Geological Timeline

In this pack you will find information and activities to help your class grasp the concept of geological time, just how old our planet is, and just how young we, as a species, are.

Planet Earth is 4,600 million years old. We all know this is very old indeed, but big numbers like this are always difficult to get your head around. The activities in this pack will help your class to make visual representations of the age of the Earth to help them get to grips with the timescales involved.

IMPORTANT EVENTS IN THE EARTH'S HISTORY

4600 mya (million years ago) – Planet Earth formed. Dust left over from the birth of the sun clumped together to form planet Earth. The other planets in our solar system were also formed in this way at about the same time.

4500 mya – Earth's core and crust formed. Dense metals sank to the centre of the Earth and formed the core, while the outside layer cooled and solidified to form the Earth's crust.

4400 mya – The Earth's first oceans formed. Water vapour was released into the Earth's atmosphere by volcanism. It then cooled, fell back down as rain, and formed the Earth's first oceans. Some water may also have been brought to Earth by comets and asteroids.

3850 mya – The first life appeared on Earth. It was very simple single-celled organisms. Exactly how life first arose is a mystery.

1500 mya – Oxygen began to accumulate in the Earth's atmosphere. Oxygen is made by cyanobacteria (blue-green algae) as a product of photosynthesis. For 2,200 million years this oxygen was removed from the atmosphere as it reacted with iron, sank to the bottom of the sea and became trapped in rock layers. 1,500 million years ago the free iron ran out and oxygen began to be released into the atmosphere.

700 mya – The first animals evolved. These were simple single-celled animals.

530 mya – The first vertebrates (fish) evolved.

400 mya – The first land plants evolved. Oxygen in the atmosphere reacted to form ozone, which formed a layer. This served as a protective barrier to the harmful rays coming from space and which allowed plants to colonise the land.

350 mya – The first land vertebrates evolved. With plants present on the land to provide a food source, animals rapidly followed. The first to venture onto the land were primitive amphibians, and reptiles evolved soon afterwards.

225 mya – The first dinosaurs evolved from lizards.

65 mya – The dinosaurs went extinct. The dinosaurs, and many other species with them, were wiped out by the after-effects of a meteorite impact, or perhaps several impacts. The impact(s) set off chains of earthquakes, tsunamis and volcanic eruptions, which threw lots of dust and acid into the atmosphere, creating an impact winter. The dust blocked out the sunlight so plants could no longer photosynthesise, and food chains collapsed. After the extinction of the dinosaurs, mammals evolved rapidly and filled the evolutionary niches they left behind.

130,000 years ago (0.13 mya) – Modern humans evolved. *Homo sapiens* evolved in Africa from earlier humans. They left Africa around 35,000 years ago and spread around the globe. Human evolution is still pretty mysterious, due to gaps in the fossil record.

Cut out these slips, give them to your class and see if they can put them in the correct order:

Planet Earth formed.	Earth's core and crust formed.
The Earth's first oceans formed.	The first life appeared on Earth.
Oxygen began to accumulate in the Earth's atmosphere.	The first animals evolved.
The first animals with backbones (fish) evolved.	The first land plants evolved.
The first land animals with backbones evolved.	The first dinosaurs evolved.
The dinosaurs went extinct.	Modern humans evolved.

Fact! The Earth has only been around for about one third of the time the universe has!

Making a Geological Timeline

First find a space for your timeline. This could be the length of a classroom, a corridor, or even the playground. Measure it and choose the most appropriate length of timeline to fit your space. We have provided a choice of four different lengths of timeline, with all the distances involved worked out for you at the back of this pack. Next, choose how you're going to make your timeline. We suggest either string, people in a line holding hands, or making a very long paper chain.

For a string Timeline, you will need:

- A piece of string of the length required
- Pegs or tape to hold events in the right place along the string
- Tape measure or metre rulers
- Event cards

For a paper chain Timeline, you will need:

- Coloured card to make the rings for the chain. We suggest using strips of different coloured card 22cm by 2.5cm. Numbers of rings required for different lengths of timeline are provided at the back of this pack.
- Tape or staples to hold the rings together
- String or pipe cleaners for hanging event cards off the rings
- Tape measure or metre sticks/rulers
- Event cards

Distance tables and pre-made event cards have been provided at the back of this pack. Alternatively, have your class work out the distances themselves and make their own event cards.

