SBML Model Report

Model name: “Wodarz2003 Immunological Memory”

May 17, 2018

1 General Overview

This is a document in SBML Level 2 Version 4 format. This model was created by the following two authors: Matthew Grant Roberts[1] and Catherine Lloyd[2] at June 25th 2010 at 1:23 p. m. and last time modified at March eighth 2018 at 4:30 p. m. Table 1 gives an overview of the quantities of all components of this model.

Table 1: Number of components in this model, which are described in the following sections.

Element	Quantity	Element	Quantity
compartment types	0	compartments	1
species types	0	species	0
events	0	constraints	0
reactions	0	function definitions	0
global parameters	28	unit definitions	3
rules	15	initial assignments	0

Model Notes

This a model from the article:
Evolution of immunological memory and the regulation of competition betweenpathogens.
Wodarz D. Curr Biol 2003 Sep 16;13(18):1648-52 13678598 ,
Abstract:

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Memory is a central characteristic of immune responses. It is defined as anelevated number of specific immune cells that remain after resolution ofinfection and can protect the host against reinfection. The evolution ofimmunological memory is subject to debate. The advantages of memory discussed sofar include protection from reinfection, control of chronic infection, and thetransfer of immune function to the next generation. Mathematical models are usedto identify a new force that can drive the evolution of immunological memory:the duration of memory can regulate the degree of competition between differentpathogens. While a long duration of memory provides lasting protection againstreinfection, it may also allow an inferior pathogen species to persist. This canbe detrimental for the host if the inferior pathogen is more virulent. On theother hand, a shorter duration of memory ensures that an inferior pathogenspecies is excluded. This can be beneficial for the host if the inferiorpathogen is more virulent. Thus, while in the absence of pathogen diversitymemory is always expected to evolve to a long duration, under specificcircumstances, memory can evolve toward shorter durations in the presence ofpathogen diversity.

This model was taken from the CellML repository and automatically converted to SBML.
The original model was: **Wodarz D. (2003) - version=1.0**
The original CellML model was created by:
Catherine Lloyd
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The University of Auckland

2 Unit Definitions

This is an overview of seven unit definitions of which four are predefined by SBML and not mentioned in the model.

2.1 Unit day

Name day

Definition 86400 s

2.2 Unit first_order_rate_constant

Name first_order_rate_constant

Definition $(86400\ \mathrm{s})^{-1}$

2.3 Unit time

Name time

Definition 86400 s

2.4 Unit substance

Notes Mole is the predefined SBML unit for `substance`.

Definition mol

2.5 Unit volume

Notes Litre is the predefined SBML unit for `volume`.

Definition l

2.6 Unit area

Notes Square metre is the predefined SBML unit for `area` since SBML Level 2 Version 1.

Definition m^2

2.7 Unit length

Notes Metre is the predefined SBML unit for `length` since SBML Level 2 Version 1.

Definition m

3 Compartment

This model contains one compartment.

Table 2: Properties of all compartments.

Id	Name	SBO	Spatial Dimensions	Size	Unit	Constant	Outside
COMpartment	population		3	1		☑	

3.1 Compartment COMpartment

This is a three dimensional compartment with a constant size of one litre.

Name population

4 Parameters

This model contains 28 global parameters.

Table 3: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
S	S		100.00		☐
r	r		0.50		☑
epsilon	epsilon		0.10		☑
H	H		100.00		☐
P	P		0.20		☐
I_1	I_1		0.00		☐
I_2	I_2		0.00		☐
I_12	I_12		0.00		☐
I_21	I_21		0.00		☐
R_1	R_1		0.00		☐
R_2	R_2		0.00		☐
R_12	R_12		0.00		☐
P_1	P_1		0.10		☐
k_1	k_1		0.10		☑
log_P1	log_P1		-1.00		☐
P_2	P_2		0.10		☐
k_2	k_2		0.10		☑
log_P2	log_P2		-1.00		☐
G	G		100.00		☐
g	g		0.01		☑
beta_1	beta_1		1.00		☑
alpha_1	alpha_1		0.10		☑

Id	Name	SBO	Value	Unit	Constant
beta_2	beta_2		1.00		☑
alpha_2	alpha_2		0.10		☑
a_1	a_1		0.03		☑
a_2	a_2		1.00		☑
d	d		0.01		☑
u	u		0.50		☑

5 Rules

This is an overview of 15 rules.

