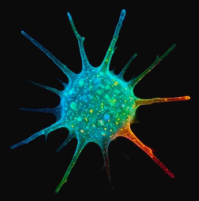
Genes.media / DEEP TIME · SAPIENS

Teaching pack

Deep Time and Sapiens are two interactive timelines. This pack describes them for teachers and their students. Websites that write about the timelines may use it too.



What is Deep Time?

Deep Time is an interactive timeline of the history of our planet and of life. It covers 4.54 billion years. Its content is drawn from the scientific literature. Each date is the result of a measurement, or of reasoning based on measurements. These results were published by researchers in peer-reviewed journals, in which other scientists check each article before it appears. New studies may revise a date.

For each date, Deep Time indicates how certain the date is. A date may be precise, approximate, given as a range, or debated. Deep Time also cites the publications behind each date. When published estimates diverge, a note under the date explains the disagreement.

The scale of the timeline is linear at every zoom level: distances on screen are proportional to durations. At a glance, the 66 million years since the extinction of the dinosaurs can be compared with the Earth's 4.54 billion years.

Events appear on the timeline as one zooms in and moves through it. Visitors can explore it in any order. Curved lines, called arcs, link 139 of the timeline's 200 events to other events. Each arc joins an earlier event to a later one that it helped bring about. The second timeline, Sapiens, covers the 300,000 years of our species. It works like Deep Time, with dates, notes and arcs. It also has a globe that shows the routes followed by *Homo sapiens*.

Any website that writes about the timelines may copy these four paragraphs, whole or in part, without asking for permission.

For a specific lesson

Clicking an event on the timeline opens its entry, in a panel on the right of the screen. An entry is a text about the event, usually with an image. Each entry also exists as a full-screen page with its own address. A link to that page takes students straight to the entry, without going through the timeline. For example, a teacher can post such a link with a sentence like this one:

> The Great Oxidation Event is the build-up of oxygen in the Earth's air. To place it in the Earth's history, read its entry on Deep Time, an interactive timeline. The entry gives the date with its sources.
> genes.media/deep-time/en/event/great-oxidation-event/

Useful addresses

DEEP TIME

The timeline
genes.media/deep-time/en/timeline/

All 200 entries
genes.media/deep-time/en/events/

The geologic time scale
genes.media/deep-time/en/geologic-time-scale/

The history of Earth
genes.media/deep-time/en/history-of-earth/

The history of life
genes.media/deep-time/en/history-of-life/

The major transitions of life
genes.media/deep-time/en/major-transitions-in-evolution/

SAPIENS

The timeline
genes.media/sapiens/en/timeline/

All 200 entries
genes.media/sapiens/en/events/

The timeline from prehistory to today
genes.media/sapiens/en/prehistory/

The key dates of *Homo sapiens*
genes.media/sapiens/en/chronology-of-homo-sapiens/

METHODS AND SHARING

How the two timelines were built
genes.media/deep-time/en/methods/

Sharing the timelines in Google Classroom
genes.media/for-teachers/

The entries, theme by theme

In each theme, events run from the oldest to the most recent. Each title is a link to the entry's page.

THE AGE OF THE EARTH AND THE MEASUREMENT OF TIME · DEEP TIME

The Formation of the Earth
~4.54 billion years ago

The Jack Hills Zircons
~4.4 billion years ago

The Acasta Gneiss: Oldest Rock
~4.03 billion years ago (older claims to 4.3 Ga)

James Hutton and Deep Time
1788 CE

Naming the Geological Periods
1815 to today

Radiocarbon Dating
1949 CE

The Age of the Earth
1956 CE

THE EARTH'S ATMOSPHERE AND LIFE · DEEP TIME

Earth's First Atmosphere
~4.45 to 4.3 billion years ago

The Proof of an Oxygen-Free Atmosphere
~3.5 to 2.4 billion years ago

Banded Iron Formations
~3.5 to 1.8 billion years ago

The Oldest Reef: Built by Microbes
~3.43 billion years ago

Oxygenic Photosynthesis
~3.2–2.8 billion years ago

The Great Oxidation Event
~2.4 billion years ago

The End of Banded Iron
~1.85 billion years ago

The Ozone Layer Forms
~430 million years ago

THE HISTORY OF LIFE · DEEP TIME

LUCA: the Last Universal Ancestor
~4.2 billion years ago (estimates 4.3 to 3.5 Ga)

