A Day in the Life of a Cyanobacterium: integrating temporal and environmental information

Synechococcus elongatus is a discrete nanomachine comprising three proteins – KaiA, KaiB, and KaiC – which interact progressively to set up the timekeeping mechanism, and two kinases whose activities are altered by engaging the Kai oscillator. The key events that enable the clock to tell time, become set to local time, and regulate global patterns of gene expression and metabolism, rely on these five proteins plus the target of the kinases: a transcription factor, RpaA. The clock is permissive late in the day for processes that prepare the cell for night, when photosynthetic metabolism will be inoperative. Transcripts of genes peak at dusk that encode enzymes of a night-time metabolic program. During the night, glycogen stored during the day is broken down to fuel the synthesis of a crucial reductant, NADPH. Prior to dawn, the night-time program is turned off by the clock, enabling the cell to switch from utilizing stored carbon to synthesizing cellular components when light becomes available to power photosynthesis.