

SBML Model Report

Model name: “Jenkinson2011_EGF_MAPK”



May 6, 2016

1 General Overview

This is a document in SBML Level 2 Version 1 format. This model was created by the following two authors: Vijayalakshmi Chelliah¹ and Garrett Jenkinson² at November third 2011 at 2:33 p. m. and last time modified at April eighth 2016 at 5:21 p. m. Table 1 provides 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	3
species types	0	species	100
events	0	constraints	0
reactions	125	function definitions	0
global parameters	90	unit definitions	7
rules	8	initial assignments	0

Model Notes

This is a model described in the article:

Thermodynamically Consistent Model Calibration in Chemical Kinetics.

Garrett Jenkinson and John Goutsias, BMC Systems Biology 2011 May 6;5(1):64.; PMID:21548948.

ABSTRACT:

BACKGROUND:

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The dynamics of biochemical reaction systems are constrained by the fundamental laws of thermodynamics, which impose well-defined relationships among the reaction rate constants characterizing these systems. Constructing biochemical reaction systems from experimental observations often leads to parameter values that do not satisfy the necessary thermodynamic constraints. This can result in models that are not physically realizable and may lead to inaccurate, or even erroneous, descriptions of cellular function.

RESULTS:

We introduce a thermodynamically consistent model calibration (TCMC) method that can be effectively used to provide thermodynamically feasible values for the parameters of an open biochemical reaction system. The proposed method formulates the model calibration problem as a constrained optimization problem that takes thermodynamic constraints (and, if desired, additional non-thermodynamic constraints) into account. By calculating thermodynamically feasible values for the kinetic parameters of a well-known model of the EGF/ERK signaling cascade, we demonstrate the qualitative and quantitative significance of imposing thermodynamic constraints on these parameters and the effectiveness of our method for accomplishing this important task. MATLAB software, using the Systems Biology Toolbox 2.1, can be accessed from [www.cis.jhu.edu/CSS lab/software.html](http://www.cis.jhu.edu/CSS_lab/software.html). An SBML file containing the thermodynamically feasible EGF/ERK signaling cascade model can be found in the BioModels database.

CONCLUSIONS:

TCMC is a simple and flexible method for obtaining physically plausible values for the kinetic parameters of open biochemical reaction systems. It can be effectively used to recalculate a thermodynamically consistent set of parameter values for existing thermodynamically infeasible biochemical reaction models of cellular function as well as to estimate thermodynamically feasible values for the parameters of new models. Furthermore, TCMC can provide dimensionality reduction, better estimation performance, and lower computational complexity, and can help to alleviate the problem of data overfitting.

This model is a thermodynamically feasible version of a previous model in the BioModels database, [BIOMD0000000019](https://www.ebi.ac.uk/biomodels/BIOMD0000000019), described in Computational modeling of the dynamics of the MAP kinase cascade activated by surface and internalized EGF receptors. Schoeberl et al (2002), PMID: [11923843](https://pubmed.ncbi.nlm.nih.gov/11923843/).

The only difference between the present model and the model listed under [BIOMD0000000019](https://www.ebi.ac.uk/biomodels/BIOMD0000000019) are the values of the parameters.

This model originates from BioModels Database: A Database of Annotated Published Models (<http://www.ebi.ac.uk/biomodels/>). It is copyright (c) 2005-2012 The BioModels.net Team.

For more information see the [terms of use](#).

To cite BioModels Database, please use: [Li C, Donizelli M, Rodriguez N, Dharuri H, Endler L, Chelliah V, Li L, He E, Henry A, Stefan MI, Snoep JL, Hucka M, Le Novre N, Laibe C \(2010\) BioModels Database: An enhanced, curated and annotated resource for published quantitative kinetic models. BMC Syst Biol., 4:92.](#)

2 Unit Definitions

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

2.1 Unit `substance`

Name `items`

Definition `item`

2.2 Unit `time`

Name `min`

Definition `60 s`

2.3 Unit `volume`

Name `pl`

Definition `pl`

2.4 Unit `pmin`

Name `permin`

Definition $(60 \text{ s})^{-1}$

2.5 Unit `ipmin`

Name `itemspermin`

Definition $\text{item} \cdot (60 \text{ s})^{-1}$

2.6 Unit `pipmin`

Name `peritempermin`

Definition $(60 \text{ s})^{-1} \cdot \text{item}^{-1}$

2.7 Unit `piplpmin`

Name `plperitempermin`

Definition $\text{pl} \cdot \text{item}^{-1} \cdot (60 \text{ s})^{-1}$

2.8 Unit area

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

Definition m^2

2.9 Unit length

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

Definition m

3 Compartments

This model contains three compartments.

Table 2: Properties of all compartments.

Id	Name	SBO	Spatial Dimensions	Size	Unit	Constant	Outside
c1	extracellular volume		3	1	litre	<input checked="" type="checkbox"/>	
c2	cytoplasm		3	1	litre	<input checked="" type="checkbox"/>	
c3	endosomal volume		3	$4.3 \cdot 10^{-6}$	pl	<input checked="" type="checkbox"/>	

3.1 Compartment c1

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

Name extracellular volume

3.2 Compartment c2

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

Name cytoplasm

3.3 Compartment c3

This is a three dimensional compartment with a constant size of $4.3 \cdot 10^{-6}$ pl.

Name endosomal volume

4 Species

This model contains 100 species. The boundary condition of seven of these species is set to `true` so that these species' amount cannot be changed by any reaction. Section 8 provides further details and the derived rates of change of each species.

Table 3: Properties of each species.

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
x1	EGF	c1	item	<input type="checkbox"/>	<input checked="" type="checkbox"/>
x2	EGFR	c1	item	<input type="checkbox"/>	<input type="checkbox"/>
x3	EGF-EGFR	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x4	EGF-EGFR ²	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x5	EGF-EGFR* ²	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x6	EGFRi	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x7	EGF-EGFR* ² -GAP-Grb2-Prot	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x8	EGF-EGFRi* ²	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x9	Proti	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x10	EGF-EGFRi	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x11	EGF-EGFRi ²	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x12	Prot	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x13	EGFideg	c3	item	<input type="checkbox"/>	<input type="checkbox"/>
x14	GAP	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x15	EGF-EGFR* ² -GAP	c3	item	<input type="checkbox"/>	<input type="checkbox"/>
x16	EGFi	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x17	EGF-EGFRi* ² -GAP	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x18	EGF-EGFRi* ² -GAP-Grb2	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x19	EGF-EGFRi* ² -GAP-Grb2-Sos	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x20	EGF-EGFRi* ² -GAP-Grb2-Sos-Ras-GDP	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x21	EGF-EGFRi* ² -GAP-Grb2-Sos-Ras-GTP	c2	item	<input type="checkbox"/>	<input type="checkbox"/>

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
x22	Grb2	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x23	EGF-EGFR* $\hat{2}$ -GAP-Grb2	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x24	Sos	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x25	EGF-EGFR* $\hat{2}$ -GAP-Grb2-Sos	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x26	Ras-GDP	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x27	EGF-EGFR* $\hat{2}$ -GAP-Grb2-Sos-Ras-GDP	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x28	Ras-GTP	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x29	EGF-EGFR* $\hat{2}$ -GAP-Grb2-Sos-Ras-GTP	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x30	Grb2-Sos	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x31	Shc	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x32	EGF-EGFR* $\hat{2}$ -GAP-Shc	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x33	EGF-EGFR* $\hat{2}$ -GAP-Shc*	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x34	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x35	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x36	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GDP	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x37	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GTP	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x38	Shc*-Grb2-Sos	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x39	Shc*-Grb2	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x40	Shc*	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x41	Raf	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x42	Raf-Ras-GTP	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x43	Ras-GTP*	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x44	Phosphatase1	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x45	Raf*	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x46	Raf*-P'ase	c2	item	<input type="checkbox"/>	<input type="checkbox"/>

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
x47	MEK	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x48	MEK-Raf*	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x49	MEK-P	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x50	MEK-P-Raf*	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x51	MEK-PP	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x52	MEK-PP-P'ase2	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x53	Phosphatase2	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x54	MEK-P-P'ase2	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x55	ERK	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x56	ERK-MEK-PP	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x57	ERK-P	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x58	ERK-P-MEK-PP	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x59	ERK-PP	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x60	Phosphatase3	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x61	ERK-PP-P'ase3	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x62	ERK-P-P'ase3	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x63	EGF-EGFRi* $\hat{2}$ -GAP-Shc	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x64	EGF-EGFRi* $\hat{2}$ -GAP-Shc*	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x65	EGF-EGFRi* $\hat{2}$ -GAP-Shc*-Grb2	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x66	EGF-EGFRi* $\hat{2}$ -GAP-Shc*-Grb2-Sos	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x67	EGF-EGFRi* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GDP	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x68	EGF-EGFRi* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GTP	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x69	Rasi-GTP	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x70	Rafi-Rasi-GTP	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x71	Rasi-GTP*	c2	item	<input type="checkbox"/>	<input type="checkbox"/>

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
x72	Raf [*]	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x73	Raf [*] -P ^{'ase}	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x74	MEK ⁱ -Raf [*]	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x75	MEK ⁱ -P	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x76	MEK ⁱ -P-Raf [*]	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x77	MEK ⁱ -PP	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x78	MEK ⁱ -PP-P ^{'ase2i}	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x79	MEK ⁱ -P-P ^{'ase2i}	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x80	ERK ⁱ -MEK ⁱ -PP	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x81	ERK ⁱ -P	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x82	ERK ⁱ -P-MEK ⁱ -PP	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x83	ERK ⁱ -PP	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x84	ERK ⁱ -PP-P ^{'ase3i}	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x85	ERK ⁱ -P-P ^{'ase3i}	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x86	EGFR ^{ideg}	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x87	EGF-EGFR ⁱ * ^{2deg}	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x88	EGF-EGFR* ² -GAP-Grb2-Sos-Prot	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x89	EGF-EGFR* ² -GAP-Grb2-Sos-Ras-GDP-Prot	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x90	EGF-EGFR* ² -GAP-Grb2-Sos-Ras-GTP-Prot	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x91	EGF-EGFR* ² -GAP-Shc*-Grb2-Prot	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x92	EGF-EGFR* ² -GAP-Shc*-Grb2-Sos-Prot	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x93	EGF-EGFR* ² -GAP-Shc*-Grb2-Sos-Ras-GDP-Prot	c2	item	<input type="checkbox"/>	<input type="checkbox"/>
x94	EGF-EGFR* ² -GAP-Shc*-Grb2-Sos-Ras-GTP-Prot	c2	item	<input type="checkbox"/>	<input type="checkbox"/>

Id	Name	Compartment	Derived Unit	Constant	Boundary Condition
Raf_act	t_Raf*	c2	item	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Ras_GTP	t_Ras_GTP	c2	item	<input type="checkbox"/>	<input checked="" type="checkbox"/>
MEK_PP	t_MEK_PP	c2	item	<input type="checkbox"/>	<input checked="" type="checkbox"/>
ERK_PP	t_ERK_PP	c2	item	<input type="checkbox"/>	<input checked="" type="checkbox"/>
SHC_P_t	t_SHC_P_t	c2	item	<input type="checkbox"/>	<input checked="" type="checkbox"/>
EGF_EGFR_act	t_EGF_EGFR*	c2	item	<input type="checkbox"/>	<input checked="" type="checkbox"/>

5 Parameters

This model contains 90 global parameters.

Table 4: Properties of each parameter.

Id	Name	SBO	Value	Unit	Constant
k1			0.002	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
kr1			0.115	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
kr2			0.510	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
k2			$4.80156 \cdot 10^{-4}$	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
k3			31.719	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
kr3			2.221	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
k4			$3.047285 \cdot 10^{-5}$	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
kr4			0.123	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
k5			0.000	$(60 \text{ s})^{-1}$	<input type="checkbox"/>
k6			$4.123214 \cdot 10^{-4}$	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
kr6			0.294	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
k7			0.003	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
k8			$5.174108 \cdot 10^{-4}$	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
kr8			0.906	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
k10			3803.728	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
kr10			171.695	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
kr11			0.510	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
k11			$4.80156 \cdot 10^{-4}$	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
kr12			2.221	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
k12			31.719	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
k13			0.455	$\text{item} \cdot (60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
k14			$6.370566 \cdot 10^{-7}$	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
kr14			196.648	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
k15			46468.780	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
kr16			0.451	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
k16			$4.021305 \cdot 10^{-4}$	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
kr17			2.524	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
k17			$3.099213 \cdot 10^{-4}$	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
kr18			11.136	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
k18			0.004	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
kr19			$5.84737 \cdot 10^{-6}$	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
k19			349.772	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
kr20			12.816	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
k20			$5.17656 \cdot 10^{-5}$	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>

Id	Name	SBO	Value	Unit	Constant
k21			0.472	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
kr21			$1.714441 \cdot 10^{-5}$	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
k22			$1.445554 \cdot 10^{-4}$	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
kr22			0.622	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
k23			420.336	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
kr23			17.393	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
k24			0.007	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
kr24			563.214	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
kr25			1.218	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
k25			$6.871213 \cdot 10^{-4}$	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
k28			$9.826084 \cdot 10^{-6}$	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
kr28			0.968	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
k29			931.109	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
kr29			$1.096614 \cdot 10^{-4}$	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
kr32			$5.54527 \cdot 10^{-5}$	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
k32			14.199	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
k33			10.962	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
kr33			$1.788597 \cdot 10^{-5}$	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
k34			0.247	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
kr34			$1.283286 \cdot 10^{-4}$	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
k35			1.836	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
kr35			$3.866434 \cdot 10^{-4}$	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
Vm36			615.033	$\text{item} \cdot (60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
Km36			$7.719778 \cdot 10^{14}$	item	<input checked="" type="checkbox"/>
k37			29.347	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
kr37			$5.477036 \cdot 10^{-6}$	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
k40			$7.409959 \cdot 10^{-5}$	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
kr40			2.749	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
kr41			44.602	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
k41			0.002	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
k42			0.010	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
kr42			1.870	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
k43			51.609	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
kr44			0.599	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
k44			0.001	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>
k45			6340.081	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
k47			1632.425	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
kr48			1489.015	$(60 \text{ s})^{-1}$	<input checked="" type="checkbox"/>
k48			$6.874119 \cdot 10^{-4}$	$(60 \text{ s})^{-1} \cdot \text{item}^{-1}$	<input checked="" type="checkbox"/>

Id	Name	SBO	Value	Unit	Constant
k49			10.731	(60 s) ⁻¹	<input checked="" type="checkbox"/>
kr50			9.955	(60 s) ⁻¹	<input checked="" type="checkbox"/>
k50			5.464454 · 10 ⁻⁴	(60 s) ⁻¹ · item ⁻¹	<input checked="" type="checkbox"/>
k52			0.004	(60 s) ⁻¹ · item ⁻¹	<input checked="" type="checkbox"/>
kr52			19.853	(60 s) ⁻¹	<input checked="" type="checkbox"/>
k53			62181.840	(60 s) ⁻¹	<input checked="" type="checkbox"/>
k55			1120.398	(60 s) ⁻¹	<input checked="" type="checkbox"/>
kr56			1.230	(60 s) ⁻¹	<input checked="" type="checkbox"/>
k56			0.005	(60 s) ⁻¹ · item ⁻¹	<input checked="" type="checkbox"/>
k57			19.752	(60 s) ⁻¹	<input checked="" type="checkbox"/>
kr58			0.114	(60 s) ⁻¹	<input checked="" type="checkbox"/>
k58			1.714511 · 10 ⁻⁴	(60 s) ⁻¹ · item ⁻¹	<input checked="" type="checkbox"/>
k59			6.409	(60 s) ⁻¹	<input checked="" type="checkbox"/>
k60			0.087	(60 s) ⁻¹	<input checked="" type="checkbox"/>
k61			0.006	(60 s) ⁻¹	<input checked="" type="checkbox"/>
C	C_internalization		0.000		<input type="checkbox"/>
RT	total_Receptors		50000.000	item	<input checked="" type="checkbox"/>

6 Rules

This is an overview of eight rules.