5.1 Rule H

Rule H is an assignment rule for parameter H:

$$\mathrm{H} = \mathrm{S} + \mathrm{I\_1} + \mathrm{R\_1} + \mathrm{I\_2} + \mathrm{R\_2} + \mathrm{I\_12} + \mathrm{I\_21} + \mathrm{R\_12} \tag{1}$$

5.2 Rule P

Rule P is an assignment rule for parameter P:

$$\mathrm{P} = \mathrm{P\_1} + \mathrm{P\_2} \tag{2}$$

5.3 Rule log_P2

Rule log_P2 is an assignment rule for parameter log_P2:

$$\mathrm{log\_P2} = \frac{\log_{10} \mathrm{P\_2}}{\log_{10} 10} \tag{3}$$

Derived unit dimensionless

5.4 Rule G

Rule G is an assignment rule for parameter G:

$$\mathrm{G} = \frac{1}{\mathrm{g}} \tag{4}$$

5.5 Rule log_P1

Rule log_P1 is an assignment rule for parameter log_P1:

$$\mathrm{log\_P1} = \frac{\log_{10} \mathrm{P\_1}}{\log_{10} 10} \tag{5}$$

Derived unit dimensionless

5.6 Rule S

Rule S is a rate rule for parameter S:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{S} = \frac{\mathrm{r} \cdot \mathrm{H}}{\mathrm{epsilon} \cdot \mathrm{H} + 1} - \mathrm{d} \cdot \mathrm{S} - \mathrm{beta\_1} \cdot \mathrm{S} \cdot \mathrm{P\_1} - \mathrm{beta\_2} \cdot \mathrm{S} \cdot \mathrm{P\_2} + \mathrm{g} \cdot (\mathrm{R\_1} + \mathrm{R\_2} + \mathrm{R\_12}) \quad (6)$$

5.7 Rule I_1

Rule I_1 is a rate rule for parameter I_1:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{I\_1} = \mathrm{beta\_1} \cdot \mathrm{S} \cdot \mathrm{P\_1} - \mathrm{a\_1} \cdot \mathrm{I\_1} - \mathrm{alpha\_1} \cdot \mathrm{I\_1} \quad (7)$$

5.8 Rule I_2

Rule I_2 is a rate rule for parameter I_2:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{I\_2} = \mathrm{beta\_2} \cdot \mathrm{S} \cdot \mathrm{P\_2} - \mathrm{a\_2} \cdot \mathrm{I\_2} - \mathrm{alpha\_2} \cdot \mathrm{I\_2} \quad (8)$$

5.9 Rule I_12

Rule I_12 is a rate rule for parameter I_12:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{I\_12} = \mathrm{beta\_2} \cdot \mathrm{R\_1} \cdot \mathrm{P\_2} - \mathrm{a\_2} \cdot \mathrm{I\_12} - \mathrm{alpha\_2} \cdot \mathrm{I\_12} \quad (9)$$

5.10 Rule I_21

Rule I_21 is a rate rule for parameter I_21:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{I\_21} = \mathrm{beta\_1} \cdot \mathrm{R\_2} \cdot \mathrm{P\_1} - \mathrm{a\_1} \cdot \mathrm{I\_21} - \mathrm{alpha\_1} \cdot \mathrm{I\_21} \quad (10)$$

5.11 Rule R_1

Rule R_1 is a rate rule for parameter R_1:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R\_1} = \mathrm{alpha\_1} \cdot \mathrm{I\_1} - \mathrm{d} \cdot \mathrm{R\_1} - \mathrm{g} \cdot \mathrm{R\_1} - \mathrm{beta\_2} \cdot \mathrm{R\_1} \cdot \mathrm{P\_2} \quad (11)$$

5.12 Rule R_2

Rule R_2 is a rate rule for parameter R_2:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R\_2} = \mathrm{alpha\_2} \cdot \mathrm{I\_2} - \mathrm{d} \cdot \mathrm{R\_2} - \mathrm{g} \cdot \mathrm{R\_2} - \mathrm{beta\_1} \cdot \mathrm{R\_2} \cdot \mathrm{P\_1} \quad (12)$$

5.13 Rule R_12

Rule R_12 is a rate rule for parameter R_12:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{R\_12} = \mathrm{alpha\_2} \cdot \mathrm{I\_12} + \mathrm{alpha\_1} \cdot \mathrm{I\_21} - \mathrm{d} \cdot \mathrm{R\_12} - \mathrm{g} \cdot \mathrm{R\_12} \tag{13}$$

5.14 Rule P_1

Rule P_1 is a rate rule for parameter P_1:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{P\_1} = \mathrm{k\_1} \cdot (\mathrm{I\_1} + \mathrm{I\_21}) - \mathrm{u} \cdot \mathrm{P\_1} \tag{14}$$

5.15 Rule P_2

Rule P_2 is a rate rule for parameter P_2:

$$\frac{\mathrm{d}}{\mathrm{d}t}\mathrm{P\_2} = \mathrm{k\_2} \cdot (\mathrm{I\_2} + \mathrm{I\_12}) - \mathrm{u} \cdot \mathrm{P\_2} \tag{15}$$

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