Toilet Paper Time

Care to bring some toilet humour into your classroom? Why not use a roll of toilet paper to make your point? If you use a roll of toilet paper as a base for your timeline instead of string or a paper, you can just count sheets of toilet paper, instead of doing all that measuring. Please note that as the paper is delicate this is typically a one-off activity.

You will need:

- 1 roll of toilet paper
- Pens to mark important events on the toilet paper

Carefully unroll the roll of toilet paper along the ground, counting sheets as you go. You may wish to put number markers on the sheets as you go, so that you don't lose count. When you come to an important event in Earth's history, write it on the sheet using a felt-tip pen. Numbers of sheets required are provided in a table at the back of this pack.

Class Discussion Talking Points

We have only been around for a tiny fraction of the Earth's history.

Our oxygen has not always been here. It was made by tiny bacteria over millions of years, and we wouldn't be here without them!

Although now extinct, dinosaurs ruled the Earth for 160 million years. We've only been around for 130 thousand years.

For over 3,000 million years the Earth's only inhabitants were simple bacteria. That's 68% of the Earth's history!

Flowchart Fun

So many of the important events in Earth's history are linked. Why not get your class to create their own posters with flowcharts explaining how the oxygen made by bacteria lead to the ozone layer, plants and animals colonising the land, and eventually, our own evolution? Alternatively they could write their own drama piece to explain the links. There is an example flowchart provided at the back of this pack.

True or False?

The Earth is thousands of millions of years old.	TRUE
Oxygen has been in our atmosphere since the Earth first formed.	FALSE
Animals colonised the land before plants did.	FALSE
The first life on Earth was plants.	FALSE
The first animals with backbones were fish.	TRUE
Modern humans have only been around for 6,000 years..	FALSE

Resources

- The British Geological Survey website has some very good information on geological time. There is an interactive online timeline and teachers' notes with more events you could choose to include in your timeline.

http://www.bgs.ac.uk/discoveringGeology/time/timeline/home.html

- The Science Education Resource Centre has further information on making a toilet paper timeline.

http://serc.carleton.edu/quantskills/activities/TPGeoTime.html

- This pack links in nicely with the James Hutton and Charles Lyell packs, also provided by Dynamic Earth Education. For more information see the Dynamic Earth website support materials section.

http://www.dynamicearth.co.uk/learning/curriculum-for-excellence/support-materials

- There is a very good free app called EarthViewer that lets users explore different aspects of the Earth's deep history, including plate tectonics, climate and fossils.

http://www.hhmi.org/biointeractive/earthviewer

Curriculum Links

I can show my understanding of what I listen to or watch by responding to literal, inferential, evaluative and other types of questions, and by asking different kinds of questions of my own. **LIT 2-07a**

If doing poster: I consider the impact that layout and presentation will have and can combine lettering, graphics and other features to engage my reader. **LIT 2-24a**

If doing drama piece: I have created and presented scripted or improvised drama, beginning to take account of audience and atmosphere. **EXA 2-14a**

I can convey information, describe events or processes, share my opinions or persuade my reader in different ways. **LIT 1-28a / LIT 1-29a**

I can convey information, describe events, explain processes or combine ideas in different ways. **LIT 2-28a, LIT 3-28a**

I can use the common units of measure, convert between related units of the metric system and carry out calculations when solving problems. **MNU 2-11b**

I understand how animal and plant species depend on each other and how living things are adapted for survival. I can predict the impact of population growth and natural hazards on biodiversity. **SCN 4-01a**

Having investigated processes which form and shape landscapes, I can explain their impact on selected landscapes in Scotland, Europe and beyond. **SOC 3-07a** [Geological time is mentioned in the appendix.]