6.1 Rule Ras_GTP

Rule Ras_GTP is an assignment rule for species Ras_GTP:

$$[\text{Ras_GTP}] = x42 + x28 + x70 + x69 \quad (1)$$

Derived unit item

6.2 Rule MEK_PP

Rule MEK_PP is an assignment rule for species MEK_PP:

$$[\text{MEK_PP}] = x51 + x77 \quad (2)$$

Derived unit item

6.3 Rule ERK_PP

Rule ERK_PP is an assignment rule for species ERK_PP:

$$[\text{ERK_PP}] = x59 + x83 \quad (3)$$

Derived unit item

6.4 Rule Raf_act

Rule Raf_act is an assignment rule for species Raf_act:

$$[\text{Raf_act}] = x45 + x46 + x48 + x50 + x72 + x73 + x74 + x76 \quad (4)$$

Derived unit item

6.5 Rule SHC_P_t

Rule SHC_P_t is an assignment rule for species SHC_P_t:

$$[\text{SHC_P_t}] = x33 + x34 + x35 + x36 + x37 + x38 + x39 + x40 + x91 \\ + x92 + x93 + x94 + x64 + x65 + x66 + x67 + x68 \quad (5)$$

Derived unit item

6.6 Rule EGF_EGFR_act

Rule EGF_EGFR_act is an assignment rule for species EGF_EGFR_act:

$$[\text{EGF_EGFR_act}] = x5 + x7 + x15 + x23 + x25 + x27 + x29 + x32 + x33 + x34 + x35 \\ + x36 + x37 + x88 + x89 + x90 + x91 + x92 + x93 + x94 + x8 + x11 \\ + x17 + x18 + x19 + x20 + x21 + x63 + x64 + x65 + x66 + x67 + x68 \quad (6)$$

Derived unit item

6.7 Rule C

Rule C is an assignment rule for parameter C:

$$C = \frac{RT}{\frac{kr1}{k1 \cdot x1} + 1} \quad (7)$$

6.8 Rule k5

Rule k5 is an assignment rule for parameter k5:

$$k5 = \begin{cases} 1.55 & \text{if } C < 3100 \\ 0.2 & \text{if } C > 100000 \\ C \cdot -1.3500000000000001E - 5 + 1.55 & \text{otherwise} \end{cases} \quad (8)$$

7 Reactions

This model contains 125 reactions. All reactions are listed in the following table and are subsequently described in detail. If a reaction is affected by a modifier, the identifier of this species is written above the reaction arrow.

Table 5: Overview of all reactions

Nº	Id	Name	Reaction Equation	SBO
1	v1	v1	$x1 + x2 \rightleftharpoons x3$	
2	v2	v2	$2 x3 \rightleftharpoons x4$	
3	v3	v3	$x4 \rightleftharpoons x5$	
4	v4	v4	$x23 + x12 \rightleftharpoons x7$	
5	v5	v5	$x7 \rightleftharpoons x18 + x9$	
6	v6	v6	$x2 \rightleftharpoons x6$	
7	v7	v7	$x5 \longrightarrow x8$	
8	v8	v8	$x5 + x14 \rightleftharpoons x15$	
9	v9	v9	$x23 \longrightarrow x18$	
10	v10	v10	$x6 + x16 \rightleftharpoons x10$	
11	v11	v11	$2 x10 \rightleftharpoons x11$	
12	v12	v12	$x11 \rightleftharpoons x8$	
13	v13	v13	$\emptyset \longrightarrow x2$	
14	v14	v14	$x8 + x14 \rightleftharpoons x17$	
15	v15	v15	$x9 \longrightarrow x12$	
16	v16	v16	$x22 + x15 \rightleftharpoons x23$	
17	v17	v17	$x24 + x23 \rightleftharpoons x25$	
18	v18	v18	$x26 + x25 \rightleftharpoons x27$	
19	v19	v19	$x27 \rightleftharpoons x28 + x25$	
20	v20	v20	$x25 + x43 \rightleftharpoons x29$	
21	v21	v21	$x29 \rightleftharpoons x25 + x26$	
22	v22	v22	$x31 + x15 \rightleftharpoons x32$	
23	v23	v23	$x32 \rightleftharpoons x33$	

Nº	Id	Name	Reaction Equation	SBO
24	v24	v24	$x_{22} + x_{33} \rightleftharpoons x_{34}$	
25	v25	v25	$x_{24} + x_{34} \rightleftharpoons x_{35}$	
26	v26	v26	$x_{26} + x_{35} \rightleftharpoons x_{36}$	
27	v27	v27	$x_{36} \rightleftharpoons x_{35} + x_{28}$	
28	v28	v28	$x_{28} + x_{41} \rightleftharpoons x_{42}$	
29	v29	v29	$x_{42} \rightleftharpoons x_{43} + x_{45}$	
30	v30	v30	$x_{35} + x_{43} \rightleftharpoons x_{37}$	
31	v31	v31	$x_{37} \rightleftharpoons x_{35} + x_{26}$	
32	v32	v32	$x_{35} \rightleftharpoons x_{15} + x_{38}$	
33	v33	v33	$x_{38} \rightleftharpoons x_{40} + x_{30}$	
34	v34	v34	$x_{25} \rightleftharpoons x_{15} + x_{30}$	
35	v35	v35	$x_{30} \rightleftharpoons x_{24} + x_{22}$	
36	v36	v36	$x_{40} \longrightarrow x_{31}$	
37	v37	v37	$x_{33} \rightleftharpoons x_{15} + x_{40}$	
38	v38	v38	$x_{22} + x_{40} \rightleftharpoons x_{39}$	
39	v39	v39	$x_{34} \rightleftharpoons x_{15} + x_{39}$	
40	v40	v40	$x_{24} + x_{39} \rightleftharpoons x_{38}$	
41	v41	v41	$x_{30} + x_{33} \rightleftharpoons x_{35}$	
42	v42	v42	$x_{44} + x_{45} \rightleftharpoons x_{46}$	
43	v43	v43	$x_{46} \rightleftharpoons x_{41} + x_{44}$	
44	v44	v44	$x_{47} + x_{45} \rightleftharpoons x_{48}$	
45	v45	v45	$x_{48} \rightleftharpoons x_{49} + x_{45}$	
46	v46	v46	$x_{49} + x_{45} \rightleftharpoons x_{50}$	
47	v47	v47	$x_{50} \rightleftharpoons x_{51} + x_{45}$	
48	v48	v48	$x_{51} + x_{53} \rightleftharpoons x_{52}$	
49	v49	v49	$x_{52} \rightleftharpoons x_{49} + x_{53}$	
50	v50	v50	$x_{53} + x_{49} \rightleftharpoons x_{54}$	
51	v51	v51	$x_{54} \rightleftharpoons x_{47} + x_{53}$	
52	v52	v52	$x_{55} + x_{51} \rightleftharpoons x_{56}$	

Nº	Id	Name	Reaction Equation	SBO
53	v53	v53	$x56 \rightleftharpoons x51 + x57$	
54	v54	v54	$x51 + x57 \rightleftharpoons x58$	
55	v55	v55	$x58 \rightleftharpoons x59 + x51$	
56	v56	v56	$x59 + x60 \rightleftharpoons x61$	
57	v57	v57	$x61 \rightleftharpoons x57 + x60$	
58	v58	v58	$x60 + x57 \rightleftharpoons x62$	
59	v59	v59	$x62 \rightleftharpoons x55 + x60$	
60	v60	v60	$x6 \longrightarrow x86$	
61	v61	v61	$x16 \longrightarrow x13$	
62	v62	v62	$x8 \longrightarrow x87$	
63	v63	v63	$x17 + x22 \rightleftharpoons x18$	
64	v64	v64	$x24 + x18 \rightleftharpoons x19$	
65	v65	v65	$x26 + x19 \rightleftharpoons x20$	
66	v66	v66	$x20 \rightleftharpoons x69 + x19$	
67	v67	v67	$x71 + x19 \rightleftharpoons x21$	
68	v68	v68	$x21 \rightleftharpoons x19 + x26$	
69	v69	v69	$x31 + x17 \rightleftharpoons x63$	
70	v70	v70	$x63 \rightleftharpoons x64$	
71	v71	v71	$x22 + x64 \rightleftharpoons x65$	
72	v72	v72	$x24 + x65 \rightleftharpoons x66$	
73	v73	v73	$x26 + x66 \rightleftharpoons x67$	
74	v74	v74	$x67 \rightleftharpoons x66 + x69$	
75	v75	v75	$x69 + x41 \rightleftharpoons x70$	
76	v76	v76	$x70 \rightleftharpoons x71 + x72$	
77	v77	v77	$x71 + x66 \rightleftharpoons x68$	
78	v78	v78	$x68 \rightleftharpoons x66 + x26$	
79	v79	v79	$x66 \rightleftharpoons x17 + x38$	
80	v80	v80	$x19 \rightleftharpoons x17 + x30$	
81	v81	v81	$x64 \rightleftharpoons x17 + x40$	

Nº	Id	Name	Reaction Equation	SBO
82	v82	v82	$x65 \rightleftharpoons x17 + x39$	
83	v83	v83	$x30 + x64 \rightleftharpoons x66$	
84	v84	v84	$x44 + x72 \rightleftharpoons x73$	
85	v85	v85	$x73 \rightleftharpoons x41 + x44$	
86	v86	v86	$x47 + x72 \rightleftharpoons x74$	
87	v87	v87	$x74 \rightleftharpoons x75 + x72$	
88	v88	v88	$x72 + x75 \rightleftharpoons x76$	
89	v89	v89	$x76 \rightleftharpoons x72 + x77$	
90	v90	v90	$x77 + x53 \rightleftharpoons x78$	
91	v91	v91	$x78 \rightleftharpoons x75 + x53$	
92	v92	v92	$x53 + x75 \rightleftharpoons x79$	
93	v93	v93	$x79 \rightleftharpoons x47 + x53$	
94	v94	v94	$x55 + x77 \rightleftharpoons x80$	
95	v95	v95	$x80 \rightleftharpoons x81 + x77$	
96	v96	v96	$x77 + x81 \rightleftharpoons x82$	
97	v97	v97	$x82 \rightleftharpoons x83 + x77$	
98	v98	v98	$x83 + x60 \rightleftharpoons x84$	
99	v99	v99	$x84 \rightleftharpoons x81 + x60$	
100	v100	v100	$x60 + x81 \rightleftharpoons x85$	
101	v101	v101	$x85 \rightleftharpoons x55 + x60$	
102	v102	v102	$x15 \rightleftharpoons x17$	
103	v103	v103	$x32 \rightleftharpoons x63$	
104	v104	v104	$x33 \rightleftharpoons x64$	
105	v105	v105	$x25 \rightleftharpoons x19$	
106	v106	v106	$x25 + x12 \rightleftharpoons x88$	
107	v107	v107	$x88 \rightleftharpoons x9 + x19$	
108	v108	v108	$x27 \rightleftharpoons x20$	
109	v109	v109	$x27 + x12 \rightleftharpoons x89$	
110	v110	v110	$x89 \rightleftharpoons x9 + x20$	

Nº	Id	Name	Reaction Equation	SBO
111	v111	v111	$x_{29} \rightleftharpoons x_{21}$	
112	v112	v112	$x_{29} + x_{12} \rightleftharpoons x_{90}$	
113	v113	v113	$x_{90} \rightleftharpoons x_9 + x_{21}$	
114	v114	v114	$x_{34} \rightleftharpoons x_{65}$	
115	v115	v115	$x_{34} + x_{12} \rightleftharpoons x_{91}$	
116	v116	v116	$x_{91} \rightleftharpoons x_9 + x_{65}$	
117	v117	v117	$x_{35} \rightleftharpoons x_{66}$	
118	v118	v118	$x_{35} + x_{12} \rightleftharpoons x_{92}$	
119	v119	v119	$x_{92} \rightleftharpoons x_9 + x_{66}$	
120	v120	v120	$x_{36} \rightleftharpoons x_{67}$	
121	v121	v121	$x_{36} + x_{12} \rightleftharpoons x_{93}$	
122	v122	v122	$x_{93} \rightleftharpoons x_9 + x_{67}$	
123	v123	v123	$x_{37} \rightleftharpoons x_{68}$	
124	v124	v124	$x_{37} + x_{12} \rightleftharpoons x_{94}$	
125	v125	v125	$x_{94} \rightleftharpoons x_{68} + x_9$	

7.1 Reaction v_1

This is a reversible reaction of two reactants forming one product.

Name v_1

Reaction equation



Reactants

Table 6: Properties of each reactant.

Id	Name	SBO
x_1	EGF	
x_2	EGFR	

Product

Table 7: Properties of each product.

Id	Name	SBO
x_3	EGF-EGFR	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_1 = k_1 \cdot x_1 \cdot x_2 - k_{r1} \cdot x_3 \quad (10)$$

7.2 Reaction v_2

This is a reversible reaction of one reactant forming one product.

Name v_2

Reaction equation



Reactant

Table 8: Properties of each reactant.

Id	Name	SBO
x3	EGF-EGFR	

Product

Table 9: Properties of each product.

Id	Name	SBO
x4	EGF-EGFR ²	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_2 = k_2 \cdot x_3 \cdot x_3 - k_{r2} \cdot x_4 \quad (12)$$

7.3 Reaction v3

This is a reversible reaction of one reactant forming one product.

Name v3

Reaction equation



Reactant

Table 10: Properties of each reactant.

Id	Name	SBO
x4	EGF-EGFR ²	

Product

Table 11: Properties of each product.

Id	Name	SBO
x5	EGF-EGFR* ²	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_3 = k_3 \cdot x_4 - k_{r3} \cdot x_5 \quad (14)$$

7.4 Reaction v4

This is a reversible reaction of two reactants forming one product.

Name v4

Reaction equation



Reactants

Table 12: Properties of each reactant.

Id	Name	SBO
x23	EGF-EGFR* $\hat{2}$ -GAP-Grb2	
x12	Prot	

Product

Table 13: Properties of each product.

Id	Name	SBO
x7	EGF-EGFR* $\hat{2}$ -GAP-Grb2-Prot	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_4 = k_4 \cdot x_{23} \cdot x_{12} - k_{r4} \cdot x_7 \quad (16)$$

7.5 Reaction v5

This is a reversible reaction of one reactant forming two products.