The Oldest Traces of Life
~3.7 billion years ago (claims 3.95–3.5 Ga)

The First Eukaryotes
~2.0–1.8 billion years ago

The Ediacara Biota
~575 to 539 million years ago

The Cambrian Explosion
~540–518 million years ago

The First Land Plants
~470 million years ago

The First Tetrapods on Land
~390 million years ago

Archaeopteryx and the First Birds
~150 million years ago

The Rise of the Mammals
~66 to 56 million years ago

MASS EXTINCTIONS · DEEP TIME

The End-Ordovician Extinction
~445 million years ago

The Late Devonian Extinctions
~372 to 359 million years ago

The Great Dying: Permian Extinction
~252 million years ago

The End-Triassic Extinction
~201 million years ago

The Deccan Traps
~66 million years ago

Chicxulub and the End of the Dinosaurs
66.0 million years ago

The Sixth Extinction
since about 1900 CE

PAST CLIMATES · DEEP TIME

The Huronian Glaciations
~2.45 to 2.22 billion years ago

Snowball Earth
~717 to 635 million years ago

The Late Palaeozoic Ice Age
~360 to 260 million years ago

The Cretaceous Thermal Maximum
~94 to 83 million years ago

The Palaeocene-Eocene Thermal Maximum
~56 million years ago

The Freezing of Antarctica
~34 million years ago

The Quaternary Ice Ages
~2.6 million to 11,700 years ago

The Younger Dryas
~12,900 to 11,700 years ago

The Keeling Curve
1958 to 2016 CE

The EPICA Dome C Ice Core
2004 CE

THE EARTH IN MOTION · DEEP TIME

The Start of Plate Tectonics
~3 billion years ago (estimates 3.8 to 2.2 Ga)

The Supercontinent Rodinia
~1.1 billion to 700 million years ago

Pangaea
~335 to 175 million years ago

The Break-Up of Pangaea
~201 to 135 million years ago

The Messinian Salinity Crisis
~5.96 to 5.33 million years ago

The Isthmus of Panama Closes
~2.8 million years ago (contested)

Seafloor Spreading and Magnetic Stripes
1963 to 1968 CE

HUMAN EVOLUTION · DEEP TIME

Sahelanthropus: the First Hominin
~7 million years ago

Laetoli and the Origin of Bipedalism
~3.7 to 3.2 million years ago

Lomekwi: the Oldest Stone Tools
~3.3 million years ago

The Oldest *Homo* Fossil
~2.8 million years ago

Dmanisi: the First Departure
~2.1 to 1.8 million years ago

The Control of Fire
~1 million years ago (habitual use by ~400,000 years ago)

