Circadian Rhythms

Circadian rhythms are physical, mental and behavioral changes that follow a roughly 24-hour cycle, responding primarily to light and darkness in an organism's environment. They are found in most living things, including animals, plants and many tiny microbes. The study of circadian rhythms is called chronobiology.

How Circadian Rhythms Work

Circadian rhythms are produced by natural factors within the body, but they are also affected by signals from the environment. Light is the main cue influencing circadian rhythms, turning on or turning off genes that control an organism's internal clock. Researchers have already identified genes that direct circadian rhythms in people, fruit flies, mice, fungi and several other model organisms.

Circadian rhythms can change sleep-wake cycles, hormone release, body temperature and other important bodily functions.

Circadian Rhythms and Sleep

Circadian rhythms are important in determining human sleep patterns. The body's master clock, or SCN, controls the production of melatonin, a hormone that makes a person sleepy. Since it is located just above the optic nerves, which relay information from the eyes to the brain, the SCN receives information about incoming light. When there is less light — like at night — the SCN tells the brain to make more melatonin so a person gets drowsy.

Circadian rhythms have also been linked to various sleep disorders, such as insomnia and disrupted sleep-wake cycles. Abnormal circadian rhythms have been associated with depression, bipolar disorder and seasonal affective disorder.

Jet lag occurs when travelers suffer from disrupted circadian rhythms. When a traveler passes through different time zones, the body's clock will be different from the traveler's wristwatch. For example, if someone flies in an airplane from California to New York, that person "loses" three hours of time. So when awakened at 7 a.m., the body still thinks it is 4 a.m., making the traveler feel groggy and disoriented. The body's clock will eventually reset itself, but this often takes a few days.

Research

Scientists can study circadian rhythms by studying humans or by using model organisms, such as mice or even algae. Basic researchers doing these experiments control the subject's environment by altering light and dark periods and then look for changes in gene activity or other molecular signals.

Understanding what makes our biological clocks tick may lead researchers to treatments for sleep disorders, jet lag and other health problems. Learning more about the genes responsible for circadian rhythms will also enhance our understanding of biological systems and the human body.

Biological Clocks

The biological clocks that control circadian rhythms are groupings of interacting molecules in cells throughout the body. A "master clock" in the brain coordinates all the body clocks so they are in sync.

While circadian rhythms are not the same thing as biological clocks, our biological clocks drive our circadian rhythms.

Master Clock

The "master clock" that controls circadian rhythms consists of a group of nerve cells in the brain called the suprachiasmatic nucleus, or SCN. The SCN contains about 20,000 nerve cells and is located in the hypothalamus, an area of the brain just above where the optic nerves from the eyes cross.

Resources

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