The Circadian Clockwork: A Genetic and Biochemical Mechanism that Helps the Body to Tell the Time

Gregor Eichele

*Max Planck Institute for Biophysical Chemistry, Genes and Behavior Department, Am Fassberg 11, 37077 Goettingen, Germany.*

Circadian clocks are ubiquitous cellular pacemakers that synchronize cellular and organismal physiology to the 24 hour rhythm of the rotation of the earth. Circadian clocks consist of a transcriptional/translational feedback loop involving approximately 10 proteins that are largely conserved in evolution. Having a circadian clock allows organisms to gear their gene expression program so as to optimally respond to environmental changes tied directly (light, temperature) or indirectly (availability of food, presence of predators) to the rotation of the earth.

In mammals approximately 10% of all transcripts in each cell show a circadian rhythm. We will discuss how these rhythms of gene expression are generated by the circadian pacemaker and how they are affected by a change of the day/night schedule as occurs e.g. in jet lag. Light can directly reset the circadian clock and the underlying biochemical mechanisms will be discussed. Using the example of the circadian clock of the choroid plexus, a tissue separating the blood from the cerebrospinal fluid, we will illustrate how the finely tuned circadian clock impacts on brain physiology. We will conclude with an assessment of how epigenetically acting proteins contribute to the molecular regulation of the circadian pacemaker.