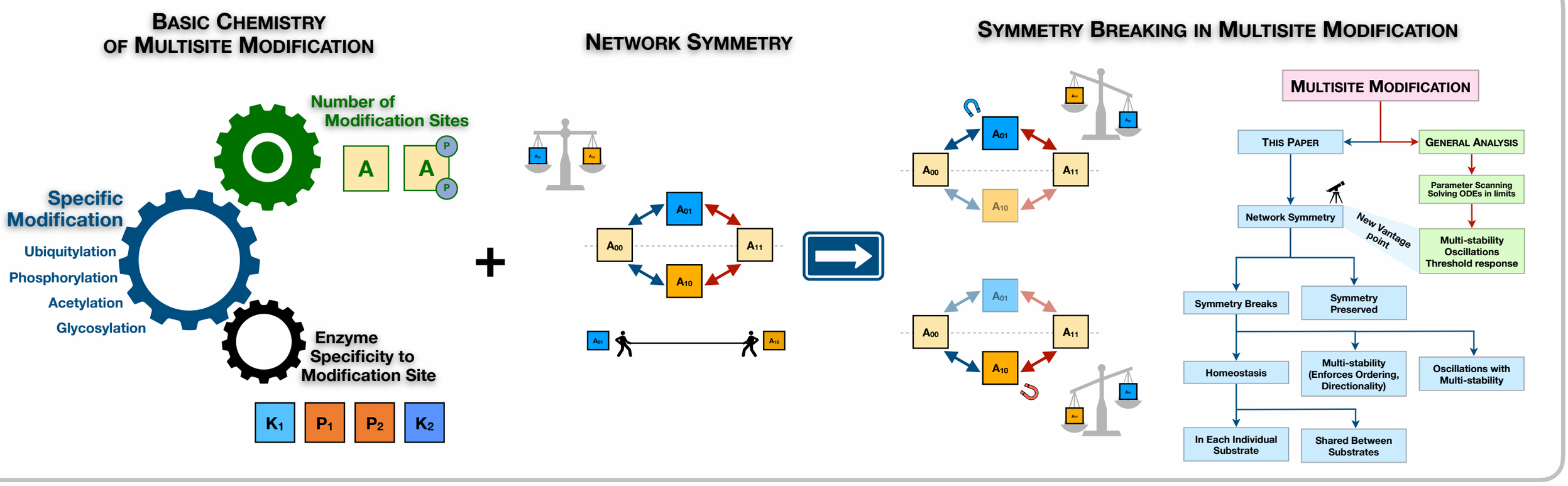
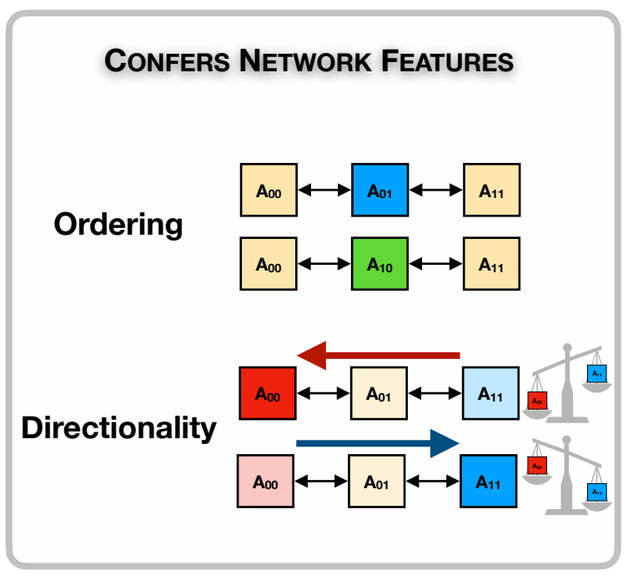
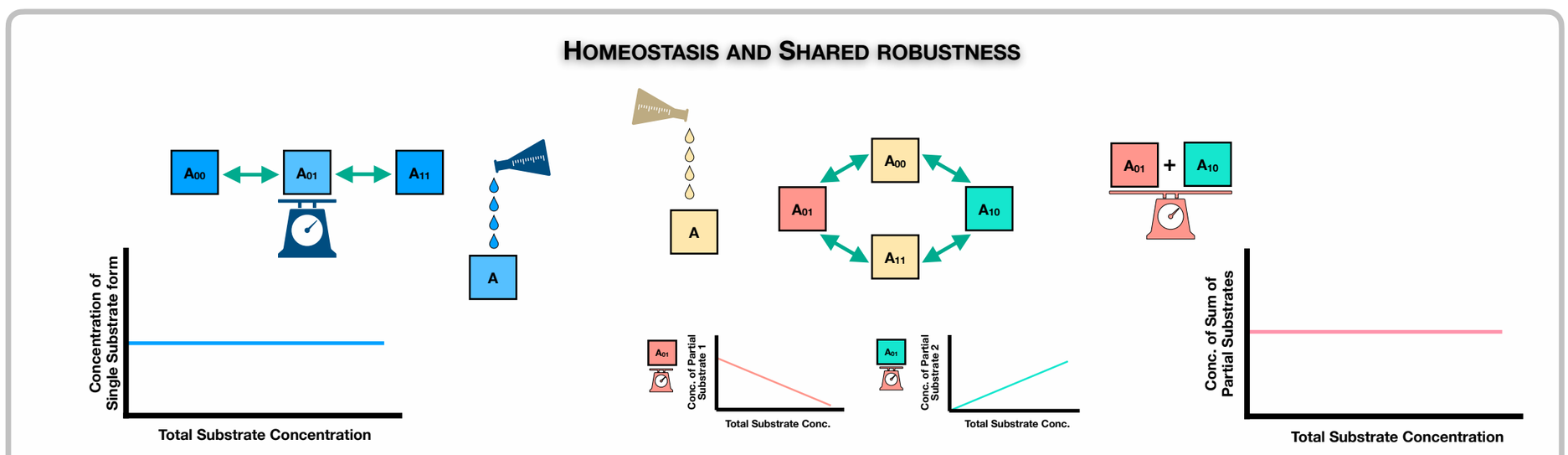
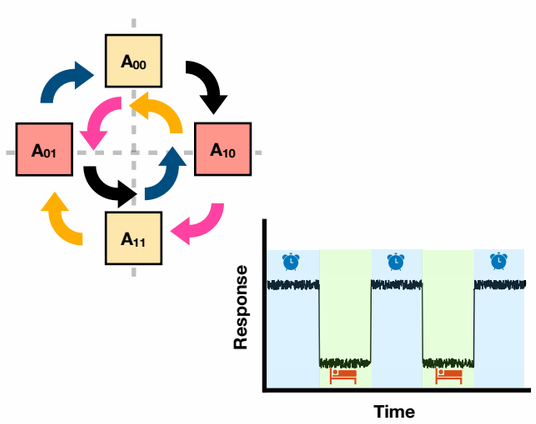
(A). Symmetry Breaking in Multisite Modification

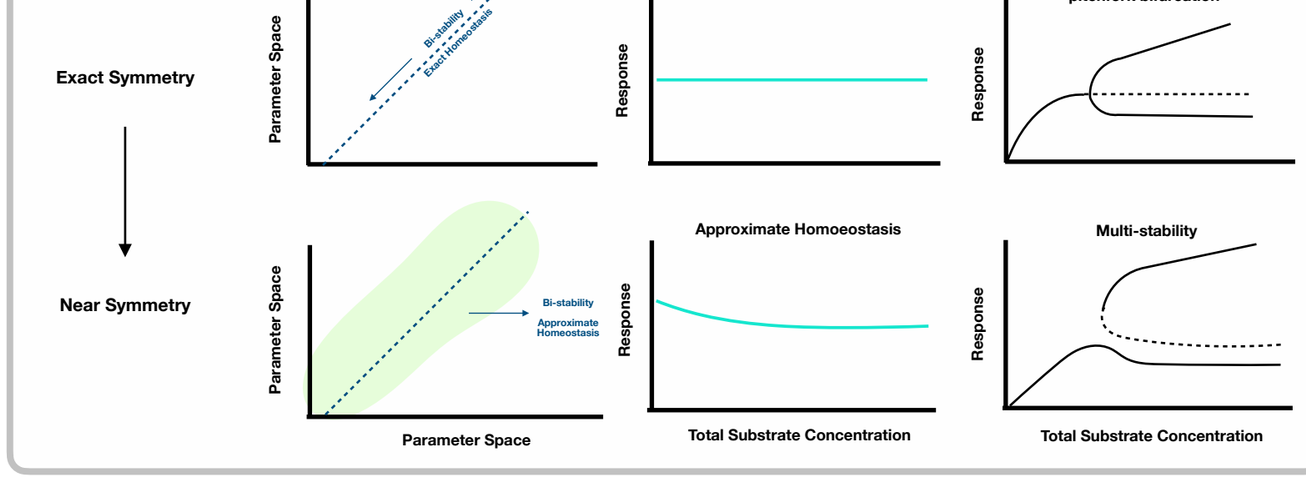


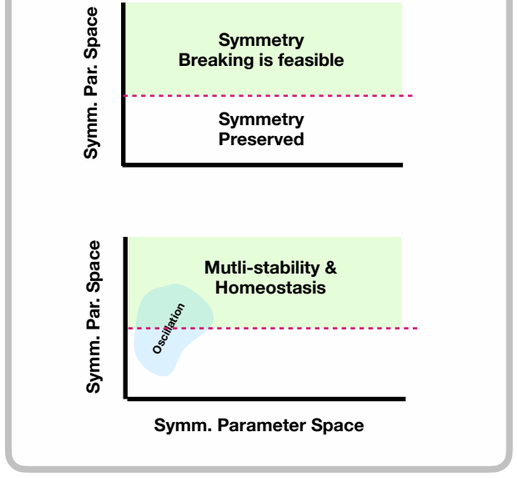
(B). Symmetry & Symmetry Breaking as a Focal Point for Understanding Behaviour and Engineering Functionality in Multisite Networks











(C). Summary of Symmetry and Symmetry Breaking Behavior in MSP Networks

	Case 1		Case 2		Case 3	
Ordered DSP (Common Kinase Common Phosphatase)	Yes	Partial substrate form (A_p) exhibits concentration robustness post symmetry breaking				
Random System 1 (Common Kinase Common Phosphatase)	Yes	Partial substrate forms (A_{01} & A_{10}) individually exhibit concentration robustness post symmetry breaking	No		Yes	Sum of the partially modified substrates (A_{01} + A_{10}) exhibit concentration robustness post symmetry breaking
Random System 2 (Separate Kinase Common Phosphatase)			No			
Random System 3 (Separate Kinase Separate Phosphatase)	Yes	Partial substrate forms (A_{01} & A_{10}) individually exhibit concentration robustness post symmetry breaking	Yes	Completely modified and the unmodified substrates (A_{00} & A_{11}) individually exhibit concentration robustness post symmetry breaking	Yes*	No exact robustness exhibited (Approximate concentration robustness in pairs of substrate possible - see text)
Mixed Random 1 (Common Kinase Common Phosphatase Distributive Phosphorylation Processive Dephosphorylation)			No			
Mixed Random 2 (Separate Kinase Common Phosphatase Distributive Phosphorylation Processive Dephosphorylation)			Yes	Completely modified and the unmodified substrates (A_{00} & A_{11}) individually exhibit concentration robustness post symmetry breaking		