



## Computational Embryology

An important goal in birth defects research is to derive the architecture and function of developing systems as biological networks. At the Birth Defects Center, Dr. Knudsen's laboratory used genomic and systems biology to understand the developmental consequences of prenatal exposures to alcohol and environmental toxicants. With vast genomics data and bioinformatics tools now at hand, efforts are underway to reverse-engineer gene regulatory networks (GRNs) that underlie birth defects and developmental abnormalities. Dr. Knudsen relocated to the National Center for Computational Toxicology at the US Environmental Protection Agency in late 2007 to spear-head a new research program aiming to develop a sophisticated computer model of a mammalian embryo that can be used to help scientists better understand the prenatal risks posed by chemicals and other environmental stressors - the 'Virtual Embryo Project' (v-Embryo™). This project is using computers to develop models of GRNs and reconstruct embryonic tissues *in silico* (<http://www.epa.gov/ncct/v-Embryo/>). 'Virtual tissue' technology enables researchers to interact with a computer-simulated environment of specific embryonic tissues. The ability to perform complex operations on simulated system gives insight to conditions hard to evaluate due to time, scale, and cost (monetary and animal). Challenges for technology development include a knowledgebase to extract, organize, and store data (database) and facts (literature) about the tissue in a computable form, and a simulation engine for multi-scale models to study how different mechanisms interact at one level and cause effects at a higher level. Validated computational (*in silico*) models of the embryo may someday help scientists integrate *in vitro* data at different scales molecules to phenotype as well as to help link toxicity pathways with prenatal developmental effects *in vivo*.

## Publications

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## Thomas Knudsen, PhD

Adjunct Professor (ULSD)  
Developmental Systems Biologist (US EPA)



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### External activities

- Editor-in-Chief, *Reproductive Toxicology* (impact factor 3.34)
- Scientific Liaison Coalition (Chair), Society of Toxicology

### Thomas B. Knudsen, PhD

National Center for Computational Toxicology (B205-01)  
Office of Research & Development  
U.S. Environmental Protection Agency  
Research Triangle Park, NC 27711  
Email: knudsen.thomas@epa.gov  
Phone 919 541 9776 Fax 919 541 1194