

Earth Timeline

What's this activity about?

Big Questions:

- When in Earth's history did life develop?
- How long did it take for complex life to develop?
- What can these answers tell us about the type of life we might find on other planets?



Big Activities:

Participants guess when various kinds of organisms first developed in the history of Earth. Then the actual timeline of life is revealed, usually to great surprise. The early development of simple life and the relatively late development of complex life changes many people's ideas of what alien life may look like.

Participants:

From the club: A minimum of one person.

Visitors: The Earth Timeline is appropriate for families, the general public, and school groups ages 10 and up. One to 30 visitors at a time may comfortably participate.

Duration:

10 to 15 minutes

Topics Covered:

- Life on Earth developed soon after oceans formed.
- Complex life developed recently (in the last ½ billion years) in the Earth's history.
- Scientists expect most life in the Universe to be simple. If any life is found in our Solar System beyond Earth, it is likely to be simple.

Where could I use this activity?

ACTIVITY	Star Party	Pre-Star Party – Outdoors	Pre-Star Party – Indoors	Girl Scouts / Youth Group Meeting	Classroom			Club Mtg	Public Presentation (Seated)	Gen Public Presentation (Interactive)
					K-4	5-8	9-12			
Earth Timeline		√	√	√		√	√	√		√

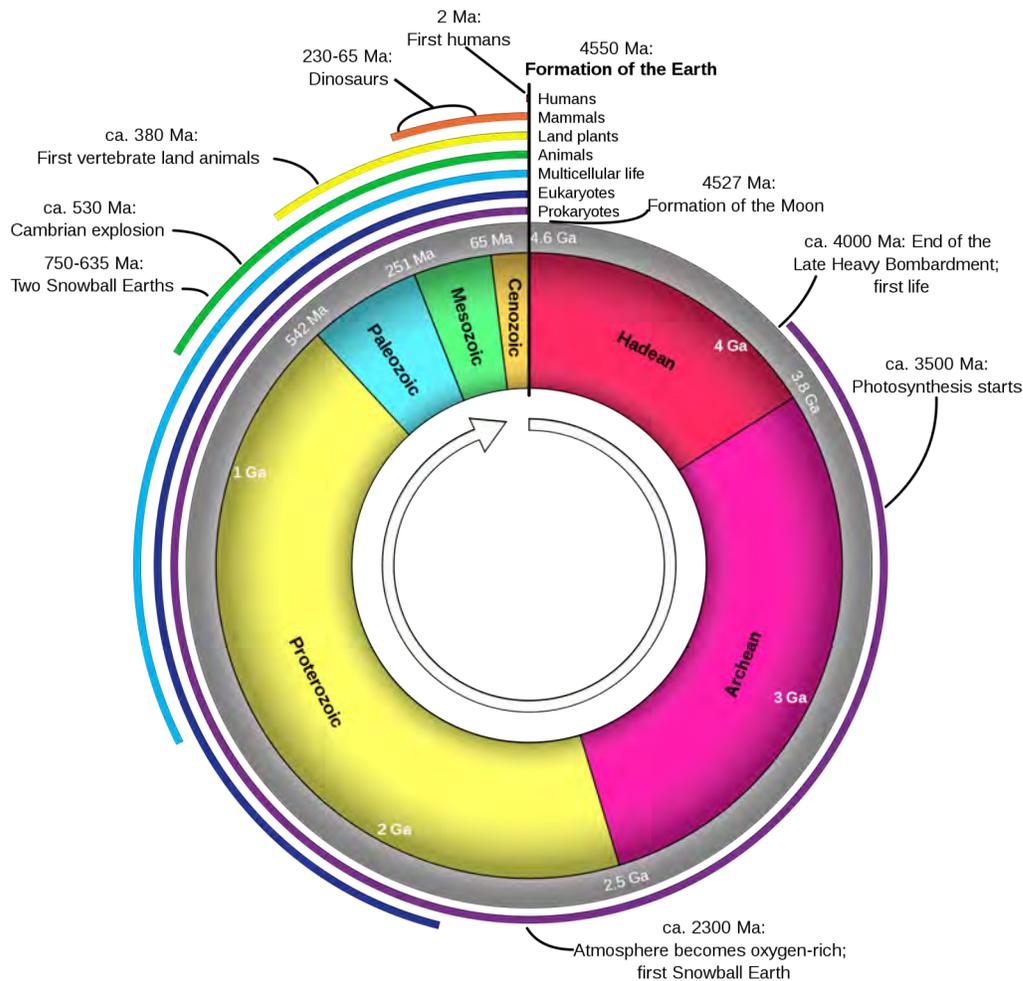
What do I need to do before I use this activity?

