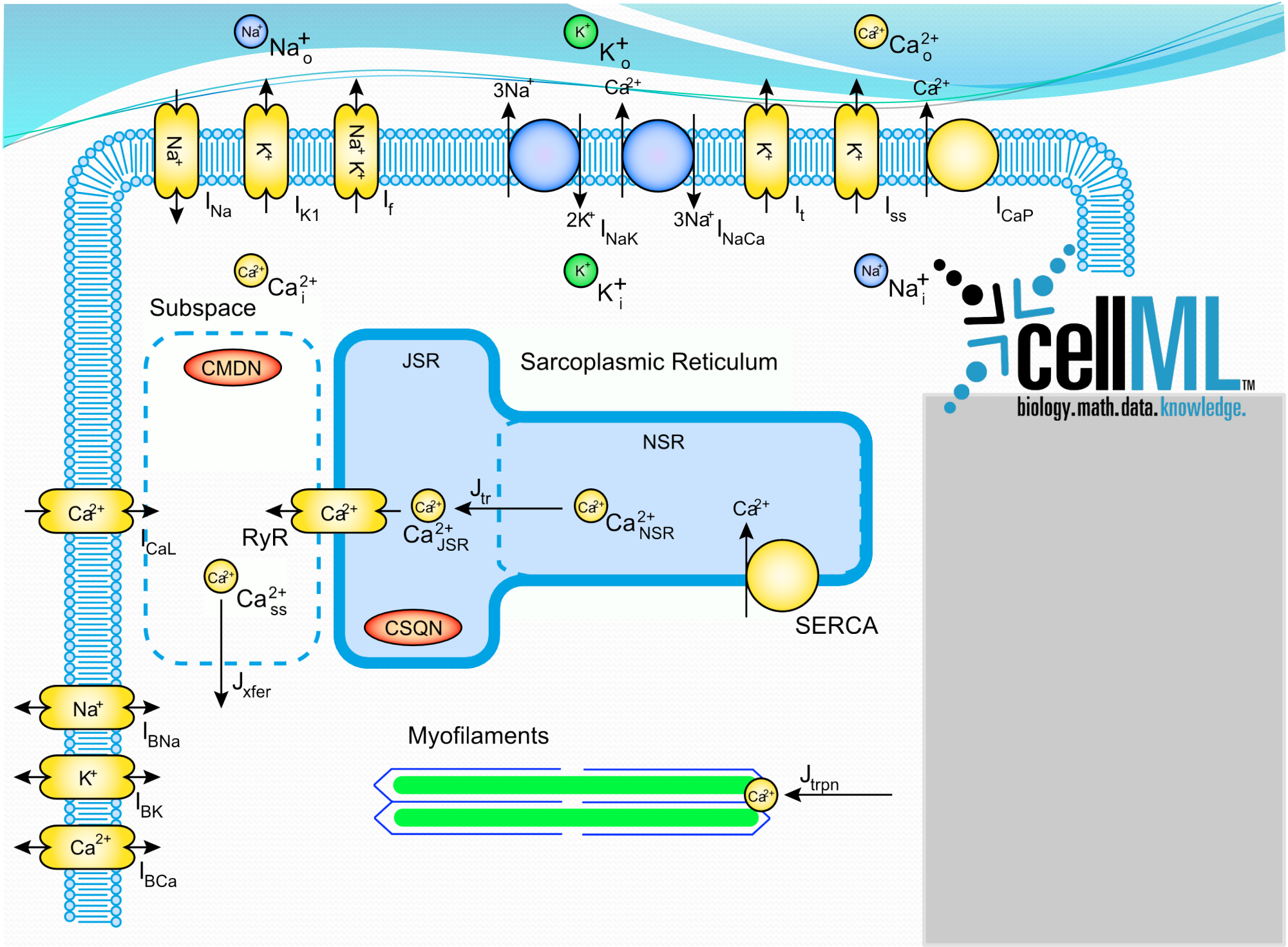
From model to models

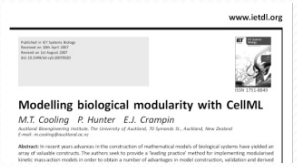
Constructing libraries of modular CellML models

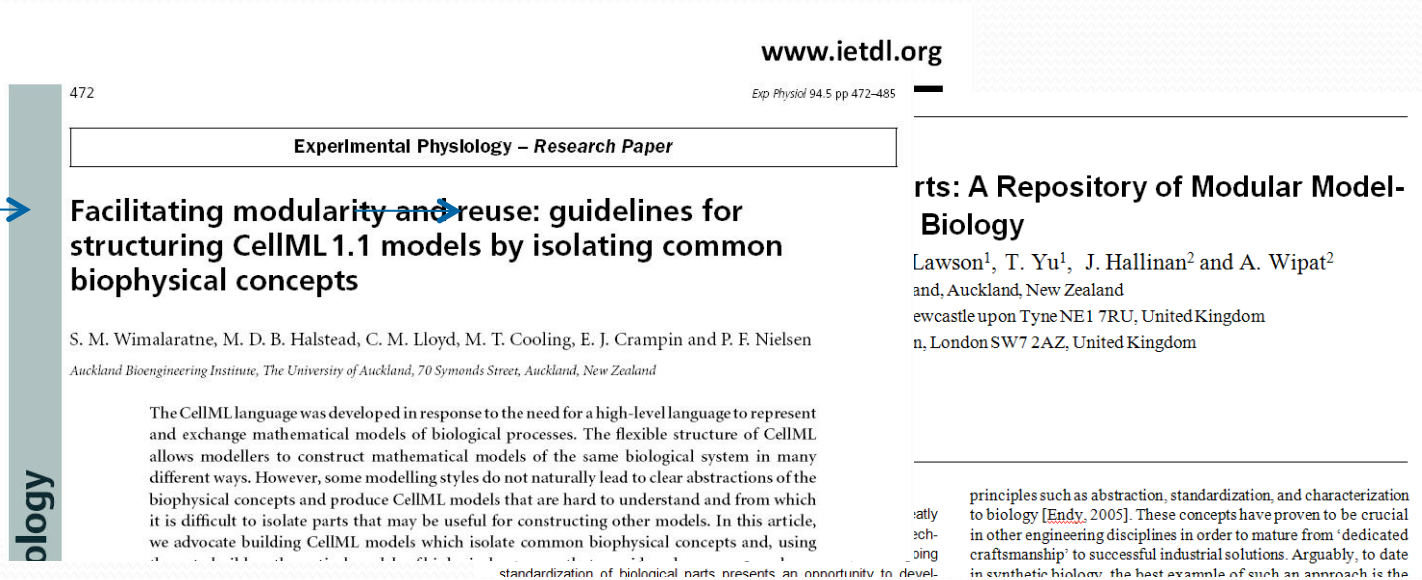
Mike Cooling, February 2010
Auckland Bioengineering Institute

