

SUPPORTING FACT SHEETS**CONTENTS**

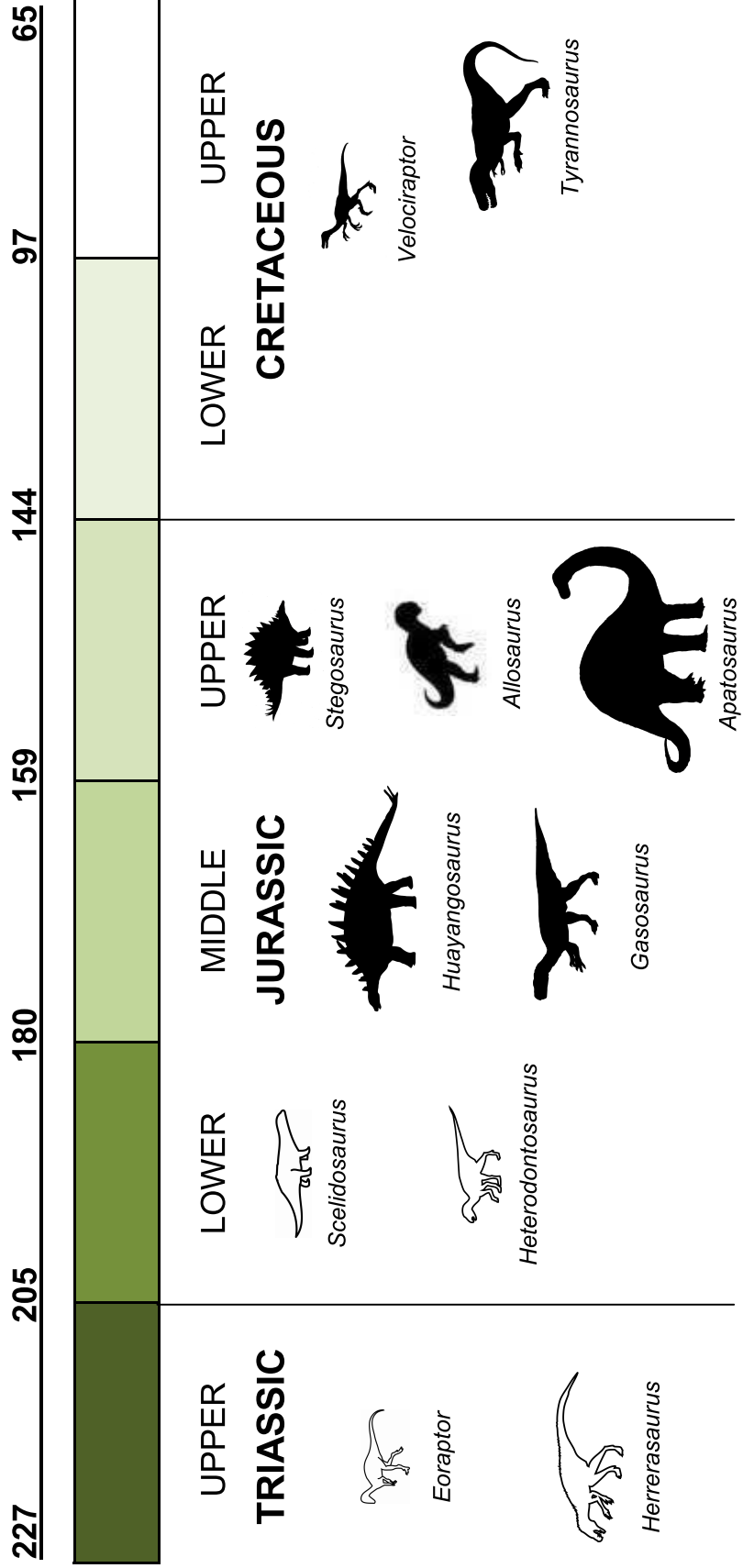
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THE DINOSAUR AGE

DINOSAURS
alive!

timeline

Millions of years ago (mya)



