



How does our body clock tick?
The CO₂ incubator in chronobiology

Switzerland is world-famous for its clocks. It therefore seems logical that four renowned Swiss universities, located in Basel, Geneva, Zurich and Lausanne, are dedicated to chronobiology. Freiburg University, which is located nearby, is also on this list. Why some people are "early birds" while others are "night owls" and turn night into day is just one question this branch of research deals with on a cellular and molecular level.



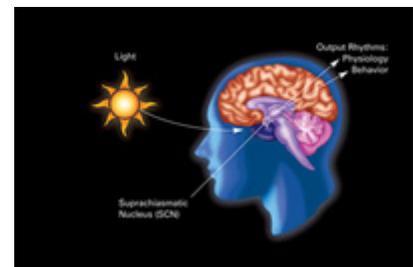
Memmert CO₂
incubator INCOmed for
cell cultivation

Chronobiology provides results on the body clock

At a rough estimate, the human organism consists of 100 trillion cells. An internal clock, which is based on genetically determined machinery, ticks in every single one of them. The suprachiasmatic nucleus (SCN), which is located in the brain's hypothalamus, acts as the master clock for most organs and physiological processes. These processes follow a daily individual circadian rhythm, for example the heartbeat, blood pressure, digestion and hormone production. When the body clock is synchronised to switch between day and night on earth, light plays the leading role. Chronobiology is the study of the function of the body clock, as well as its effects on the physiological and pathological processes inside the human body. The information it provides on the effects of night work, jetlag or lack of sunlight during winter, as well as on fluctuations in liver detoxification capacity delivers valuable insights for medical and pharmaceutical research.

What makes us an "early bird" or a "night owl"?

Over the past few years, a host of chronobiological study results have been published by leading scientist Dr. Steven Brown and other researchers of the departments for chronobiology and sleep research at the Institute of Pharmacology and Toxicology at the University of Zurich. In many cases there were joint research projects between different laboratories at the university of Zurich, as well as institutes of the Swiss universities in Basel and Geneva, and Berlin Charité or Humboldt University. These projects revealed, among other things, that in the course of our life, our body clock makes us change from "night owl" to "early bird" due to hormonal changes (1). In 2008 evidence was found showing that the circadian period of "early birds" is far shorter than that of "night owls" who have difficulty getting up in the morning (2). A study that was published in 2012 concluded that the circadian rhythm directly influences numerous metabolic processes in the human body, even when the usual daytime activities like sleeping and eating were not taken into consideration. Maybe the saying: "True



The effect of light on the circadian rhythm, published in the Public Domain by National Institute of General Medical Sciences.

beauty comes from within" will soon have to be changed into: "True beauty follows the body clock".

Tests on gene expression in the Memmert CO2 incubator

Gene expression tests are performed to investigate the mechanism of the body clock on a molecular-biological level. This is done using two Memmert CO2 incubators INCO246med which are set up in the laboratory of the Institute of Pharmacology and Toxicology at Zurich University; a third is used for regular cell cultivation. To visualise the processes in a cell in vitro, researchers use a trick. They use bioluminescence, the ability of insects and other creatures to produce light. The luciferase gene, which is responsible for light production, is transfected under the control of a "clock gene" into the cell which is investigated. This "reporter" makes the cells light up as soon as this gene is activated. The intensity of the light radiation is measured in the CO2 incubators with the help of a robot that moves the ultra-sensitive light sensors over the cells at regular intervals. Other current research projects focus on the signal paths in human skin cells. For example, verifiable evidence of significant differences between mentally ill and healthy people was found (3).

Bioluminescence tests in pitch black

Even minimum light incidence in the CO2 incubator can falsify test results. For this reason, total darkness is an absolute must. The appliances are placed in a separate, air-conditioned, dark room, and even the integrated CO2 sensors were sealed as they emit a small amount of light. What the team at the Institute of Pharmacology and Toxicology at the University of Zurich values particularly highly in the Memmert INCOmed is the possibility to seal off the chamber entirely, as well as the sterilisation function.

This article is essentially based on the explanations and publications provided by the Institute of Pharmacology and Toxicology at the University of Zurich. AtmoSAFE would like to thank Prof. Steven Brown, PhD, as well as Dr. Robert

Breeding of zebrafish in the constant climate chamber

At the University of Ghent, a large number of zebrafish are bred with the help of light in a Memmert constant climate chamber HPP. This low-vibration, low-noise environment is the ideal stress-free setting for the zebrafish to develop in.

[more information](#)

Dallmann, Senior Scientist, for their kind assistance.

Further information and literature:

<http://www.pharma.uzh.ch/research/chronobiology/areas/chronobiology/publications.html>

Sources:

1 Pagani et al. (2011) Serum factors in older individuals change cellular clock properties

<http://www.pnas.org/content/108/17/7218.full>

2 Brown et al. (2008) Molecular insights into human daily behaviour

<http://www.pnas.org/content/105/5/1602.full>

3 Gaspar et al. (2014), Human cellular differences in cAMP – CREB signalling correlate with light-dependent melatonin suppression and bi-polar disorder

<http://onlinelibrary.wiley.com/doi/10.1111/ejn.12602/abstract>

Dallmann et al. (2012) The human circadian metabolome

<http://www.pnas.org/content/early/2012/01/30/1114410109>

An overview of the main topics

- Body clock, biological clock, circadian rhythm
- Morning grouch, late riser and early riser
- Institute of Pharmacology and Toxicology
- University of Zurich
- Gene expression
- Cell cultivation
- CO2 incubator
- Chronobiology
- Bioluminescence

Laboratory equipment for incubation

[CO2 incubator INCOmed](#)

[Incubator I](#)

[Cooled incubator ICP](#)

[Peltier-cooled incubator IPP](#)

[Cooled storage incubator IPS](#)

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