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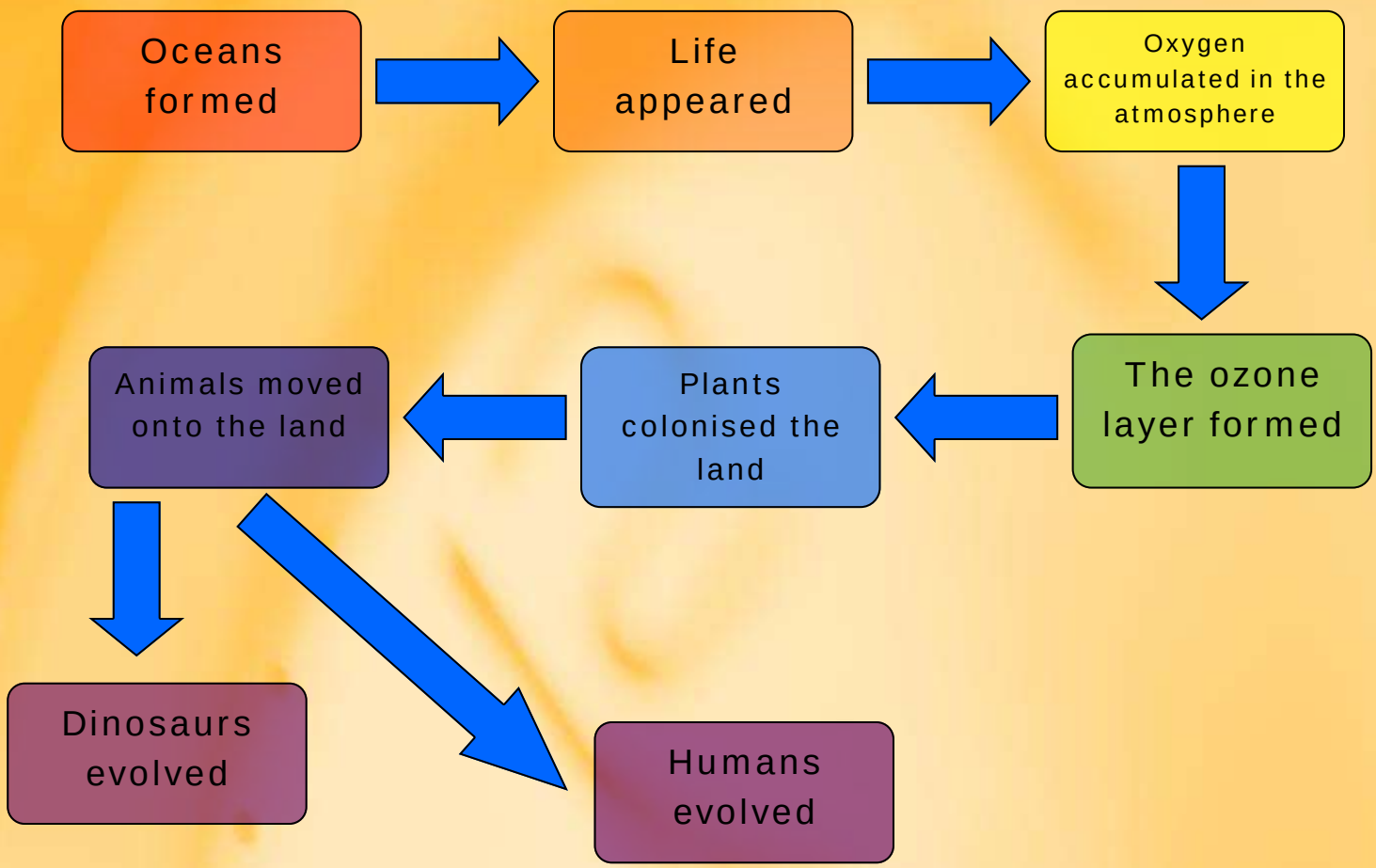
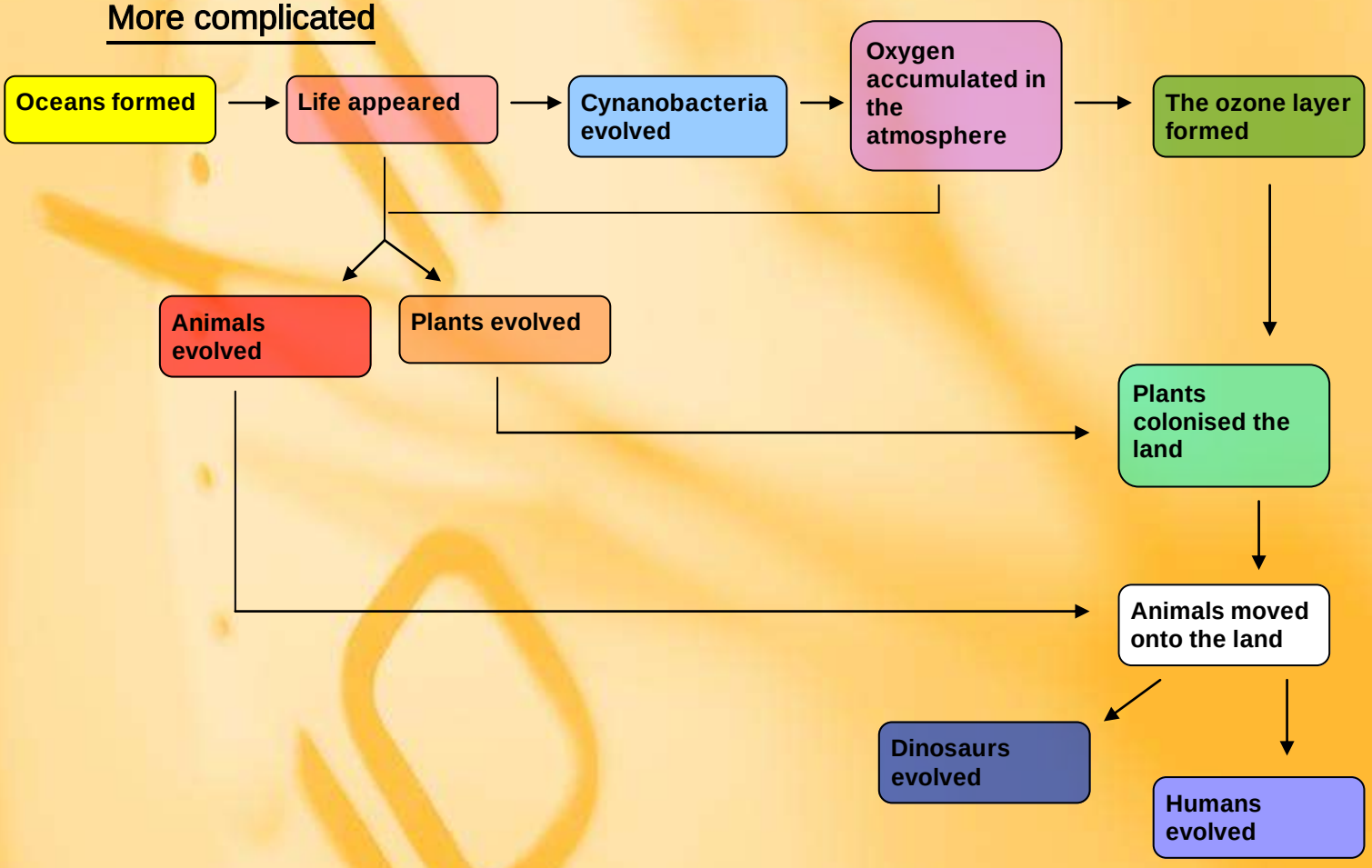
Example Flowcharts

