Box 1. Methods Summary

To estimate the total information content of the biosphere, DNA was quantified in five major subgroups of life: prokaryotes, plants, animals, unicellular eukaryotes (sometimes referred to as protists), and fungi. For each group, available quantifications of biomass, number of individuals, or their respective densities were converted to DNA quantities through appropriate conversions (S1 Methods), including average genome size. For prokaryotes, the estimated total number of cells, 5×10^{30} cells [5] was combined with the average prokaryotic genome size, 3.2147 Mb [6], as determined by Pulsed Field Gel Electrophoresis (PFGE), to give the total amount of DNA contained in the group. For plants, the average biomass from four different estimates, 561.8 Gt of carbon [5], 520 Gt of carbon [7], 1,841 Gt biomass [8], and 890 Gt biomass [9], was converted to the number of cells, assuming carbon content is 50% of dry weight and using a plant cell mass of 2×10^{-10} g [10] and, lastly, converted to a total amount of DNA of 3.65×10^{31} Mb using an average genome size of 5,958.01 Mb [11]. DNA quantities in the animal kingdom were found using estimates for the total biomass in major subgroups of animals (S1 Methods), which was converted to a total number of cells using a human cell mass of 1×10^{-9} g [12]. For each group, the number of cells was combined with the average genome size for that group, taking the mean of the relevant available genome size entries in the Animal Genome Size Database [13], before the total DNA amount was summed from the individual contributions, to give a final DNA quantity in animals of 4.24×10^{29} Mb. An alternative approach was also employed, whereby animal biomass densities from different habitats and biomes were used to find a global animal biomass using biome data (S1 Methods), which combined with the average animal genome size of 4,456 Mb [13] resulted in an animal DNA content of 3.67×10^{29} Mb. The abundance of unicellular eukaryotes was based on density measurements of algae, ciliates, amoebae, and testacea from different biomes: Austria (meadow, beech forest, spruce forest) [14], Australia (arid) [15], Puerto Rico (rainforest) [16], Scotland (upland grassland) [17], United States (coniferous rain forest, desert) [18,19], and Bangladesh (water) [20]. Using the average genome size of 855.59 Mb [21] for algae and 59.529 Mb [22] for other unicellular eukaryotes, a DNA quantity in unicellular eukaryotes of 1.31×10^{29} Mb was established. Biomass densities above and below ground were used to estimate the total DNA content of fungi as 1.73×10^{27} Mb, using an average genome size of 31.874 Mb [23] and eukaryotic cell mass of 2×10^{-10} g [10]. Viruses also contribute to the total DNA available on Earth. The total number of viruses on Earth has been estimated at 10^{31} [24], which, combined with an average viral genome size of 0.039518 Mb [25], gives a DNA content in viruses of 3.95×10^{29} Mb. Other DNA that was not included in the estimate of the total DNA in the biosphere is chloroplast DNA (approximately 0.12–0.2 Mb), mitochondrial DNA (mtDNA, approximately 0.0165 Mb in humans), plasmids (approximately 0.001–1 Mb) and extracellular DNA in the environment. Owing to their small genome size compared to the nuclear genome size, they are unlikely to have an order-of-magnitude effect on the total DNA estimate we derive. Fossilised DNA is assumed not to be playing a role in the computational capacity of the biosphere. We did not take into account leaf litter, which has been estimated to have a biomass of 122 Gt [7]; assuming a plant genome size of 5,958 Mb, this gives a total DNA contained within litter of 7×10^{30} Mb. This material is analogous to old garbage data. The total DNA amount in the biosphere was, hence, found to be $5.3(3.6) \times 10^{31}$ Mb. Uncertainties were quantified for all groups (S1 Methods).