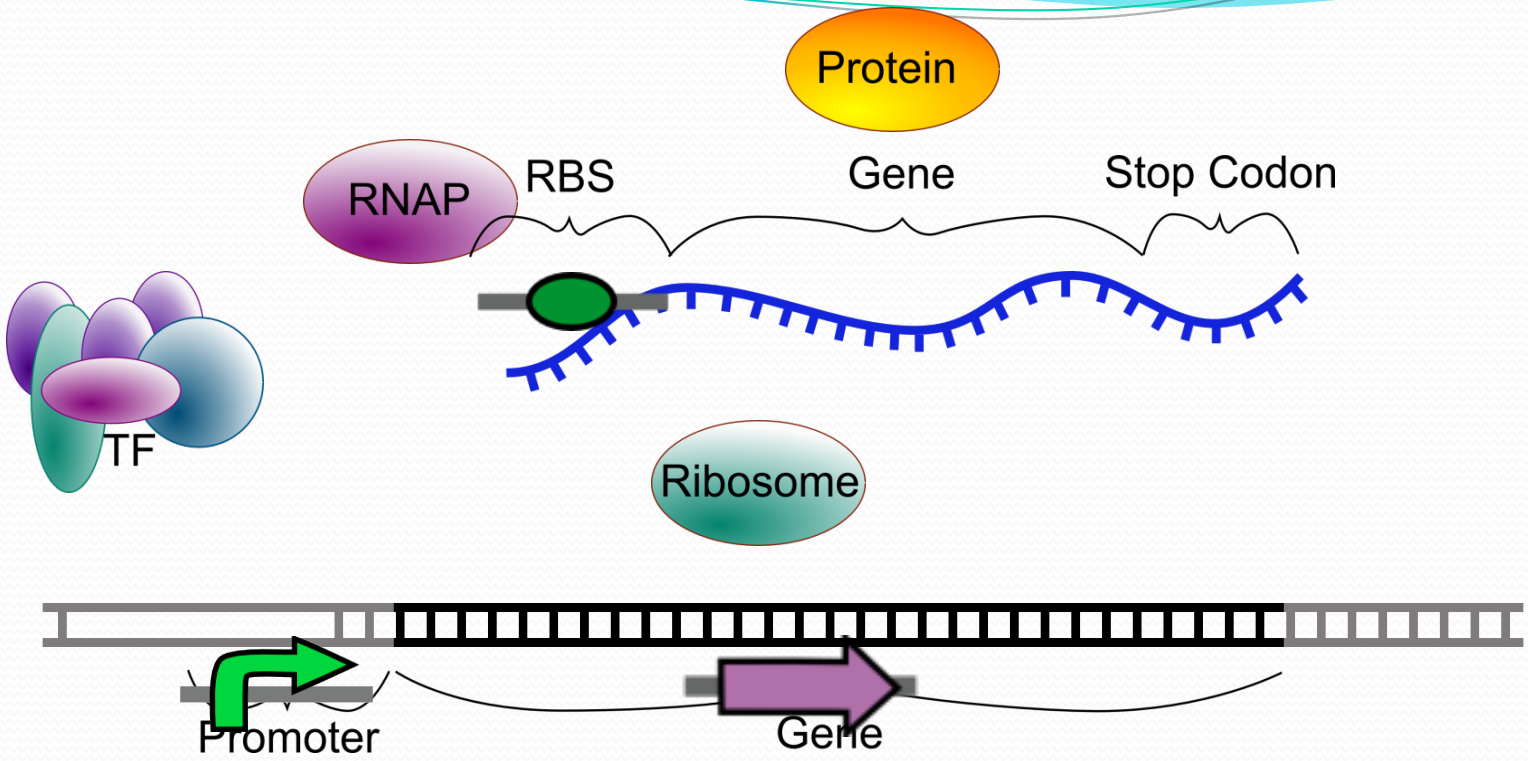

Na^+_o
K^+_o
Ca^{2+}_o
3Na+
Ca2+
Ca2+
Na+
K+
Na+ K+
K+
K+
I_{Na}
I_{K1}
I_f
2K+ I_{NaK}
3Na+ I_{NaCa}
I_t
I_{ss}
I_{CaP}
Ca^{2+}_i
Subspace
K^+_i
Na^+_i
CMDN
JSR
Sarcoplasmic Reticulum
NSR
J_{tr}
Ca^{2+}_{NSR}
Ca^{2+}_{JSR}
RyR
I_{CaL}
Ca^{2+}_{ss}
J_{xfer}
CSQN
SERCA
I_{BNa}
I_{BK}
I_{BCa}
Myofilaments
J_{trpn}
cellML
biology.math.data.knowledge.

Modular Models

- Construction with recombination in mind
- Fine-grained reuse – mathematical equation level







Registry of Standard Parts

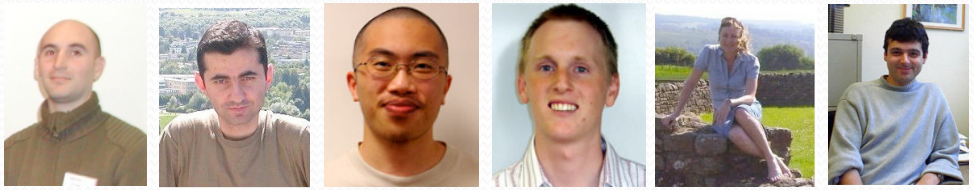
Constitutive *E. coli* σ^{70} promoters

This section lists promoters that are recognized by *E. coli* σ^{70} RNAP. σ^{70} is the major *E. coli* sigma factor so there should be RNAP present to transcribe these promoters under most growth conditions (although maximally during exponential growth).

