures—like the bone structures in a frog's foot, a human hand and arm, a bird's wing, and a whale's flipper—because they inherited them from a common ancestor.

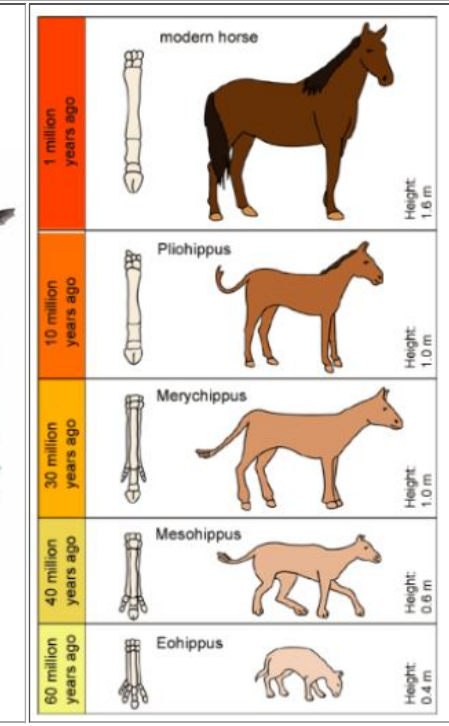
Some species have vestigial structures such as flightless beetle wings or human tailbones, that serve little to no purpose but match functioning parts in related species.

There are striking similarities in the early embryo stages of widely different species, revealing a shared genetic blueprint. For example all vertebrate embryos share pharyngeal arches during early development. In fish they become gills, in humans they do not.

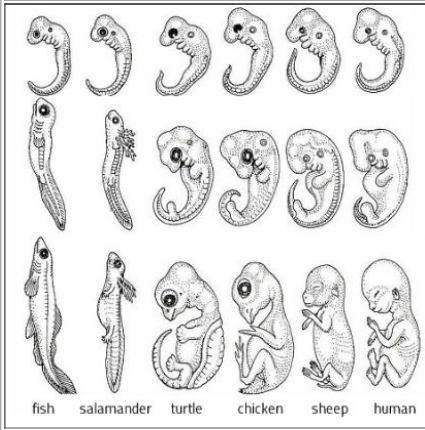
Geographical Distribution: The global distribution of unique plants and animals is best explained by plate tectonics and evolution rather than random placement. Remote islands often feature distinct species that adapted over generations from a single mainland ancestor (adaptive radiation).



From Comparative anatomy



From the fossil record



From Embryology

Animal	Number of Amino Acid Differences Compared to Human Cytochrome C	Animal	Number of Amino Acid Differences Compared to Human Cytochrome C
Horse	5	Shark	14
Chicken	7	Turtle	8
Tuna	11	Monkey	1
Frog	9	Rabbit	4

From DNA / Protein record; in this example using cytochrome c

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History of the idea of evolution; the lives and contributions of Jean-Baptiste Lamark, Charles Lyell, Joseph Hooker, Alfed Russel Wallace and Charles Darwin

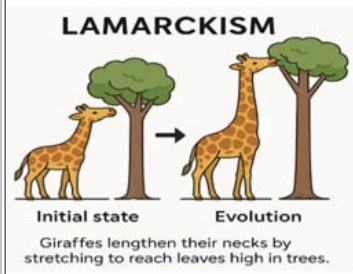
Jean-Baptiste Lamarck 1744 - 1829

Lamarck was a French naturalist, biologist, academic, and soldier. He was an early proponent of the idea that biological evolution occurred and proceeded in accordance with natural laws. He fought in the Seven Years' War against Prussia. Posted to Monaco, Lamarck became interested in natural history. He retired from the army to study medicine. He developed a particular interest in botany, and after publishing *Flore française* in 1778, he gained membership of the French Academy of Sciences and became involved in the Jardin des Plantes and was appointed to the Chair of Botany. When the French National Assembly founded the Muséum national d'Histoire naturelle in 1793, Lamarck became a professor of zoology.