Simple



More complicated



Timeline Distance Tables

4.6m		
Distance from start	**Distance from previous marker**	
0m	0m	planet Earth formed
0.1m	0.1m	Earth's core and crust formed
0.2m	0.1m	oceans formed
0.75m	0.55m	first life
3.1m	2.35m	oxygen begins to accumulate in the atmosphere
3.9m	0.8m	first animals
4.07m	0.17m	first vertebrates
4.2m	0.13m	first land plants
4.25m	0.05m	first land animals
4.375m	0.125m	first dinosaurs
4.535m	0.16m	extinction of the dinosaurs
4.6m	0.065m	first humans
4.6m	0m	present day

9.2m		
Distance from start	**Distance from previous marker**	
0m	0m	planet Earth formed
0.2m	0.2m	Earth's core and crust formed
0.4m	0.2m	oceans formed
1.5m	1.1m	first life
6.2m	4.7m	oxygen begins to accumulate in the atmosphere
7.8m	1.6m	first animals
8.14m	0.34m	first vertebrates
8.4m	0.26m	first land plants
8.5m	0.1m	first land animals
8.75m	0.25m	first dinosaurs
9.07m	0.32m	extinction of the dinosaurs
9.2m	0.13m	first humans
9.2m	0m	present day

18.4m		
Distance from start	**Distance from previous marker**	
0m	0m	planet Earth formed
0.4m	0.4m	Earth's core and crust formed
0.8m	0.4m	oceans formed
3m	2.2m	first life
12.4m	9.4m	oxygen begins to accumulate in the atmosphere
15.6m	3.2m	first animals
16.28m	0.68m	first vertebrates
16.8m	0.52m	first land plants
17m	0.2m	first land animals
17.5m	0.5m	first dinosaurs
18.14m	0.64m	extinction of the dinosaurs
18.399m	0.259m	first humans
18.4m	0.001m	present day