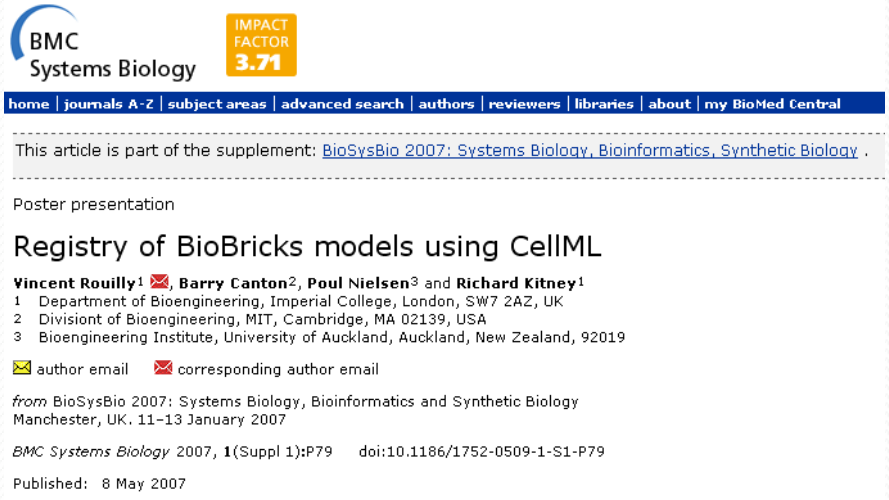
More...

-?-	Name	Description	Promoter Sequence	Positive Regulators	Negative Regulators
1☆	BBa_I14018	P(Bla)	. . . gtttatacataggcgagtactctgttatgg		
1☆	BBa_I14033	P(Cat)	. . . agaggttccaactttcaccataatgaaaca		
1☆	BBa_I14034	P(Kat)	. . . taaacaactaacggacaattctacctaaca		
	BBa_I732021	Template for Building Primer Family Member	. . . acatcaagccaaattaaacaggattaacac		
	BBa_I742126	Reverse lambda cI-regulated promoter	. . . gaggtaaaatagtcaacacgcacggtgtta		

Our goal



- Registry of Standard *Virtual* Parts to complement the Registry of Standard Biological Parts



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This article is part of the supplement: BioSysBio 2007: Systems Biology, Bioinformatics, Synthetic Biology .

Poster presentation

Registry of BioBricks models using CellML

Vincent Rouilly[1], **Barry Canton**[2], **Poul Nielsen**[3] and **Richard Kitney**[1]

1 Department of Bioengineering, Imperial College, London, SW7 2AZ, UK
2 Divisiont of Bioengineering, MIT, Cambridge, MA 02139, USA
3 Bioengineering Institute, University of Auckland, Auckland, New Zealand, 92019

author email corresponding author email

from BioSysBio 2007: Systems Biology, Bioinformatics and Synthetic Biology
Manchester, UK. 11-13 January 2007

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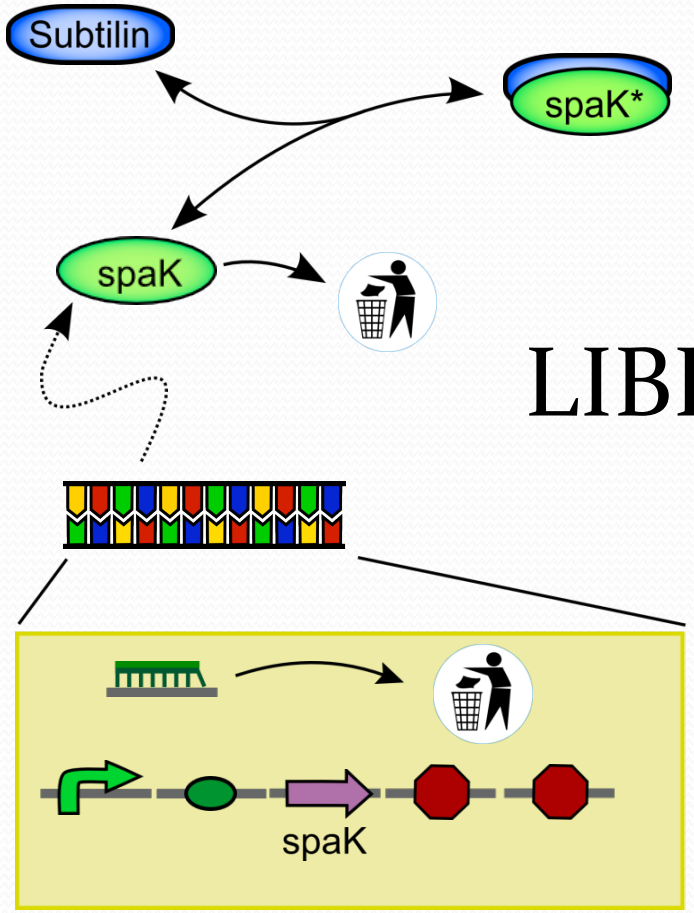
Published: 8 May 2007

