

Keeping the daily clock ticking in a fluctuating environment: Hints from a green alga

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Researchers in France have uncovered a mechanism which explains how biological clocks accurately synchronize to the day/night cycle despite large fluctuations in light intensity during the day and from day to day. Following the identification of two central "clock genes" of a green alga, *Ostreococcus tauri*, a mathematical model reproducing their daily activity profiles has revealed that their internal clock is influenced by the naturally varying light levels throughout the day only at periods when it needs resetting.

The results found by the biologists at Oceanologic Observatory of Université Paris 6 in Banyuls, France, physicists at Université Lille 1, France, together with the Centre National de la Recherche Scientifique, are published November 11 in the open-access journal *PLoS Computational Biology*.

Circadian clocks keep track of time in many living organisms, allowing them to anticipate environmental changes induced by day/night alternation. They consist of networks of [genes](#) and proteins which interact to generate biochemical oscillations with a period close to 24 hours. Exact synchronization to the day/night cycle requires that some clock components sense daylight. *Ostreococcus* has evolved a simple but effective strategy to shield the circadian clock from interference caused by fluctuations in the levels of daylight by limiting sensitivity to light to specific times of day. In the authors' model, as in experiments, this

ability is furthermore inactivated when the clock is in phase with the day/night cycle but resets the clock when it is out of phase. Such a clock architecture is immune to strong daylight fluctuation such as due to cloud cover.

Light sensing is assumed to be activated only when the core oscillator controlling the biological clock is blind to perturbations and variations. As anyone who has pushed a swing knows, the response of a periodic motion to a perturbation depends indeed very much on the timing; pushing a swing mid-arc doesn't achieve much. With this simple trick, the clock is insensitive to light and its fluctuations when it is on time. However, if the clock becomes out of phase, it will be subjected to light at a different time of its cycle, and respond to the perturbation so as to be reset to the correct time.

More information: Thommen Q, Pfeuty B, Morant P-E, Corellou F, Bouget F-Y, et al. (2010) Robustness of Circadian Clocks to Daylight Fluctuations: Hints from the Picoeucaryote *Ostreococcus tauri*. *PLoS Comput Biol* 6(11): e1000990. [doi:10.1371/journal.pcbi.1000990](https://doi.org/10.1371/journal.pcbi.1000990)

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