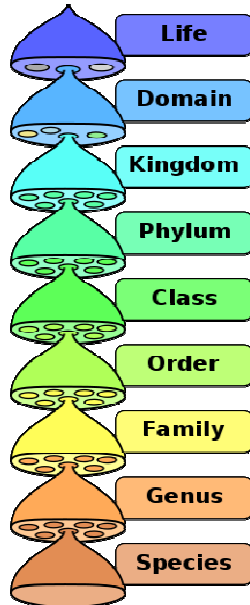
PERMIAN-TRIASSIC EXTINCTION

CRETACEOUS-PALEOGENE EXTINCTION

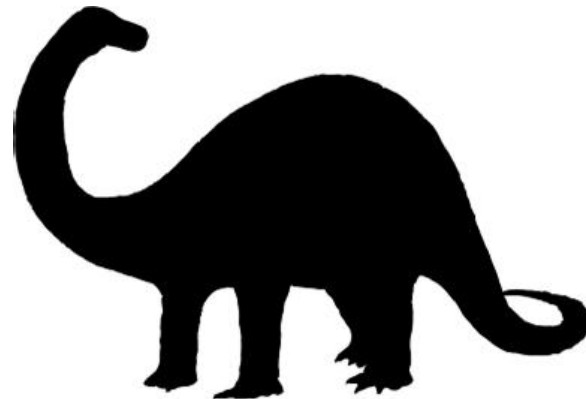
DINOSAUR

classification

Biological Classification,
Peter Halasz.



Kingdom	Animalia
Phylum	Chordata
Class	Reptilia
Superorder	Dinosauria
Order	Saurischia
Suborder	Sauropodomorpha
Infraorder	Sauropoda
Family	Diplodocidae
Subfamily	Apatosaurinae
Genus	APATOSAURUS
Species	<i>A. Ajax</i> Marsh, 1877 <i>A. Excelsus</i> , Marsh, 1879 [originally <i>Brontosaurus</i>] <i>A. Louisae</i> , Holland, 1915 <i>A. Parvus</i> , Peterson & Gilmore, 1902



Dinosaurs are classified into categories to help us understand the relationships between different organisms. The diagram to the left illustrates the eight major ranks of classification. The system begins at the top of the diagram and becomes more specific as you work downwards.

In 1842 the name 'Dinosauria' was proposed for a distinct **superorder** of reptile. This classification was then split into two orders based on hip structure: **Saurischia** meaning 'lizard-hipped' and **Ornithischia** meaning 'bird-hipped'.

Let's have a look at *Apatosaurus* to see how it is classified. You will notice that this **genus** fits into the eight major ranks, plus several other minor ranks.

A **genus** includes one or more species, and it forms part of the scientific name given to an organism. For example, all modern and primitive human beings belong to the genus *Homo*. **Species** is the final level of classification, and it is formed by two words, genus and species. For example, humans are *Homo sapiens*.

In the classification above you can see that within the *Apatosaurus* genus there are four species: *A. Ajax* Marsh, *A. Excelsus*, *A. Louisae*, *A. Parvus*. Most dinosaurs are commonly referred to by their genus name only, with an exception being *Tyrannosaurus rex*. *Tyrannosaurus* is the genus name, *Tyrannosaurus rex* is the species. The number of species in a genus varies from one scientist to another. This is because classification is a man-made invention therefore viewpoints may differ.

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EXTINCTION

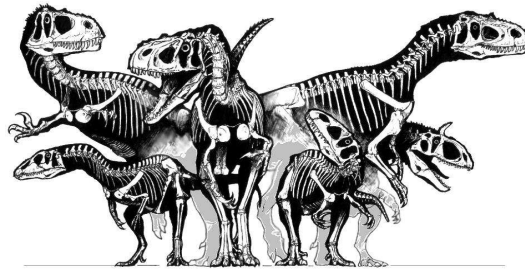
natural and man-made

Extinction: the dying out of a plant or animal species.

(Collins Essential English Dictionary 2nd Edition 2006)

Despite what you may think, the Earth was no stranger to extinction before humans evolved. In fact, more than 99% of all of the organisms that have ever lived on this planet are now extinct. As a species, humans have been in existence for a mere 190,000 years of the Earth's 4.5 billion year history!

The deadliest event experienced on Earth since animals evolved happened around 250 million years ago: the **Permian-Triassic extinction**. More than 90% of animal species disappeared in an event that appears to have been caused by climate change. Scientists have found evidence to suggest that the Earth's temperature warmed and cooled so quickly that many species could not adjust to the new climates and therefore simply died out.



Assemblage of Tetanuran theropods.

This significant event preceded the evolution of the dinosaurs 230 million years ago. They gradually evolved in response to new climates and ecological opportunities. These magnificent creatures collectively roamed the Earth for 165 million years before they too were overcome by climate change in the **Cretaceous-Paleogene extinction**. Whilst species had come and gone during this time, the very last of the **non-avian*** (see below) dinosaurs disappeared from this planet around 65 million years ago.

*Vertebrate palaeontologist consider birds to be dinosaurs! Birds are therefore regarded as **avian dinosaurs**. While other dinosaurs are called **non-avian** (unlike a bird) dinosaurs.