In 1801, he published *Système des animaux sans vertèbres*, a major work on the classification of invertebrates, a term which he coined. In an 1802 publication, he became one of the first to use the term "biology" in its modern sense.

In 1809, Lamarck published his monumental *Philosophie zoologique* (Zoological Philosophy) putting forth the first comprehensive, systematic theory of biological evolution, asserting that organisms pass down physical traits acquired or modified during their lifetime to their offspring. This theory is also called soft inheritance, use/disuse theory, or Lamarckism. This is the historical evolutionary theory that an organism can pass on physical traits or modifications acquired during its lifetime to its offspring. In his time it was accepted by many natural historians. His idea of use/disuse later aligned with Darwin's idea of natural selection and is believed to have in part inspired Darwin. Lamarck's contribution to evolutionary theory consisted of the first cohesive theory of biological evolution, in which a complexifying force drove organisms up a ladder of complexity, and a second environmental force adapted them to local environments through use and disuse of characteristics, differentiating them from other organisms. Scientists have debated whether advances in the field of transgenerational epigenetics mean that Lamarck was to an extent correct, or not.





Caricature of Lamarck's idea

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Charles Lyell. His *Principles of Geology* (1830 – 1833) was the vital catalyst for the theory of evolution. It had a huge influence on Darwin and Wallace who both took this with them on their ground-breaking explorations. Building on the earlier ideas of James Hutton, Lyell argued that the Earth's crust was not formed by sudden, violent, supernatural catastrophes. Instead, he proved that geological features are the result of ordinary, slow, and continuous natural forces—such as wind, rain, erosion, earthquakes, and volcanic activity—operating at the same intensity today as they did millions of years ago. Darwin effectively applied Lyell's gradualist framework for geology to biological organisms.



Charles Lyell

Joseph Dalton Hooker. His relationship with Charles Darwin was one of the most significant and influential friendships in the history of science. Hooker, a brilliant botanist and eventual director of the Royal Botanic Gardens at Kew, was Darwin's closest friend and greatest scientific ally. Over a span of 40 years, the two men exchanged about 1,400 letters, forming a deep intellectual and personal bond. The professional relationship truly began in 1843 when Darwin returned from his voyage on HMS Beagle. He transferred his plant collection to Hooker, whose precise taxonomic classification of the Galápagos flora provided Darwin with critical empirical evidence regarding geographic distribution and variation. Darwin was deeply hesitant to share his radical ideas about evolution with the scientific community. But in 1844, he wrote to Hooker, admitting his belief in the "transmutation of species". In the letter, Darwin noted that this was "like confessing a murder." Hooker responded with interest, sympathy, and constructive criticism, providing Darwin with the safe intellectual space he needed to refine his theory.



Joseph Hooker

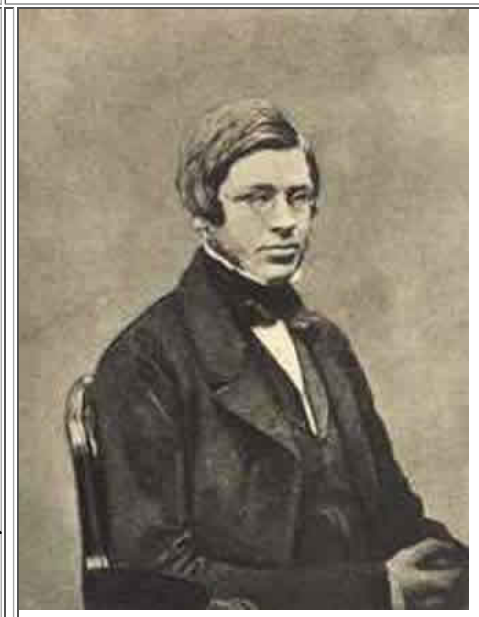
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Alfred Russel Wallace (1823–1913)

Wallace was a visionary British naturalist, explorer, and geographer who independently conceived the theory of evolution by natural selection. He made major contributions to biology and geography that remain critical today. He was a professional collector of insects, birds, and all other animals. He travelled extensively in South America (1848 – 1852) and the Malay Archipelago (1854–1862). He successfully brought back more than 125,000 specimens from Southeast Asia, identifying thousands of new species.

