

P2: Evolution of plant circadian clocks.

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Circadian clocks are 24-hr biological oscillators that allow organisms to anticipate predictable diurnal changes in environmental conditions. Recent work in my laboratory and others identified some of the key components of the circadian system of *Arabidopsis*. As in *Drosophila*, mammals, fungi and cyanobacteria, the core mechanism of the plant circadian clock is thought to consist of a transcriptional feedback loop. During the day, the MYB transcription factors LHY and CCA1 repress expression of the *TOC1* gene, encoding an atypical response regulator protein. Reduced expression of LHY and CCA1 at night allows expression of *TOC1*, which in turn promotes transcription from the LHY and CCA1 promoters at dawn. This regulatory feedback loop is entrained to environmental cycles through the action of multiple photoreceptors (phytochromes and cryptochromes). The clock feeds back on these light input pathways to modulate responsiveness with the time of the day. Thus expression of multiple elements of phototransduction pathways (including the photoreceptors themselves) exhibits circadian rhythmicity, and the contribution of these additional oscillatory feedback loops to the overall rhythmicity is not clear.

Comparison of circadian clock mechanisms between *Drosophila* and mammals, as well as between species of insects has revealed conserved aspects as well as striking differences. In order to identify an ancestral and possibly simpler form of the plant circadian clock, we now wish to investigate the molecular mechanism of the circadian clock in a primitive land plant. The moss, *Physcomitrella patens*, is an attractive system because of its easy transformation and of gene targeting possibilities. So far we have demonstrated that expression of the *Chlorophyll a/b-binding protein (CAB)* gene exhibits circadian rhythmicity in moss. We have identified sequences in EST databases that show homologies to components of the *Arabidopsis* clock. We plan to systematically knock-out and overexpress these proteins in order to test whether their loss-of function or misexpression results in aberrant rhythmic expression of CAB.