Circudian Oscillations

Oscillations with period 2 24 hours
Oscillations continue event constant
dark or constant light.

Light + Darkness entrain the endogenous circadian oscillator to

give appropriate AMA period.

[melatonin]

melatonin is

produced by

the pinneal

ayand in

human

= longer period

Melatonin causes drowsiness and decreases the body temperature

In invertebrates, the circudian

oscillator sensors are in the eyes.

In mammals, cells that produce C.D.s are in the hypothalamus (region of the brain above brain stem). These cells are in the region ralled the suprachiasmatic nucleus (S(N)

retinal hypothalamic

tvact

oo

over the stand of These cells are independent of vision cells. An example of circudiar rythms: "Menimal model of circudean oscillators" By Scheper et al J. Neuroscience, vol 19 pp. 40-47,

Circadian gene/protein Biology; V trunscription mRNA 1 translation Protein addition of a 7 phosphate group turns protein V processing Phosphory lation enzymes on loff Dimerization. > chemical union Transport to nucleus of 2 identical Protein* molecules Negative feedback Effective protein loop: increase in protein* decreases transcription. Modeli *degradation Non-linear dynamics

Parameters (rute): variables: m=[MRNA] Ym= mRNA production P= [protein] rp= protein production Im= mRNA degradation ap = protein degradation Key features. 1) Time delay (2) -> 4 hours in original paper (z) Negative feedback from protein* -> mRNA 3) Non-linearity: Nonlinear functions => mRNA: m=in-out $M = \frac{Vm}{1+p^2} - q_m M$ Protein: p= in-out p= 1pm (t-2) 3-4pp In the paper: rm= lhi, rp= lhi $4m = 0.21 h^{-1}$, $4p = -.71 h^{-1}$

the expression for p is a

delay differential equation

where plane does not work.

Trajectories can cross.

M

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Trajectories can cross.

mRNA reaches maximum before protein