His *Sarawak Law* refers to a landmark evolutionary principle published in his 1855 paper, "On the Law Which Has Regulated the Introduction of New Species"."Every species has come into existence coincident both in space and time with a pre-existing closely allied species." For the original paper Click here; For a full discussion Click here.
The law explicitly stated that new species evolve directly from pre-existing, closely related ones rather than being created independently. However, at this stage, Wallace had not yet identified how this happened (he develped the mechanism of natural selection three years later in 1858).

While working near Bali he noted that species to the east were similar to other eastern species whereas those in islands only 15 miles west were very different, resembling those of western regions. We now know that this area is where three tectonic plates converge - so the separation of the areas in which he was collecting had been previously great distances apart.





He pioneered research into warning coloration in animals and developed the "Wallace effect," which explains how natural selection contributes to speciation by creating barriers against hybridisation.

He wrote extensive notes on his ideas leading to his idea of Natural Selection and had started preparations for a book on the subject - a parallel Origin of Species

Wallace in 1848 at age 25	Wallace on return from the East in 1862

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Charles Darwin (1809–1882)

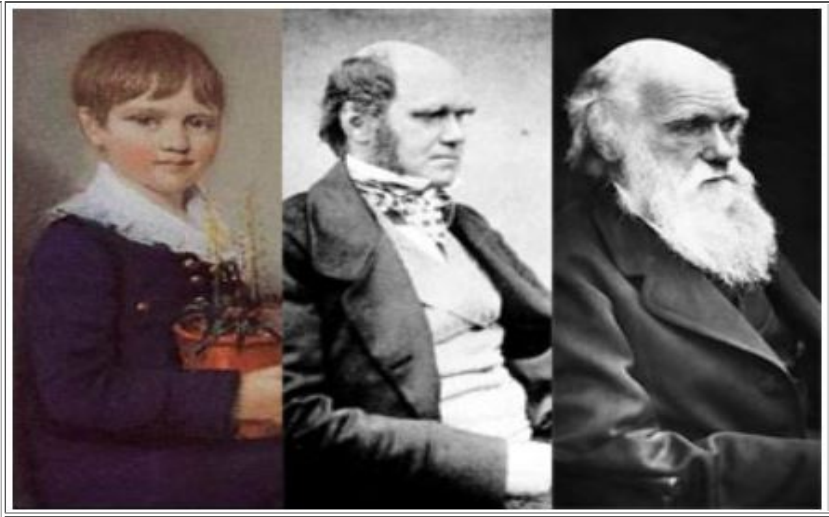
Charles Robert Darwin was an English naturalist, geologist, and biologist widely known as the architect of the theory of evolution by natural selection. His seminal work, *On the Origin of Species*, fundamentally transformed the scientific understanding of life on Earth by establishing that all species evolve through a process of common descent. Note; Alfred Russel Wallace was the 'co-proposer' of the theory but Darwin's publication of *The Origin of Species* made him the centre of attention and of future work on the subject.

He was born in Shrewsbury, England, into a wealthy and well-connected family. His father pushed him to study medicine at the University of Edinburgh, but Darwin found surgery distasteful. He transferred to Christ's College, Cambridge, to prepare for a career as an Anglican clergyman, graduating in 1831. However, his true passion remained in natural history and entomology.

In 1831 at the age of 22, Darwin joined a five-year global surveying expedition aboard the HMS Beagle. He spent years exploring the coastlines of South America and isolated archipelagos, most famously the Galápagos Islands. He was especially interested in variations in wildlife—such as the differing beak shapes of his collection of Galápagos finches—and he began questioning how species originate.

