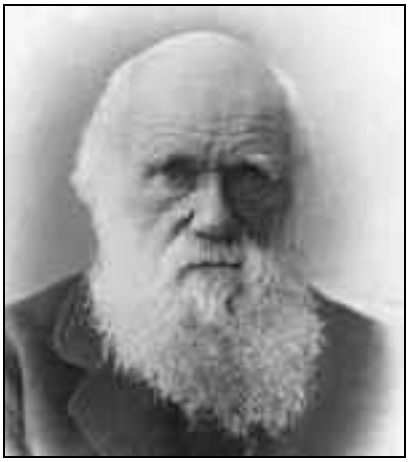
STAB 6133 Filogeni, Kepelbagaian & Taksonomi Kriptogam

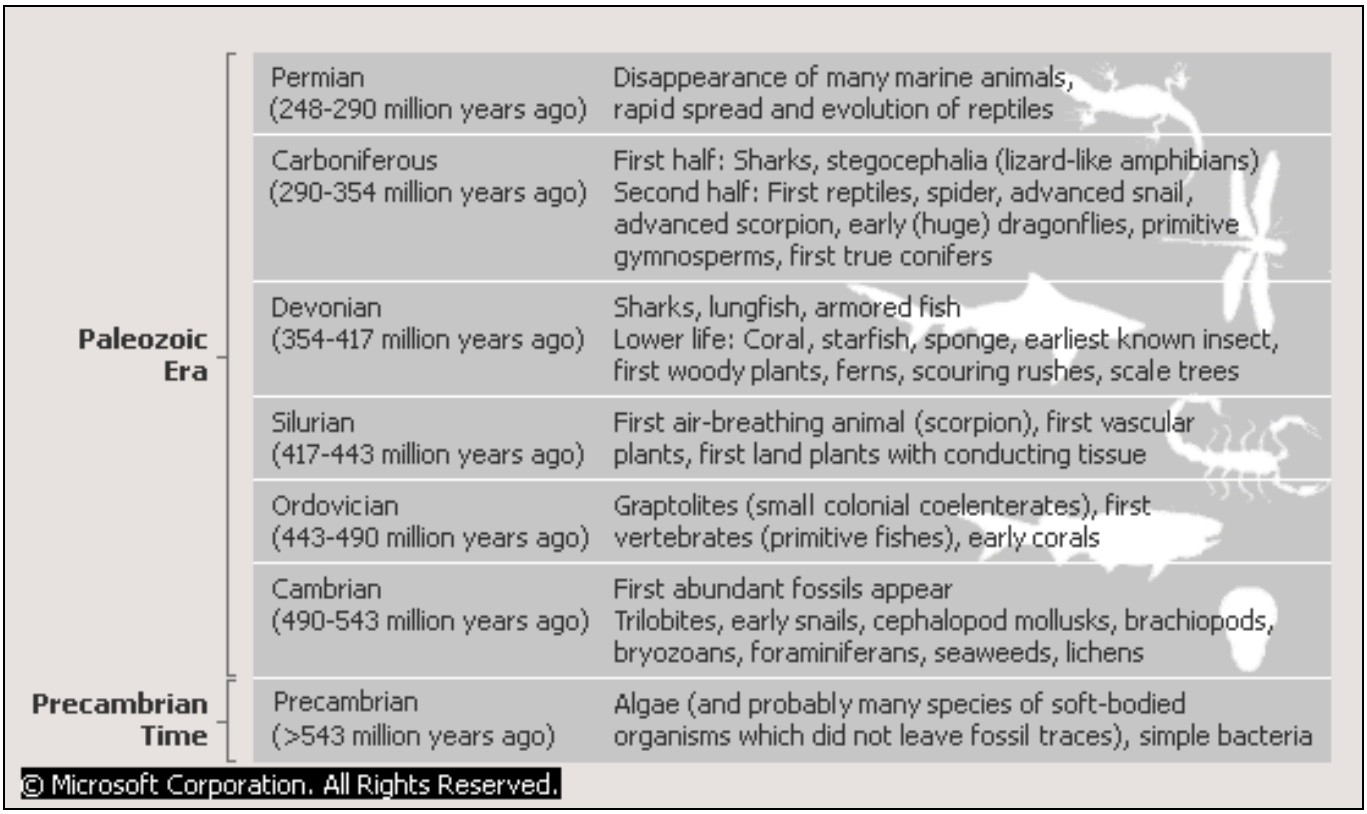
PENGENALAN

- Kepelbagaian tinggi
    - ½ juta tumbuhan dan 1 juta haiwan
    - Belum ditemui sekitar **10 – 30 juta**
- Kepelbagaian dari segi saiz, bentuk dan cara hidup
    - Bakteria seni hingga tumbuhan 100 meter tinggi
    - Air panas hingga ke Antartik
    - **Rumpai laut** di laut dalam hingga **lumut** di Everest
- Hasil proses evolusi
    - **Semua benda hidup mempunyai pertalian darah melalui moyang sempunya**
        - **Charles Darwin**
            - Origin of species (1859)