46m		
Distance from start	**Distance from previous marker**	
0m	0m	planet Earth formed
1m	1m	Earth's core and crust formed
2m	1m	oceans formed
7.5m	5.5m	first life
31m	23.5m	oxygen begins to accumulate in the atmosphere
39m	8m	first animals
40.7m	1.7m	first vertebrates
42m	1.3m	first land plants
42.5m	0.5m	first land animals
43.75m	1.25m	first dinosaurs
45.33m	1.58m	extinction of the dinosaurs
45.999m	0.669m	first humans
46m	0.001m	present day

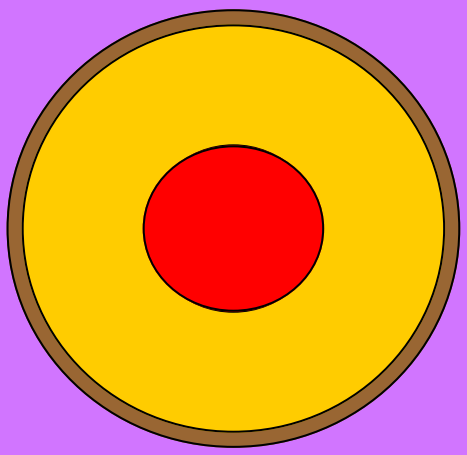
Paper Chain Timeline	
You need approximately 14 rings per metre of Timeline	
Length of Timeline	**Number of rings required**
4.6m Timeline	66 rings
9.2m Timeline	131 rings
18.4m Timeline	263 rings
46m Timeline	657 rings

Toilet Paper Timeline (~200 sheets)		
Sheets from start	**Sheets from previous marker**	
1 sheet	1 sheet	planet Earth formed
4 sheets	3 sheets	Earth's core and crust formed
9 sheets	5 sheets	oceans formed
33 sheets	24 sheets	first life
135 sheets	132 sheets	oxygen begins to accumulate in the atmosphere
170 sheets	35 sheets	first animals
177 sheets	7 sheets	first vertebrates
183 sheets	6 sheets	first land plants
185 sheets	2 sheets	first land animals
190 sheets	5 sheets	first dinosaurs
197 sheets	7 sheets	extinction of the dinosaurs
200 sheets	3 sheets	first humans
200 sheets	0 sheets	present day

Cut-outs for the Timeline

Planet Earth was formed from dust left over from the birth of the sun, **4,600,000,000 years ago.**

Dense metals sank to the centre of the Earth and formed the core, while the outside layer cooled and solidified to form the Earth's crust **4,500,000,000 years ago**.

