**THE EARLY EARTH AND THE BUILDING BLOCKS OF LIFE by Luke Mastin**

The Earth was formed about 4.5 billion years ago from the swirling dust and [gas](javascript:void(null);) remnants of an old [star](javascript:void(null);)’s [supernova](javascript:void(null);) explosion. As the molten mass settled and cooled, a solid crust soon formed, probably within as little as about 150 million years, along with a rudimentary atmosphere composed largely of carbon dioxide (CO2), water (H2O) and nitrogen (N2).

Although the environment at that time would have been highly hazardous to [life](javascript:void(null);), the necessary ingredients were all present in some form or another: liquid water (H2O), the chemical building blocks (usually taken to be the six [elements](javascript:void(null);): oxygen (O2), hydrogen (H), carbon (C), nitrogen (N), Sulphur (S) and phosphorus (P)) and some kind of [energy](javascript:void(null);) source, such as light.

Liquid water (H2O) is considered essential to the initial development of [life](javascript:void(null);) because many chemicals dissolve easily in water allowing them to mix together and react. Carbon is important because of its ability to form long chain-like [molecules](javascript:void(null);) (carbon chains form the backbone of organic [molecules](javascript:void(null);)). Hydrogen and oxygen (the two [elements](javascript:void(null);) that make up water [molecules](javascript:void(null);)) as well as nitrogen can all bond with carbon in many different ways, and large [molecules](javascript:void(null);) made from carbon, hydrogen, oxygen and nitrogen also tend to be very stable. All chemical reactions need an [energy](javascript:void(null);) source to drive them, whether it be ultraviolet [light](javascript:void(null);) from the Sun or electrical [energy](javascript:void(null);) from lightning or chemical [energy](javascript:void(null);) from deep-sea vents, all of which would have been available on the early Earth.

Cyanobacteria (also known as blue-green algae) are one of the earliest types of [prokaryotic](javascript:void(null);) bacteria. Ancient as their origins are, these bacteria (which are still around today) were already biologically complex, with cell walls protecting their protein-producing [DNA](javascript:void(null);), so scientists think it likely that [life](javascript:void(null);) actually began much earlier, perhaps as early as 3.8 billion years ago.

These early cyanobacteria were the first oxygen-producing, evolving, organisms, and they were responsible for the initial oxygenation of the Earth's atmosphere, as they produced oxygen while using carbon dioxide in organic [molecules](javascript:void(null);) during the period from 2.7 to 2.2 billion years ago. Photosynthesizing plants evolved later and continued this process, leading to the build up of increasing levels of oxygen in the atmosphere, as well as the release of nitrogen into the atmosphere as the oxygen reacted with ammonia (NH4). Eventually, a layer of ozone (O3) formed in the atmosphere, which better protected early lifeforms from ultraviolet radiation. While oxygen was apparently not needed for the origination of [life](javascript:void(null);) on Earth (indeed it is thought by many that the absence of oxygen was a necessary condition), the rapid explosion of [life](javascript:void(null);) began only after oxygen became abundant. http://www.physicsoftheuniverse.com/topics\_life\_early.html