

Life on Planet Earth: A One-Page Summary

History

The universe began 10–20 billion years ago.

Earth formed 4.8 billion years ago.

The genetic code became established 3.8 billion years ago with the appearance of prokaryotes (relatively small, simple cells including bacteria and archaea).

Eukaryotes developed 1.8 billion years ago (bigger, more complex cells with nuclei, including protozoa, fungi, plants and animals).

In the “Cambrian explosion” 540 million years ago, most of today’s classes and orders appeared. Everything on this page was learned in the last 160 years, most of it in the last 50.

What life is made of

There are 10^7 – 10^8 species of organisms.

A species consists of up to perhaps 10^{16} (multicellular) or 10^{20} (unicellular) individuals.

Organisms are composed of cells (between 1 and 10^{15} of them).

Cells are constructed from proteins (and contain also lipids and carbohydrates made by proteins).

Proteins are folded-up chains of amino acids (typically 100–1000, but up to 10^4).

There are 20 amino acids used in life on earth (A,C,D,E,F,G,H,I,K,L,M,N,P,Q,R,S,T,V,W,Y).

Each amino acid is a molecule made of atoms of H, C, N and O (and in two cases S).

The coding mechanism

Eukaryotic cells contain an inner nucleus.

The nucleus contains chromosomes (between 1 and 100 of them).

A chromosome is made up of DNA, a molecule with the structure of a double helix.

Each side of the helix is a chain of nucleotides A, C, G, T (adenine, cytosine, guanine, thymine).

The opposite side consists of the chain made from the complementary letters T, G, C, A.

Construction of proteins from DNA is carried out by a universal apparatus:

1. Transcription: conversion of DNA to RNA; here each T becomes a U (uracil).
2. Translation: construction of proteins from RNA.

The code itself

Only part of the RNA (e.g., 10%) is expressed (“exons”).

The rest (“introns”) is largely ignored, so far as is known at present.

Each triplet codes for one amino acid (e.g., GGC → Glycine).

Three triplets are “stop” punctuation marks (UAA, UGA, UAG).

Each chromosome codes for many proteins (up to 10^4 or more of them).

A “gene” is the portion of a chromosome that codes for one protein.

Reproduction and evolution

Reproduction is achieved by unzipping the helix and making new complementary chains.

Routine variation is achieved via sexual reproduction and other kinds of recombination.

The chromosomes of sexually reproducing organisms typically come in pairs.

Each offspring gets half a pair from each parent . . . except for complications of “crossover.”

Mutations are generated by “random” errors (but even this is under evolutionary control).

Variation combined with natural selection has generated all the species on the planet.