FACT SHEET

EXTINCTION**natural and man-made**

So what caused the eradication of these extraordinary creatures?

Some of the world's smartest minds have pondered over this question, but the answer is somewhat of a mystery. The two most popular current theories for the extinction of dinosaurs are **volcanism** and **extraterrestrial impact** (such as a comet or meteorite). In both of these scenarios the skies would have filled with debris, blocking the penetration of sunlight to the Earth, starving the plants of essential energy and negatively impacting on the entire food chain. When the dust particles settled, many of the creatures that were surviving in lingering darkness perished in soaring temperatures caused by greenhouse gases trapped in the atmosphere.

Both volcanism and extraterrestrial impact are plausible theories. In fact, some scientists believe both of these events may have been to blame. Meanwhile, a minority of scientists think that the process was a more gradual change in climatic conditions and fluctuating sea levels.



So climate change, global warming and extinction are just natural processes...nothing to worry about, right?

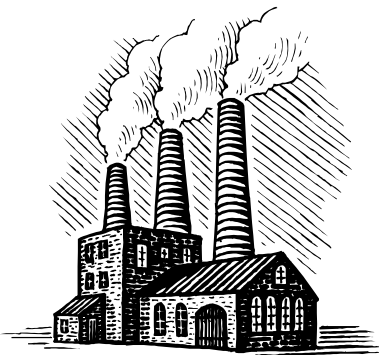
WRONG, not this time! The cause of what many scientists believe will be the **sixth mass-extinction** is our mistreatment of the Earth. Humans have been doing terrible things to the planet, like polluting the waterways and air, overfishing and destroying natural habitats. These are all contributing to what may be the fastest mass-extinction in the history of this planet. By 2100 it is possible we will be responsible for the extinction of over 50% of Earth's marine and land species.

FACT SHEET

EXTINCTION**and climate change**

Climate change is a long-term **difference** in **typical weather conditions** for a particular area. It can occur **naturally**, **HOWEVER...**

Late in the **18th century** the **Industrial Revolution** began in the United Kingdom. This event was marked by the **replacement** of **hand tools** with **power-driven machines**, and the **concentration** of **large scale factory production**.



This revolution has had **serious consequences** for our **environment**. We have seen a massive **increase** in **deforestation** and processes like **burning fossil fuels** (for electricity and to run our cars). These activities cause a **huge increase** in the amount of **greenhouse gases** present in our atmosphere.

The term “**Greenhouse Effect**” refers to a **natural process** in which **greenhouse gases** [carbon dioxide (CO_2), methane (CH_4), nitrous oxide (NO_2), and water vapour] are **released** into the air, **absorbing** the radiation from the **sun** and **trapping** the energy within our **atmosphere**. This process **warms** the planet and is something we would be unable to **live** without.

Interestingly, dinosaurs thrived on extreme greenhouse gases during the Mesozoic Era (Age of Dinosaurs). High levels of carbon dioxide during the Mesozoic Era was part of the reason Earth could sustain such a diverse and abundant fauna of huge dinosaurs. In fact, if carbon dioxide levels during the Mesozoic Era were to drop to current levels, the whole ecosystem would collapse. Similarly, today’s ecosystems would also fail if carbon dioxide levels were to rise at Mesozoic levels.

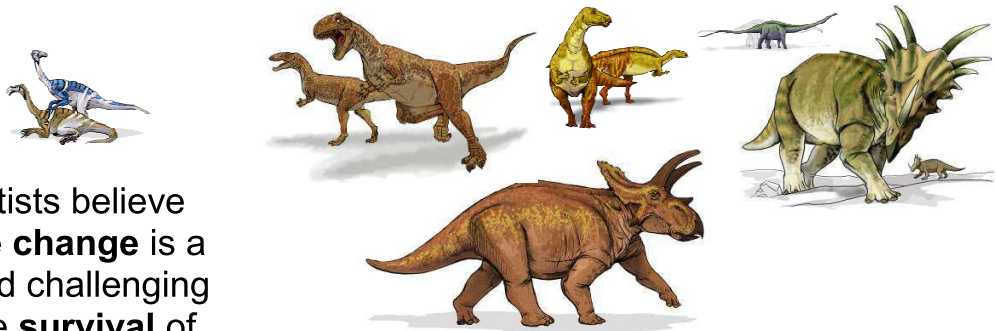


FACT SHEET

EXTINCTION**and climate change**

When a species is **unable** to **survive** or **reproduce** in its **own environment**, and is **unable** to find a suitable **alternative environment**, it becomes **extinct**.

