**436f Membrane Descriptions for a Mathematical Model of a Minimal Cell**

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We wish to understand the relationship between cellular regulation and genomic instructions. Our goal is to develop a computer model for a minimal cell that includes the essential functions required for life. A minimal cell is an organism with the minimum number of genes, able to grow and divide in an environment with preformed nutrients and constant temperature and pH. Our starting point is a dimensionless coarse grain whole cell model [1]. The modular nature of this model has been previously tested. A genomically detailed module (nucleotide metabolism) was added while maintaining all interconnections and dynamic features of the original model [2]. This model predicts typical physiological responses of bacteria.

In this study, we have developed a new module, which describes with chemical detail the composition of the membrane for a minimal cell and the corresponding essential genes. Membranes allow selective nutrient passage, harmful substance exclusion, and energy generation. Bacterial membrane elements range from lipids to fatty acids and proteins, and are structurally similar to eukaryotes cell membranes. Membranes are dynamic structures, and experimental analyses of bacterial composition show great variations. The flexibility of the model is such that different membrane compositions could be obtained in response to parameters under the user's control. The knowledge gathered from the simplest bacterial membrane could aid in the understanding of more complex behavior of higher species (toxin secretion) as well as identification of potential targets for antimicrobials.

[1] Domach, M.M., et al., Computer model for glucose-limited growth of a single cell of Escherichia coli B/r-A. Reprinted from Biotechnology and Bioengineering, Vol. 26, Issue 3, Pp 203-216 (1984). Biotechnology and Bioengineering, 2000. 67(6): p. 827-840.

[2] Castellanos, M., D.B. Wilson, and M.L. Shuler, A modular minimal cell model: Purine and pyrimidine transport and metabolism. Proceedings of the National Academy of Sciences of the United States of America, 2004. 101(17): p. 6681-6686.