By 1838, Darwin formulated his concept of natural selection: organisms with traits better suited to their environment are more likely to survive and reproduce. He spent over 20 years quietly gathering evidence and In 1858, his theory of Natural Selection together with Wallace's paper was presented at the Linnean Society. The next year he published *On the Origin of Species*, which became an immediate bestseller and sparked intense international debate. He expanded his theory to humans in *The Descent of Man* (1871), arguing that humans share common ancestry with apes.

He continued to live a quiet, secluded life at Down House in Kent with his wife Emma, though he was continuously plagued by chronic illness. Darwin died on 19 April 1882. He was granted the exceptional honour of a state burial at Westminster Abbey, reflecting the widespread scientific acceptance of his work by the end of his life.



An indication of the wide range of Darwin's interests and achievements is nicely provided by this chronological list of his major published books:

1839: The Voyage of the Beagle (Journal of Researches)
1842: The Structure and Distribution of Coral Reefs
1844: Geological Observations on the Volcanic Islands
1846: Geological Observations on South America
1851: Monograph on the Sub-class Cirripedia (Barnacles)
1859: On the Origin of Species
1862: On the Various Contrivances by which British and Foreign Orchids are Fertilised by Insects
1865: The Movements and Habits of Climbing Plants
1868: The Variation of Animals and Plants under Domestication
1871: The Descent of Man