Name v5

Reaction equation



Reactant

Table 14: Properties of each reactant.

Id	Name	SBO
x7	EGF-EGFR* $\hat{2}$ -GAP-Grb2-Prot	

Products

Table 15: Properties of each product.

Id	Name	SBO
x18	EGF-EGFRi* $\hat{2}$ -GAP-Grb2	
x9	Proti	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_5 = k_5 \cdot x7 \quad (18)$$

7.6 Reaction v6

This is a reversible reaction of one reactant forming one product.

Name v6

Reaction equation



Reactant

Table 16: Properties of each reactant.

Id	Name	SBO
x2	EGFR	

Product

Table 17: Properties of each product.

Id	Name	SBO
x6	EGFRi	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_6 = k_6 \cdot x_2 - k_{r6} \cdot x_6 \quad (20)$$

7.7 Reaction v_7

This is an irreversible reaction of one reactant forming one product.

Name v_7

Reaction equation



Reactant

Table 18: Properties of each reactant.

Id	Name	SBO
x5	EGF-EGFR* $\hat{2}$	

Product

Table 19: Properties of each product.

Id	Name	SBO
x8	EGF-EGFRi* $\hat{2}$	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_7 = k_7 \cdot x_5 \quad (22)$$

7.8 Reaction v_8

This is a reversible reaction of two reactants forming one product.

Name v_8

Reaction equation



Reactants

Table 20: Properties of each reactant.

Id	Name	SBO
x_5	EGF-EGFR* $\hat{2}$	
x_{14}	GAP	

Product

Table 21: Properties of each product.

Id	Name	SBO
x_{15}	EGF-EGFR* $\hat{2}$ -GAP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_8 = k_8 \cdot x_5 \cdot x_{14} - k_{r8} \cdot x_{15} \quad (24)$$

7.9 Reaction v_9

This is an irreversible reaction of one reactant forming one product.

Name v_9

Reaction equation



Reactant

Table 22: Properties of each reactant.

Id	Name	SBO
x23	EGF-EGFR* $\hat{2}$ -GAP-Grb2	

Product

Table 23: Properties of each product.

Id	Name	SBO
x18	EGF-EGFRi* $\hat{2}$ -GAP-Grb2	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_9 = k_7 \cdot x_{23} \quad (26)$$

7.10 Reaction v10

This is a reversible reaction of two reactants forming one product.

Name v10

Reaction equation



Reactants

Table 24: Properties of each reactant.

Id	Name	SBO
x6	EGFRi	
x16	EGFi	

Product

Table 25: Properties of each product.

Id	Name	SBO
x10	EGF-EGFRi	

Id	Name	SBO
----	------	-----

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{10} = k_{10} \cdot x_6 \cdot x_{16} - k_{r10} \cdot x_{10} \quad (28)$$

7.11 Reaction v_{11}

This is a reversible reaction of one reactant forming one product.

Name v_{11}

Reaction equation



Reactant

Table 26: Properties of each reactant.

Id	Name	SBO
x_{10}	EGF-EGFRi	

Product

Table 27: Properties of each product.

Id	Name	SBO
x_{11}	EGF-EGFRi ²	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{11} = k_2 \cdot x_{10} \cdot x_{10} - k_{r2} \cdot x_{11} \quad (30)$$

7.12 Reaction v_{12}

This is a reversible reaction of one reactant forming one product.

Name v_{12}

Reaction equation



Reactant

Table 28: Properties of each reactant.

Id	Name	SBO
x11	EGF-EGFRi ²	

Product

Table 29: Properties of each product.

Id	Name	SBO
x8	EGF-EGFRi* ²	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{12} = k_3 \cdot x11 - kr_3 \cdot x8 \quad (32)$$

7.13 Reaction v13

This is an irreversible reaction of no reactant forming one product.

Name v13

Reaction equation



Product

Table 30: Properties of each product.

Id	Name	SBO
x2	EGFR	

Kinetic Law

Derived unit $\text{item} \cdot (60 \text{ s})^{-1}$

$$v_{13} = k_{13} \quad (34)$$

7.14 Reaction v_{14}

This is a reversible reaction of two reactants forming one product.

Name v_{14}

Reaction equation



Reactants

Table 31: Properties of each reactant.

Id	Name	SBO
x_8	EGF-EGFRi* $\hat{2}$	
x_{14}	GAP	

Product

Table 32: Properties of each product.

Id	Name	SBO
x_{17}	EGF-EGFRi* $\hat{2}$ -GAP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{14} = k_{14} \cdot x_8 \cdot x_{14} - k_{r14} \cdot x_{17} \quad (36)$$

7.15 Reaction v_{15}

This is an irreversible reaction of one reactant forming one product.

Name v_{15}

Reaction equation



Reactant

Table 33: Properties of each reactant.

Id	Name	SBO
x9	Proti	

Product

Table 34: Properties of each product.

Id	Name	SBO
x12	Prot	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

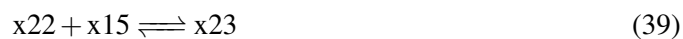
$$v_{15} = k_{15} \cdot x9 \quad (38)$$

7.16 Reaction v16

This is a reversible reaction of two reactants forming one product.

Name v16

Reaction equation



Reactants

Table 35: Properties of each reactant.

Id	Name	SBO
x22	Grb2	
x15	EGF-EGFR* $\hat{2}$ -GAP	

Product

Table 36: Properties of each product.

Id	Name	SBO
x23	EGF-EGFR*2-GAP-Grb2	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{16} = k_{16} \cdot x_{22} \cdot x_{15} - k_{r16} \cdot x_{23} \quad (40)$$

7.17 Reaction v17

This is a reversible reaction of two reactants forming one product.

Name v17

Reaction equation



Reactants

Table 37: Properties of each reactant.

Id	Name	SBO
x24	Sos	
x23	EGF-EGFR*2-GAP-Grb2	

Product

Table 38: Properties of each product.

Id	Name	SBO
x25	EGF-EGFR*2-GAP-Grb2-Sos	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{17} = k_{17} \cdot x_{24} \cdot x_{23} - k_{r17} \cdot x_{25} \quad (42)$$

7.18 Reaction v18

This is a reversible reaction of two reactants forming one product.

Name v18

Reaction equation



Reactants

Table 39: Properties of each reactant.

Id	Name	SBO
x26	Ras-GDP	
x25	EGF-EGFR* $\hat{2}$ -GAP-Grb2-Sos	

Product

Table 40: Properties of each product.

Id	Name	SBO
x27	EGF-EGFR* $\hat{2}$ -GAP-Grb2-Sos-Ras-GDP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{18} = k_{18} \cdot x_{26} \cdot x_{25} - k_{r18} \cdot x_{27} \quad (44)$$

7.19 Reaction v19

This is a reversible reaction of one reactant forming two products.

Name v19

Reaction equation



Reactant

Table 41: Properties of each reactant.

Id	Name	SBO
x27	EGF-EGFR* $\hat{2}$ -GAP-Grb2-Sos-Ras-GDP	

Products

Table 42: Properties of each product.

Id	Name	SBO
x28	Ras-GTP	
x25	EGF-EGFR* $\hat{2}$ -GAP-Grb2-Sos	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{19} = k_{19} \cdot x_{27} - k_{r19} \cdot x_{28} \cdot x_{25} \quad (46)$$

7.20 Reaction v20

This is a reversible reaction of two reactants forming one product.

Name v20

Reaction equation



Reactants

Table 43: Properties of each reactant.

Id	Name	SBO
x25	EGF-EGFR* $\hat{2}$ -GAP-Grb2-Sos	
x43	Ras-GTP*	

Product

Table 44: Properties of each product.

Id	Name	SBO
x29	EGF-EGFR* $\hat{2}$ -GAP-Grb2-Sos-Ras-GTP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{20} = k_{20} \cdot x_{25} \cdot x_{43} - k_{r20} \cdot x_{29} \quad (48)$$

7.21 Reaction v_{21}

This is a reversible reaction of one reactant forming two products.

Name v_{21}

Reaction equation



Reactant

Table 45: Properties of each reactant.

Id	Name	SBO
x29	EGF-EGFR* $\hat{2}$ -GAP-Grb2-Sos-Ras-GTP	

Products

Table 46: Properties of each product.

Id	Name	SBO
x25	EGF-EGFR* $\hat{2}$ -GAP-Grb2-Sos	
x26	Ras-GDP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{21} = k_{21} \cdot x_{29} - k_{r21} \cdot x_{25} \cdot x_{26} \quad (50)$$

7.22 Reaction v_{22}

This is a reversible reaction of two reactants forming one product.

Name v_{22}

Reaction equation



Reactants

Table 47: Properties of each reactant.

Id	Name	SBO
x31	Shc	
x15	EGF-EGFR* $\hat{2}$ -GAP	

Product

Table 48: Properties of each product.

Id	Name	SBO
x32	EGF-EGFR* $\hat{2}$ -GAP-Shc	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{22} = k_{22} \cdot x_{31} \cdot x_{15} - k_{r22} \cdot x_{32} \quad (52)$$

7.23 Reaction v_{23}

This is a reversible reaction of one reactant forming one product.

Name v_{23}

Reaction equation



Reactant

Table 49: Properties of each reactant.

Id	Name	SBO
x32	EGF-EGFR* $\hat{2}$ -GAP-Shc	

Product

Table 50: Properties of each product.

Id	Name	SBO
x33	EGF-EGFR* $\hat{2}$ -GAP-Shc*	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

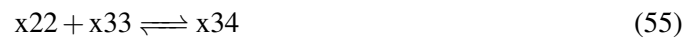
$$v_{23} = k_{23} \cdot x_{32} - k_{r23} \cdot x_{33} \quad (54)$$

7.24 Reaction v_{24}

This is a reversible reaction of two reactants forming one product.

Name v_{24}

Reaction equation



Reactants

Table 51: Properties of each reactant.

Id	Name	SBO
x22	Grb2	
x33	EGF-EGFR* $\hat{2}$ -GAP-Shc*	

Product

Table 52: Properties of each product.

Id	Name	SBO
x34	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2	

Id	Name	SBO
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Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{24} = k_{24} \cdot x_{22} \cdot x_{33} - k_{r24} \cdot x_{34} \quad (56)$$

7.25 Reaction v_{25}

This is a reversible reaction of two reactants forming one product.

Name v_{25}

Reaction equation



Reactants

Table 53: Properties of each reactant.

Id	Name	SBO
x24	Sos	
x34	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2	

Product

Table 54: Properties of each product.

Id	Name	SBO
x35	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

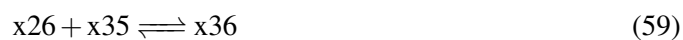
$$v_{25} = k_{25} \cdot x_{24} \cdot x_{34} - k_{r25} \cdot x_{35} \quad (58)$$

7.26 Reaction v_{26}

This is a reversible reaction of two reactants forming one product.

Name v26

Reaction equation



Reactants

Table 55: Properties of each reactant.

Id	Name	SBO
x26	Ras-GDP	
x35	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos	

Product

Table 56: Properties of each product.

Id	Name	SBO
x36	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GDP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

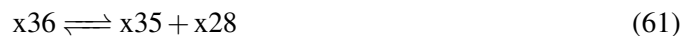
$$v_{26} = k_{18} \cdot x_{26} \cdot x_{35} - k_{r18} \cdot x_{36} \quad (60)$$

7.27 Reaction v27

This is a reversible reaction of one reactant forming two products.

Name v27

Reaction equation



Reactant

Table 57: Properties of each reactant.

Id	Name	SBO
x36	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GDP	

Products

Table 58: Properties of each product.

Id	Name	SBO
x35	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos	
x28	Ras-GTP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{27} = k_{19} \cdot x_{36} - k_{r19} \cdot x_{35} \cdot x_{28} \quad (62)$$

7.28 Reaction v_{28}

This is a reversible reaction of two reactants forming one product.

Name v_{28}

Reaction equation



Reactants

Table 59: Properties of each reactant.

Id	Name	SBO
x28	Ras-GTP	
x41	Raf	

Product

Table 60: Properties of each product.

Id	Name	SBO
x42	Raf-Ras-GTP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{28} = k_{28} \cdot x_{28} \cdot x_{41} - k_{r28} \cdot x_{42} \quad (64)$$

7.29 Reaction v_{29}

This is a reversible reaction of one reactant forming two products.

Name v_{29}

Reaction equation



Reactant

Table 61: Properties of each reactant.

Id	Name	SBO
x42	Raf-Ras-GTP	

Products

Table 62: Properties of each product.

Id	Name	SBO
x43	Ras-GTP*	
x45	Raf*	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{29} = k_{29} \cdot x_{42} - k_{r29} \cdot x_{43} \cdot x_{45} \quad (66)$$

7.30 Reaction v30

This is a reversible reaction of two reactants forming one product.

Name v30

Reaction equation



Reactants

Table 63: Properties of each reactant.

Id	Name	SBO
x35	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos	
x43	Ras-GTP*	

Product

Table 64: Properties of each product.

Id	Name	SBO
x37	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GTP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{30} = k_{20} \cdot x_{35} \cdot x_{43} - k_{r20} \cdot x_{37} \quad (68)$$

7.31 Reaction v31

This is a reversible reaction of one reactant forming two products.

Name v31

Reaction equation



Reactant

Table 65: Properties of each reactant.

Id	Name	SBO
x37	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GTP	

Products

Table 66: Properties of each product.

Id	Name	SBO
x35	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos	
x26	Ras-GDP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{31} = k_{21} \cdot x_{37} - k_{r21} \cdot x_{35} \cdot x_{26} \quad (70)$$

7.32 Reaction v_{32}

This is a reversible reaction of one reactant forming two products.

Name v_{32}

Reaction equation



Reactant

Table 67: Properties of each reactant.

Id	Name	SBO
x35	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos	

Products

Table 68: Properties of each product.

Id	Name	SBO
x15	EGF-EGFR* $\hat{2}$ -GAP	

Id	Name	SBO
x38	Shc*-Grb2-Sos	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{32} = k_{32} \cdot x_{35} - k_{r32} \cdot x_{15} \cdot x_{38} \quad (72)$$

7.33 Reaction v_{33}

This is a reversible reaction of one reactant forming two products.

Name v_{33}

Reaction equation



Reactant

Table 69: Properties of each reactant.

Id	Name	SBO
x38	Shc*-Grb2-Sos	

Products

Table 70: Properties of each product.

Id	Name	SBO
x40	Shc*	
x30	Grb2-Sos	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

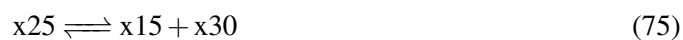
$$v_{33} = k_{33} \cdot x_{38} - k_{r33} \cdot x_{40} \cdot x_{30} \quad (74)$$

7.34 Reaction v_{34}

This is a reversible reaction of one reactant forming two products.

Name v34

Reaction equation



Reactant

Table 71: Properties of each reactant.

Id	Name	SBO
x25	EGF-EGFR*2-GAP-Grb2-Sos	

Products

Table 72: Properties of each product.

