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The Swiss Initiative in Systems Biology

## What is Systems Biology?

**The efforts of Systems Biology may be the path to understanding the language of life and offer the pharma industry a way out of their innovations crisis.**

The cell is the foundation and smallest unit of life. During the last century, scientists attempted to learn as much as they could about these cells relying mostly on microscopy and molecular techniques. The deeper their investigations went, the more they learned about the molecular composition of these cells. However, as the foundation of life was being dissected, the only thing leftover from the system as a whole was by definition Chemistry and Physics.

Near the end of the twentieth century, a movement to tackle this issue started to take form. The goal was to map where genes were on the individual chromosomes. The pinnacle of this research culminated in successful sequencing of the entire human genome. In the summer of 2000, President Clinton announced the completion of this massive sequencing project together with Prime Minister Blair. After the announcement, deciphering what exactly this code contained became the new priority. The expectations Clinton and Blair roused for its applications in Science and Medicine were massive.

Nowadays, genomes for all sorts of organisms are published regularly. We have amassed a great deal of letters, or text in a language we are not really able to interpret effectively. The code is written with familiar letters, but in a language foreign to us. Consequently its medical applications have been relatively limited. Although pharma industry spending on R&D has increased substantially since 2000, the number of medically active substances which have resulted in an approved pharmaceutical product has dropped simultaneously.

Systems Biology offers a way to fight this trend. Systems Biology can be seen as an initiative to learn and interpret this complex genomic language. We need to go beyond the translation or writing down of a few sentences or books. The aim is to understand the language's semantics, syntax, and grammar. Using a book as a metaphor for the genome of a single organism, a protein is a word, and a metabolic pathway is a sentence. The content and message the book is like all the interactions within and among cells of a single organism.

Mathematical modeling of biological pathways is the key to understanding all the different interactions a cell is capable of. For this to be realized, Chemists, Biologists, Physicists, Mathematicians, and Computer Scientists need to integrate their capacities and competencies. The interplay of theory, observation, and experimentation should eventually help Biology move from a qualitative to a quantitative natural science like Physics.