

Contents

Foreword	v
Preface	vii
1 Introduction	1
1.1 Intracellular Events	1
1.1.1 Transcription, Translation, and Regulation	1
1.1.2 Signaling Pathways and Proteins	3
1.1.3 Metabolism and Genes	3
1.2 Intracellular Reactions and Pathways	3
2 Pathway Databases	5
2.1 Major Pathway Databases	5
2.1.1 KEGG	6
2.1.2 BioCyc	8
2.1.3 Ingenuity Pathways Knowledge Base	8
2.1.4 TRANSPATH	8
2.1.5 ResNet	9
2.1.6 Signal Transduction Knowledge Environment (STKE): Database of Cell Signaling	9
2.1.7 Reactome	11
2.1.8 Metabolome.jp	12
2.1.9 Summary and Conclusion	12
2.2 Software for Pathway Display	13
2.2.1 Ingenuity Pathway Analysis (IPA)	13
2.2.2 Pathway Builder	14
2.2.3 Pathway Studio	14
2.2.4 Connections Maps	14
2.2.5 Cytoscape	14
2.3 File Formats for Pathways	15
2.3.1 Gene Ontology	15

2.3.2	PSI MI	16
2.3.3	CellML	16
2.3.4	SBML	16
2.3.5	BioPAX	16
2.3.6	CSML/CSO	17
3	Pathway Simulation Software	19
3.1	Simulation Software Backend	19
3.1.1	Architecture: Deterministic, Probabilistic, or Hybrid?	20
3.1.2	Methods of Pathway Modeling	20
3.2	Major Simulation Software Tools	21
3.2.1	Gepasi/COPASI	21
3.2.2	Virtual Cell	21
3.2.3	Systems Biology Workbench (SBW), Cell Designer, JDesigner	21
3.2.4	Dizzy	22
3.2.5	E-Cell	22
3.2.6	Cell Illustrator	22
3.2.7	Summary	24
4	Starting Cell Illustrator	25
4.1	Installing Cell Illustrator	25
4.1.1	Operating Systems and Hardware Requirements	25
4.1.2	Cell Illustrator Lineup	26
4.1.3	Installing and Running Cell Illustrator	26
4.1.4	License Install	28
4.2	Basic Concepts in Cell Illustrator	28
4.2.1	Basic Concepts	28
4.2.2	Entity	28
4.2.3	Process	30
4.2.4	Connector	33
4.2.5	Rules for Connecting Elements	34
4.2.6	Icons for Elements	35
4.3	Editing a Model on Cell Illustrator	36
4.3.1	Adding Elements	36
4.3.2	Model Editing and Canvas Controls	39
4.4	Simulating Models	41
4.4.1	Simulation Settings	41
4.4.2	Graph Settings	41
4.4.3	Executing Simulation	43
4.5	Simulation Parameters and Rules	44
4.5.1	Creating a Model with Discrete Entity and Process	44
4.5.2	Creating a Model with Continuous Entity and Process	49
4.5.3	Concepts of Discrete and Continuous	51
4.6	Pathway Modeling Using Illustrated Elements	52

4.7	Creating Pathway Models Using Cell Illustrator	55
4.7.1	Degradation	55
4.7.2	Translocation	57
4.7.3	Transcription	60
4.7.4	Binding	62
4.7.5	Dissociation	64
4.7.6	Inhibition	66
4.7.7	Phosphorylation by Enzyme Reaction	68
4.8	Conclusion	73
5	Pathway Modeling and Simulation	75
5.1	Modeling Signaling Pathway	75
5.1.1	Main Players: Ligand and Receptor	75
5.1.2	Modeling EGFR Signaling with EGF Stimulation	76
5.2	Modeling Metabolic Pathways	87
5.2.1	Chemical Equations and Pathway Representations	87
5.2.2	Michaelis-Menten Kinetics and Cell Illustrator Pathway Representation	88
5.2.3	Creating Glycolysis Pathway Model	89
5.2.4	Simulation of Glycolysis Pathway	101
5.2.5	Improving the Model	101
5.3	Modeling Gene Regulatory Networks	106
5.3.1	Biological Clocks and Circadian Rhythms	106
5.3.2	Gene Regulatory Network for Circadian Rhythms in Mice	107
5.3.3	Modeling Circadian Rhythms in Mice	108
5.3.4	Creating Hypothesis by Simulation	119
5.4	Summary	124
6	Computational Platform for Systems Biology	127
6.1	Gene Network of Yeast	127
6.2	Computational Analysis of Gene Network	128
6.2.1	Displaying Gene Network	128
6.2.2	Layout of Gene Networks	130
6.2.3	Pathway Search Function	131
6.2.4	Extracting Subnetworks	132
6.2.5	Comparing Two Subnetworks	133
6.3	Further Functionalities for Systems Biology	136
6.3.1	Languages for Pathways: CSML 3.0 and CSO	136
6.3.2	SaaS Technology	137
6.3.3	Pathway Parameter Search	138
6.3.4	Much Faster Simulation	138
6.3.5	Exporting Pathway Models to Programming Languages	138
6.3.6	Pathway Layout Algorithms	139
6.3.7	Pathway Database Management System	141
6.3.8	More Visually: Automatic Generation of Icons	142

Bibliographic Notes	145
Index	151

Foundations of Systems Biology

Using Cell Illustrator and Pathway Databases

Nagasaki, M.; Saito, A.; Doi, A.; Matsuno, H.; Miyano, S.

2009, XII, 155 p. With CD-ROM., Hardcover

ISBN: 978-1-84882-022-7