



Life on Earth is extremely persistent. Since the rise of life, there have been 5 mass extinction events<sup>1</sup> and it has, in one way or another, continued to survive. However, these were not the only events that threatened the existence of life on our planet. It is proposed that twice in its history, Earth's surface has been entirely (or nearly so) covered in ice/glaciers. These two events which occurred about 2.4 billion years ago and 580 million years ago<sup>2</sup> are referred to as the 'snowball earth' hypothesis. It is believed that these events occurred due to a rise of oxygen levels and a decrease in greenhouse gases like carbon dioxide and methane which ultimately resulted in a cooling positive feedback loop causing the temperature of Earth to plummet and freeze over. These events are, obviously, not ideal for life – even so, life persisted. If another snowball earth episode occurred today, the vast majority of multicellular life would likely be killed off, though life itself would not be entirely eradicated.

Large surface organisms would be killed off because they would no longer have a reliable source of energy. Plants would no longer be able to efficiently use water and the ice crystals that would cover them causes damage their cells, ultimately killing them.<sup>3</sup> With plants dying, animals that feed off those plants would begin to starve, affecting the entire food chain. Marine organisms living close to the surface of the water would also likely die. Thick sheets of ice would block light for photosynthesis while fish and other animals would freeze.<sup>4</sup> Deep sea life (1000m and below), however, would be minimally affected if at all. Because organisms living at such depths do not rely heavily on sunlight or the atmosphere, their ecosystems would be mostly unchanged.

Deep ocean multicellular life would not be the only surviving organisms, but some bacteria and archaea would survive as well. In previous essays, we have written about extremophiles and life without photosynthesis. In them, we found that some life can not only survive at extremely cold environments, but they prefer those environments. For example, a microbe was found to live beneath an Antarctic glacier while isolated from the rest of the ocean for up to 1.5 million years.<sup>5</sup> Organisms have also been found to create energy independent from photosynthesis, making use of other chemical reactions from the rocks around them.

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<sup>1</sup> <https://cosmosmagazine.com/palaeontology/big-five-extinctions>

<sup>2</sup> <https://www.britannica.com/science/Snowball-Earth-hypothesis>

<sup>3</sup> <https://caldwell.ces.ncsu.edu/2015/02/freezing-weather-and-why-it-harms-plants/>

<sup>4</sup> textbook

<sup>5</sup> <https://www.newscientist.com/article/dn16965-polar-bugs-may-explain-how-life-survived-snowball-earth/>

Thus, if a snowball earth were to occur today, most life on earth would die out, however life would not die out entirely. There are environments and organisms that could survive such an event.