The **mass extinctions** of the past happened so long ago that it is very difficult for scientists to be certain of the causes. However, the two most popular current **theories** in many of these events, including the extinction of **non-avian dinosaurs**, are **volcanism** and **extraterrestrial impact**. It is believed that these events were **catalysts** for **climate change**. The **inability** of the surviving non-avian dinosaurs to **adapt** to the new climate resulted in their **extinction**.



Some scientists believe that **climate change** is a very real and challenging **threat** to the **survival** of today's **plants** and **animals**. In the 21st century they must overcome dramatic **climate change**, and an array of hazardous human activities and impacts including **pollution**, **overharvesting**, the **introduction** of **new predators**, **food competitors** and **habitat destruction**!

We may sometimes forget that we are only **one component** of a very complex and amazing **ecosystem**. We have done so much **damage** to our **environment** that we are possibly beginning to suffer the **consequences** of our actions. Some scientists believe that **climate change** and **extinction** are real and immediate **threats** to all species on Earth, including humans.

FACT SHEET

FOSSILS

What are fossils?

In the **past**, some people thought that fossilised bones were the remains of **dragons**, **proof** of the **biblical great flood**, the work of a mysterious **force** within the **Earth** or of the **devil**, or 'star stones' that had fallen from the skies. Back in 500 BC Greek philosopher Xanthos of Sardis was the first scholar to write that fossils were the remains of once living creatures.

Today we know that fossils are the preserved remains or traces of **organisms** (any living thing) from prehistoric times and are generally **10,000 years old or more**. 'Fossil' comes from the Latin word *fossus* meaning '**having been dug up**' and fossilisation is a process that happens to very few organisms out of the billions that have lived on Earth.

There are three main kinds of fossils:

Body fossils are **preserved remains** of an organism and include such things as bones, shells, wood, teeth and soft tissue (very rare). These three small ammonites fossils are each approximately 1.5 cm across. They were of the order Ammonitida who are an extinct group of marine animals that lived 200 to 65.5 million years ago.



Trace fossils are **preserved marks** left behind by an organism while it was alive. This could include footprints, burrows, moulds, casts, impressions and coprolites (dung). Cheirotherium (meaning 'hand-beast') left evidence of its presence 240 million years ago.



Chemical fossils are **organic compounds** found **in rock**. Petroleum and coal are examples of chemical fossils or 'fossil' fuels. This image depicts a lump of coal.



FACT SHEET

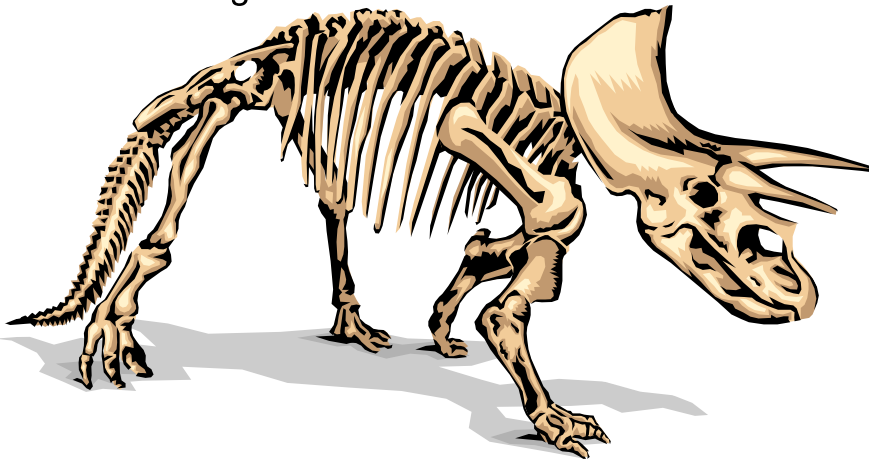
FOSSILS

How are fossils formed?

Body fossils are created when an **organism dies** and the whole or part of the **body** or the body's **impact** is preserved in some way.

Usually, but not always, the remains or impact of the organism quickly becomes **covered** in some sort of **sediment** like sand, clay, silt or less commonly, volcanic ash. These **protect** the remains from weathering and scavengers.

Then the specimen may undergo an assortment of **chemical** and **physical changes** within the sediment casing. Heat and pressure within the Earth's crust may turn it into rock (**lithification**) or the specimen may change chemically as minerals like opal or hematite replace the specimen (**petrification**). Alternatively, the specimen may dissolve all together leaving only an **impression or mould** in the surrounding rock.



