EARTH IN 12 HOURS (THE CLOCK)

Earth in 12 hours places our planet's long history in perspective: if 4.5 million years of geological and biological development were condensed into 12 hours, for how long would there have been life on the planet? When did the moon form? Has there always been oxygen in the atmosphere, or where does it come from? And exactly how long have human beings existed?

People do not often consider our planet as inhospitable, barren, and completely unpopulated, however, that is what the largest part of our planet's history looks like. The Earth has only really been full of life a small proportion of the time. For several hundred million years, there was no life at all before the first bacteria emerged. It was also through cyanobacteria (photosynthesising silica algae) that the atmosphere started to oxygenate – a prerequisite for life on land.

If the Earth were 12 hours old, it would only be one and a half hours since the very first animals started to develop. The dinosaurs (except for their descendants, the birds) died out after a large meteorite impact approximately 10 minutes ago and we humans have only existed for a few seconds.

By studying fossils and other traces of earlier life forms we can see the different cycles of mass extinctions (often due to climate change) that are followed by so-called life explosions (when many ecological niches open up to new organisms). Researchers talk about five major mass extinctions, 'the Big 5', and many believe we are currently experiencing a sixth mass extinction. Although many previous extinctions have been due to climate change, the difference today is that we humans greatly contribute to the changes by burning fossil fuels (such as carbon and oil) and changing the landscape by clearing forests and expanding cultivated land.

Prerequisites for life on Earth

Water is necessary for many chemical reactions and enables chemicals to be transported and dissolved. The water temperature must also be between 15 and 115 degrees to ensure that the water does not freeze or evaporate.

Energy – either in the form of light energy or in chemical form is a requirement for life. Energy enables metabolic processes that in turn ensure that living organisms can reproduce.

The atmosphere enables life on Earth by providing protection from the sun's radiation while keeping the planet warm enough for life to exist.

Nutrients are something that all living organisms require to survive. The atmosphere can provide the planet with these nutrients and volcanic eruptions and weather systems can ensure they are circulated and renewed in the system.

Life & Death

Life – there are several theories about how life began. What we know is that living organisms have certain things in common, such as the fact that they consist of carbon compounds and have the ability to grow and reproduce. In addition, they require access to water and energy. During long periods of stable climate, many new plant and animal species develop.
Death – Earth has suffered five major mass extinctions, 'the Big 5'. They are often linked to rapid climate change. The most recent mass extinction occurred 66 million years ago, when most of the dinosaurs died out. Mass extinctions have made way for an explosive evolution of new species, which are adapted to the new climate.
Temperature – Explore how the Earth's temperature is linked to life explosions and mass extinctions!

Known causes of/theories on climate change on Earth throughout history

- **The strength of the sun** varies over time and affects the temperature.
- **The Earth's orbit**: when the Earth is closer to the sun it is warmer.
- **The orientation of Earth's axis of rotation**: when the axial tilt increases, summer becomes warmer and winter becomes colder.
- **The amount of greenhouse gases in the Earth's atmosphere** (carbon dioxide, methane, water vapour, dinitrogen oxide): the more greenhouse gases, the more of the sun's radiation is captured in the atmosphere, and the warmer the climate becomes.
- **Plate tectonics:** the formation of major mountain ranges can affect the air circulation around the world and redistribute warm air to colder areas.
- **Volcanic eruptions**: accumulation of gases and particles in the atmosphere that can heat or cool the Earth's surface depending on how they interact with sunlight.
- **Ocean currents**: ocean currents can distribute heat to other parts of the Earth (e.g. the Gulf Stream). The direction of these can change, which leads to a change in the distribution of heat. The oceans store a lot of heat, so small changes can have great consequences.
- **Vegetation** on land (vegetation in the oceans?): Plants absorb carbon dioxide and, in doing so, regulate the temperature by reducing the carbon dioxide levels in the air.
- **Meteorite impacts**: increase the number of particles in the atmosphere and can prevent sunlight and heat from breaking through, making it cold. When the particles have fallen to the ground the greenhouse gases that remain in the atmosphere can have an increased greenhouse effect and opposite effect – heat.
- **Positioning of landmasses**: increased land mass at the poles leads to increased formation of ice, as there is less radiation from the sun there, and ice forms more easily on land than in water.
- **Combinations** of these can lead to "feedback". Example: PETM, snowball.