What materials from the ToolKit are needed for this activity?	What do I need to supply to run this activity that is not included in the kit?	Preparation and Set-Up
<ul style="list-style-type: none"> • Earth Timeline banner • 7 Life Form cards with Glue Dots or other temporary adhesive • One Alien card 	A flat surface (table, fence, or car) to present the banner	<ul style="list-style-type: none"> • Use the Velcro strips to attach the banner to a fence or car. • Fold the bottom of the timeline and attach using the Velcro to hide the life forms.

Background Information

Origins of Life

The Earth formed about 4.6 billion years ago. The earliest life formed on Earth around one billion years later. This is when we have undisputed fossils of microbe-like organisms. It seems likely that these developed from even more primitive organisms that did not leave fossils. We do not know the earliest life, but estimates from rocks show changes in the atmosphere possibly indicating life around 3.8 billion years ago.



Further Activities

A brief, interactive history of life on Earth can be found here:
<http://www.pbs.org/wgbh/nova/evolution/brief-history-life.html>

If you would like a longer, more detailed timeline activity, there are models here:
<http://serc.carleton.edu/quantskills/activities/calculatortape.html>
and here:
<http://www.worsleyschool.net/science/files/toiletpaper/history.html>

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Additional astronomy activities can be found here: <http://nightsky.jpl.nasa.gov>

Detailed Activity Description

Earth Timeline

Leader's Role	Participants' Role (Anticipated)
<p><u>Presentation Tip:</u> There is silhouette of a person on the bottom of the banner and many points from this activity can be made even if you do not have the banner. Face your audience and set up the scale for them so that the Solar System formed at the tip of your right hand and today is at the tip of your left hand. Then the scale is:</p> <ul style="list-style-type: none"> • The first life developed at some point on the earliest (right) forearm. • Complex life did not occur until almost the "most recent" wrist. • Dinosaurs occupied from the end of the palm through the middle knuckle of a finger. • And filing the end of your fingernail could erase all of human history. 	 
Leader's Role	Participants' Role (Anticipated)
<p><u>To Do:</u> Hang the banner using the Velcro straps attached to the grommets or place it on a long table. Fold the bottom of the banner to cover the life forms, using the Velcro dots.</p> <p><u>To Say:</u> What do you think aliens might look like?</p> <p><u>To Do:</u> Hold up the alien card and the single-celled organism drop. Ask the audience what they think we are more likely to encounter as we search for extraterrestrials.</p>	 Little green men Most think the "alien" is more likely

Leader's Role	Participants' Role (Anticipated)
<p><u>To Say:</u> We only have one example of life in the Universe, and that's right here on Earth. Let's take a look at how life has developed on Earth and see if it gives us any clues about the types of life we might find elsewhere.</p>	
<p><u>Presentation Tip:</u> If you're worried about the response that words like "evolution" might elicit from an audience, try using words such as "develop" or "progression" instead. You can often get across the concept without hitting any hot-button issues.</p>	
<p><u>To Say:</u> Earth is known to be about 4 and a half billion years old, shown on the left side. We represent that 4 ½ billion years by this 4 ½ feet, with the formation of the Solar System and Earth on the left, and today located all the way here on the right.</p> <p>A lot has happened in that 4 ½ billion years. The early Earth survived bombardment to form a Moon and oceans. It had several ice ages, many extinction events, and eventually become home to us, here on the far right.</p> <p><u>To Do:</u> Place Modern Civilization on the far right of the timeline, above the word "present." Hand out the remaining life form drops to 6 visitors.</p> <p><u>To Say:</u> You each have a type of life that has developed on Earth. Who thinks they have one of the earliest life forms?</p> <p>That's right. That's the very first kind of life that developed on Earth. When do you think that happened in Earth's history? Go ahead and put the single-celled organism on the timeline where you think it developed. The pictures on top of the Timeline might help you decide.</p>	<p>Single-celled organisms</p>

Leader's Role	Participants' Role (Anticipated)
<p><u>To Say:</u> Now, which life form do you think comes next? Great! The rest of the life forms, go ahead and guess where you think this type of life first developed. If you don't have a life form, help cheer us on.</p> <p><u>To Do:</u> After everyone has placed their life forms on the banner, encourage the other visitors to chime in with changes they would make. Move the life forms as the group directs. Encourage discussion so the group owns the exercise and there is less pressure to get it right on the people who initially guessed.</p>	<p>Placement varies for all life forms</p>
<p><u>Presentation Tip:</u> For younger audiences, ask them to put themselves in the order that these life forms developed first. Then have them place their life forms on the Velcro. At any age, it's fine that your visitors get this guess completely wrong. Most people don't have a good concept of the timeline of life on Earth. This is an opportunity to dispel some misconceptions.</p>	