Neanderthals
~430,000 to 40,000 years ago

The Origin of *Homo sapiens*
~300,000 years ago

The Denisovans
~300,000 to 50,000 years ago

Out of Africa
~60,000 years ago

PREHISTORY AND THE FIRST SOCIETIES · SAPIENS

Jebel Irhoud: Oldest *Homo sapiens*
~315,000 years ago

Out of Africa
~70,000–50,000 years ago

Neanderthal Admixture in Our DNA
~50,500 to 43,500 years ago

Chauvet Cave: Aurignacian Art
~37,000–33,500 years ago

Lascaux Cave
~21,000 years ago

The Neolithic Revolution
~11,500 years ago

Gobekli Tepe: a Temple Before Farming
~11,500 years ago

Catalhoyuk: a Neolithic Town
~9,100 years ago

Uruk: the First City
~3500 BCE

The Invention of Writing
~5,200 years ago

THE HISTORY OF SCIENCE · DEEP TIME

James Hutton and Deep Time
1788 CE

The First Vaccine
1796 CE

Darwin: Descent with Modification
1859 CE

Mendel's Rules of Inheritance
1866 CE

The Chromosome Theory of Inheritance
1902 to 1915 CE

The Discovery of Penicillin
1928 to 1945 CE

Avery and the Role of DNA
1944 to 1952 CE

Radiocarbon Dating
1949 CE

The Structure of DNA
1953 CE

The Age of the Earth
1956 CE

The Molecular Clock
1962 to 1965 CE

Seafloor Spreading and Magnetic Stripes
1963 to 1968 CE

The Iridium Layer at the K-Pg Boundary
1980 CE

The Polymerase Chain Reaction
1983 to 1985 CE

Ancient DNA
1984 to 2010 CE

CRISPR Genome Editing
2012 CE

Four ideas for activities

1 Estimate, then check

Students take a paper strip 4.54 metres long, on which one metre stands for one billion years. Without looking at the timeline, they mark on the strip where they think each of these seven events falls:

- the formation of the Earth;
- the oldest traces of life;
- the Great Oxidation Event, the build-up of oxygen in the air;
- the Cambrian explosion, the rapid appearance of most major groups of animals;
- the first four-limbed vertebrates on land;
- the Chicxulub impact, the fall of an asteroid off the Yucatán at the end of the dinosaurs;
- the appearance of *Homo sapiens*.

They then look the events up on Deep Time. On the strip, they mark the date given by each entry, next to their own mark. The gap between the two marks measures the error of each estimate. On the strip, the Chicxulub impact lies 6.6 centimetres from the present. The appearance of *Homo sapiens* lies only 0.3 millimetres from the present.

2 Debate contested traces

The entry “The Oldest Traces of Life” gives this date: “~3.7 billion years ago (claims 3.95–3.5 Ga)”. The sign ~ means “about”. Ga means a billion years: “3.5 Ga” is 3.5 billion years ago. The range in brackets spans the ages that different studies have claimed. These traces are of two kinds. Some are layered structures built by mats of microbes. Others are carbon that has kept a chemical signature of living cells. Below the date, a note sets out why their biological origin is contested. Students list the proposed ages and the publications behind each one. In the note and in these publications, they look for the arguments that would make a trace of life convincing. The class then debates which claims hold up.

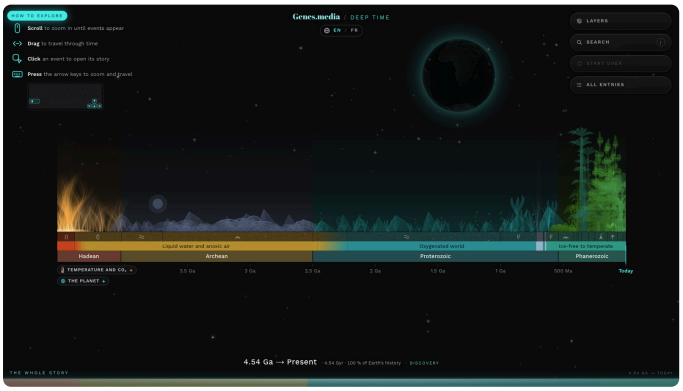
3 Follow a chain of causes

On the timeline, clicking the Great Oxidation Event opens its entry. Arcs are then drawn between this event and others. The arcs on the left lead to the events that helped bring it about. One of these events is oxygenic photosynthesis. This form of photosynthesis releases oxygen. The arcs on the right lead to the events that the Great Oxidation Event helped bring about. Hovering over an arc or tapping it brings up a sentence about the connection between the two events. Students read these sentences. Then they write down each step that led from the oxygen released by photosynthesis to its build-up in the air.

4 Compare durations

Below the timeline, a line of text describes the stretch of time on screen: its dates, its duration and its share of the Earth’s history. The Earth’s history is divided into four eons. The Phanerozoic is the most recent. Its name means “visible life”: its rocks hold fossils of animals and plants visible to the naked eye. Students zoom in on the Phanerozoic. They see that it covers the last 12 per cent of the Earth’s history.