            - Semua tumbuhan dan haiwan berasal daripada organisma bak bakteria yang hidup **3 bilion tahun** dahulu.



Charles Darwin

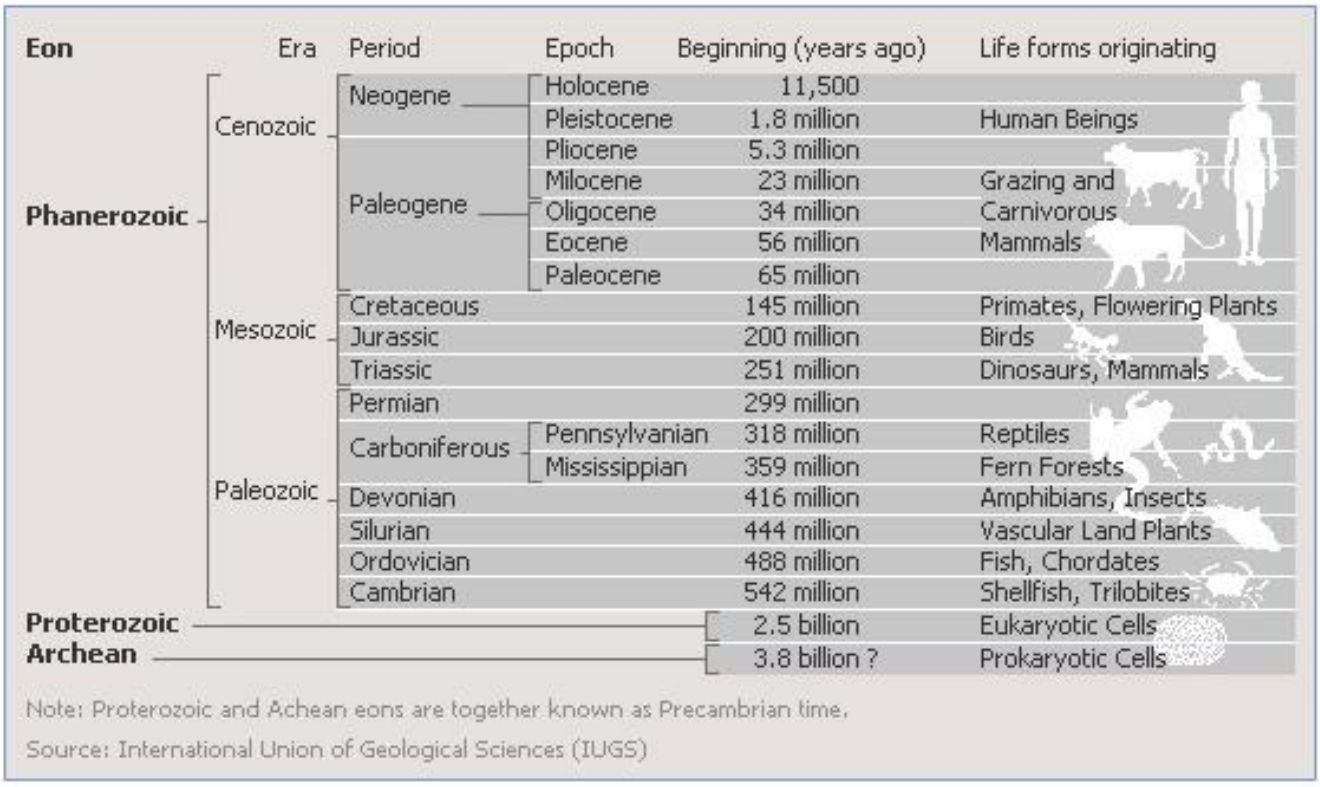
Charles Darwin was greatly influenced by the geologist Adam Sedgwick and naturalist John Henslow in his development of the theory of natural selection, which was to become the foundation concept supporting the **theory of evolution**. Darwin's theory holds that environmental effects lead to varying degrees of reproductive success in individuals and groups of organisms. This revolutionary theory was published in 1859 in Darwin's now famous treatise ***On the Origin of Species by Means of Natural Selection.***