Leader's Role	Participants' Role (Anticipated)
<p><u>To Do:</u> Once everyone has finished, unfold the bottom of the banner to show the actual timeline. Leave the guesses where they are for comparison.</p> <p><u>To Say:</u> How did we do? What do you notice?</p> <p>Wow, simple life developed very early in the history of the Earth. The first fossils have been dated back to 3.5 billion years ago, but there is other evidence that life may have developed even earlier. Basically, as soon as there were stable oceans, there was life.</p> <p>What else?</p> <p>That's right. It took almost 3 billion years for anything other than simple life to develop!</p> <p>And Humans are one of the very most recent animals to develop.</p> <p><u>To Do:</u> Hold out your arms like the illustration on the timeline.</p> <p><u>To Say:</u> In fact, if this timeline were as long as my arms, a simple file of my fingernail would remove all trace of humans on Earth.</p> <p>Okay, so when we go looking for aliens on other worlds, do you think those other worlds might also take a while to develop complex life?</p> <p>It's true, we don't know what kind of life forms we might find on other planets. But our experience on Earth gives us some clues. They may not be as advanced as the aliens in science fiction stories. What do you think some alien looking at our planet would have thought about Earth's inhabitants a billion years ago?</p>	<p>Most people put the beginning of life much later.</p> <p>Animals are pretty recent</p> <p>Maybe?</p>

Common Follow-up Questions

You can inspire these questions by asking, "What else might we take into consideration when thinking about life on Earth?" or, "How long do you think Earth will have intelligent civilizations on it?"

How much longer will Earth be around?

Certainly no longer than another 5 billion years. That's another timeline added after the present point. What do you think might happen in the next half of Earth's lifetime?

How long humans will be around?

If we are as lucky as dinosaurs, maybe many millions of years. Mammal species have an average lifespan from origination to extinction of perhaps a few million years. But that is just an average.

Other Questions to Answer with the Earth Timeline

How often do asteroids hit Earth?

In the beginning of Earth's history, asteroids were constantly hitting the Earth. This was called the Heavy Bombardment Phase and ended 3.8 billion years ago, allowing a more stable environment for life to form. In Earth's recent history, there are fewer impacts, but they do still happen. The last large impact happened 65 million years ago and that spelled doom for the dinosaurs but made space for mammals.

Will the Sun die and freeze the Earth?

The Sun will eventually run out of fuel and puff out into a big, old, bloated star. This will make the Earth too hot for liquid water before the Sun finally throws off its outer shell and becomes a white dwarf. This will all happen in another 5 billion years. So, imagine another timeline of the same length next to this one. Who knows what will happen in Earth's future before then?

How long do stars live?

Stars like our Sun live 2 people-widths, or about 10 billion years. Big, bright stars live only a few million years. On this scale a few million years is less than 1 cm (less than a quarter inch even). Very small stars can live for trillions of years. That would be more than 20 banners (or people with their arms out) in a row.

You can connect this distribution of stars visible in the night sky with the *Are All Stars Like Our Sun? PowerPoint* found here:

http://nightsky.jpl.nasa.gov/download-view.cfm?Doc_ID=182

When did major extinctions happen?

Extinctions have occurred many times over the history of Earth. In the past 540 million years there have been five major events when over 50% of animal species died. For example, around 200 billion years ago, the Great Oxygenation Event (also called the Oxygenation Catastrophe) was when the iron in the oceans was mostly rusted and all of the oxygen being produced went into the atmosphere. This sounds great to us, but it was poisonous to organisms on Earth at the time.

Weren't all of the continents once a big land mass?

Around 3.8 billion years ago, the Earth's crust cooled enough to form continents. At that time, continental plates were probably moving around quite quickly, forming many different super-continent and breaking apart many times. Are you familiar with the most recent super-continent, Pangaea? In this configuration, the Americas were connected to Europe, Asia, and Africa. It occurred just before the time of the dinosaurs, not very long ago on the Earth Timeline.

Materials

What do I need to prepare?

Before using for the first time:

- Place Velcro dots on the two rows of "x"s, with the soft loop side on top by the timeline and the harder hook side on the "x"s along the bottom of the banner.



- Cut out the life form drops and one alien of your choice. Place a removable glue dot on the back of each life form drop, at the top.



To begin the activity:

- Hang the Earth Timeline banner or place it on a table
- Fold the bottom of the banner up so the Velcro dots meet.

Where do I get additional materials?

1. There are masters of the life form cards on the Manual & Resources CD.
2. A large pdf of the banner is included on the Manual & Resources CD in the file named Masters. It can also be found on the Night Sky Network website by searching under Astronomy Activities for "timeline." You can get prints made for around \$100 at many banner and copy centers:

<http://nightsky.jpl.nasa.gov/>