Id	Name	SBO
x15	EGF-EGFR*2-GAP	
x30	Grb2-Sos	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{34} = k_{34} \cdot x25 - k_{r34} \cdot x15 \cdot x30 \quad (76)$$

7.35 Reaction v35

This is a reversible reaction of one reactant forming two products.

Name v35

Reaction equation



Reactant

Table 73: Properties of each reactant.

Id	Name	SBO
x30	Grb2-Sos	

Products

Table 74: Properties of each product.

Id	Name	SBO
x24	Sos	
x22	Grb2	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{35} = k_{35} \cdot x_{30} - k_{r35} \cdot x_{24} \cdot x_{22} \quad (78)$$

7.36 Reaction v_{36}

This is an irreversible reaction of one reactant forming one product.

Name v_{36}

Reaction equation



Reactant

Table 75: Properties of each reactant.

Id	Name	SBO
x40	Shc*	

Product

Table 76: Properties of each product.

Id	Name	SBO
x31	Shc	

Id	Name	SBO
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Kinetic Law

Derived unit $\text{item} \cdot (60 \text{ s})^{-1}$

$$v_{36} = \frac{V_{m36} \cdot x_{40}}{K_{m36} + x_{40}} \quad (80)$$

7.37 Reaction v_{37}

This is a reversible reaction of one reactant forming two products.

Name v_{37}

Reaction equation



Reactant

Table 77: Properties of each reactant.

Id	Name	SBO
x_{33}	EGF-EGFR* $\hat{2}$ -GAP-Shc*	

Products

Table 78: Properties of each product.

Id	Name	SBO
x_{15}	EGF-EGFR* $\hat{2}$ -GAP	
x_{40}	Shc*	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{37} = k_{37} \cdot x_{33} - k_{r37} \cdot x_{15} \cdot x_{40} \quad (82)$$

7.38 Reaction v_{38}

This is a reversible reaction of two reactants forming one product.

Name v38

Reaction equation



Reactants

Table 79: Properties of each reactant.

Id	Name	SBO
x22	Grb2	
x40	Shc*	

Product

Table 80: Properties of each product.

Id	Name	SBO
x39	Shc*-Grb2	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{38} = k_{24} \cdot x_{22} \cdot x_{40} - k_{r24} \cdot x_{39} \quad (84)$$

7.39 Reaction v39

This is a reversible reaction of one reactant forming two products.

Name v39

Reaction equation



Reactant

Table 81: Properties of each reactant.

Id	Name	SBO
x34	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2	

Products

Table 82: Properties of each product.

Id	Name	SBO
x15	EGF-EGFR* $\hat{2}$ -GAP	
x39	Shc*-Grb2	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{39} = k_{37} \cdot x_{34} - k_{r37} \cdot x_{15} \cdot x_{39} \quad (86)$$

7.40 Reaction v_{40}

This is a reversible reaction of two reactants forming one product.

Name v_{40}

Reaction equation



Reactants

Table 83: Properties of each reactant.

Id	Name	SBO
x24	Sos	
x39	Shc*-Grb2	

Product

Table 84: Properties of each product.

Id	Name	SBO
x38	Shc*-Grb2-Sos	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{40} = k_{40} \cdot x_{24} \cdot x_{39} - k_{r40} \cdot x_{38} \quad (88)$$

7.41 Reaction v_{41}

This is a reversible reaction of two reactants forming one product.

Name v_{41}

Reaction equation



Reactants

Table 85: Properties of each reactant.

Id	Name	SBO
x30	Grb2-Sos	
x33	EGF-EGFR* $\hat{2}$ -GAP-Shc*	

Product

Table 86: Properties of each product.

Id	Name	SBO
x35	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{41} = k_{41} \cdot x_{30} \cdot x_{33} - k_{r41} \cdot x_{35} \quad (90)$$

7.42 Reaction v42

This is a reversible reaction of two reactants forming one product.

Name v42

Reaction equation



Reactants

Table 87: Properties of each reactant.

Id	Name	SBO
x44	Phosphotase I	
x45	Raf*	

Product

Table 88: Properties of each product.

Id	Name	SBO
x46	Raf*-P'ase	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{42} = k_{42} \cdot x_{44} \cdot x_{45} - k_{r42} \cdot x_{46} \quad (92)$$

7.43 Reaction v43

This is a reversible reaction of one reactant forming two products.

Name v43

Reaction equation



Reactant

Table 89: Properties of each reactant.

Id	Name	SBO
x46	Raf*-P'ase	

Products

Table 90: Properties of each product.

Id	Name	SBO
x41	Raf	
x44	Phosphotase1	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{43} = k_{43} \cdot x_{46} \quad (94)$$

7.44 Reaction v_{44}

This is a reversible reaction of two reactants forming one product.

Name v_{44}

Reaction equation



Reactants

Table 91: Properties of each reactant.

Id	Name	SBO
x47	MEK	
x45	Raf*	

Product

Table 92: Properties of each product.

Id	Name	SBO
x48	MEK-Raf*	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{44} = k_{44} \cdot x_{47} \cdot x_{45} - k_{r44} \cdot x_{48} \quad (96)$$

7.45 Reaction v_{45}

This is a reversible reaction of one reactant forming two products.

Name v_{45}

Reaction equation



Reactant

Table 93: Properties of each reactant.

Id	Name	SBO
x48	MEK-Raf*	

Products

Table 94: Properties of each product.

Id	Name	SBO
x49	MEK-P	
x45	Raf*	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{45} = k_{45} \cdot x_{48} \quad (98)$$

7.46 Reaction v_{46}

This is a reversible reaction of two reactants forming one product.

Name v_{46}

Reaction equation



Reactants

Table 95: Properties of each reactant.

Id	Name	SBO
x_{49}	MEK-P	
x_{45}	Raf*	

Product

Table 96: Properties of each product.

Id	Name	SBO
x_{50}	MEK-P-Raf*	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{46} = k_{44} \cdot x_{49} \cdot x_{45} - k_{r44} \cdot x_{50} \quad (100)$$

7.47 Reaction v_{47}

This is a reversible reaction of one reactant forming two products.

Name v_{47}

Reaction equation



Reactant

Table 97: Properties of each reactant.

Id	Name	SBO
x50	MEK-P-Raf*	

Products

Table 98: Properties of each product.

Id	Name	SBO
x51	MEK-PP	
x45	Raf*	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{47} = k_{47} \cdot x_{50} \quad (102)$$

7.48 Reaction v_{48}

This is a reversible reaction of two reactants forming one product.

Name v_{48}

Reaction equation



Reactants

Table 99: Properties of each reactant.

Id	Name	SBO
x51	MEK-PP	
x53	Phosphatase2	

Product

Table 100: Properties of each product.

Id	Name	SBO
x52	MEK-PP-P'ase2	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

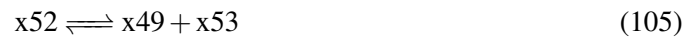
$$v_{48} = k_{48} \cdot x_{51} \cdot x_{53} - k_{r48} \cdot x_{52} \quad (104)$$

7.49 Reaction v_{49}

This is a reversible reaction of one reactant forming two products.

Name v_{49}

Reaction equation



Reactant

Table 101: Properties of each reactant.

Id	Name	SBO
x52	MEK-PP-P'ase2	

Products

Table 102: Properties of each product.

Id	Name	SBO
x49	MEK-P	
x53	Phosphatase2	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{49} = k_{49} \cdot x_{52} \quad (106)$$

7.50 Reaction v50

This is a reversible reaction of two reactants forming one product.

Name v50

Reaction equation



Reactants

Table 103: Properties of each reactant.

Id	Name	SBO
x53	Phosphatase2	
x49	MEK-P	

Product

Table 104: Properties of each product.

Id	Name	SBO
x54	MEK-P-P'ase2	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{50} = k_{50} \cdot x_{53} \cdot x_{49} - k_{r50} \cdot x_{54} \quad (108)$$

7.51 Reaction v51

This is a reversible reaction of one reactant forming two products.

Name v51

Reaction equation



Reactant

Table 105: Properties of each reactant.

Id	Name	SBO
x54	MEK-P-P'ase2	

Products

Table 106: Properties of each product.

Id	Name	SBO
x47	MEK	
x53	Phosphatase2	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{51} = k_{49} \cdot x_{54} \quad (110)$$

7.52 Reaction v52

This is a reversible reaction of two reactants forming one product.

Name v52

Reaction equation



Reactants

Table 107: Properties of each reactant.

Id	Name	SBO
x55	ERK	
x51	MEK-PP	

Product

Table 108: Properties of each product.

Id	Name	SBO
x56	ERK-MEK-PP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{52} = k_{52} \cdot x_{55} \cdot x_{51} - k_{r52} \cdot x_{56} \quad (112)$$

7.53 Reaction v_{53}

This is a reversible reaction of one reactant forming two products.

Name v_{53}

Reaction equation



Reactant

Table 109: Properties of each reactant.

Id	Name	SBO
x56	ERK-MEK-PP	

Products

Table 110: Properties of each product.

Id	Name	SBO
x51	MEK-PP	
x57	ERK-P	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{53} = k_{53} \cdot x_{56} \quad (114)$$

7.54 Reaction v_{54}

This is a reversible reaction of two reactants forming one product.

Name v_{54}

Reaction equation



Reactants

Table 111: Properties of each reactant.

Id	Name	SBO
x_{51}	MEK-PP	
x_{57}	ERK-P	

Product

Table 112: Properties of each product.

Id	Name	SBO
x_{58}	ERK-P-MEK-PP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{54} = k_{52} \cdot x_{51} \cdot x_{57} - k_{r52} \cdot x_{58} \quad (116)$$

7.55 Reaction v_{55}

This is a reversible reaction of one reactant forming two products.

Name v_{55}

Reaction equation



Reactant

Table 113: Properties of each reactant.

Id	Name	SBO
x58	ERK-P-MEK-PP	

Products

Table 114: Properties of each product.

Id	Name	SBO
x59	ERK-PP	
x51	MEK-PP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{55} = k_{55} \cdot x_{58} \quad (118)$$

7.56 Reaction v56

This is a reversible reaction of two reactants forming one product.

Name v56

Reaction equation



Reactants

Table 115: Properties of each reactant.

Id	Name	SBO
x59	ERK-PP	
x60	Phosphotase3	

Product

Table 116: Properties of each product.

Id	Name	SBO
x61	ERK-PP-P'ase3	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{56} = k_{56} \cdot x_{59} \cdot x_{60} - k_{r56} \cdot x_{61} \quad (120)$$

7.57 Reaction v_{57}

This is a reversible reaction of one reactant forming two products.

Name v_{57}

Reaction equation



Reactant

Table 117: Properties of each reactant.

Id	Name	SBO
x61	ERK-PP-P'ase3	

Products

Table 118: Properties of each product.

Id	Name	SBO
x57	ERK-P	
x60	Phosphatase3	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{57} = k_{57} \cdot x_{61} \quad (122)$$

7.58 Reaction v58

This is a reversible reaction of two reactants forming one product.

Name v58

Reaction equation



Reactants

Table 119: Properties of each reactant.

Id	Name	SBO
x60	Phosphotase3	
x57	ERK-P	

Product

Table 120: Properties of each product.

Id	Name	SBO
x62	ERK-P-P'ase3	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{58} = k_{58} \cdot x60 \cdot x57 - k_{r58} \cdot x62 \quad (124)$$

7.59 Reaction v59

This is a reversible reaction of one reactant forming two products.

Name v59

Reaction equation



Reactant

Table 121: Properties of each reactant.

Id	Name	SBO
x62	ERK-P-P'ase3	

Products

Table 122: Properties of each product.

Id	Name	SBO
x55	ERK	
x60	Phosphotase3	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{59} = k_{59} \cdot x_{62} \quad (126)$$

7.60 Reaction v60

This is an irreversible reaction of one reactant forming one product.

Name v60

Reaction equation



Reactant

Table 123: Properties of each reactant.

Id	Name	SBO
x6	EGFRi	

Product

Table 124: Properties of each product.

Id	Name	SBO
x86	EGFRideg	

Id	Name	SBO
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Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{60} = k_{60} \cdot x_6 \quad (128)$$

7.61 Reaction v_{61}

This is an irreversible reaction of one reactant forming one product.

Name v_{61}

Reaction equation



Reactant

Table 125: Properties of each reactant.

Id	Name	SBO
x_{16}	EGFi	

Product

Table 126: Properties of each product.

Id	Name	SBO
x_{13}	EGFideg	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{61} = k_{61} \cdot x_{16} \quad (130)$$

7.62 Reaction v_{62}

This is an irreversible reaction of one reactant forming one product.

Name v_{62}

Reaction equation



Reactant

Table 127: Properties of each reactant.

Id	Name	SBO
x8	EGF-EGFRi*2	

Product

Table 128: Properties of each product.

Id	Name	SBO
x87	EGF-EGFRi*2deg	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{62} = k_{60} \cdot x8 \quad (132)$$

7.63 Reaction v63

This is a reversible reaction of two reactants forming one product.

Name v63

Reaction equation



Reactants

Table 129: Properties of each reactant.

Id	Name	SBO
x17	EGF-EGFRi*2-GAP	
x22	Grb2	

Product

Table 130: Properties of each product.

Id	Name	SBO
x18	EGF-EGFRi* $\hat{2}$ -GAP-Grb2	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{63} = k_{16} \cdot x_{17} \cdot x_{22} - k_{r16} \cdot x_{18} \quad (134)$$

7.64 Reaction v_{64}

This is a reversible reaction of two reactants forming one product.

Name v_{64}

Reaction equation



Reactants

Table 131: Properties of each reactant.

Id	Name	SBO
x24	Sos	
x18	EGF-EGFRi* $\hat{2}$ -GAP-Grb2	

Product

Table 132: Properties of each product.

Id	Name	SBO
x19	EGF-EGFRi* $\hat{2}$ -GAP-Grb2-Sos	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{64} = k_{17} \cdot x_{24} \cdot x_{18} - k_{r17} \cdot x_{19} \quad (136)$$

7.65 Reaction v_{65}

This is a reversible reaction of two reactants forming one product.

Name v_{65}

Reaction equation



Reactants

Table 133: Properties of each reactant.

Id	Name	SBO
x26	Ras-GDP	
x19	EGF-EGFRi*2-GAP-Grb2-Sos	

Product

Table 134: Properties of each product.

Id	Name	SBO
x20	EGF-EGFRi*2-GAP-Grb2-Sos-Ras-GDP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

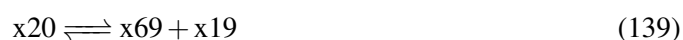
$$v_{65} = k_{18} \cdot x_{26} \cdot x_{19} - k_{r18} \cdot x_{20} \quad (138)$$

7.66 Reaction v_{66}

This is a reversible reaction of one reactant forming two products.

Name v_{66}

Reaction equation



Reactant

Table 135: Properties of each reactant.

Id	Name	SBO
x20	EGF-EGFRi*2̂-GAP-Grb2-Sos-Ras-GDP	

Products

Table 136: Properties of each product.