Paleozoic Era	Permian (248-290 million years ago)	Disappearance of many marine animals, rapid spread and evolution of reptiles
	Carboniferous (290-354 million years ago)	First half: Sharks, stegocephalia (lizard-like amphibians) Second half: First reptiles, spider, advanced snail, advanced scorpion, early (huge) dragonflies, primitive gymnosperms, first true conifers
	Devonian (354-417 million years ago)	Sharks, lungfish, armored fish Lower life: Coral, starfish, sponge, earliest known insect, first woody plants, ferns, scouring rushes, scale trees
	Silurian (417-443 million years ago)	First air-breathing animal (scorpion), first vascular plants, first land plants with conducting tissue
	Ordovician (443-490 million years ago)	Graptolites (small colonial coelenterates), first vertebrates (primitive fishes), early corals
	Cambrian (490-543 million years ago)	First abundant fossils appear Trilobites, early snails, cephalopod mollusks, brachiopods, bryozoans, foraminiferans, seaweeds, lichens
Precambrian Time	Precambrian (>543 million years ago)	Algae (and probably many species of soft-bodied organisms which did not leave fossil traces), simple bacteria

Stratigraphic Column

Fossils preserved in rock strata **provide scientists with clues** to evolutionary history. This stratigraphic column is based on paleontological evidence and **shows the order in which organisms appeared** in the fossil-rich Paleozoic era. Each layer represents a particular time frame and shows a representative organism that flourished during that time. Although fossils are rarely found in the idealized and localized fashion shown here, they are often in more or less chronological order. Generally, **the oldest fossils appear in lower layer**s, and **the most recent fossils at the top**, so that placement may be used as an aid in dating the specimens.



Eon	Era	Period	Epoch	Beginning (years ago)	Life forms originating
Phanerozoic	Cenozoic	Neogene	Holocene	11,500	
			Pleistocene	1.8 million	Human Beings
		Paleogene	Pliocene	5.3 million	
			Milocene	23 million	Grazing and
			Oligocene	34 million	Carnivorous
			Eocene	56 million	Mammals
			Paleocene	65 million	
	Mesozoic	Cretaceous		145 million	Primates, Flowering Plants
		Jurassic		200 million	Birds
		Triassic		251 million	Dinosaurs, Mammals
	Paleozoic	Permian		299 million	
		Carboniferous	Pennsylvanian	318 million	Reptiles
			Mississippian	359 million	Fern Forests
		Devonian		416 million	Amphibians, Insects
		Silurian		444 million	Vascular Land Plants
		Ordovician		488 million	Fish, Chordates
		Cambrian		542 million	Shellfish, Trilobites
Proterozoic				2.5 billion	Eukaryotic Cells
Archean				3.8 billion ?	Prokaryotic Cells

Note: Proterozoic and Achean eons are together known as Precambrian time.