- Composition of models to provide *in silico* simulations

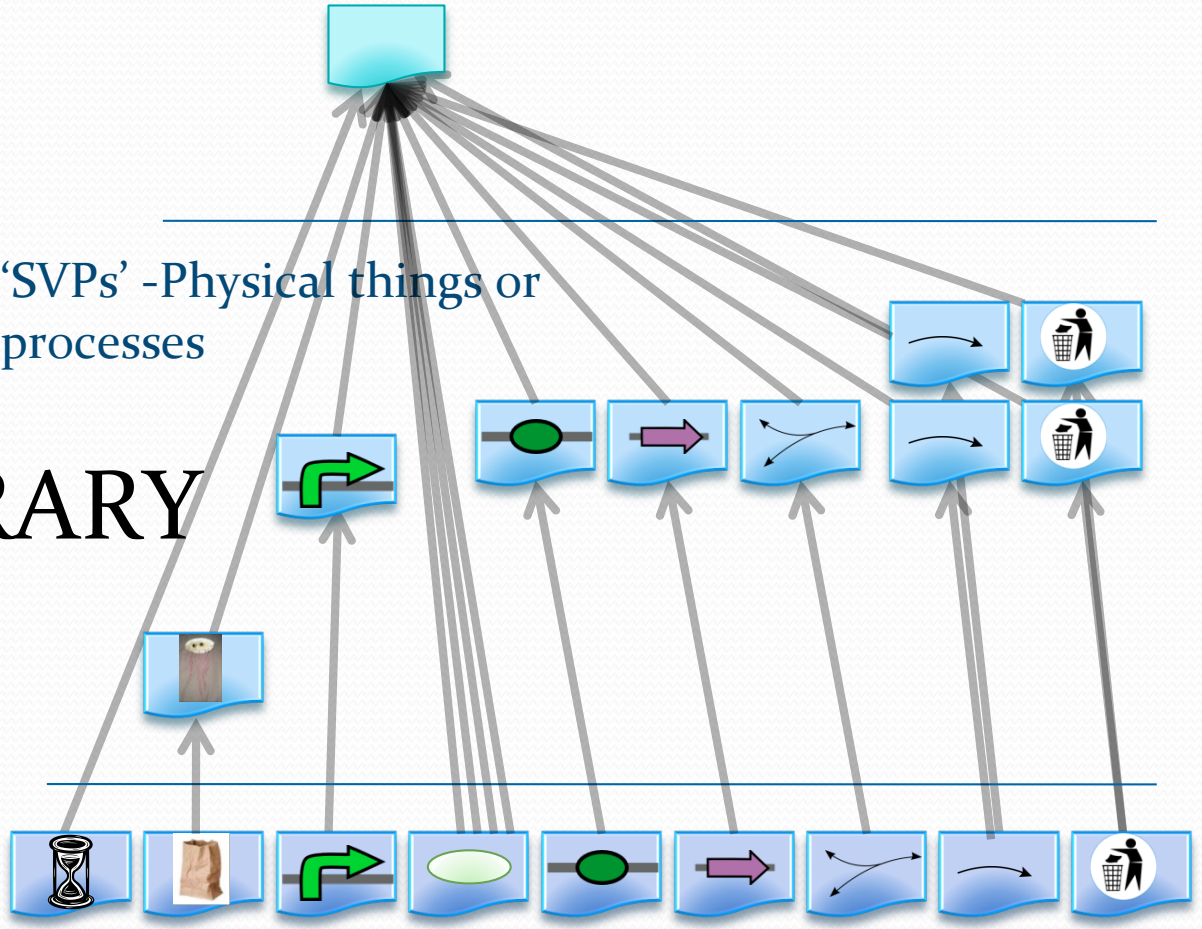
Example



‘System Models’