Australia has many rocks of the right age to contain dinosaur fossils, yet we've discovered relatively few. Why?

Some other countries have dedicated significantly **more time** and **money** to discovering new specimens, partly explaining our shortfall.

Also, Australia is an **ancient** and generally very **flat land**. It has relatively **few geomorphological features** like deep valleys and canyons, which **expose fresh rocks** and potentially reveal fossils. Of the fossils we have found, most of these have been from the **Early Cretaceous period**. Fossils **younger** than these are likely to have been **eroded away** in Australia, whilst those that are **older** may remain locked away **underground**.

FACT SHEET

FOSSILS

What dinosaur fossils have been found in Australia?



Map of Australia showing where dinosaur fossils have been found.

Source: ©The Dinosaur Society

INTERESTING FACT

Gondwana was the name of a huge **southern continent** which broke up into several landmasses during the **Mesozoic Era** (Age of Dinosaurs). These landmasses are now called Africa, South America, India, Antarctica, and Australia.

ROBOTICS

Robotics is the science and technology of robots, their design, manufacture, and application. The term robot comes from the Czech word *robota*, generally translated as “forced labour”.

A typical robot has a **movable physical structure**, a **motor** of some sort, a **sensor system**, a **power supply** and a **computer ‘brain’** that controls all of these elements. Essentially, robots are man-made versions of animal life, they are machines that replicate human and animal behaviour.

A BRIEF HISTORY OF ROBOTICS

- Around 400 BC, **Archytas of Tarentum** is reputed to have built a flying mechanical pigeon, possibly powered by steam.
- **Al-Jazari**, a Muslim inventor during the Artuqid dynasty, designed and constructed a number of automated machines, including kitchen appliances, musical automata powered by water, and the first programmable humanoid robots in 1206.
- **Leonardo Da Vinci** designed a humanoid automaton in knight's armour in 1495, but it is not known if the design was ever built.
- In 1926, **Fritz Lang's** movie *Metropolis* was released. Maria (a main character) was the first robot ever seen on film.
- In 1961 the first digitally operated and programmable robot, the **Unimate**, was installed on the General Motors assembly line.
- In the late nineties **Kismet** was developed at **MIT's Artificial Intelligence Lab**. Kismet recognises human body language and voice inflection and responds appropriately.

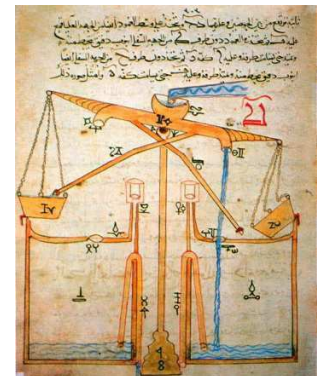
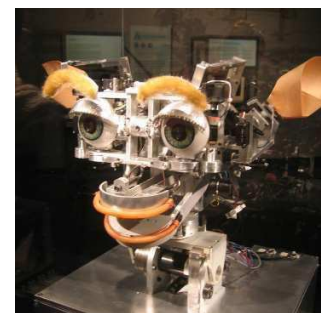


Diagram of a Hydro-powered water-raising machine by Al-Jazari.



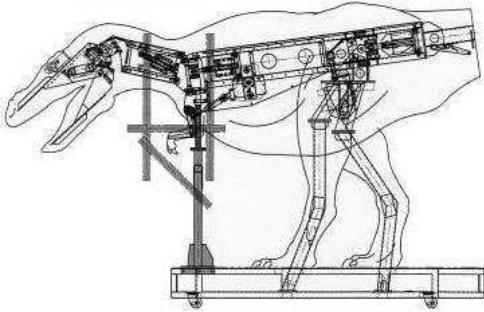
Model of Leonardo's robot with inner workings, as displayed in Berlin.



Kismet © Jared C. Benedict

ROBOTICS

Creature creation: how is a robot dinosaur made?



1. Planning and technical designs

Detailed plans and technical designs are created. Everything else relies on the accuracy of these designs. Good planning is fundamental for the realistic movement of the robot.



2. Structure

A frame is created to form the 'bones' and 'muscles' of the robot. All of the electronic and mechanical components of the robot need something to attach to, and the skin must have a frame to maintain its shape.



3. Surface

Special sponges (Urethane foam) are cut out and shaped with a knife to create the form and 'skin' of the dinosaur. Various techniques and materials are utilised to make the robot look as real as possible.



4. Electronic control systems

Electronic control systems are needed to operate the robot. Typically starting from scratch and creating their own custom circuit boards, these engineers are essentially building giant remote-controlled toys!