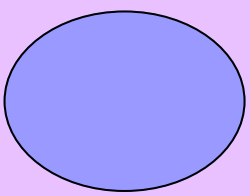


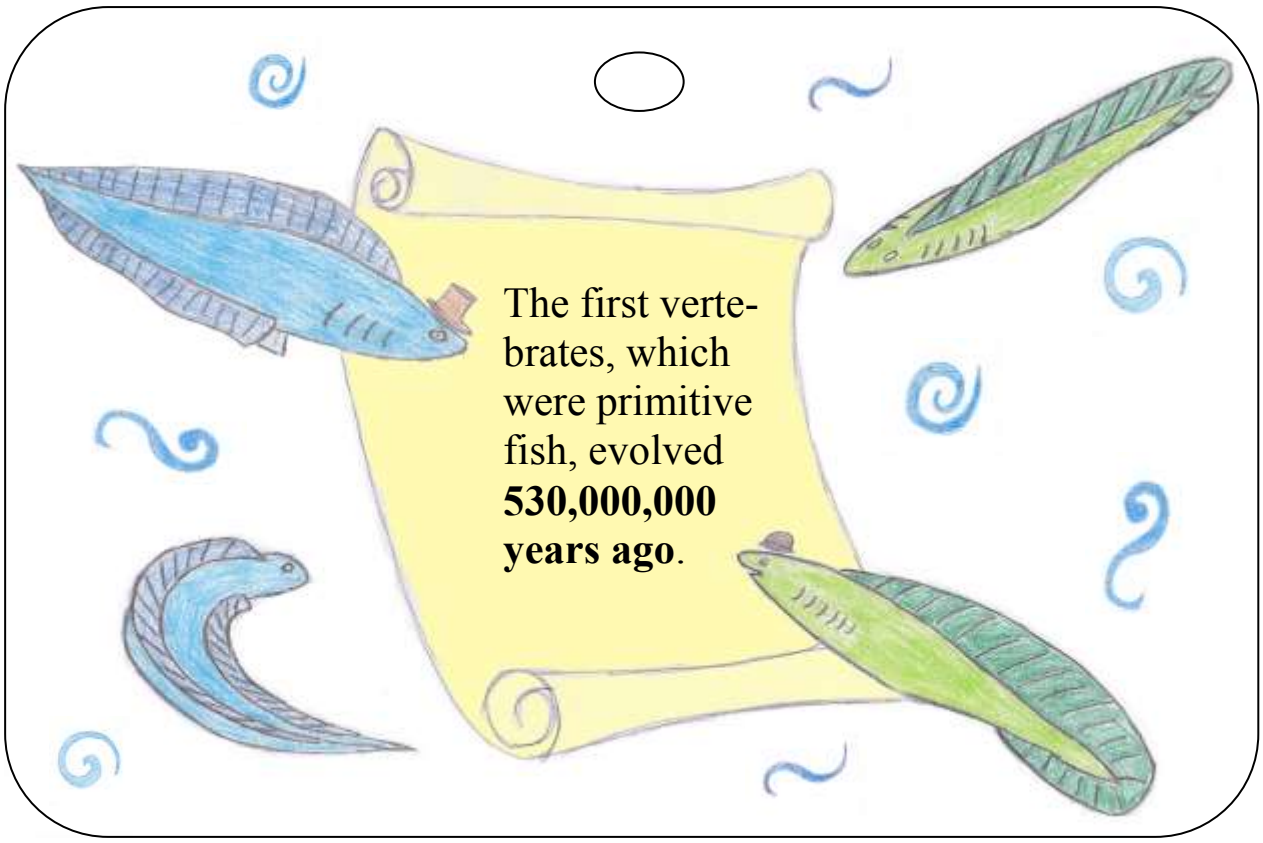
Water vapour was released into the Earth's atmosphere through volcanism. It then cooled and formed the Earth's first oceans **4,400,000,000 years ago**.

The first life appeared on Earth **3,850,000,000 years ago**. It was very simple, single-celled organisms.

Made by bacteria, oxygen began to accumulate in the atmosphere **1,500,000,000 million years ago**.

The first animals evolved **700,000,000 years ago**.

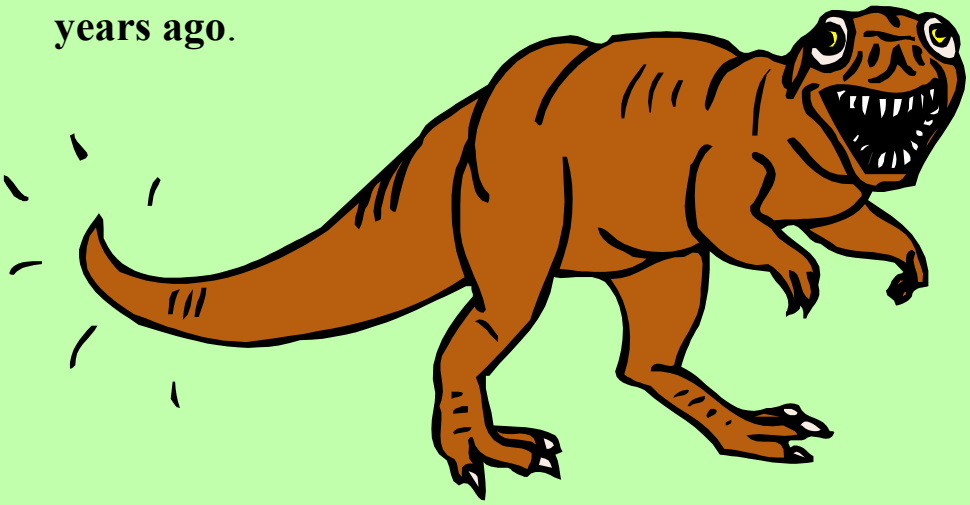




Plants first moved onto the land **400,000,000 years ago**.

The first vertebrates moved on-to the land **350,000,000 years ago**.

The first dinosaurs evolved **225,000,000 years ago**.



The dinosaurs were wiped out by a meteorite impact, or perhaps several, **65,000,000 years ago**.

The first modern humans evolved **130,000 years ago**.