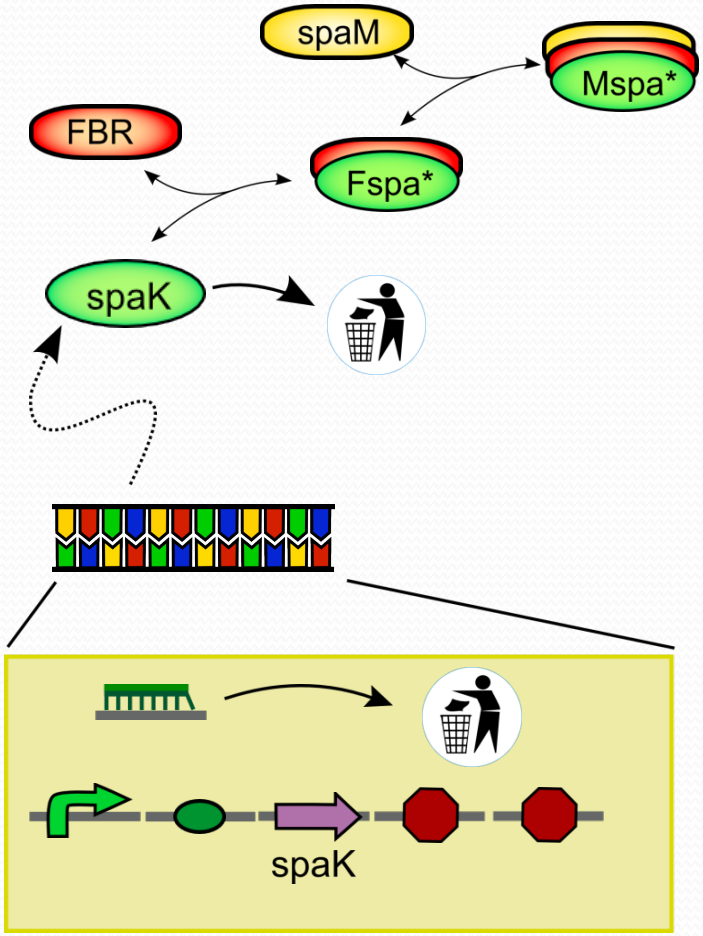
‘SVPs’ -Physical things or processes

LIBRARY



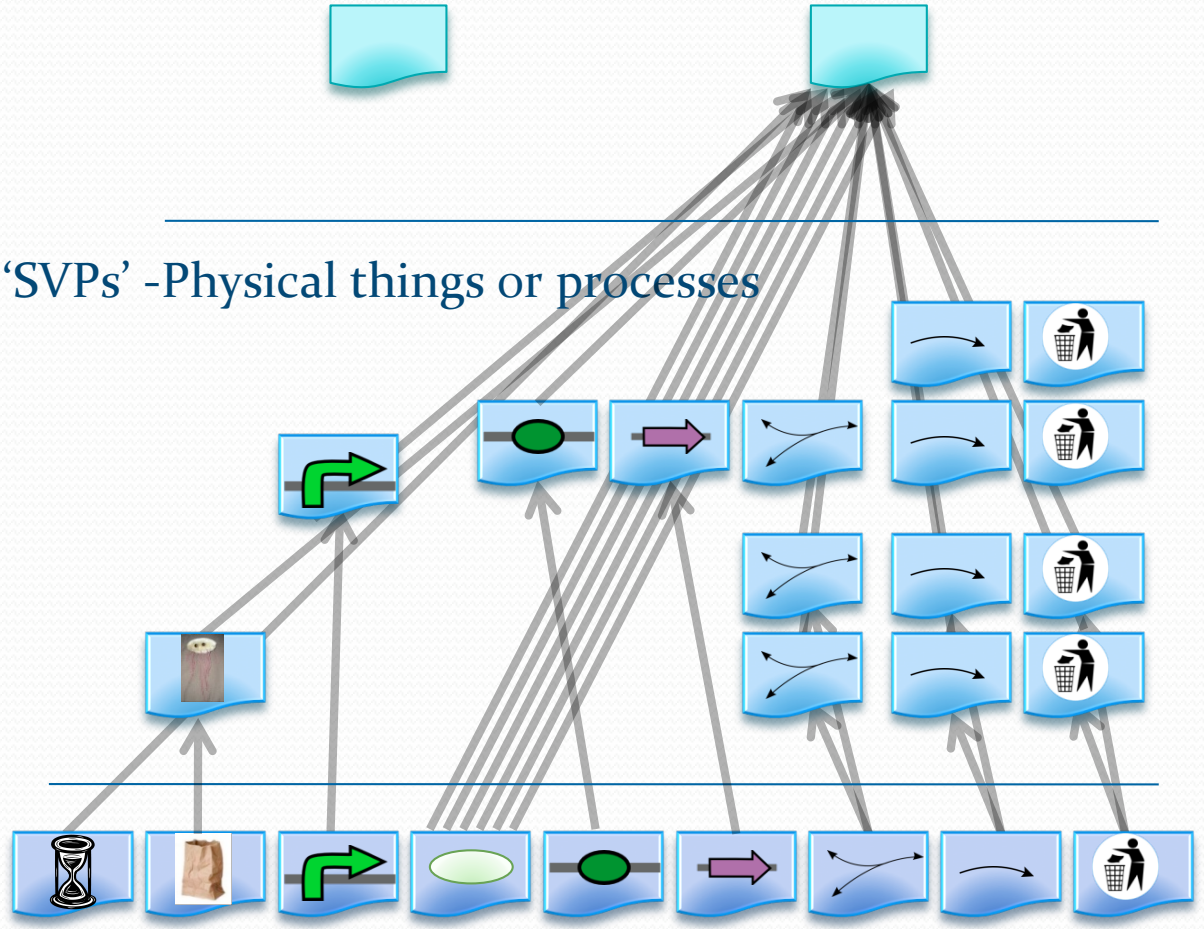
‘Templates’ – Mathematical structures

Example



‘System Models’

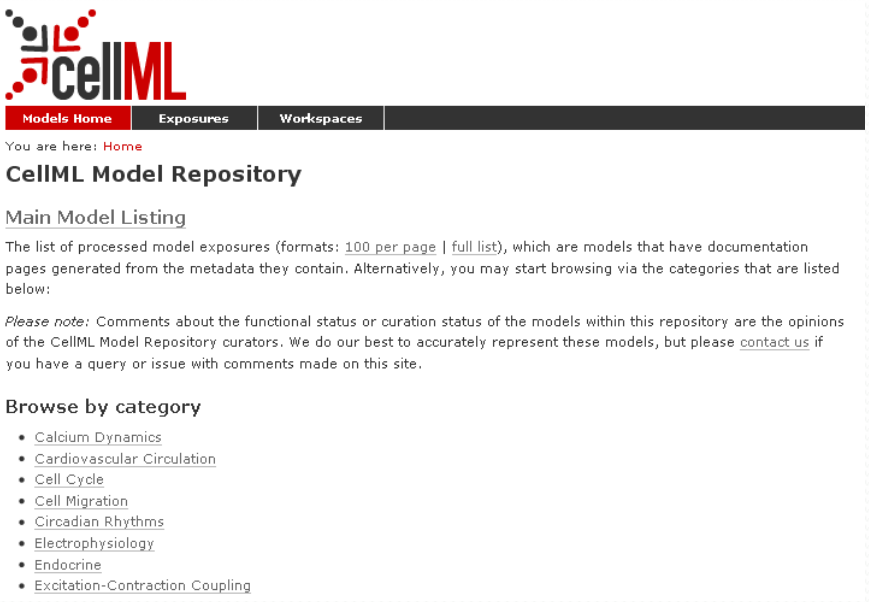
‘SVPs’ -Physical things or processes



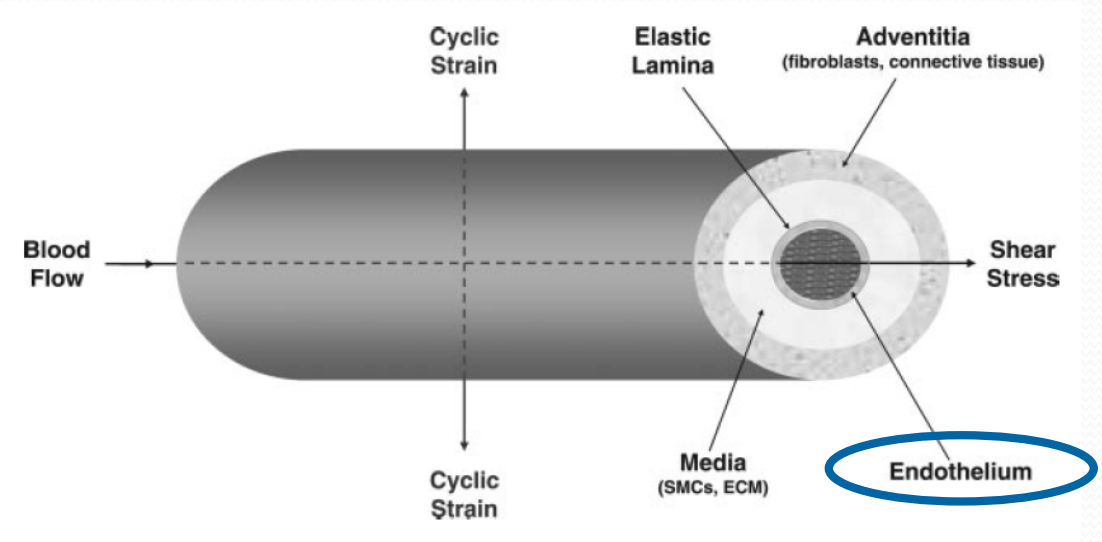
‘Templates’ – Mathematical structures

http://models.cellml.org

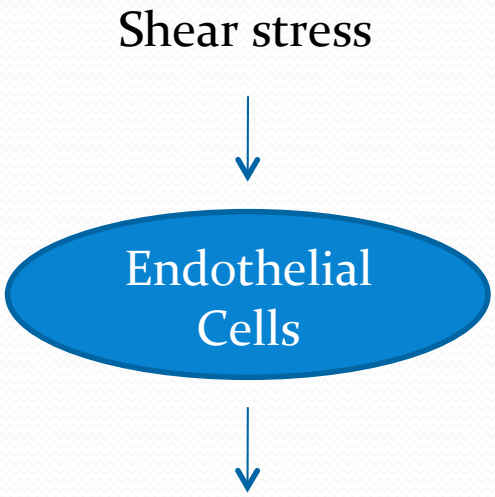
- Support for v1.1 models (multi-file, imports)
- ‘Sharing’ of models between projects through ‘embedded workspaces’
- Collaborative options
- (Distributed) version control