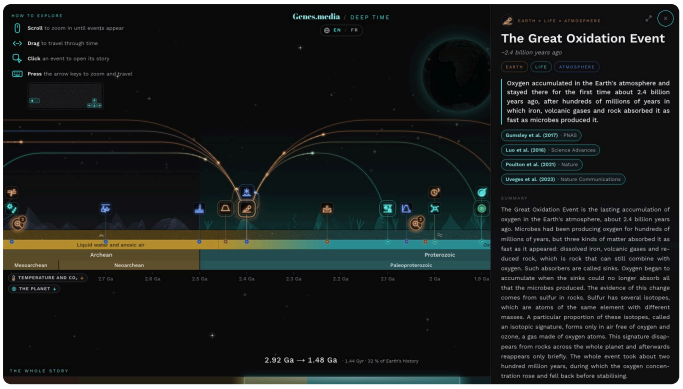
Screenshots



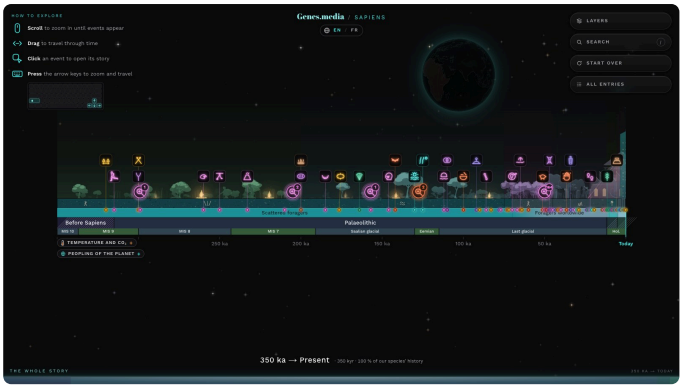
Deep Time as it opens, from the formation of the Earth to the present day.



Deep Time set to the last 714 million years. Trilobite silhouette: Sam Gon III, PhyloPic image bank, CC BY 4.0 licence.



The Great Oxidation Event entry, with the arcs that link it to earlier and later events.

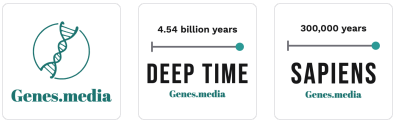


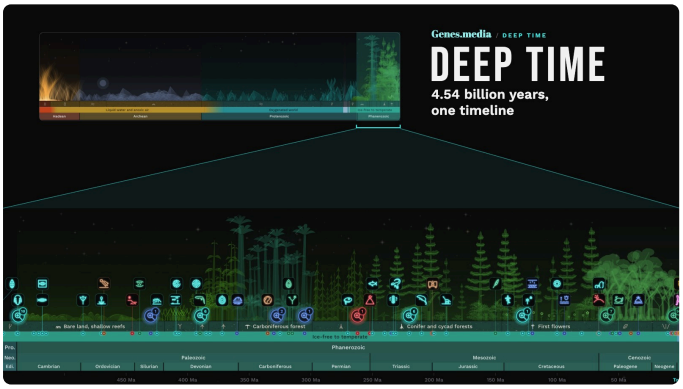
Sapiens from 350,000 years ago to the present day, with all its events displayed at once. The timeline starts a little before the oldest known fossils of *Homo sapiens*.

Any screenshot of the two timelines may be reused in teaching materials. Credit Genes.media and give the address of the page shown. Some images have another author, such as the trilobite silhouette. That author must be credited as well.

Logos and images to download

Genes.media provides its logo and the logos of Deep Time and Sapiens, with an image of each timeline. They can be used to introduce the timelines on a website or in teaching materials. They can be downloaded from the “For teachers” page of Genes.media: genes.media/for-teachers/





The Deep Time image shows the whole timeline at the top. Below, it shows the last 550 million years.



The globe of Sapiens shows the routes that *Homo sapiens* had already followed 45,000 years ago.

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Have you used Deep Time or Sapiens in class, linked to them from your course page or shared them with colleagues? Do you have a question, or an idea for an activity or for a feature? Write to Genes.media through its contact form. The form is in French. Messages in English are welcome: genes.media/a-propos/#contact

If you find the timelines useful, please tell your colleagues about them, on social media or in the teacher groups you belong to.