

E-CELL Project Overview: Towards Integrative Simulation of Cellular Processes

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1 Introduction

The E-CELL project [?] was launched in 1996 at Keio University in order to model and simulate various cellular processes with the ultimate goal of simulating the cell as a whole. The first version of the E-CELL simulation system, which is a generic software package for cell modeling, was completed in 1997. The E-CELL system enables us to model not only metabolic pathways but also other higher-order cellular processes such as protein synthesis and membrane transport within the same framework. These various processes can then be integrated into a single simulation model.

Using the E-CELL system, we have successfully constructed a virtual cell with 127 genes sufficient for “self-support”. The gene set was selected from the genome of *Mycoplasma genitalium*, the organism having the smallest known genome. The set includes genes for transcription, translation, the glycolysis pathway for energy production, membrane transport, and the phospholipid biosynthesis pathway for membrane structure.

2 Ongoing Research

We are now in the second phase of the project, in which the following cellular processes are being modeled using the E-CELL system:

- Other metabolic pathways, including the TCA cycle, the pentose-phosphate cycle, and biosynthesis pathways for nucleotides and amino acids (Fig. 1).
- DNA replication and procaryotic cell cycle [?].
- Lambda phage gene regulatory network.
- Signal transduction for bacterial chemotaxis [?].
- Kinetic model of human red blood cell [?].

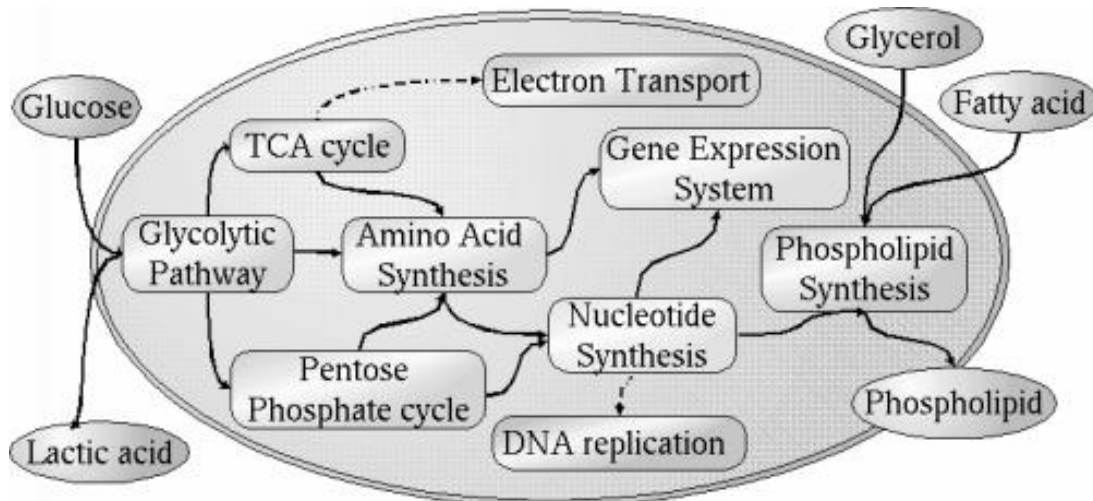


Figure 1: "Self-Supporting" Cell Model '98.

3 Concluding Remarks

Besides cell modeling work described above, the E-CELL simulation software itself is being improved in several important ways [?]. For example, reaction rules and substance definitions for simulation can now be written as a spread sheet table using any commercially or publicly available spread sheet software. Methodologies for time series analyses of metabolic network using the E-CELL system are also being developed [?]. The E-CELL system will be made available in early 1999 from our website.

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