

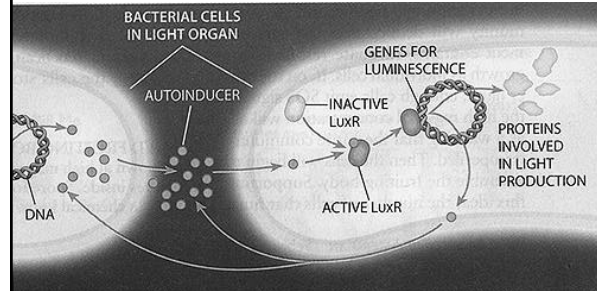
Global Control Systems

TABLE B.1 A few of the global control systems known in *Escherichia coli**

System	Signal	Primary activity of regulatory protein	Number of genes regulated
Aerobic respiration	Presence of O ₂	Repressor (ArcA)	50+
Anaerobic respiration	Lack of O ₂	Activator (FNR)	70+
Catabolite repression	Cyclic AMP concentration	Activator (CAP)	300+
Heat shock	Temperature	Alternative sigma (σ^{32})	36
Nitrogen utilization	NH ₄ limitation	Activator (NRK)/alternative sigma (σ^{54})	12+
Oxidative stress	Oxidizing agent	Activator (OxyR)	30+
SOS response	Damaged DNA	Repressor (LexA)	20+

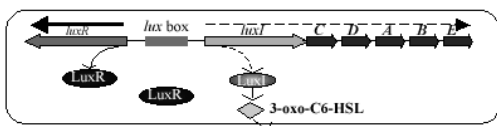
*For many of the global control systems, regulation is complex. A single regulatory protein can play more than one role. For instance, the regulatory protein for aerobic respiration is a repressor for many promoters but an activator for others, whereas the regulatory protein for anaerobic respiration is an activator protein for many promoters but a repressor for others. Regulation can also be indirect or require more than one regulatory protein. Some of the regulatory proteins involved are members of two-component systems (see Section 8.10). Many genes are regulated by more than one global system. (For a discussion of the SOS response, see Section 10.3.)

Quorum Sensing

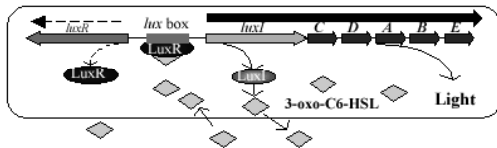


Diffusible autoinducers = HSLs

Low cell density

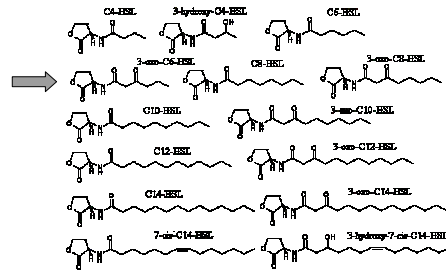


High cell density



Luciferin/Luciferase reaction made possible by the lux operon

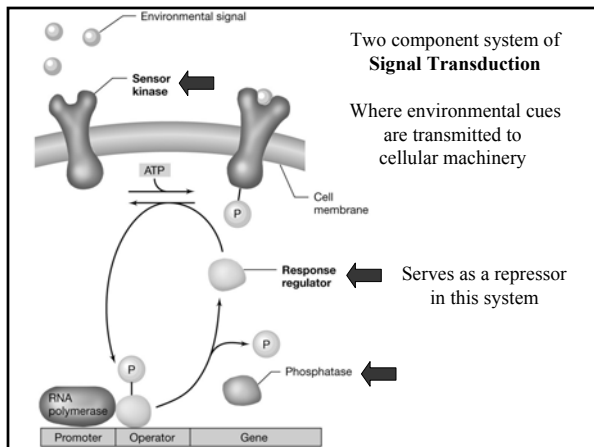
Examples of HSLs (N-acyl-L-homoserine lactones)



Used with *Vibrio fischeri*

Two component system of Signal Transduction

Where environmental cues are transmitted to cellular machinery



Two-Component Regulatory Systems

TABLE B.3 Some two-component regulatory systems from *Escherichia coli* that regulate transcription

System	Environmental signal	Sensor kinase	Response regulator	Activity of response regulator*
Arc system	O ₂	ArcB	ArcA	Repressor / Activator
Nitrate and nitrite anaerobic regulation (Nar)	Nitrate and nitrite	NarX and NarQ	NarL, NarP	Activator / Repressor
Nitrogen utilization (Ntr)	NH ₄ ⁺	NtrB, the product of <i>glnJ</i>	NtrG, the product of <i>glnK</i>	Activates RNA polymerase at promoters requiring σ^{54}
Plo regulon	Inorganic phosphate	PhoR	PhoB	Activator
Purine regulation	Osmotic pressure	EnvZ	OmpR	Activator / Repressor

*Note that several of the response regulator proteins act as both activators and repressors depending on the genes being regulated. Although ArcA can function as either an activator or a repressor, it functions as a repressor on most operators that it regulates.