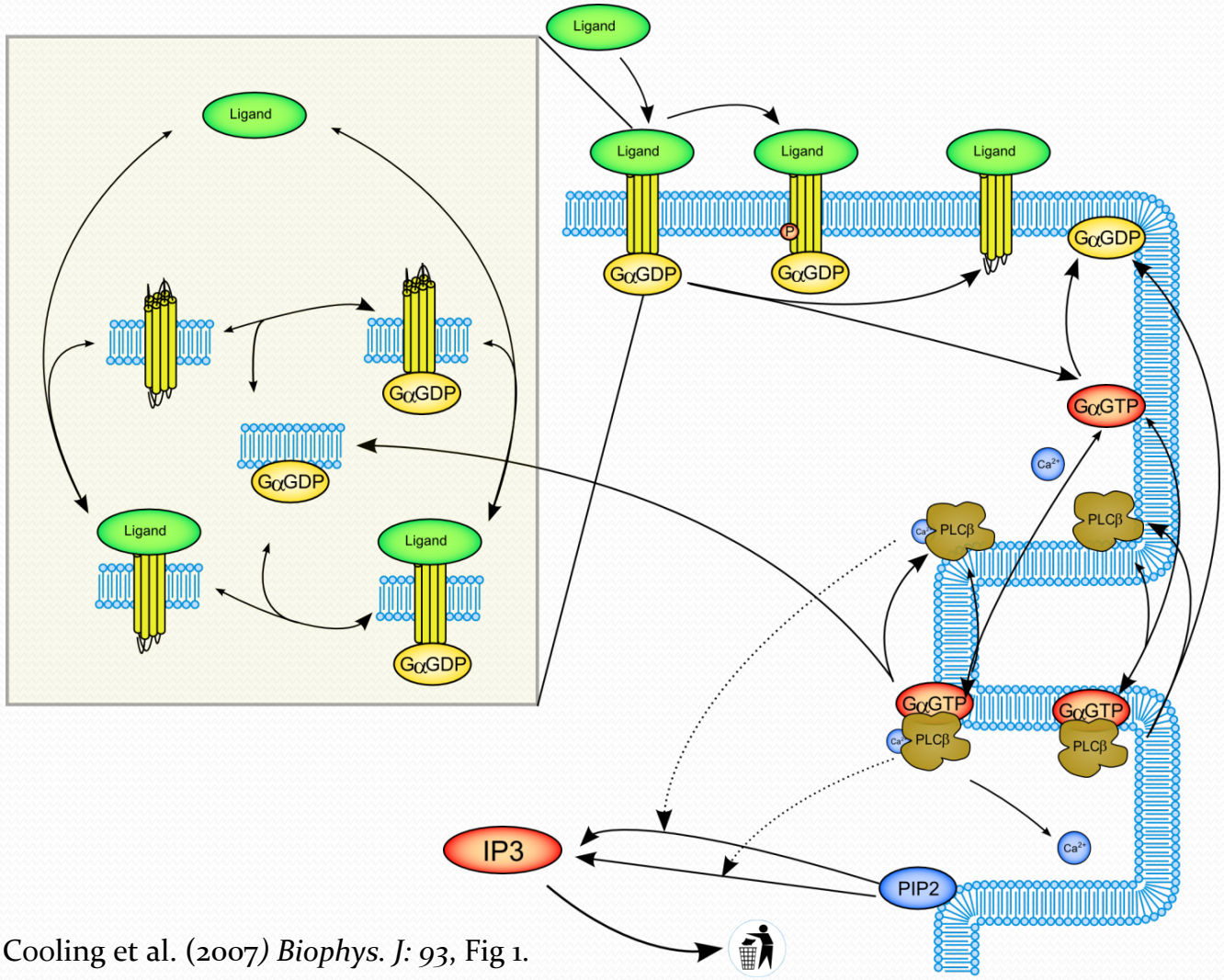
Next: Biomedical Applications



Cummins et al. (2007) *Am J Physiol Heart Circ Physiol:292*, Fig 1.



Modular Model Construction



Cooling et al. (2007) *Biophys. J: 93*, Fig 1.

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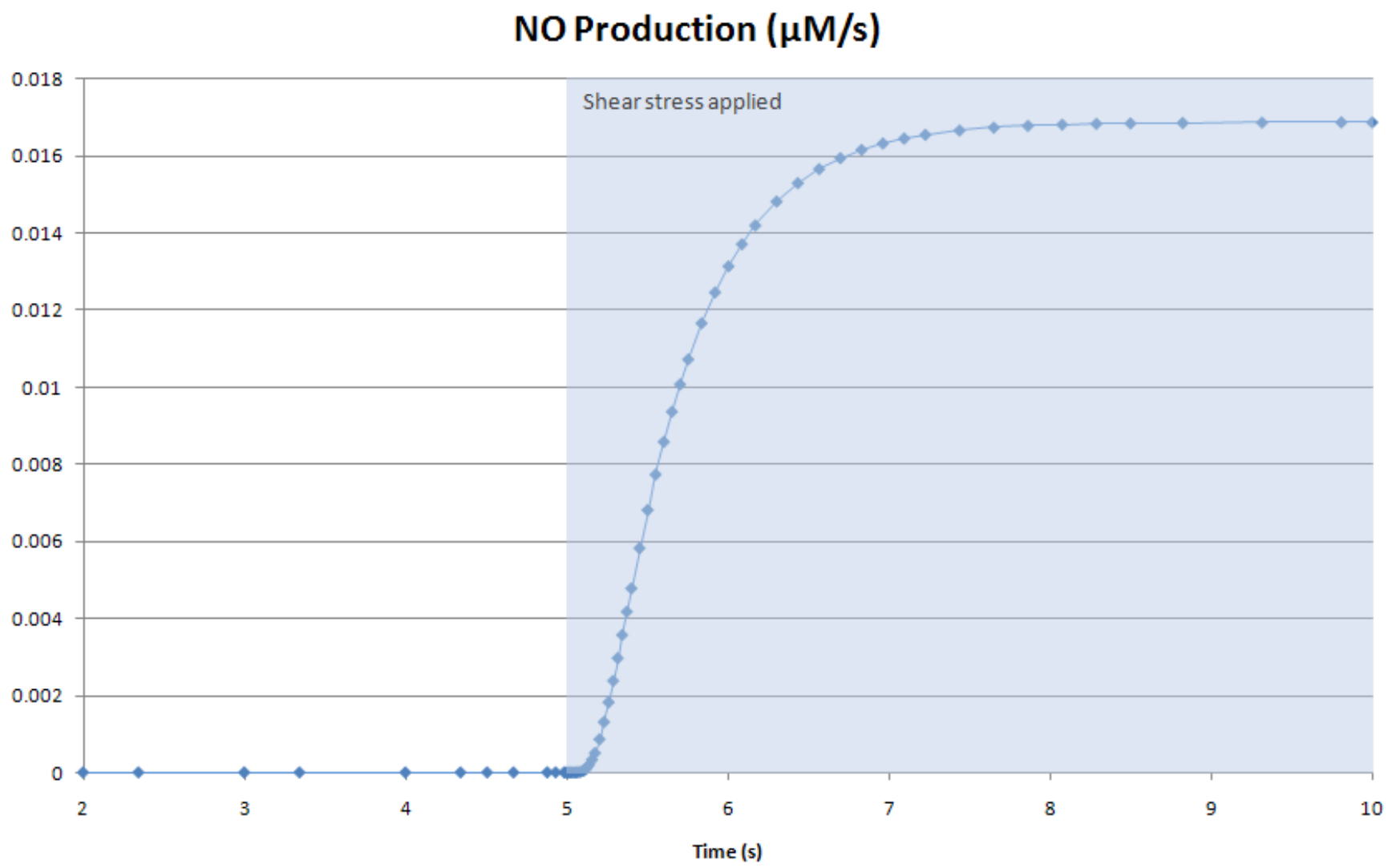
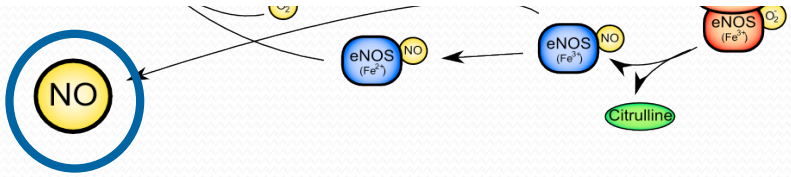