Id	Name	SBO
x69	Rasi-GTP	
x19	EGF-EGFRi*2̂-GAP-Grb2-Sos	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{66} = k_{19} \cdot x_{20} - k_{r19} \cdot x_{69} \cdot x_{19} \quad (140)$$

7.67 Reaction v_{67}

This is a reversible reaction of two reactants forming one product.

Name v_{67}

Reaction equation



Reactants

Table 137: Properties of each reactant.

Id	Name	SBO
x71	Rasi-GTP*	
x19	EGF-EGFRi*2̂-GAP-Grb2-Sos	

Product

Table 138: Properties of each product.

Id	Name	SBO
x21	EGF-EGFRi*2̂-GAP-Grb2-Sos-Ras-GTP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{67} = k_{20} \cdot x_{71} \cdot x_{19} - k_{r20} \cdot x_{21} \quad (142)$$

7.68 Reaction v68

This is a reversible reaction of one reactant forming two products.

Name v68

Reaction equation



Reactant

Table 139: Properties of each reactant.

Id	Name	SBO
x21	EGF-EGFRi*2̂-GAP-Grb2-Sos-Ras-GTP	

Products

Table 140: Properties of each product.

Id	Name	SBO
x19	EGF-EGFRi*2̂-GAP-Grb2-Sos	
x26	Ras-GDP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{68} = k_{21} \cdot x_{21} - k_{r21} \cdot x_{19} \cdot x_{26} \quad (144)$$

7.69 Reaction v69

This is a reversible reaction of two reactants forming one product.

Name v69

Reaction equation



Reactants

Table 141: Properties of each reactant.

Id	Name	SBO
x31	Shc	
x17	EGF-EGFRi*2-GAP	

Product

Table 142: Properties of each product.

Id	Name	SBO
x63	EGF-EGFRi*2-GAP-Shc	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{69} = k_{22} \cdot x_{31} \cdot x_{17} - k_{r22} \cdot x_{63} \quad (146)$$

7.70 Reaction v70

This is a reversible reaction of one reactant forming one product.

Name v70

Reaction equation



Reactant

Table 143: Properties of each reactant.

Id	Name	SBO
x63	EGF-EGFRi* $\hat{2}$ -GAP-Shc	

Product

Table 144: Properties of each product.

Id	Name	SBO
x64	EGF-EGFRi* $\hat{2}$ -GAP-Shc*	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{70} = k_{23} \cdot x_{63} - k_{r23} \cdot x_{64} \quad (148)$$

7.71 Reaction v_{71}

This is a reversible reaction of two reactants forming one product.

Name v_{71}

Reaction equation



Reactants

Table 145: Properties of each reactant.

Id	Name	SBO
x22	Grb2	
x64	EGF-EGFRi* $\hat{2}$ -GAP-Shc*	

Product

Table 146: Properties of each product.

Id	Name	SBO
x65	EGF-EGFRi* $\hat{2}$ -GAP-Shc*-Grb2	

Id	Name	SBO
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Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{71} = k_{24} \cdot x_{22} \cdot x_{64} - k_{r24} \cdot x_{65} \quad (150)$$

7.72 Reaction v_{72}

This is a reversible reaction of two reactants forming one product.

Name v_{72}

Reaction equation



Reactants

Table 147: Properties of each reactant.

Id	Name	SBO
x24	Sos	
x65	EGF-EGFRi* $\hat{2}$ -GAP-Shc*-Grb2	

Product

Table 148: Properties of each product.

Id	Name	SBO
x66	EGF-EGFRi* $\hat{2}$ -GAP-Shc*-Grb2-Sos	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{72} = k_{25} \cdot x_{24} \cdot x_{65} - k_{r25} \cdot x_{66} \quad (152)$$

7.73 Reaction v_{73}

This is a reversible reaction of two reactants forming one product.

Name v73

Reaction equation



Reactants

Table 149: Properties of each reactant.

Id	Name	SBO
x26	Ras-GDP	
x66	EGF-EGFRi* $\hat{2}$ -GAP-Shc*-Grb2-Sos	

Product

Table 150: Properties of each product.

Id	Name	SBO
x67	EGF-EGFRi* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GDP	

Kinetic Law

Derived unit (60 s)⁻¹ · item

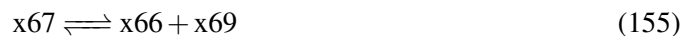
$$v_{73} = k_{18} \cdot x_{26} \cdot x_{66} - k_{r18} \cdot x_{67} \quad (154)$$

7.74 Reaction v74

This is a reversible reaction of one reactant forming two products.

Name v74

Reaction equation



Reactant

Table 151: Properties of each reactant.

Id	Name	SBO
x67	EGF-EGFRi* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GDP	

Products

Table 152: Properties of each product.

Id	Name	SBO
x66	EGF-EGFRi* $\hat{2}$ -GAP-Shc*-Grb2-Sos	
x69	Rasi-GTP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{74} = k_{19} \cdot x_{67} - k_{r19} \cdot x_{66} \cdot x_{69} \quad (156)$$

7.75 Reaction v_{75}

This is a reversible reaction of two reactants forming one product.

Name v_{75}

Reaction equation



Reactants

Table 153: Properties of each reactant.

Id	Name	SBO
x69	Rasi-GTP	
x41	Raf	

Product

Table 154: Properties of each product.

Id	Name	SBO
x70	Rafi-Rasi-GTP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{75} = k_{28} \cdot x_{69} \cdot x_{41} - k_{r28} \cdot x_{70} \quad (158)$$

7.76 Reaction v_{76}

This is a reversible reaction of one reactant forming two products.

Name v_{76}

Reaction equation



Reactant

Table 155: Properties of each reactant.

Id	Name	SBO
x70	Rafi-Rasi-GTP	

Products

Table 156: Properties of each product.

Id	Name	SBO
x71	Rasi-GTP*	
x72	Rafi*	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{76} = k_{29} \cdot x_{70} - k_{r29} \cdot x_{71} \cdot x_{72} \quad (160)$$

7.77 Reaction v_{77}

This is a reversible reaction of two reactants forming one product.

Name v_{77}

Reaction equation



Reactants

Table 157: Properties of each reactant.

Id	Name	SBO
x71	Rasi-GTP*	
x66	EGF-EGFRi* $\hat{2}$ -GAP-Shc*-Grb2-Sos	

Product

Table 158: Properties of each product.

Id	Name	SBO
x68	EGF-EGFRi* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GTP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{77} = k_{20} \cdot x_{71} \cdot x_{66} - k_{r20} \cdot x_{68} \quad (162)$$

7.78 Reaction v_{78}

This is a reversible reaction of one reactant forming two products.

Name v_{78}

Reaction equation



Reactant

Table 159: Properties of each reactant.

Id	Name	SBO
x68	EGF-EGFRi*2-GAP-Shc*-Grb2-Sos-Ras-GTP	

Products

Table 160: Properties of each product.

Id	Name	SBO
x66	EGF-EGFRi*2-GAP-Shc*-Grb2-Sos	
x26	Ras-GDP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{78} = k_{21} \cdot x_{68} - k_{r21} \cdot x_{66} \cdot x_{26} \quad (164)$$

7.79 Reaction v_{79}

This is a reversible reaction of one reactant forming two products.

Name v_{79}

Reaction equation



Reactant

Table 161: Properties of each reactant.

Id	Name	SBO
x66	EGF-EGFRi*2-GAP-Shc*-Grb2-Sos	

Products

Table 162: Properties of each product.

Id	Name	SBO
x17	EGF-EGFRi*2-GAP	

Id	Name	SBO
x38	Shc*-Grb2-Sos	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{79} = k_{32} \cdot x_{66} - k_{r32} \cdot x_{17} \cdot x_{38} \quad (166)$$

7.80 Reaction v_{80}

This is a reversible reaction of one reactant forming two products.

Name v_{80}

Reaction equation



Reactant

Table 163: Properties of each reactant.

Id	Name	SBO
x19	EGF-EGFRi* $\hat{2}$ -GAP-Grb2-Sos	

Products

Table 164: Properties of each product.

Id	Name	SBO
x17	EGF-EGFRi* $\hat{2}$ -GAP	
x30	Grb2-Sos	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

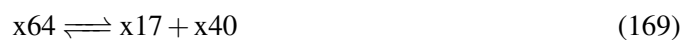
$$v_{80} = k_{34} \cdot x_{19} - k_{r34} \cdot x_{17} \cdot x_{30} \quad (168)$$

7.81 Reaction v_{81}

This is a reversible reaction of one reactant forming two products.

Name v81

Reaction equation



Reactant

Table 165: Properties of each reactant.

Id	Name	SBO
x64	EGF-EGFRi*2-GAP-Shc*	

Products

Table 166: Properties of each product.

Id	Name	SBO
x17	EGF-EGFRi*2-GAP	
x40	Shc*	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{81} = k_{37} \cdot x64 - k_{r37} \cdot x17 \cdot x40 \quad (170)$$

7.82 Reaction v82

This is a reversible reaction of one reactant forming two products.

Name v82

Reaction equation



Reactant

Table 167: Properties of each reactant.

Id	Name	SBO
x65	EGF-EGFRi* $\hat{2}$ -GAP-Shc*-Grb2	

Products

Table 168: Properties of each product.

Id	Name	SBO
x17	EGF-EGFRi* $\hat{2}$ -GAP	
x39	Shc*-Grb2	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{82} = k_{37} \cdot x_{65} - k_{r37} \cdot x_{17} \cdot x_{39} \quad (172)$$

7.83 Reaction v_{83}

This is a reversible reaction of two reactants forming one product.

Name v_{83}

Reaction equation



Reactants

Table 169: Properties of each reactant.

Id	Name	SBO
x30	Grb2-Sos	
x64	EGF-EGFRi* $\hat{2}$ -GAP-Shc*	

Product

Table 170: Properties of each product.

Id	Name	SBO
x66	EGF-EGFRi* ² -GAP-Shc*-Grb2-Sos	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{83} = k_{41} \cdot x_{30} \cdot x_{64} - k_{r41} \cdot x_{66} \quad (174)$$

7.84 Reaction v84

This is a reversible reaction of two reactants forming one product.

Name v84

Reaction equation



Reactants

Table 171: Properties of each reactant.

Id	Name	SBO
x44	Phosphatase1	
x72	Rafi*	

Product

Table 172: Properties of each product.

Id	Name	SBO
x73	Rafi*-P'ase	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{84} = k_{42} \cdot x_{44} \cdot x_{72} - k_{r42} \cdot x_{73} \quad (176)$$

7.85 Reaction v85

This is a reversible reaction of one reactant forming two products.

Name v85

Reaction equation



Reactant

Table 173: Properties of each reactant.

Id	Name	SBO
x73	Rafi*-P'ase	

Products

Table 174: Properties of each product.

Id	Name	SBO
x41	Raf	
x44	Phosphotase1	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{85} = k_{43} \cdot x_{73} \quad (178)$$

7.86 Reaction v86

This is a reversible reaction of two reactants forming one product.

Name v86

Reaction equation



Reactants

Table 175: Properties of each reactant.

Id	Name	SBO
x47	MEK	
x72	Rafi*	

Product

Table 176: Properties of each product.

Id	Name	SBO
x74	MEKi-Rafi*	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{86} = k_{44} \cdot x_{47} \cdot x_{72} - k_{r44} \cdot x_{74} \quad (180)$$

7.87 Reaction v_{87}

This is a reversible reaction of one reactant forming two products.

Name v_{87}

Reaction equation



Reactant

Table 177: Properties of each reactant.

Id	Name	SBO
x74	MEKi-Rafi*	

Products

Table 178: Properties of each product.

Id	Name	SBO
x75	MEKi-P	

Id	Name	SBO
x72	Rafi*	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{87} = k_{45} \cdot x_{74} \quad (182)$$

7.88 Reaction v88

This is a reversible reaction of two reactants forming one product.

Name v88

Reaction equation



Reactants

Table 179: Properties of each reactant.

Id	Name	SBO
x72	Rafi*	
x75	MEKi-P	

Product

Table 180: Properties of each product.

Id	Name	SBO
x76	MEKi-P-Rafi*	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{88} = k_{44} \cdot x_{72} \cdot x_{75} - k_{r44} \cdot x_{76} \quad (184)$$

7.89 Reaction v89

This is a reversible reaction of one reactant forming two products.

Name v89

Reaction equation



Reactant

Table 181: Properties of each reactant.

Id	Name	SBO
x76	MEKi-P-Rafi*	

Products

Table 182: Properties of each product.

Id	Name	SBO
x72	Rafi*	
x77	MEKi-PP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{89} = k_{47} \cdot x76 \quad (186)$$

7.90 Reaction v90

This is a reversible reaction of two reactants forming one product.

Name v90

Reaction equation



Reactants

Table 183: Properties of each reactant.

Id	Name	SBO
x77	MEKi-PP	
x53	Phosphatase2	

Product

Table 184: Properties of each product.

Id	Name	SBO
x78	MEKi-PP-P'ase2i	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

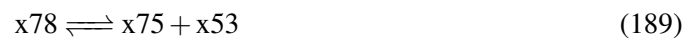
$$v_{90} = k_{48} \cdot x_{77} \cdot x_{53} - k_{r48} \cdot x_{78} \quad (188)$$

7.91 Reaction v_{91}

This is a reversible reaction of one reactant forming two products.

Name v_{91}

Reaction equation



Reactant

Table 185: Properties of each reactant.

Id	Name	SBO
x78	MEKi-PP-P'ase2i	

Products

Table 186: Properties of each product.

Id	Name	SBO
x75	MEKi-P	

Id	Name	SBO
x53	Phosphatase2	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{91} = k_{49} \cdot x_{78} \quad (190)$$

7.92 Reaction v_{92}

This is a reversible reaction of two reactants forming one product.

Name v_{92}

Reaction equation



Reactants

Table 187: Properties of each reactant.

Id	Name	SBO
x53	Phosphatase2	
x75	MEKi-P	

Product

Table 188: Properties of each product.

Id	Name	SBO
x79	MEKi-P-P'ase2i	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{92} = k_{50} \cdot x_{53} \cdot x_{75} - k_{r50} \cdot x_{79} \quad (192)$$

7.93 Reaction v_{93}

This is a reversible reaction of one reactant forming two products.

Name v93

Reaction equation



Reactant

Table 189: Properties of each reactant.

Id	Name	SBO
x79	MEKi-P-P'ase2i	

Products

Table 190: Properties of each product.

Id	Name	SBO
x47	MEK	
x53	Phosphatase2	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{93} = k_{49} \cdot x79 \quad (194)$$

7.94 Reaction v94

This is a reversible reaction of two reactants forming one product.

Name v94

Reaction equation



Reactants

Table 191: Properties of each reactant.

Id	Name	SBO
x55	ERK	
x77	MEKi-PP	

Product

Table 192: Properties of each product.

Id	Name	SBO
x80	ERKi-MEKi-PP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{94} = k52 \cdot x55 \cdot x77 - kr52 \cdot x80 \quad (196)$$

7.95 Reaction v_{95}

This is a reversible reaction of one reactant forming two products.

Name v_{95}

Reaction equation



Reactant

Table 193: Properties of each reactant.

Id	Name	SBO
x80	ERKi-MEKi-PP	

Products

Table 194: Properties of each product.