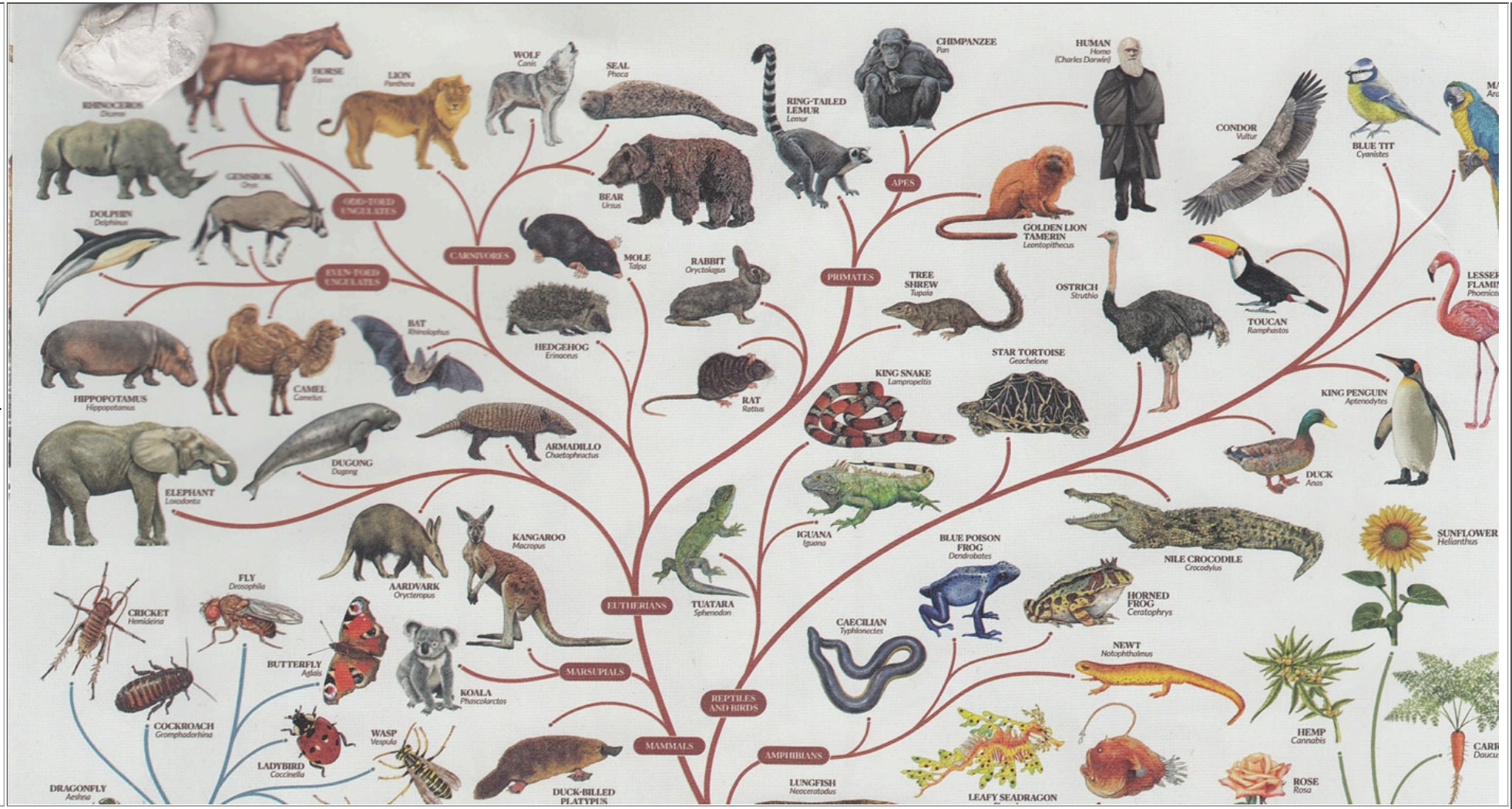
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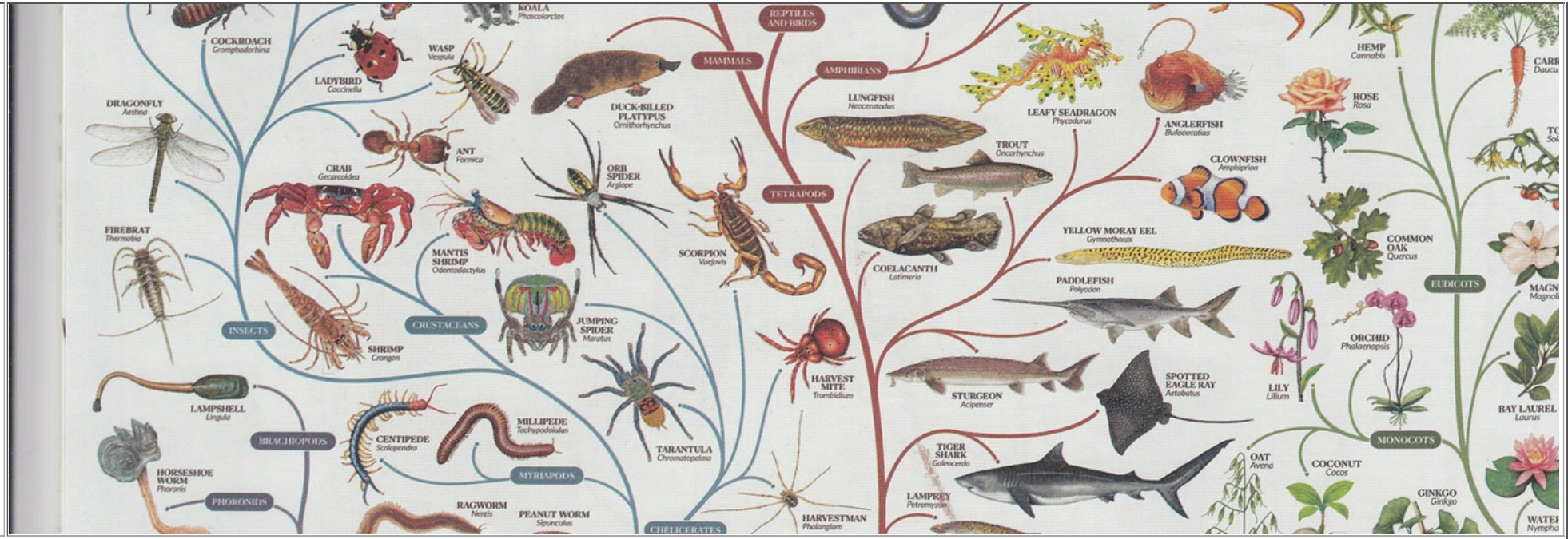
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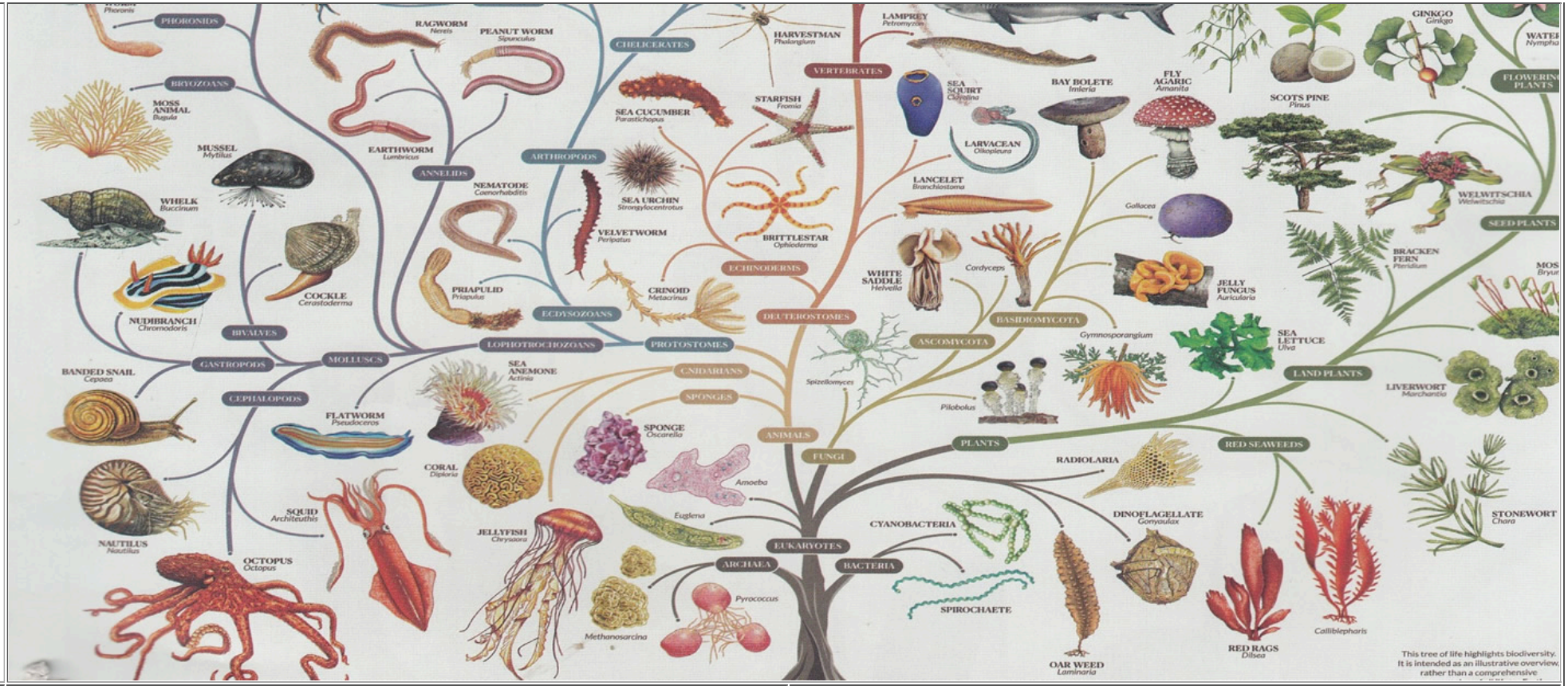
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	The public introduction of the theory of Natural Selection to explain evolution and the origin of species	Useful links from Wikipedia
	Darwin first formulated his core mechanism of natural selection in 1838 after reading Thomas Malthus's Essay on Population. He wrote a brief 35-page sketch in 1842—which was the first time he wrote down the phrase "Natural Selection"—and expanded it into an essay in 1844. He only shared these privately with close confidants like the botanist Joseph Hooker. Early in 1858 Wallace wrote an essay "On the tendency of varieties to depart indefineitely from the original type" aimed mainly at Lyell's anti-evolutionary arguments. About this time he received an encouraging letter from Darwin stating that Wallace's hero, Lyell, admired Wallace's work. This led wallace to send his essay to Darwin with a request that he should forward it to Lyell. Darwin was thrown into a panic. He immediately turned to Joseph Hooker and Charles Lyell for advice. To ensure Darwin did not lose priority for his decades of work, Hooker and Lyell rapidly orchestrated a joint presentation of Darwin's unpublished 1844 writings alongside Wallace's new essay at the Linnean Society. Interestingly, neither Darwin nor Wallace attended the presentation in person. Darwin then published his book On the Origin of Species in November 1859.	Darwin Lamarck Lyell Wallace Hooker Tectonic plates Introduction to evolution The last universal common ancestor World library of science on Darwin Understanding phylogenies and clades Phylogenetic tree of primates What is a clade The 1860 Oxford University evolution debate Evolution; the Modern Synthesis Translational epigenetic inheritance
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S	An excellent introduction to Evolution is the New Scientist Essential guide No. 6 Evolution. An extensive enjoyable survey is given by Richard Dawkins in his book 'The Greatest Show on Earth; The evidence for evolution.	
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	Evolutionary trees. Taken from the BBC poster To increase size press Ctl plus + sign


