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*The Earth is very old, the universe is older still. Life had plenty of time to develop*

How much time has been available on the Earth, and in the universe, for life to form? Methods of estimation, early and more recent. The Earth is now dated 4.6 billion years by radioactivity; the universe is dated 10–20 billion years by observations of star light.

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*All life on Earth is related to a single ancestor*

All forms of life are much more closely related than first appearances might suggest. Major differences, even between animals, plants and bacteria, are superficial. The inner workings of their cells are virtually identical. Nearly all life depends on the same source of energy, which is the simple combination of hydrogen and oxygen to make water. Life on Earth had a single origin, making the search for it easier.

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*When a timescale is added to relatedness, life is found to be very old*

Historical ideas about the youth of the Earth, some of the earlier beliefs and influential personalities. Recent progress in dating fossils. Scientific distortions such as hypothetical 'missing links' and the Piltdown Man.

**Chapter 4 Before the Ancestors**

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*Life is at least as old as the Earth*

New technology enables protein or DNA sequences to be compared, but a fresh argument questions whether this provides a reliable evolutionary timescale.

**Chapter 5 Life's Not Simple**

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*Life on Earth has always been complex*

'Primitive' life more than 3.8 billion years ago was already highly complex, with cells, genes, proteins and an intricate biochemical metabolism.

**Chapter 6 Thanks to Thermodynamics**

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*If life was never simple, how did it start?*

The central paradox of life: since life can only be complex, how can it ever have been simple? The evolution of life's chemistry happened in the 10 billion years or so before the Earth existed.

**Chapter 7 Non-Event**

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*The moment life did not come into existence*

There was no specific event.

**Chapter 8 Spreading the Message**

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*Life is universal – but don't bother searching for it*

Doubling processes, such as gene duplication and cell division, are so fundamental to life that a single primitive cell, almost regardless of its inefficiency, could colonise a sterile ocean in a blink of geological time. Ice comets could preserve and transport inter-stellar chemistry. The Oort Cloud and Kuiper Belt are great reservoirs of cometary material that can survive passage through the atmosphere into the oceans of the Earth.

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| Life's timescale is at least that of the universe, not merely the Earth. Life has changed very little in the Earth's accepted timescale of 4.6 billion years. Evolution has been merely a few simple variations on an underlying biochemical theme. Innovations have been trivial. Far from the age of the Earth providing any constraint on the antiquity of life, ultimately an understanding of the origin of life may throw fresh light on the historical timeframe of the universe. |            |
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| <i>Life could do better, but probably won't</i>                                                                                                                                                                                                                                                                                                                                                                                                                                          |            |
| A genome is a program for the construction of a living being and we are on the point of being able to rewrite that program to manufacture any grotesque combination. The human species has reached the critical point where it can change its own destiny. On the other hand, human intelligence and social behaviour have changed little in thousands of years and will change little in future millennia.                                                                              |            |
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