Id	Name	SBO
x81	ERKi-P	

Id	Name	SBO
x77	MEKi-PP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{95} = k_{53} \cdot x_{80} \quad (198)$$

7.96 Reaction v_{96}

This is a reversible reaction of two reactants forming one product.

Name v_{96}

Reaction equation



Reactants

Table 195: Properties of each reactant.

Id	Name	SBO
x77	MEKi-PP	
x81	ERKi-P	

Product

Table 196: Properties of each product.

Id	Name	SBO
x82	ERKi-P-MEKi-PP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{96} = k_{52} \cdot x_{77} \cdot x_{81} - k_{r52} \cdot x_{82} \quad (200)$$

7.97 Reaction v_{97}

This is a reversible reaction of one reactant forming two products.

Name v97

Reaction equation



Reactant

Table 197: Properties of each reactant.

Id	Name	SBO
x82	ERKi-P-MEKi-PP	

Products

Table 198: Properties of each product.

Id	Name	SBO
x83	ERKi-PP	
x77	MEKi-PP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{97} = k_{55} \cdot x_{82} \tag{202}$$

7.98 Reaction v98

This is a reversible reaction of two reactants forming one product.

Name v98

Reaction equation



Reactants

Table 199: Properties of each reactant.

Id	Name	SBO
x83	ERKi-PP	
x60	Phosphatase3	

Product

Table 200: Properties of each product.

Id	Name	SBO
x84	ERKi-PP-P'ase3i	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{98} = k_{56} \cdot x_{83} \cdot x_{60} - k_{r56} \cdot x_{84} \quad (204)$$

7.99 Reaction v_{99}

This is a reversible reaction of one reactant forming two products.

Name v_{99}

Reaction equation



Reactant

Table 201: Properties of each reactant.

Id	Name	SBO
x84	ERKi-PP-P'ase3i	

Products

Table 202: Properties of each product.

Id	Name	SBO
x81	ERKi-P	

Id	Name	SBO
x60	Phosphotase3	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{99} = k_{57} \cdot x_{84} \quad (206)$$

7.100 Reaction v_{100}

This is a reversible reaction of two reactants forming one product.

Name v_{100}

Reaction equation



Reactants

Table 203: Properties of each reactant.

Id	Name	SBO
x60	Phosphotase3	
x81	ERKi-P	

Product

Table 204: Properties of each product.

Id	Name	SBO
x85	ERKi-P'ase3i	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

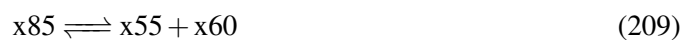
$$v_{100} = k_{58} \cdot x_{60} \cdot x_{81} - k_{r58} \cdot x_{85} \quad (208)$$

7.101 Reaction v_{101}

This is a reversible reaction of one reactant forming two products.

Name v101

Reaction equation



Reactant

Table 205: Properties of each reactant.

Id	Name	SBO
x85	ERKi-P-P'ase3i	

Products

Table 206: Properties of each product.

Id	Name	SBO
x55	ERK	
x60	Phosphotase3	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

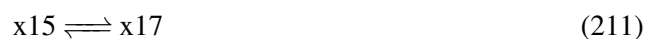
$$v_{101} = k59 \cdot x85 \quad (210)$$

7.102 Reaction v102

This is a reversible reaction of one reactant forming one product.

Name v102

Reaction equation



Reactant

Table 207: Properties of each reactant.

Id	Name	SBO
x15	EGF-EGFR* $\hat{2}$ -GAP	

Product

Table 208: Properties of each product.

Id	Name	SBO
x17	EGF-EGFRi* $\hat{2}$ -GAP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{102} = k_6 \cdot x_{15} - k_{r6} \cdot x_{17} \quad (212)$$

7.103 Reaction v103

This is a reversible reaction of one reactant forming one product.

Name v103

Reaction equation



Reactant

Table 209: Properties of each reactant.

Id	Name	SBO
x32	EGF-EGFR* $\hat{2}$ -GAP-Shc	

Product

Table 210: Properties of each product.

Id	Name	SBO
x63	EGF-EGFRi* $\hat{2}$ -GAP-Shc	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{103} = k_6 \cdot x_{32} - k_{r6} \cdot x_{63} \quad (214)$$

7.104 Reaction v104

This is a reversible reaction of one reactant forming one product.

Name v104

Reaction equation



Reactant

Table 211: Properties of each reactant.

Id	Name	SBO
x33	EGF-EGFR* $\hat{2}$ -GAP-Shc*	

Product

Table 212: Properties of each product.

Id	Name	SBO
x64	EGF-EGFRi* $\hat{2}$ -GAP-Shc*	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{104} = k_6 \cdot x_{33} - k_{r6} \cdot x_{64} \quad (216)$$

7.105 Reaction v105

This is a reversible reaction of one reactant forming one product.

Name v105

Reaction equation



Reactant

Table 213: Properties of each reactant.

Id	Name	SBO
x25	EGF-EGFR* $\hat{2}$ -GAP-Grb2-Sos	

Product

Table 214: Properties of each product.

Id	Name	SBO
x19	EGF-EGFRi* $\hat{2}$ -GAP-Grb2-Sos	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{105} = k_6 \cdot x_{25} - k_{r6} \cdot x_{19} \quad (218)$$

7.106 Reaction v_{106}

This is a reversible reaction of two reactants forming one product.

Name v_{106}

Reaction equation



Reactants

Table 215: Properties of each reactant.

Id	Name	SBO
x25	EGF-EGFR* $\hat{2}$ -GAP-Grb2-Sos	
x12	Prot	

Product

Table 216: Properties of each product.

Id	Name	SBO
x88	EGF-EGFR* $\hat{2}$ -GAP-Grb2-Sos-Prot	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{106} = k4 \cdot x25 \cdot x12 - kr4 \cdot x88 \quad (220)$$

7.107 Reaction v_{107}

This is a reversible reaction of one reactant forming two products.

Name v_{107}

Reaction equation



Reactant

Table 217: Properties of each reactant.

Id	Name	SBO
x88	EGF-EGFR* $\hat{2}$ -GAP-Grb2-Sos-Prot	

Products

Table 218: Properties of each product.

Id	Name	SBO
x9	Proti	
x19	EGF-EGFRi* $\hat{2}$ -GAP-Grb2-Sos	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{107} = k5 \cdot x88 \quad (222)$$

7.108 Reaction v108

This is a reversible reaction of one reactant forming one product.

Name v108

Reaction equation



Reactant

Table 219: Properties of each reactant.

Id	Name	SBO
x27	EGF-EGFR* $\hat{2}$ -GAP-Grb2-Sos-Ras-GDP	

Product

Table 220: Properties of each product.

Id	Name	SBO
x20	EGF-EGFRi* $\hat{2}$ -GAP-Grb2-Sos-Ras-GDP	

Kinetic Law

Derived unit (60 s)⁻¹ · item

$$v_{108} = k_6 \cdot x27 - k_{r6} \cdot x20 \quad (224)$$

7.109 Reaction v109

This is a reversible reaction of two reactants forming one product.

Name v109

Reaction equation



Reactants

Table 221: Properties of each reactant.

Id	Name	SBO
x27	EGF-EGFR* $\hat{2}$ -GAP-Grb2-Sos-Ras-GDP	
x12	Prot	

Product

Table 222: Properties of each product.

Id	Name	SBO
x89	EGF-EGFR* $\hat{2}$ -GAP-Grb2-Sos-Ras-GDP-Prot	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{109} = k_4 \cdot x_{27} \cdot x_{12} - k_{r4} \cdot x_{89} \quad (226)$$

7.110 Reaction v_{110}

This is a reversible reaction of one reactant forming two products.

Name v_{110}

Reaction equation



Reactant

Table 223: Properties of each reactant.

Id	Name	SBO
x89	EGF-EGFR* $\hat{2}$ -GAP-Grb2-Sos-Ras-GDP-Prot	

Products

Table 224: Properties of each product.

Id	Name	SBO
x9	Proti	

Id	Name	SBO
x20	EGF-EGFRi*2-GAP-Grb2-Sos-Ras-GDP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{110} = k5 \cdot x89 \quad (228)$$

7.111 Reaction v111

This is a reversible reaction of one reactant forming one product.

Name v111

Reaction equation



Reactant

Table 225: Properties of each reactant.

Id	Name	SBO
x29	EGF-EGFRi*2-GAP-Grb2-Sos-Ras-GTP	

Product

Table 226: Properties of each product.

Id	Name	SBO
x21	EGF-EGFRi*2-GAP-Grb2-Sos-Ras-GTP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{111} = k6 \cdot x29 - kr6 \cdot x21 \quad (230)$$

7.112 Reaction v112

This is a reversible reaction of two reactants forming one product.

Name v112

Reaction equation



Reactants

Table 227: Properties of each reactant.

Id	Name	SBO
x29	EGF-EGFR* $\hat{2}$ -GAP-Grb2-Sos-Ras-GTP	
x12	Prot	

Product

Table 228: Properties of each product.

Id	Name	SBO
x90	EGF-EGFR* $\hat{2}$ -GAP-Grb2-Sos-Ras-GTP-Prot	

Kinetic Law

Derived unit (60 s)⁻¹ · item

$$v_{112} = k_4 \cdot x_{29} \cdot x_{12} - k_{r4} \cdot x_{90} \tag{232}$$

7.113 Reaction v113

This is a reversible reaction of one reactant forming two products.

Name v113

Reaction equation



Reactant

Table 229: Properties of each reactant.

Id	Name	SBO
x90	EGF-EGFR* $\hat{2}$ -GAP-Grb2-Sos-Ras-GTP-Prot	

Products

Table 230: Properties of each product.

Id	Name	SBO
x9	Proti	
x21	EGF-EGFRi* $\hat{2}$ -GAP-Grb2-Sos-Ras-GTP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{113} = k5 \cdot x90 \quad (234)$$

7.114 Reaction v_{114}

This is a reversible reaction of one reactant forming one product.

Name v_{114}

Reaction equation



Reactant

Table 231: Properties of each reactant.

Id	Name	SBO
x34	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2	

Product

Table 232: Properties of each product.

Id	Name	SBO
x65	EGF-EGFRi* $\hat{2}$ -GAP-Shc*-Grb2	

Id	Name	SBO
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Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{114} = k_6 \cdot x_{34} - k_{r6} \cdot x_{65} \quad (236)$$

7.115 Reaction v_{115}

This is a reversible reaction of two reactants forming one product.

Name v_{115}

Reaction equation



Reactants

Table 233: Properties of each reactant.

Id	Name	SBO
x_{34}	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2	
x_{12}	Prot	

Product

Table 234: Properties of each product.

Id	Name	SBO
x_{91}	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Prot	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{115} = k_4 \cdot x_{34} \cdot x_{12} - k_{r4} \cdot x_{91} \quad (238)$$

7.116 Reaction v_{116}

This is a reversible reaction of one reactant forming two products.

Name v116

Reaction equation



Reactant

Table 235: Properties of each reactant.

Id	Name	SBO
x91	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Prot	

Products

Table 236: Properties of each product.

Id	Name	SBO
x9	Proti	
x65	EGF-EGFRi* $\hat{2}$ -GAP-Shc*-Grb2	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{116} = k5 \cdot x91 \quad (240)$$

7.117 Reaction v117

This is a reversible reaction of one reactant forming one product.

Name v117

Reaction equation



Reactant

Table 237: Properties of each reactant.

Id	Name	SBO
x35	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos	

Product

Table 238: Properties of each product.

Id	Name	SBO
x66	EGF-EGFRi* $\hat{2}$ -GAP-Shc*-Grb2-Sos	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{117} = k_6 \cdot x_{35} - k_{r6} \cdot x_{66} \quad (242)$$

7.118 Reaction v118

This is a reversible reaction of two reactants forming one product.

Name v118

Reaction equation



Reactants

Table 239: Properties of each reactant.

Id	Name	SBO
x35	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos	
x12	Prot	

Product

Table 240: Properties of each product.

Id	Name	SBO
x92	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Prot	

Id	Name	SBO
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Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{118} = k_4 \cdot x_{35} \cdot x_{12} - k_{r4} \cdot x_{92} \quad (244)$$

7.119 Reaction v_{119}

This is a reversible reaction of one reactant forming two products.

Name v_{119}

Reaction equation



Reactant

Table 241: Properties of each reactant.

Id	Name	SBO
x_{92}	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Prot	

Products

Table 242: Properties of each product.

Id	Name	SBO
x_9	Proti	
x_{66}	EGF-EGFRi* $\hat{2}$ -GAP-Shc*-Grb2-Sos	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

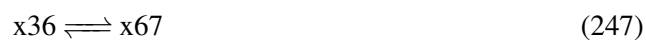
$$v_{119} = k_5 \cdot x_{92} \quad (246)$$

7.120 Reaction v_{120}

This is a reversible reaction of one reactant forming one product.

Name v120

Reaction equation



Reactant

Table 243: Properties of each reactant.

Id	Name	SBO
x36	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GDP	

Product

Table 244: Properties of each product.

Id	Name	SBO
x67	EGF-EGFRi* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GDP	

Kinetic Law

Derived unit (60 s)⁻¹ · item

$$v_{120} = k_6 \cdot x36 - kr_6 \cdot x67 \quad (248)$$

7.121 Reaction v121

This is a reversible reaction of two reactants forming one product.

Name v121

Reaction equation



Reactants

Table 245: Properties of each reactant.

Id	Name	SBO
x36	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GDP	
x12	Prot	

Product

Table 246: Properties of each product.

Id	Name	SBO
x93	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GDP-Prot	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{121} = k_4 \cdot x_{36} \cdot x_{12} - k_{r4} \cdot x_{93} \quad (250)$$

7.122 Reaction v_{122}

This is a reversible reaction of one reactant forming two products.

Name v_{122}

Reaction equation



Reactant

Table 247: Properties of each reactant.

Id	Name	SBO
x93	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GDP-Prot	

Products

Table 248: Properties of each product.

Id	Name	SBO
x9	Proti	
x67	EGF-EGFRi* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GDP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{122} = k_5 \cdot x_{93} \quad (252)$$

7.123 Reaction v_{123}

This is a reversible reaction of one reactant forming one product.

Name v_{123}

Reaction equation



Reactant

Table 249: Properties of each reactant.

Id	Name	SBO
x37	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GTP	

Product

Table 250: Properties of each product.

Id	Name	SBO
x68	EGF-EGFRi* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GTP	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{123} = k_6 \cdot x_{37} - k_{r6} \cdot x_{68} \quad (254)$$

7.124 Reaction v_{124}

This is a reversible reaction of two reactants forming one product.

Name v_{124}

Reaction equation



Reactants

Table 251: Properties of each reactant.

Id	Name	SBO
x37	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GTP	
x12	Prot	

Product

Table 252: Properties of each product.

Id	Name	SBO
x94	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GTP-Prot	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{124} = k_4 \cdot x_{37} \cdot x_{12} - k_{r4} \cdot x_{94} \quad (256)$$

7.125 Reaction v_{125}

This is a reversible reaction of one reactant forming two products.

Name v_{125}

Reaction equation



Reactant

Table 253: Properties of each reactant.