RHINOCEROS
Diceros
HORSE
Equus
LION
Panthera
WOLF
Canis
SEAL
Phoca
CHIMPANZEE
Pan
HUMAN
Homo
(Charles Darwin)
RING-TAILED LEMUR
Lemur
CONDOR
Vultur
BLUE TIT
Cyanistes
GEMSBOK
Oryx
ODD-TOED UNGULATES
BEAR
Ursus
APES
DOLPHIN
Delphinus
MOLE
Talpa
RABBIT
Oryctolagus
PRIMATES
TREE SHREW
Tupaia
GOLDEN LION TAMERIN
Leontopithecus
OSTRICH
Struthio
TOUCAN
Ramphastos
EVEN-TOED UNGULATES
CARNIVORES
BAT
Rhinolophus
HEDGEHOG
Erinaceus
HIPPOPOTAMUS
Hippopotamus
CAMEL
Camelus
RAT
Rattus
KING SNAKE
Lampropeltis
STAR TORTOISE
Geochelone
KING PENGUIN
Aptenodytes
DUCK
Anas
ELEPHANT
Loxodonta
DUGONG
Dugong
ARMADILLO
Chaetophractus
IGUANA
Iguana
NILE CROCODILE
Crocodylus
SUNFLOWER
Helianthus
AARDVARK
Orycteropus
KANGAROO
Macropus
TUATARA
Sphenodon
BLUE POISON FROG
Dendrobates
FLY
Drosophila
CRICKET
Hemideina
EUTHERIANS
HORNED FROG
Ceratophrys
CAECILIAN
Typhlonectes
NEWT
Notophthalmus
BUTTERFLY
Aglais
KOALA
Phascolarctos
MARSUPIALS
REPTILES AND BIRDS
COCKROACH
Gromphadorhina
HEMP
Cannabis
WASP
Vespula
LADYBIRD
Coccinella
MAMMALS
AMPHIBIANS
DRAGONFLY
Aeshna
DUCK-BILLED PLATYPUS
LUNGFISH
Neoceratodus
LEAFY SEADRAGON
ROSE
Rosa


