Protein-Protein Interactions and Ion Channels
G-Protein Signaling Pathways
Tyrosine Kinase Signaling Pathways

Pullamsetti and Shermully, 2010
JAK-STAT Signaling Pathway

Shuai and Liu, 2003
Feed-Forward Network in Visual Cortex

output

input

Figure 13. Nissl stain of the visual cortex reveals the different layers I through VI quite clearly.
Feed-Forward Network in Visual Cortex
What are Cyanobacteria?

A very old phylum of bacteria named for their blue-green color. Also called “blue-green algae”, but unlike algae they are prokaryotes.

By producing oxygen from photosynthesis they are thought to have caused the Great Oxygenation Event which led the way to animal life on earth.
Cyanobacterial Blooms

They reproduce very quickly and can form biofilms. The aquatic forms sometimes form blooms, as in this image taken near Fiji.
The Good, the Bad, and the Ugly

The Good: Used in agriculture to fix nitrogen, and experiments are underway to use them for biofuel production.
The Good, the Bad, and the Ugly

The Bad: Some cyanobacteria release toxins, called cyanotoxins. Some of these are harmful to humans.
The Good, the Bad, and the Ugly

The Ugly: No explanation required.
The KaiC Protein

Complex protein with six identical subunits
The KaiA Protein

KaiA increases KaiC autophosphorylation
The KaiB Protein

KaiB inhibits the action of KaiA
Circadian Rhythm in KaiC Phosphorylation State
Wheel running activity of a hamster over a period of 10 days. From Liu et al., Cell, 91:855, 1997.
Nuclei of the Hypothalamus
Retinohypothalamic pathway
Circadian Firing Frequency from Dissociated SCN Neurons of a Hamster


Wild type

Tau heterozygote

(First single-gene mutation that caused a change in period of a mammalian circadian oscillation)

Tau homozygote

Circadian Fluctuations in Period Gene Expression

System Diagram of the Goldbeter Model

Circadian Rhythm with the Goldbeter model

Circadian Oscillations with the Scheper Model

Free-running period is 24.6 hr. From Scheper et al., J. Neurosci., 19:40, 1999
Entrainment of Scheper Model to Short Pulses of “Light”

Light is simulated by short periodic pulses in which $q_p$ is doubled.