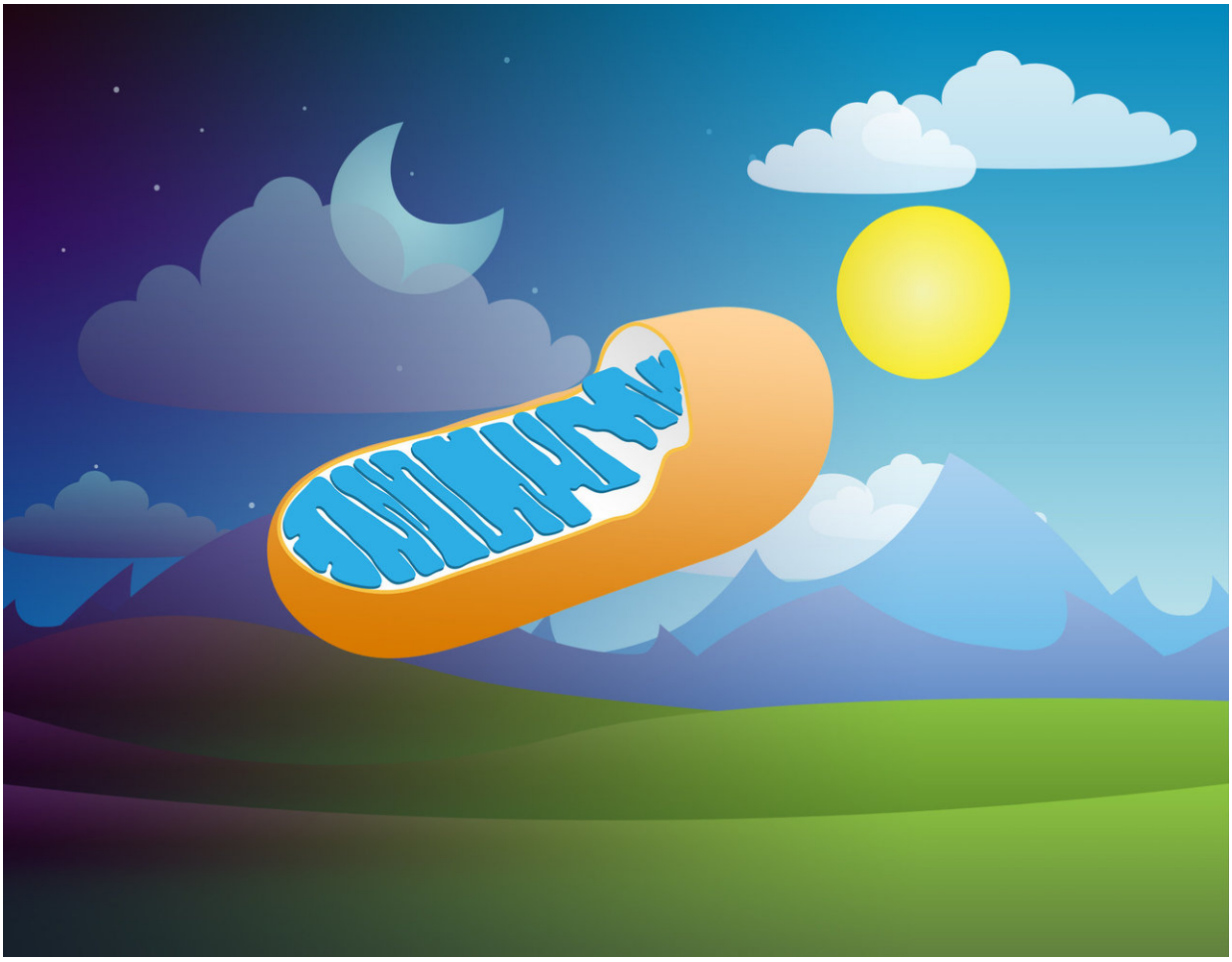
Our circadian clock sets the rhythm for our cells' powerhouses

March 7 2018



The circadian rhythm of roughly 24 hours affects the energy metabolism of mitochondria. Credit: University of Basel

Countless genetically controlled clocks keep time in different body parts, such as the liver, kidneys and heart. Among other things, they initiate metabolic processes, ensuring that these occur at the optimal time of day. Mitochondria, cellular organelles that produce energy, play an important role in these processes. Until now, it was unclear how exactly the 24-hour circadian rhythm regulated energy metabolism.

In most cells, mitochondria connect in a constantly changing network that can adapt to changing conditions. Mitochondria can thus fuse together and divide again. Disruption of this fission-fusion dynamic can lead to health problems. Researchers have now investigated exactly how the mitochondrial network interacts with our internal biological clock by using a combination of in vitro models and clock-deficient mice or mice with impaired mitochondrial fission.

Their results show that the mitochondrial fission-fusion cycle is controlled by the fission protein Drp1, which is in turn synchronized by an internal biological clock. This rhythm is integral to determining when and how much energy the mitochondria can supply. "The time of day determines the design of the mitochondrial network, and this, in turn, influences the cells' energy capacity," explains study leader Professor Anne Eckert from the University of Basel's Transfaculty Research Platform Molecular and Cognitive Neurosciences MCN.

The researchers also showed that the mitochondrial network loses its rhythm if the circadian clock is impaired, which causes a decline in energy production in the cells. Similarly, pharmacologically or genetically impairing the Drp1 fission protein upsets the energy production rhythm, which in turn affects the rhythm of the circadian clock. These findings could play a role in the development of new therapeutic approaches; for example, for diseases that are characterized by an impaired circadian clock and compromised mitochondrial function, such as Alzheimer's.

More information: Karen Schmitt et al, Circadian Control of DRP1 Activity Regulates Mitochondrial Dynamics and Bioenergetics, *Cell Metabolism* (2018). DOI: 10.1016/j.cmet.2018.01.011

Provided by University of Basel