COCKROACH
Gromphadorhina
LADYBIRD
Coccinella
WASP
Vespula
DRAGONFLY
Aeshna
ANT
Formica
CRAB
Gecarcoidea
FIREBRAT
Thermobia
MANTIS SHRIMP
Odontodactylus
SHRIMP
Crangon
INSECTS
CRUSTACEANS
LAMPSHELL
Lingula
BRACHIOPODS
HORSESHOE WORM
Phoronis
PHORONIDS
CENTIPEDE
Scolopendra
MILLIPEDE
Tachypodoiulus
MYRIAPODS
RAGWORM
Nereis
PEANUT WORM
Sipunculus
KOALA
Phascolarctos
DUCK-BILLED PLATYPUS
Ornithorhynchus
ORB SPIDER
Argiope
SCORPION
Vaejovis
JUMPING SPIDER
Maratus
TARANTULA
Chromatopelma
HARVEST MITE
Trombidium
HARVESTMAN
Phalangium
CHELICERATES
MAMMALS
REPTILES AND BIRDS
TETRAPODS
AMPHIBIANS
LUNGFISH
Neoceratodus
TROUT
Oncorhynchus
COELACANTH
Latimeria
LEAFY SEADRAGON
Phycodurus
ANGLERFISH
Bufoceratias
CLOWNFISH
Amphiprion
YELLOW MORAY EEL
Gymnothorax
PADDLEFISH
Polyodon
STURGEON
Acipenser
SPOTTED EAGLE RAY
Aetobatus
TIGER SHARK
Galeocerdo
LAMPREY
Petromyzon
HEMP
Cannabis
ROSE
Rosa
COMMON OAK
Quercus
EUDICOTS
ORCHID
Phalaenopsis
LILY
Lilium
OAT
Avena
COCONUT
Cocos
GINKGO
Ginkgo
MONOCOTS
BAY LAUREL
Laurus


