

## **An Example of Internal and External Factors Working Together to Influence Growth**

The plant's measurement of seasonal changes through photoperiodism involves not only the sensing of light and dark signals, but also referral of these signals to an endogenous biological clock, whose existence is indicated by overt circadian rhythms. Rhythms have been noted in many different processes, including leaf movements, rates of photosynthesis, cell division, and bioluminescence in algae, and the activity of some cellular enzymes. While the amplitude and phase of rhythmic oscillations are temperature sensitive, the period of most rhythmic events is essentially temperature independent. Neither the mechanism of timekeeping nor the nature of the temperature compensator is clear, but some evidence exists that rhythms are manifestations of cyclic changes in membranes.

Although rhythms are endogenous, they can be phased ("the clock reset") or entrained by appropriate temperature and light signals, the latter usually perceived by phytochrome, and possibly by a blue-light photoreceptor. Rhythms can be damped out or changed in period by several chemical agents, including ethanol, heavy water, and  $\text{Li}^+$ ; all are presumably membrane-active substances. The damping out of rhythms at low temperatures may result from solidification of membrane lipids that must be liquid for normal functioning.