Id	Name	SBO
x94	EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GTP-Prot	

Products

Table 254: Properties of each product.

Id	Name	SBO
x68	EGF-EGFRi* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GTP	

Id	Name	SBO
x9	Proti	

Kinetic Law

Derived unit $(60 \text{ s})^{-1} \cdot \text{item}$

$$v_{125} = k5 \cdot x_{94} \quad (258)$$

8 Derived Rate Equations

When interpreted as an ordinary differential equation framework, this model implies the following set of equations for the rates of change of each species.

8.1 Species x1

Name EGF

Notes 4962 molecules correspond roughly to 50 ng/ml, concentration used throughout the article (MW~6045 Da, vol=1e-12l)

Similarly, 496.2 molecules correspond roughly to 5 ng/ml, 49.62 molecules correspond roughly to .5 ng/ml, 12.405 molecules correspond roughly to 0.125 ng/ml, 6.2025 molecules correspond roughly to 0.0625 ng/ml

Initial amount 4962 item

This species takes part in one reaction (as a reactant in v1), which does not influence its rate of change because this species is on the boundary of the reaction system:

$$\frac{d}{dt}x_1 = 0 \quad (259)$$

8.2 Species x2

Name EGFR

Initial amount 50000 item

This species takes part in three reactions (as a reactant in v1, v6 and as a product in v13).

$$\frac{d}{dt}x_2 = v_{13} - v_1 - v_6 \quad (260)$$

8.3 Species x_3

Name EGF-EGFR

Initial amount 0 item

This species takes part in two reactions (as a reactant in v_2 and as a product in v_1).

$$\frac{d}{dt}x_3 = v_1 - 2v_2 \quad (261)$$

8.4 Species x_4

Name EGF-EGFR $\hat{2}$

Initial amount 0 item

This species takes part in two reactions (as a reactant in v_3 and as a product in v_2).

$$\frac{d}{dt}x_4 = v_2 - v_3 \quad (262)$$

8.5 Species x_5

Name EGF-EGFR* $\hat{2}$

Initial amount 0 item

This species takes part in three reactions (as a reactant in v_7 , v_8 and as a product in v_3).

$$\frac{d}{dt}x_5 = v_3 - v_7 - v_8 \quad (263)$$

8.6 Species x_6

Name EGFR i

Initial amount 0 item

This species takes part in three reactions (as a reactant in v_{10} , v_{60} and as a product in v_6).

$$\frac{d}{dt}x_6 = v_6 - v_{10} - v_{60} \quad (264)$$

8.7 Species x_7

Name EGF-EGFR* $\hat{2}$ -GAP-Grb2-Prot

Initial amount 0 item

This species takes part in two reactions (as a reactant in v_5 and as a product in v_4).

$$\frac{d}{dt}x_7 = v_4 - v_5 \quad (265)$$

8.8 Species x_8

Name EGF-EGFRi*2

Initial amount 0 item

This species takes part in four reactions (as a reactant in [v14](#), [v62](#) and as a product in [v7](#), [v12](#)).

$$\frac{d}{dt}x_8 = v_7 + v_{12} - v_{14} - v_{62} \quad (266)$$

8.9 Species x_9

Name Proti

Initial amount 0 item

This species takes part in nine reactions (as a reactant in [v15](#) and as a product in [v5](#), [v107](#), [v110](#), [v113](#), [v116](#), [v119](#), [v122](#), [v125](#)).

$$\frac{d}{dt}x_9 = v_5 + v_{107} + v_{110} + v_{113} + v_{116} + v_{119} + v_{122} + v_{125} - v_{15} \quad (267)$$

8.10 Species x_{10}

Name EGF-EGFRi

Initial amount 0 item

This species takes part in two reactions (as a reactant in [v11](#) and as a product in [v10](#)).

$$\frac{d}{dt}x_{10} = v_{10} - 2v_{11} \quad (268)$$

8.11 Species x_{11}

Name EGF-EGFRi2

Initial amount 0 item

This species takes part in two reactions (as a reactant in [v12](#) and as a product in [v11](#)).

$$\frac{d}{dt}x_{11} = v_{11} - v_{12} \quad (269)$$

8.12 Species x_{12}

Name Prot

Initial amount 81000 item

This species takes part in nine reactions (as a reactant in [v4](#), [v106](#), [v109](#), [v112](#), [v115](#), [v118](#), [v121](#), [v124](#) and as a product in [v15](#)).

$$\frac{d}{dt}x_{12} = v_{15} - v_4 - v_{106} - v_{109} - v_{112} - v_{115} - v_{118} - v_{121} - v_{124} \quad (270)$$

8.13 Species x_{13}

Name EGFideg

Initial amount 0 item

This species takes part in one reaction (as a product in [v61](#)).

$$\frac{d}{dt}x_{13} = v_{61} \quad (271)$$

8.14 Species x_{14}

Name GAP

Initial amount 12000 item

This species takes part in two reactions (as a reactant in [v8](#), [v14](#)).

$$\frac{d}{dt}x_{14} = -v_8 - v_{14} \quad (272)$$

8.15 Species x_{15}

Name EGF-EGFR* $\hat{2}$ -GAP

Initial amount 0 item

This species takes part in eight reactions (as a reactant in [v16](#), [v22](#), [v102](#) and as a product in [v8](#), [v32](#), [v34](#), [v37](#), [v39](#)).

$$\frac{d}{dt}x_{15} = v_8 + v_{32} + v_{34} + v_{37} + v_{39} - v_{16} - v_{22} - v_{102} \quad (273)$$

8.16 Species x_{16}

Name EGF_i

Initial amount 0 item

This species takes part in two reactions (as a reactant in [v10](#), [v61](#)).

$$\frac{d}{dt}x_{16} = -v_{10} - v_{61} \quad (274)$$

8.17 Species x_{17}

Name EGF-EGFR_i*²-GAP

Initial amount 0 item

This species takes part in eight reactions (as a reactant in [v63](#), [v69](#) and as a product in [v14](#), [v79](#), [v80](#), [v81](#), [v82](#), [v102](#)).

$$\frac{d}{dt}x_{17} = v_{14} + v_{79} + v_{80} + v_{81} + v_{82} + v_{102} - v_{63} - v_{69} \quad (275)$$

8.18 Species x_{18}

Name EGF-EGFR_i*²-GAP-Grb2

Initial amount 0 item

This species takes part in four reactions (as a reactant in [v64](#) and as a product in [v5](#), [v9](#), [v63](#)).

$$\frac{d}{dt}x_{18} = v_5 + v_9 + v_{63} - v_{64} \quad (276)$$

8.19 Species x_{19}

Name EGF-EGFR_i*²-GAP-Grb2-Sos

Initial amount 0 item

This species takes part in eight reactions (as a reactant in [v65](#), [v67](#), [v80](#) and as a product in [v64](#), [v66](#), [v68](#), [v105](#), [v107](#)).

$$\frac{d}{dt}x_{19} = v_{64} + v_{66} + v_{68} + v_{105} + v_{107} - v_{65} - v_{67} - v_{80} \quad (277)$$

8.20 Species x_{20}

Name EGF-EGFRi* $\hat{2}$ -GAP-Grb2-Sos-Ras-GDP

Initial amount 0 item

This species takes part in four reactions (as a reactant in v_{66} and as a product in v_{65} , v_{108} , v_{110}).

$$\frac{d}{dt}x_{20} = v_{65} + v_{108} + v_{110} - v_{66} \quad (278)$$

8.21 Species x_{21}

Name EGF-EGFRi* $\hat{2}$ -GAP-Grb2-Sos-Ras-GTP

Initial amount 0 item

This species takes part in four reactions (as a reactant in v_{68} and as a product in v_{67} , v_{111} , v_{113}).

$$\frac{d}{dt}x_{21} = v_{67} + v_{111} + v_{113} - v_{68} \quad (279)$$

8.22 Species x_{22}

Name Grb2

Initial amount 11000 item

This species takes part in six reactions (as a reactant in v_{16} , v_{24} , v_{38} , v_{63} , v_{71} and as a product in v_{35}).

$$\frac{d}{dt}x_{22} = v_{35} - v_{16} - v_{24} - v_{38} - v_{63} - v_{71} \quad (280)$$

8.23 Species x_{23}

Name EGF-EGFR* $\hat{2}$ -GAP-Grb2

Initial amount 0 item

This species takes part in four reactions (as a reactant in v_4 , v_9 , v_{17} and as a product in v_{16}).

$$\frac{d}{dt}x_{23} = v_{16} - v_4 - v_9 - v_{17} \quad (281)$$

8.24 Species x_{24}

Name Sos

Initial amount 26300 item

This species takes part in six reactions (as a reactant in [v17](#), [v25](#), [v40](#), [v64](#), [v72](#) and as a product in [v35](#)).

$$\frac{d}{dt}x_{24} = v_{35} - v_{17} - v_{25} - v_{40} - v_{64} - v_{72} \quad (282)$$

8.25 Species x_{25}

Name EGF-EGFR* $\hat{2}$ -GAP-Grb2-Sos

Initial amount 0 item

This species takes part in eight reactions (as a reactant in [v18](#), [v20](#), [v34](#), [v105](#), [v106](#) and as a product in [v17](#), [v19](#), [v21](#)).

$$\frac{d}{dt}x_{25} = v_{17} + v_{19} + v_{21} - v_{18} - v_{20} - v_{34} - v_{105} - v_{106} \quad (283)$$

8.26 Species x_{26}

Name Ras-GDP

Initial amount 72000 item

This species takes part in eight reactions (as a reactant in [v18](#), [v26](#), [v65](#), [v73](#) and as a product in [v21](#), [v31](#), [v68](#), [v78](#)).

$$\frac{d}{dt}x_{26} = v_{21} + v_{31} + v_{68} + v_{78} - v_{18} - v_{26} - v_{65} - v_{73} \quad (284)$$

8.27 Species x_{27}

Name EGF-EGFR* $\hat{2}$ -GAP-Grb2-Sos-Ras-GDP

Initial amount 0 item

This species takes part in four reactions (as a reactant in [v19](#), [v108](#), [v109](#) and as a product in [v18](#)).

$$\frac{d}{dt}x_{27} = v_{18} - v_{19} - v_{108} - v_{109} \quad (285)$$

8.28 Species x28

Name Ras-GTP

Initial amount 0 item

This species takes part in three reactions (as a reactant in v28 and as a product in v19, v27).

$$\frac{d}{dt}x_{28} = v_{19} + v_{27} - v_{28} \quad (286)$$

8.29 Species x29

Name EGF-EGFR* $\hat{2}$ -GAP-Grb2-Sos-Ras-GTP

Initial amount 0 item

This species takes part in four reactions (as a reactant in v21, v111, v112 and as a product in v20).

$$\frac{d}{dt}x_{29} = v_{20} - v_{21} - v_{111} - v_{112} \quad (287)$$

8.30 Species x30

Name Grb2-Sos

Initial amount 40000 item

This species takes part in six reactions (as a reactant in v35, v41, v83 and as a product in v33, v34, v80).

$$\frac{d}{dt}x_{30} = v_{33} + v_{34} + v_{80} - v_{35} - v_{41} - v_{83} \quad (288)$$

8.31 Species x31

Name Shc

Initial amount 101000 item

This species takes part in three reactions (as a reactant in v22, v69 and as a product in v36).

$$\frac{d}{dt}x_{31} = v_{36} - v_{22} - v_{69} \quad (289)$$

8.32 Species x32

Name EGF-EGFR* $\hat{2}$ -GAP-Shc

Initial amount 0 item

This species takes part in three reactions (as a reactant in v23, v103 and as a product in v22).

$$\frac{d}{dt}x_{32} = v_{22} - v_{23} - v_{103} \quad (290)$$

8.33 Species x33

Name EGF-EGFR* $\hat{2}$ -GAP-Shc*

Initial amount 0 item

This species takes part in five reactions (as a reactant in v24, v37, v41, v104 and as a product in v23).

$$\frac{d}{dt}x_{33} = v_{23} - v_{24} - v_{37} - v_{41} - v_{104} \quad (291)$$

8.34 Species x34

Name EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2

Initial amount 0 item

This species takes part in five reactions (as a reactant in v25, v39, v114, v115 and as a product in v24).

$$\frac{d}{dt}x_{34} = v_{24} - v_{25} - v_{39} - v_{114} - v_{115} \quad (292)$$

8.35 Species x35

Name EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos

Initial amount 0 item

This species takes part in nine reactions (as a reactant in v26, v30, v32, v117, v118 and as a product in v25, v27, v31, v41).

$$\frac{d}{dt}x_{35} = v_{25} + v_{27} + v_{31} + v_{41} - v_{26} - v_{30} - v_{32} - v_{117} - v_{118} \quad (293)$$

8.36 Species x36

Name EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GDP

Initial amount 0 item

This species takes part in four reactions (as a reactant in v27, v120, v121 and as a product in v26).

$$\frac{d}{dt}x_{36} = v_{26} - v_{27} - v_{120} - v_{121} \quad (294)$$

8.37 Species x37

Name EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GTP

Initial amount 0 item

This species takes part in four reactions (as a reactant in v31, v123, v124 and as a product in v30).

$$\frac{d}{dt}x_{37} = v_{30} - v_{31} - v_{123} - v_{124} \quad (295)$$

8.38 Species x38

Name Shc*-Grb2-Sos

Initial amount 0 item

This species takes part in four reactions (as a reactant in v33 and as a product in v32, v40, v79).

$$\frac{d}{dt}x_{38} = v_{32} + v_{40} + v_{79} - v_{33} \quad (296)$$

8.39 Species x39

Name Shc*-Grb2

Initial amount 0 item

This species takes part in four reactions (as a reactant in v40 and as a product in v38, v39, v82).

$$\frac{d}{dt}x_{39} = v_{38} + v_{39} + v_{82} - v_{40} \quad (297)$$

8.40 Species x40

Name Shc*

Initial amount 0 item

This species takes part in five reactions (as a reactant in v36, v38 and as a product in v33, v37, v81).

$$\frac{d}{dt}x_{40} = v_{33} + v_{37} + v_{81} - v_{36} - v_{38} \quad (298)$$

8.41 Species x41

Name Raf

Initial amount 40000 item

This species takes part in four reactions (as a reactant in v28, v75 and as a product in v43, v85).

$$\frac{d}{dt}x_{41} = v_{43} + v_{85} - v_{28} - v_{75} \quad (299)$$

8.42 Species x42

Name Raf-Ras-GTP

Initial amount 0 item

This species takes part in two reactions (as a reactant in v29 and as a product in v28).

$$\frac{d}{dt}x_{42} = v_{28} - v_{29} \quad (300)$$

8.43 Species x43

Name Ras-GTP*

Initial amount 0 item

This species takes part in three reactions (as a reactant in v20, v30 and as a product in v29).

$$\frac{d}{dt}x_{43} = v_{29} - v_{20} - v_{30} \quad (301)$$

8.44 Species x44

Name Phosphatase1

Initial amount 40000 item

This species takes part in four reactions (as a reactant in v42, v84 and as a product in v43, v85).