PHORONIDS
BRYOZOANS
MOSS ANIMAL Bugula
MUSSEL Mytilus
WHELK Buccinum
NUDIBRANCH Chromodoris
COCKLE Cerastoderma
BIVALVES
GASTROPODS
BANDED SNAIL Cepaea
CEPHALOPODS
NAUTILUS Nautilus
SQUID Architeuthis
OCTOPUS Octopus
MOLLUSCS
RAGWORM Nereis
PEANUT WORM Sipunculus
EARTHWORM Lumbricus
ANNELIDS
NEMATODE Caenorhabditis
PRIAPULID Priapulus
FLATWORM Pseudoceros
LOPHOTROCHOZOANS
CHELICERATES
HARVESTMAN Phalangium
SEA CUCUMBER Parastichopus
ARTHROPODS
SEA URCHIN Strongylocentrotus
VELVETWORM Peripatus
ECDYSOZOANS
CRINOID Metacrinus
ECHINODERMS
STARFISH Fromia
BRITTLESTAR Ophioderma
DEUTEROSTOMES
PROTOSTOMES
SEA ANEMONE Actinia
CNIDARIANS
CORAL Diploria
SPONGES
SPONGE Oscarella
JELLYFISH Chrysaora
ANIMALS
Amoeba
Euglena
FUNGI
PLANTS
EUKARYOTES
ARCHAEA
BACTERIA
Methanosarcina
Pyrococcus
CYANOBACTERIA
SPIROCHAETE
LAMPREY Petromyzon
VERTEBRATES
SEA SQUIRT Clavelina
LARVACEAN Oikopleura
LANCELET Branchiostoma
WHITE SADDLE Helvella
Cordyceps
BASIDIOMYCOTA
ASCOMYCOTA
Spizellomyces
Pilobolus
Gymnosporangium
BAY BOLETE Imleria
FLY AGARIC Amanita
Gallacea
JELLY FUNGUS Auricularia
SEA LETTUCE Ulva
LAND PLANTS
RADIOLARIA
DINOFLAGELLATE Gonyaulax
RED SEAWEEDS
OAR WEED Laminaria
RED RAGS Dilsea
Calliblepharis
GINKGO Ginkgo
SCOTS PINE Pinus
WELWITSCHIA Welwitschia
SEED PLANTS
BRACKEN FERN Pteridium
LIVERWORT Marchantia
STONEWORT Chara
This tree of life highlights biodiversity. It is intended as an illustrative overview, rather than a comprehensive

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