NO Production (µM/s)
Shear stress applied
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
2
3
4
5
6
7
8
9
10
Time (s)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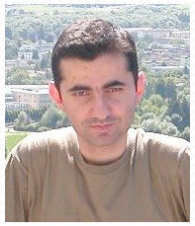
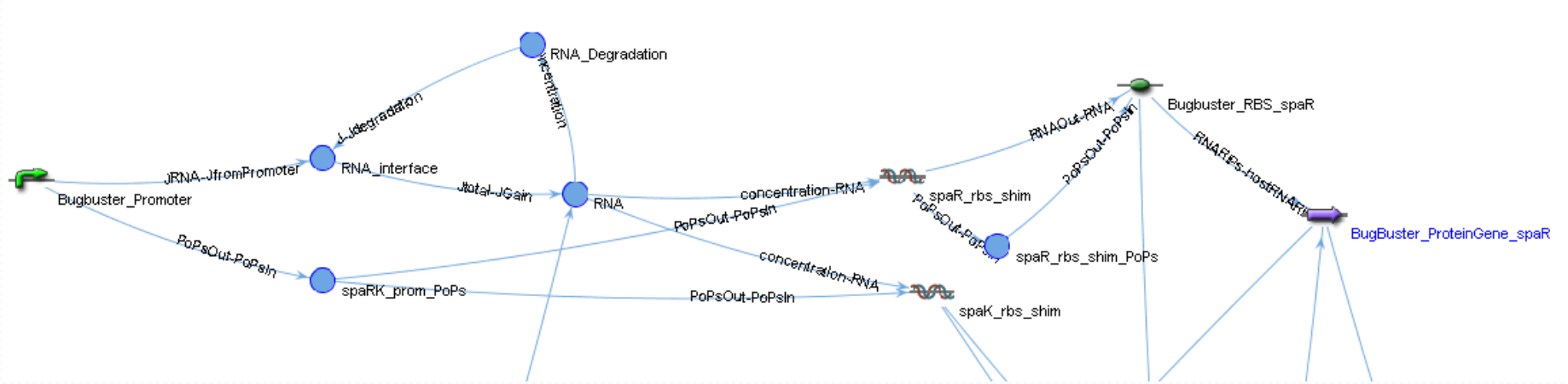
eNOS
NO
eNOS
NO
eNOS
Citrulline