$$\frac{d}{dt}x_{44} = v_{43} + v_{85} - v_{42} - v_{84} \quad (302)$$

8.45 Species x45

Name Raf*

Initial amount 0 item

This species takes part in six reactions (as a reactant in v42, v44, v46 and as a product in v29, v45, v47).

$$\frac{d}{dt}x_{45} = v_{29} + v_{45} + v_{47} - v_{42} - v_{44} - v_{46} \quad (303)$$

8.46 Species x46

Name Raf*-P'ase

Initial amount 0 item

This species takes part in two reactions (as a reactant in v43 and as a product in v42).

$$\frac{d}{dt}x_{46} = v_{42} - v_{43} \quad (304)$$

8.47 Species x47

Name MEK

Initial amount $2.2 \cdot 10^7$ item

This species takes part in four reactions (as a reactant in v44, v86 and as a product in v51, v93).

$$\frac{d}{dt}x_{47} = v_{51} + v_{93} - v_{44} - v_{86} \quad (305)$$

8.48 Species x48

Name MEK-Raf*

Initial amount 0 item

This species takes part in two reactions (as a reactant in v45 and as a product in v44).

$$\frac{d}{dt}x_{48} = v_{44} - v_{45} \quad (306)$$

8.49 Species x49

Name MEK-P

Initial amount 0 item

This species takes part in four reactions (as a reactant in v46, v50 and as a product in v45, v49).

$$\frac{d}{dt}x_{49} = v_{45} + v_{49} - v_{46} - v_{50} \quad (307)$$

8.50 Species x50

Name MEK-P-Raf*

Initial amount 0 item

This species takes part in two reactions (as a reactant in v47 and as a product in v46).

$$\frac{d}{dt}x_{50} = v_{46} - v_{47} \quad (308)$$

8.51 Species x51

Name MEK-PP

Initial amount 0 item

This species takes part in six reactions (as a reactant in v48, v52, v54 and as a product in v47, v53, v55).

$$\frac{d}{dt}x_{51} = v_{47} + v_{53} + v_{55} - v_{48} - v_{52} - v_{54} \quad (309)$$

8.52 Species x52

Name MEK-PP-P'ase2

Initial amount 0 item

This species takes part in two reactions (as a reactant in v49 and as a product in v48).

$$\frac{d}{dt}x_{52} = v_{48} - v_{49} \quad (310)$$

8.53 Species x53

Name Phosphatase2

Initial amount 40000 item

This species takes part in eight reactions (as a reactant in v48, v50, v90, v92 and as a product in v49, v51, v91, v93).

$$\frac{d}{dt}x_{53} = v_{49} + v_{51} + v_{91} + v_{93} - v_{48} - v_{50} - v_{90} - v_{92} \quad (311)$$

8.54 Species x54

Name MEK-P-P'ase2

Initial amount 0 item

This species takes part in two reactions (as a reactant in v51 and as a product in v50).

$$\frac{d}{dt}x54 = v50 - v51 \quad (312)$$

8.55 Species x55

Name ERK

Initial amount $2.1 \cdot 10^7$ item

This species takes part in four reactions (as a reactant in v52, v94 and as a product in v59, v101).

$$\frac{d}{dt}x55 = v59 + v101 - v52 - v94 \quad (313)$$

8.56 Species x56

Name ERK-MEK-PP

Initial amount 0 item

This species takes part in two reactions (as a reactant in v53 and as a product in v52).

$$\frac{d}{dt}x56 = v52 - v53 \quad (314)$$

8.57 Species x57

Name ERK-P

Initial amount 0 item

This species takes part in four reactions (as a reactant in v54, v58 and as a product in v53, v57).

$$\frac{d}{dt}x57 = v53 + v57 - v54 - v58 \quad (315)$$

8.58 Species x58

Name ERK-P-MEK-PP

Initial amount 0 item

This species takes part in two reactions (as a reactant in v55 and as a product in v54).

$$\frac{d}{dt}x58 = v54 - v55 \quad (316)$$

8.59 Species x59

Name ERK-PP

Initial amount 0 item

This species takes part in two reactions (as a reactant in v56 and as a product in v55).

$$\frac{d}{dt}x59 = v55 - v56 \quad (317)$$

8.60 Species x60

Name Phosphatase3

Initial amount 10^7 item

This species takes part in eight reactions (as a reactant in v56, v58, v98, v100 and as a product in v57, v59, v99, v101).

$$\frac{d}{dt}x60 = v57 + v59 + v99 + v101 - v56 - v58 - v98 - v100 \quad (318)$$

8.61 Species x61

Name ERK-PP-P'ase3

Initial amount 0 item

This species takes part in two reactions (as a reactant in v57 and as a product in v56).

$$\frac{d}{dt}x61 = v56 - v57 \quad (319)$$

8.62 Species x62

Name ERK-P-P'ase3

Initial amount 0 item

This species takes part in two reactions (as a reactant in v59 and as a product in v58).

$$\frac{d}{dt}x62 = v58 - v59 \quad (320)$$

8.63 Species x63

Name EGF-EGFRi*2-GAP-Shc

Initial amount 0 item

This species takes part in three reactions (as a reactant in v70 and as a product in v69, v103).

$$\frac{d}{dt}x63 = v69 + v103 - v70 \quad (321)$$

8.64 Species x_{64}

Name EGF-EGFRi* $\hat{2}$ -GAP-Shc*

Initial amount 0 item

This species takes part in five reactions (as a reactant in [v71](#), [v81](#), [v83](#) and as a product in [v70](#), [v104](#)).

$$\frac{d}{dt}x_{64} = v_{70} + v_{104} - v_{71} - v_{81} - v_{83} \quad (322)$$

8.65 Species x_{65}

Name EGF-EGFRi* $\hat{2}$ -GAP-Shc*-Grb2

Initial amount 0 item

This species takes part in five reactions (as a reactant in [v72](#), [v82](#) and as a product in [v71](#), [v114](#), [v116](#)).

$$\frac{d}{dt}x_{65} = v_{71} + v_{114} + v_{116} - v_{72} - v_{82} \quad (323)$$

8.66 Species x_{66}

Name EGF-EGFRi* $\hat{2}$ -GAP-Shc*-Grb2-Sos

Initial amount 0 item

This species takes part in nine reactions (as a reactant in [v73](#), [v77](#), [v79](#) and as a product in [v72](#), [v74](#), [v78](#), [v83](#), [v117](#), [v119](#)).

$$\frac{d}{dt}x_{66} = v_{72} + v_{74} + v_{78} + v_{83} + v_{117} + v_{119} - v_{73} - v_{77} - v_{79} \quad (324)$$

8.67 Species x_{67}

Name EGF-EGFRi* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GDP

Initial amount 0 item

This species takes part in four reactions (as a reactant in [v74](#) and as a product in [v73](#), [v120](#), [v122](#)).

$$\frac{d}{dt}x_{67} = v_{73} + v_{120} + v_{122} - v_{74} \quad (325)$$

8.68 Species x68

Name EGF-EGFRi*2-GAP-Shc*-Grb2-Sos-Ras-GTP

Initial amount 0 item

This species takes part in four reactions (as a reactant in v78 and as a product in v77, v123, v125).

$$\frac{d}{dt}x68 = v77 + v123 + v125 - v78 \quad (326)$$

8.69 Species x69

Name Rasi-GTP

Initial amount 0 item

This species takes part in three reactions (as a reactant in v75 and as a product in v66, v74).

$$\frac{d}{dt}x69 = v66 + v74 - v75 \quad (327)$$

8.70 Species x70

Name Rafi-Rasi-GTP

Initial amount 0 item

This species takes part in two reactions (as a reactant in v76 and as a product in v75).

$$\frac{d}{dt}x70 = v75 - v76 \quad (328)$$

8.71 Species x71

Name Rasi-GTP*

Initial amount 0 item

This species takes part in three reactions (as a reactant in v67, v77 and as a product in v76).

$$\frac{d}{dt}x71 = v76 - v67 - v77 \quad (329)$$

8.72 Species x72

Name Rafi*

Initial amount 0 item

This species takes part in six reactions (as a reactant in v84, v86, v88 and as a product in v76, v87, v89).

$$\frac{d}{dt}x72 = v76 + v87 + v89 - v84 - v86 - v88 \quad (330)$$

8.73 Species x73

Name Rafi*-P'ase

Initial amount 0 item

This species takes part in two reactions (as a reactant in v85 and as a product in v84).

$$\frac{d}{dt}x73 = v84 - v85 \quad (331)$$

8.74 Species x74

Name MEKi-Rafi*

Initial amount 0 item

This species takes part in two reactions (as a reactant in v87 and as a product in v86).

$$\frac{d}{dt}x74 = v86 - v87 \quad (332)$$

8.75 Species x75

Name MEKi-P

Initial amount 0 item

This species takes part in four reactions (as a reactant in v88, v92 and as a product in v87, v91).

$$\frac{d}{dt}x75 = v87 + v91 - v88 - v92 \quad (333)$$

8.76 Species x76

Name MEKi-P-Rafi*

Initial amount 0 item

This species takes part in two reactions (as a reactant in v89 and as a product in v88).

$$\frac{d}{dt}x76 = v88 - v89 \quad (334)$$

8.77 Species x_{77}

Name MEKi-PP

Initial amount 0 item

This species takes part in six reactions (as a reactant in v_{90} , v_{94} , v_{96} and as a product in v_{89} , v_{95} , v_{97}).

$$\frac{d}{dt}x_{77} = v_{89} + v_{95} + v_{97} - v_{90} - v_{94} - v_{96} \quad (335)$$

8.78 Species x_{78}

Name MEKi-PP-P'ase2i

Initial amount 0 item

This species takes part in two reactions (as a reactant in v_{91} and as a product in v_{90}).

$$\frac{d}{dt}x_{78} = v_{90} - v_{91} \quad (336)$$

8.79 Species x_{79}

Name MEKi-P-P'ase2i

Initial amount 0 item

This species takes part in two reactions (as a reactant in v_{93} and as a product in v_{92}).

$$\frac{d}{dt}x_{79} = v_{92} - v_{93} \quad (337)$$

8.80 Species x_{80}

Name ERKi-MEKi-PP

Initial amount 0 item

This species takes part in two reactions (as a reactant in v_{95} and as a product in v_{94}).

$$\frac{d}{dt}x_{80} = v_{94} - v_{95} \quad (338)$$

8.81 Species x81

Name ERKi-P

Initial amount 0 item

This species takes part in four reactions (as a reactant in v96, v100 and as a product in v95, v99).

$$\frac{d}{dt}x81 = v95 + v99 - v96 - v100 \quad (339)$$

8.82 Species x82

Name ERKi-P-MEKi-PP

Initial amount 0 item

This species takes part in two reactions (as a reactant in v97 and as a product in v96).

$$\frac{d}{dt}x82 = v96 - v97 \quad (340)$$

8.83 Species x83

Name ERKi-PP

Initial amount 0 item

This species takes part in two reactions (as a reactant in v98 and as a product in v97).

$$\frac{d}{dt}x83 = v97 - v98 \quad (341)$$

8.84 Species x84

Name ERKi-PP-P'ase3i

Initial amount 0 item

This species takes part in two reactions (as a reactant in v99 and as a product in v98).

$$\frac{d}{dt}x84 = v98 - v99 \quad (342)$$

8.85 Species x85

Name ERKi-P-P'ase3i

Initial amount 0 item

This species takes part in two reactions (as a reactant in v101 and as a product in v100).

$$\frac{d}{dt}x85 = v100 - v101 \quad (343)$$

8.86 Species x86

Name EGFRideg

Initial amount 0 item

This species takes part in one reaction (as a product in v60).

$$\frac{d}{dt}x86 = v60 \quad (344)$$

8.87 Species x87

Name EGF-EGFRi*2deg

Initial amount 0 item

This species takes part in one reaction (as a product in v62).

$$\frac{d}{dt}x87 = v62 \quad (345)$$

8.88 Species x88

Name EGF-EGFR*2-GAP-Grb2-Sos-Prot

Initial amount 0 item

This species takes part in two reactions (as a reactant in v107 and as a product in v106).

$$\frac{d}{dt}x88 = v106 - v107 \quad (346)$$

8.89 Species x89

Name EGF-EGFR*2-GAP-Grb2-Sos-Ras-GDP-Prot

Initial amount 0 item

This species takes part in two reactions (as a reactant in v110 and as a product in v109).

$$\frac{d}{dt}x89 = v109 - v110 \quad (347)$$

8.90 Species x90

Name EGF-EGFR*2-GAP-Grb2-Sos-Ras-GTP-Prot

Initial amount 0 item

This species takes part in two reactions (as a reactant in v113 and as a product in v112).

$$\frac{d}{dt}x90 = v112 - v113 \quad (348)$$

8.91 Species `x91`

Name EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Prot

Initial amount 0 item

This species takes part in two reactions (as a reactant in [v116](#) and as a product in [v115](#)).

$$\frac{d}{dt}x91 = v_{115} - v_{116} \quad (349)$$

8.92 Species `x92`

Name EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Prot

Initial amount 0 item

This species takes part in two reactions (as a reactant in [v119](#) and as a product in [v118](#)).

$$\frac{d}{dt}x92 = v_{118} - v_{119} \quad (350)$$

8.93 Species `x93`

Name EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GDP-Prot

Initial amount 0 item

This species takes part in two reactions (as a reactant in [v122](#) and as a product in [v121](#)).

$$\frac{d}{dt}x93 = v_{121} - v_{122} \quad (351)$$

8.94 Species `x94`

Name EGF-EGFR* $\hat{2}$ -GAP-Shc*-Grb2-Sos-Ras-GTP-Prot

Initial amount 0 item

This species takes part in two reactions (as a reactant in [v125](#) and as a product in [v124](#)).

$$\frac{d}{dt}x94 = v_{124} - v_{125} \quad (352)$$

8.95 Species `Raf_act`

Name `t_Raf*`

Initial amount 0 item

Involved in rule [Raf_act](#)

One rule determines the species' quantity.

8.96 Species [Ras_GTP](#)

Name t_Ras_GTP

Initial amount 0 item

Involved in rule [Ras_GTP](#)

One rule determines the species' quantity.

8.97 Species [MEK_PP](#)

Name t_MEK_PP

Initial amount 0 item

Involved in rule [MEK_PP](#)

One rule determines the species' quantity.

8.98 Species [ERK_PP](#)

Name t_ERK_PP

Initial amount 0 item

Involved in rule [ERK_PP](#)

One rule determines the species' quantity.

8.99 Species [SHC_P_t](#)

Name t_SHC_P_t

Initial amount 0 item

Involved in rule [SHC_P_t](#)

One rule determines the species' quantity.

8.100 Species [EGF_EGFR_act](#)

Name t_EGF_EGFR*

Initial amount 0 item

Involved in rule [EGF_EGFR_act](#)

One rule determines the species' quantity.

SBML²AT_EX was developed by Andreas Dräger^a, Hannes Planatscher^a, Dieudonné M Wouamba^a, Adrian Schröder^a, Michael Hucka^b, Lukas Endler^c, Martin Golebiewski^d and Andreas Zell^a. Please see <http://www.ra.cs.uni-tuebingen.de/software/SBML2LaTeX> for more information.

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