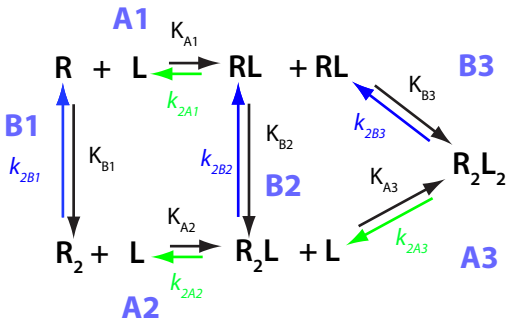
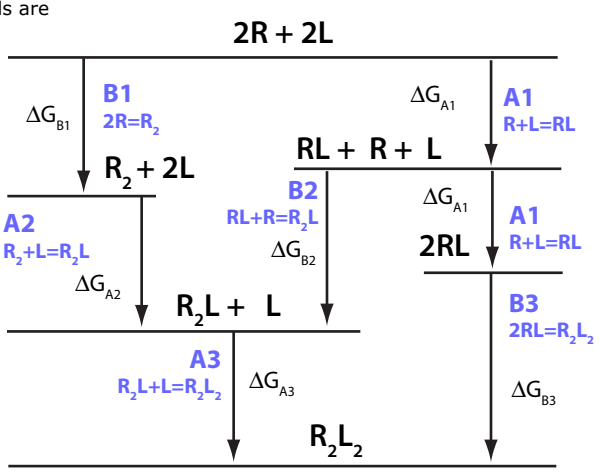
B-R2-R2L2
Receptor dimerization coupled with binding of one ligand per receptor monomer

Macroscopic reaction scheme



Free-energy diagram
(positions of energy levels are chosen for easy viewing)



Thermodynamic cycle

$\Delta G^o_{B1} + \Delta G^o_{A2} = \Delta G^o_{A1} + \Delta G^o_{B2} \Rightarrow K_{B1} K_{A2} = K_{A1} K_{B2}$

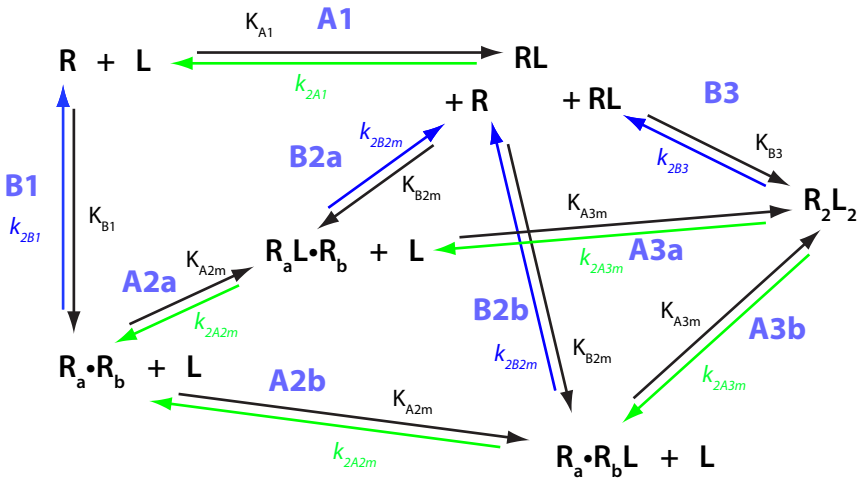
$\Delta G^o_{B1} + \Delta G^o_{A2} + \Delta G^o_{A3} = 2\Delta G^o_{A1} + \Delta G^o_{B3} \Rightarrow K_{B1} K_{A2} K_{A3} = K_{A1}^2 K_{B3}$

Dependent transitions: B2 and B3

$K_{B2}=K_{A2}K_{B1}/K_{A1}$

$K_{B3}=K_{B1}K_{A2}K_{A3}/K_{A1}^2$

Microscopic reaction scheme



By symmetric design of the model:

$\Delta G^o_{B2a} = \Delta G^o_{B2b}$, $K_{B2a}=K_{B2b}=K_{B2m}$ (microscopic)

$\Delta G^o_{A2a} = \Delta G^o_{A2b}$, $K_{A2a}=K_{A2b}=K_{A2m}$

$\Delta G^o_{A3a} = \Delta G^o_{A3b}$, $K_{A3a}=K_{A3b}=K_{A3m}$

The same holds for kinetic constants.

Thermodynamic cycles:

$\Delta G^o_{B1} + \Delta G^o_{A2a} = \Delta G^o_{A1} + \Delta G^o_{B2a}$

$\Delta G^o_{B1} + \Delta G^o_{A2b} = \Delta G^o_{A1} + \Delta G^o_{B2b}$

$K_{B1}K_{A2m}=K_{A1}K_{B2m}$

$\Delta G^o_{B2b} + \Delta G^o_{A3b} = \Delta G^o_{A1} + \Delta G^o_{B3}$

$K_{B2m} K_{A3m} = K_{A1} K_{B3}$

Dependent transitions: B2 and B3

$K_{B2m}=K_{B1}K_{A2m}/K_{A1}$

$K_{B3}=K_{B1}K_{A2m}K_{A3m}/K^2_{A1}$