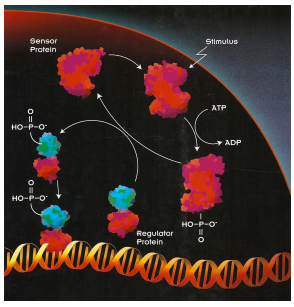
System Engineering

20.109(F10)
M2D2 lecture
10.19.10

As simple as the box it comes in…

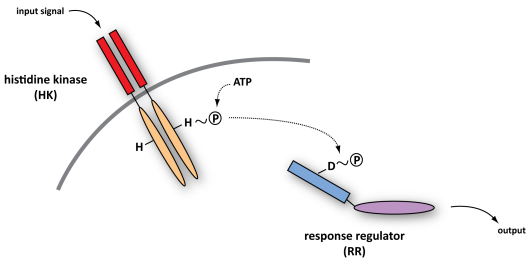
Stimulus	Response
carbon source	motility, chemotaxis
pH	stress, virulence
oxidative stress	superoxide dismutase
temperature	heat shock proteins syn
bacterial density	quorum response
nitrogen	metabolic changes
osmotic stress	uptake/output changes
…	

The 2CS paradigm: in general



Stimulus
Sensor protein
±Ⓟ
Response regulator
Output

The 2CS paradigm: Phosphorelay rxns



Slide from Mike Laub

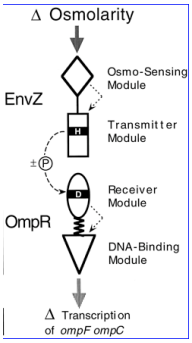
The 2CS paradigm: Phosphorelay rxns

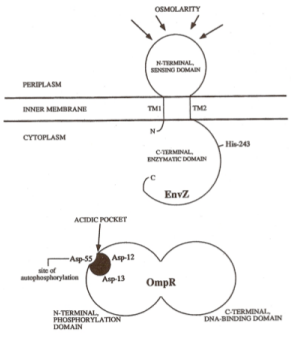
RXN 1: Autophosphorylation in response to stimuli

RXN 2: Phosphotransferase from Sensor to Response regulator

RXN 3: Phosphatase inactivates Response regulator, resets system

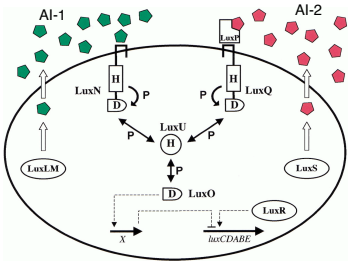
2CS examples: Osmoregulation





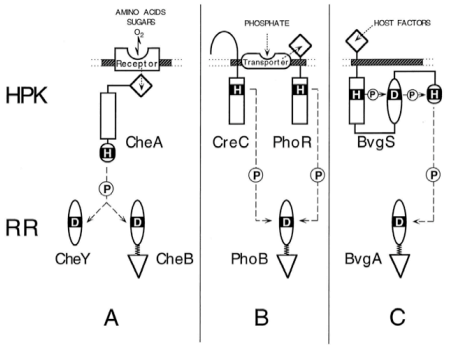
2CS transduction, Hoch and Silhavy

2CS examples: Quorum sensing



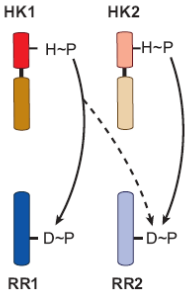
Genes & Dev. 2001. 15: 1468-1480 doi: 10.1101/gad.899601

2CS examples: possible networks



http://www.plantphysiol.org/content/vol117/issue3/images/large/pp0785128002.jpeg

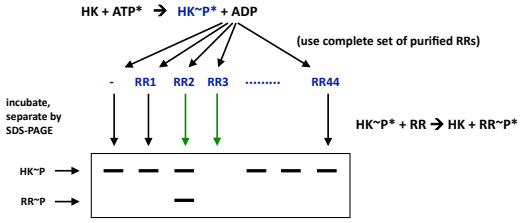
Preventing cross-talk



At least *in vitro* the answer seems to be a kinetic preference of sensor for its response regulator

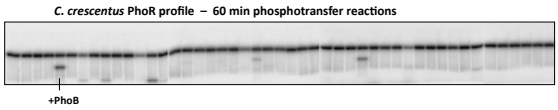
Ann Rev Genetics, 2007 Laub and Goulian

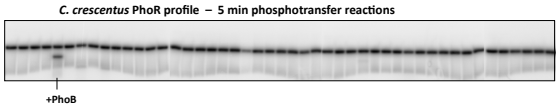
Phosphotransfer profiling



Slide from Mike Laub

Assessing Specificity: Phosphotransfer Profiling

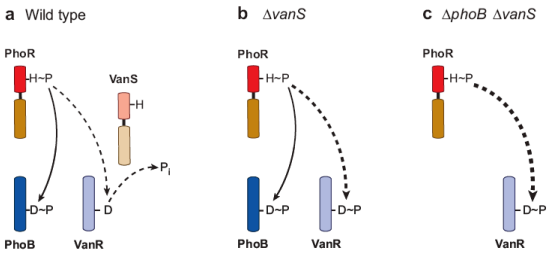




- histidine kinases exhibit a strong kinetic preference *in vitro* for their *in vivo* cognate substrate
- specificity based on molecular recognition

Slide from Mike Laub

Preventing cross-talk: phosphatase activity



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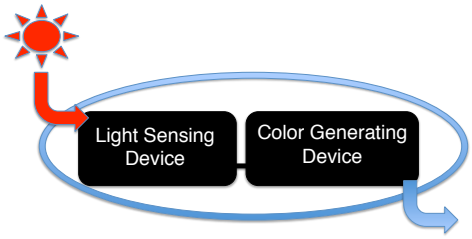
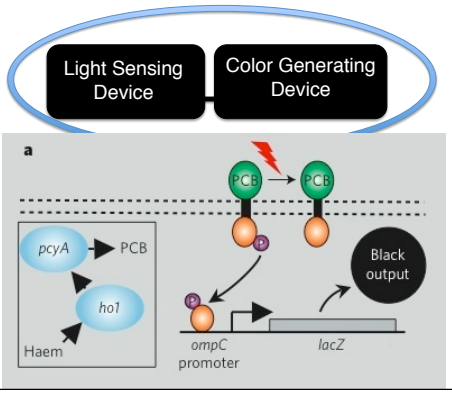
As simple as the box it comes in…



Photons	Color
1 (= cells are in the light)	0
0 (= cells are in the dark)	1

As simple as the box it comes in…



Summary