Chapter 0 Questions and Problems

1. Carry out the following metric unit conversions.

Size: 1 m = ... cm = ... mm = ... μm = ... nm

1 nm = ... μm = ... mm = ... cm = ... m

Mass: 1 g = ... mg = ...μg = ... ng

1 ng = ... μg = ... mg = ...g

Volume: 1 L = ... mL = ... μL

1 μL = ... mL = ... L

2. In their paper "Prokaryotes: The Unseen Majority", Whitman et al (1998) reviewed many studies about the abundance of prokaryotes in various habitats. Collating this information they concluded the total number of prokaryotic cells on Earth is approximately 5×10^{30} (See **Table 1-0** in the Custom Text).

(a) Estimate the total volume of all the Earth's prokaryotic cells in km^3.
(b) Estimate the total mass of the Earth's prokaryotes in kg.
(c) Compare these estimates to the volume and mass of the Earth (Google "Earth Fact Sheet NASA").
(d) Since the publication of Whitman et al (1998), the abundance of prokaryotes in oceanic subsurface materials has been revised downward by about 90% from about 350 to about 35×10^{28}. (Kallmeyer et al, 2012. Global distribution of microbial abundance and biomass in subseafloor sediment. Proc. Natl. Acad. Sci. USA. 109: 16213-16216). Given this information, recalculate the estimate of the total number of prokaryotic cells on Earth (See **Table 0-1** of the Custom Text).

Assume

- All prokaryotic cells are unicellular spheres with an average volume of $1 \mu m^3$
- The density of prokaryotic "tissue" is close to the density of water, i.e. 1 g/cm^3
- The volume and mass of the Earth given in the NASA fact sheet **(c)** includes its prokaryotes.

3. There are approximately 10 times the number of microbial cells in an adult body than there are human cells: 10^{14} versus 10^{13}. Many of these microbes are bacteria found in the large intestine. If roughly 3 kg of bacteria are found in the large intestine of a single human, estimate the total number of bacteria inhabiting your intestine as well as the intestines of all of the humans currently (~7 billion) on the Earth. See Question/Problem #2 for assumptions.