Extensions - Annotations





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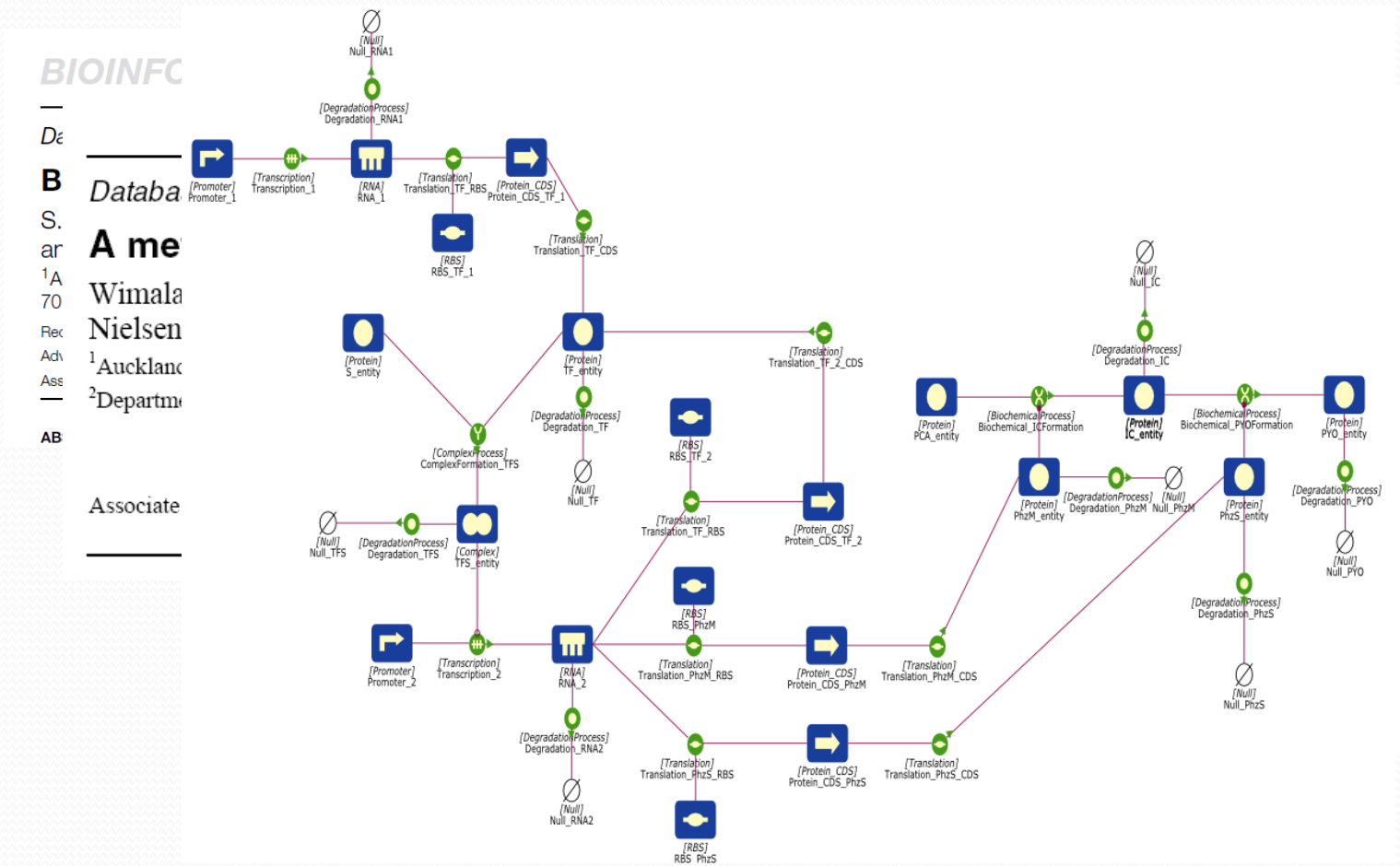
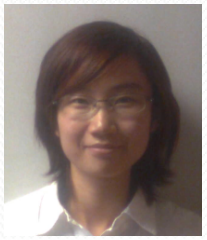
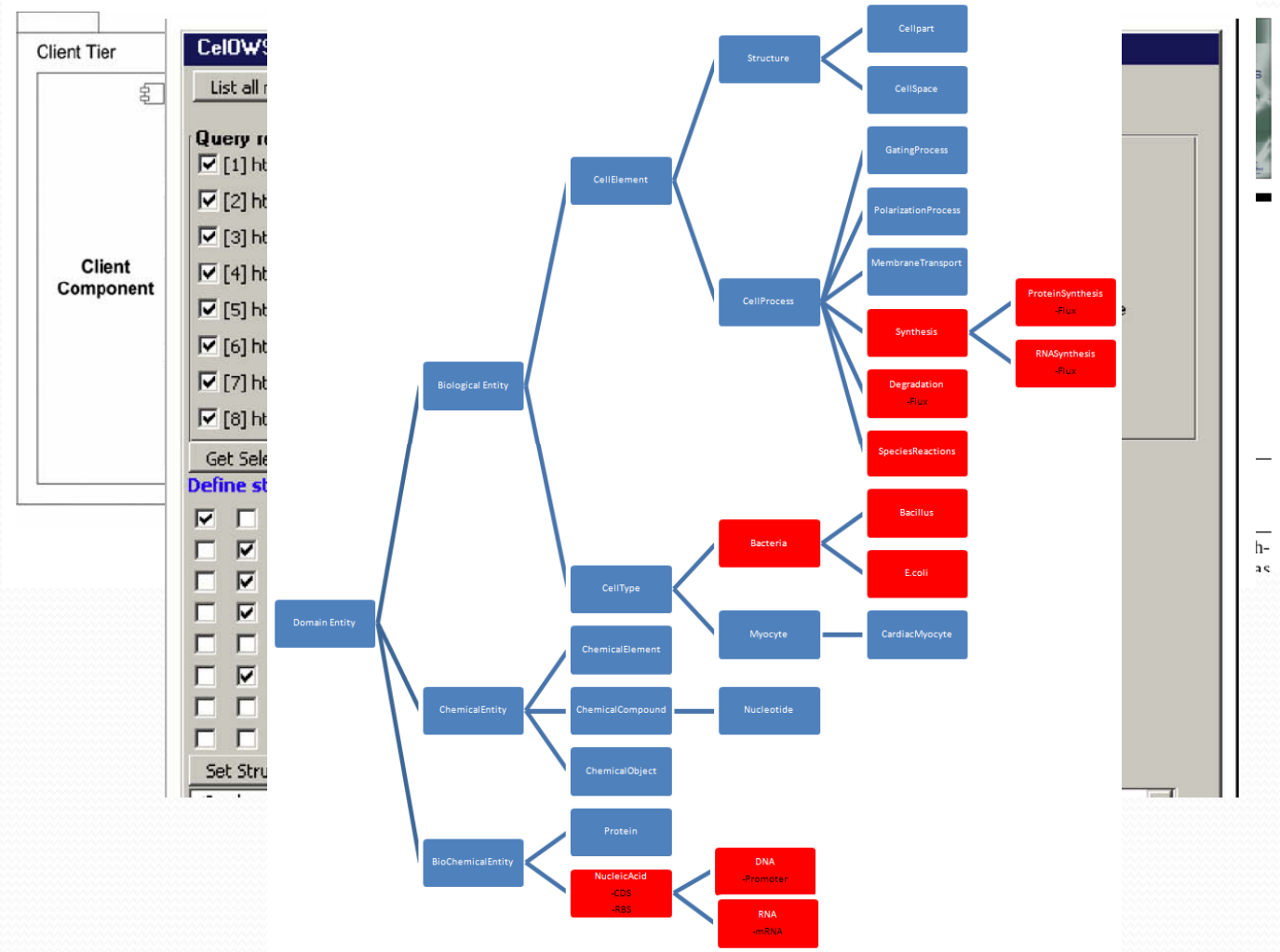
(Semi-Automated) Visualisation





(Semi-Automated) Composition



Summary

- Constructing libraries of modular reusable components in CellML
- Building larger models from those parts
- Goal: to make it easier to build and understand large models from reusable components.
  - Visualisation
  - Composition
  - Ontologies
  - Tools
- Practices not perfect….

Funding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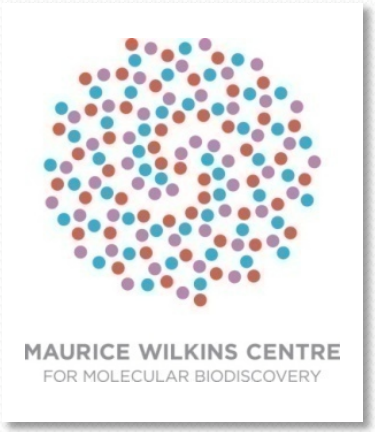
Te Whare Wānanga o Tāmaki Makaurau


wellcome trust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