Source: International Union of Geological Sciences (IUGS)

Geologic Time Scale

REKOD FOSIL

- **Ahli paleontologi**
  - Organisma pupus – berbeza dari yang hidup sekarang
  - Terdapat sesaran (pergantian) organisma mengikut waktu

Carbonized Leaf

When plants are preserved through carbonization, the oils in the plant gradually **leach out**, leaving a carbon film. The rigid walls of plant cells preserved in this manner **reveal the original cellular structure** of the ancient plant.

Fossilized Trilobites

Although trilobites became extinct about 250 million years ago, their fossilized casts can be found in rock formations. This silica shale formation shows several trilobites. Because these primitive arthropods were typical organisms of the Paleozoic era, a paleontologist may use them to **determine the relative age** of the rock strata.

Marine Fossils

Most types of common marine fossils, buried in shale, limestone, and sandstone and initially laid down in prehistoric seas, are found in coastal areas where the sea is actively eroding cliffs. Many of the **hard-shelled invertebrates and early vertebrate animals** are fairly well represented in the fossil record, while **soft-bodied animals**, such as sea anemones and worms, are poorly represented.

Midge Fly Caught in Amber

Paleontologists can learn about prehistoric life by studying the remains of ancient insects, such as this midge fly, trapped in **tree resin** when they were alive. The resin eventually hardens and fossilizes into **amber**. Occasionally whole organisms are preserved in this manner.

- Kaedah **pengukuran reputan radioaktif** – anggar umur fosil & batu
    - Dunia terbentuk **4.5 bilion tahun** dahulu

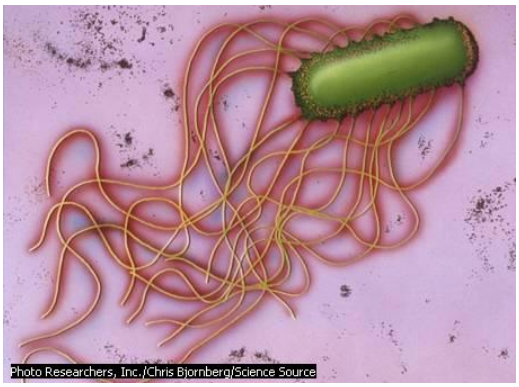
- Fosil yang paling tua
- Organisma seni **bak bakteria** dan **alga biru hijau**
  - Umur sekitar **3.5 bilion tahun**

The Early Earth

Life originated on Earth about **four billion years ago**, when oceans dotted with volcanic islands covered most of Earth's surface and **continents were very small**. The air was **hot** and contained almost **no breathable oxygen**. The **Moon** was much closer to Earth, and a day was less than 15 hours long. Meteorites fell more frequently, and there was more **volcanic activity** than there is today.

Cyanobacteria

Cyanobacteria (formerly blue-green algae) are among the most ancient organisms on Earth. These photosynthetic organisms can be single-celled, connected in a filamentous form as shown here, or arranged in simple colonies. Cyanobacteria are capable of enduring a wide variety of environmental conditions ranging from freshwater and marine habitats to snowfields and glaciers. They are capable of surviving and flourishing even at **extremely** high temperatures.



Bacterium Showing Flagella

Although many forms of bacteria are not capable of independent movement, species such as the *Salmonella* bacterium pictured here can move by means of fine threadlike projections called flagella. The arrangement of flagella across the surface of the bacterium differs from species to species; they can be present at the ends of the bacterium or all across the body surface. Forward movement is accomplished either by a tumbling motion or in a forward manner without tumbling.

The Earliest Animals

The earliest known animals on Earth were a **bizarre collection** of life forms that emerged just prior to and during the Cambrian Period, some of which were exquisitely preserved in fossil beds in various parts of the world. Some of the more extraordinary creatures (depicted in this artist's conception) were the formidable predator *Anomalocaris* (foreground upper right) about to make a meal of *Waptia*, which it holds in its extended claws. Just below *Anomalocaris* and slightly to its left is *Opabinia* using its long, trunklike snout to grasp *Burgessochaeta,* a bristle worm. The fernlike objects (left and center) are actually animals, as are the primitive sponges (center foreground) that resemble a saguaro cactus. The depictions of these fernlike animals are based on a group of fossils known as the Ediacaran fossils and date from about 550 million years ago.

