

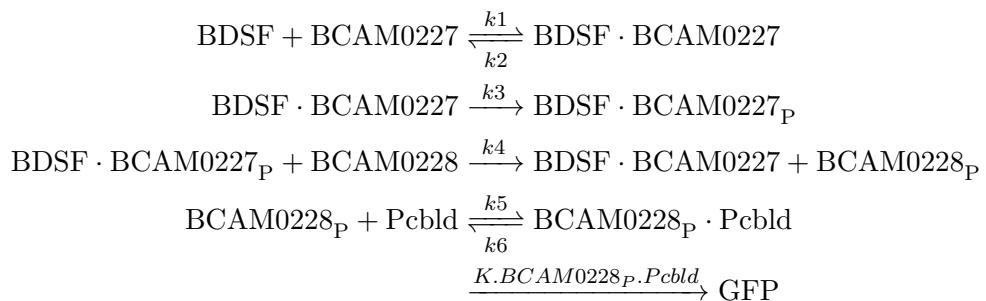
Appendix 2 - BDSF

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1 Introduction

In order to help analyse, construct and optimise the biochemical pathways in the Lung Ranger, we used a variety of mathematical tools to create algorithms and simulations. The derivation of the BDSF model can be found in this appendix.

2 Chemical Reactions



3 Differential Equations

BDSF, S , binds to the cell receptor BCAM0227, R , at rate k_1 to form a complex, C . The complex degrades as S and R dissociate at rate k_2 and autophosphorylates at rate k_3 to form BCAM0227[P], C_P . There is then a phosphorelay between BCAM0227[P] and BCAM0228, B , to produce BCAM0228[P], B_P .

$$\begin{aligned} \frac{dC}{dt} &= k_1 SR - k_2 C - k_3 C + k_4 R_P B \\ \frac{dR_P}{dt} &= k_3 C - k_4 R_P B \end{aligned}$$

BCAM0228[P] binds to the promoter to form the activated-promoter complex, A , at rate k_5 .

The complex degrades as B_P and P dissociate at rate k_6 .

$$\begin{aligned}\frac{dB_P}{dt} &= k_4 R_P B - k_5 B_P P + k_6 A \\ \frac{dA}{dt} &= k_5 B_P P - k_6 A\end{aligned}$$

Finally, the expression of GFP, G , is proportional to the concentration of A .

$$\frac{dG}{dt} = KA$$

4 Default Parameters

We used the following parameters:

Default Parameters	Value	Reference
BDSF and BCAM0227 association rate (k_1) [$M^{-1}s^{-1}$]	0.005	Set here
BDSF and BCAM0227 dissociation rate (k_2) [s^{-1}]	$8.3 * 10^{-4}$	Set here
Autophosphorylation rate (k_3) [s^{-1}]	$1.6 * 10^{-4}$	Set here
Phosphorelay rate (k_4) [s^{-1}]	$1.6 * 10^{-4}$	Set here
BCAM0228[P] and <i>PcblD</i> association rate (k_5) [$M^{-1}s^{-1}$]	0.0033	Set here
BCAM0228[P] and <i>PcblD</i> dissociation rate (k_6) [s^{-1}]	$3.3 * 10^{-4}$	Set here
Maximal rate of GFP expression per promoter (K) [s^{-1}]	0.016	Set here
Concentration of promoters in the cell (P) [μM]	0.083	[1, 2]
Concentration of BCAM0227 in the cell (R) [μM]	4.98	[1, 2]
Concentration of BCAM0228 in the cell (B) [μM]	4.98	[1, 2]

References

- [1] Leake, M.C. et al. *Variable stoichiometry of the TatA component of the twin-arginine protein transport system observed by in vivo single-molecule imaging*, Proc Natl Acad Sci USA, 40, 15376-15381 (2008).
- [2] Twigg, A. et al. *Trans-complementable copy-number mutants of plasmid ColE1*, Nature, 283, 216-218 (1980).