Adaptation and evolution

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We hope that life exists beyond the earth. It would be especially important to find extraterrestrial life with an origin independent from that on earth, since this could significantly contribute to the debate about necessary versus contingent features of life. Current understanding of evolution strongly suggests that open-ended evolution by natural selection requires digital storage of genetic information. Beyond this, we do not really know how far evolution can proceed in a given time in a set of even 'identical' planets. Evolution of life on earth is marked by 'major transitions' (inclusive of the origin of the genetic code and the origin of natural language, for example). Some of these transitions might be so difficult that even if life is not uncommon, complex life might be very rare. The nature of extreme forms of adaptations achievable by evolution strongly depends on the physical environment, but also on important population genetic factors such as population size and the presence or absence of recombination.