CLASSIFICATION OF ORGANISMS

The classification of living organisms has been controversial throughout time, and these schemes are among those in use today. *Top:* Aristotle's system distinguished only between **plants and animals** on the basis of **movement, feeding mechanism, and growth patterns**. This system groups prokaryotes, algae, and fungi with the plants, and moving, feeding protozoa with the animals. *Center:* The increasing sophistication of laboratory methods and equipment, however, revealed the differences between prokaryotic and eukaryotic cells, prompting a classification system that reflects them. *Bottom:* Most recently, **five kingdoms** have emerged to take both cellular organization and mode of nutrition into account.

- Greek philosopher **Aristotle** (384-322 BC) grouped life forms as either plant or animal. Microscopic organisms were unknown.

PLANTS	ANIMALS
Plants	Animals
Fungi	

- In 1735 Swedish naturalist **Carolus Linnaeus** formalized the use of two Latin names to identify each organism, a system called **binomial nomenclature**. He grouped closely related organisms and

introduced the modern classification groups: kingdom, phylum, class, order, family, genus, and species. Single-celled organisms were observed but not classified.

PLANTAE	ANIMALIA
Plants	Animals
Fungi	

- In 1866 German biologist **Ernst Haecke**l proposed a third kingdom, **Protista**, to include all single-celled organisms. Some taxonomists also placed simple multicellular organisms, such as seaweeds, in Kingdom Protista. Bacteria, which lack nuclei, were placed in a separate group within Protista called Monera.

PROTISTA	PLANTAE	ANIMALIA
All single-celled organisms, such as amoebas and diatoms, and sometimes simple multicellular organisms such as seaweeds.	Plants	Animals

- In 1938 American biologist **Herbert Copeland** proposed a fourth kingdom, **Monera**, to include only bacteria. This was the first classification proposal to separate organisms without nuclei, called **prokaryotes**, from organisms with nuclei, called **eukaryotes**, at the kingdom level.

PROKARYOTES	EUKARYOTES		
MONERA (PROKARYOTE)	**PROTISTA**	**PLANTAE**	**ANIMALIA**
Bacteria	Amoebas, diatoms, and other single-celled eukaryotes, and sometimes simple multicellular organisms, such as seaweeds.	Plants Fungi	Animals

- In 1957 American biologist **Robert H. Whittake**r proposed a fifth kingdom, **Fungi**, based on fungi's unique structure and method of obtaining food. Fungi do not ingest food as animals do, nor do they make their own food, as plants do; rather, they secrete digestive enzymes around their food and then absorb it into their cells.

MONERA (PROKARYOTE)	**PROTISTA**	**FUNGI**	**PLANTAE**	**ANIMALIA**
Bacteria	Amoebas, diatoms, and other single-celled eukaryotes, and sometimes simple multicellular organisms, such as seaweeds.	Multicellular, filamentous organisms that absorb food	Multicellular organisms that obtain food through photosynthesis	Multicellular organisms that ingest food

- In 1990 American molecular biologist Carl Woese proposed a new category, called a **Domain**, to reflect evidence from nucleic acid studies that more precisely reveal evolutionary, or family, relationships. He suggested three domains, **Archaea, Bacteria, and Eucarya**, based largely on the type of ribonucleic acid (RNA) in cells.

	PROKARYOTES			**EUKARYOTES**			
DOMAIN	**ARCHAEA**		**BACTERIA**	**EUCARYA**			
Kingdom	Crenarchaeota	Euryachaeota		Protista	Fungi	Plantae	Animalia
Organisms	Ancient bacteria that produce methane	Ancient bacteria that grow in high temperatures					