

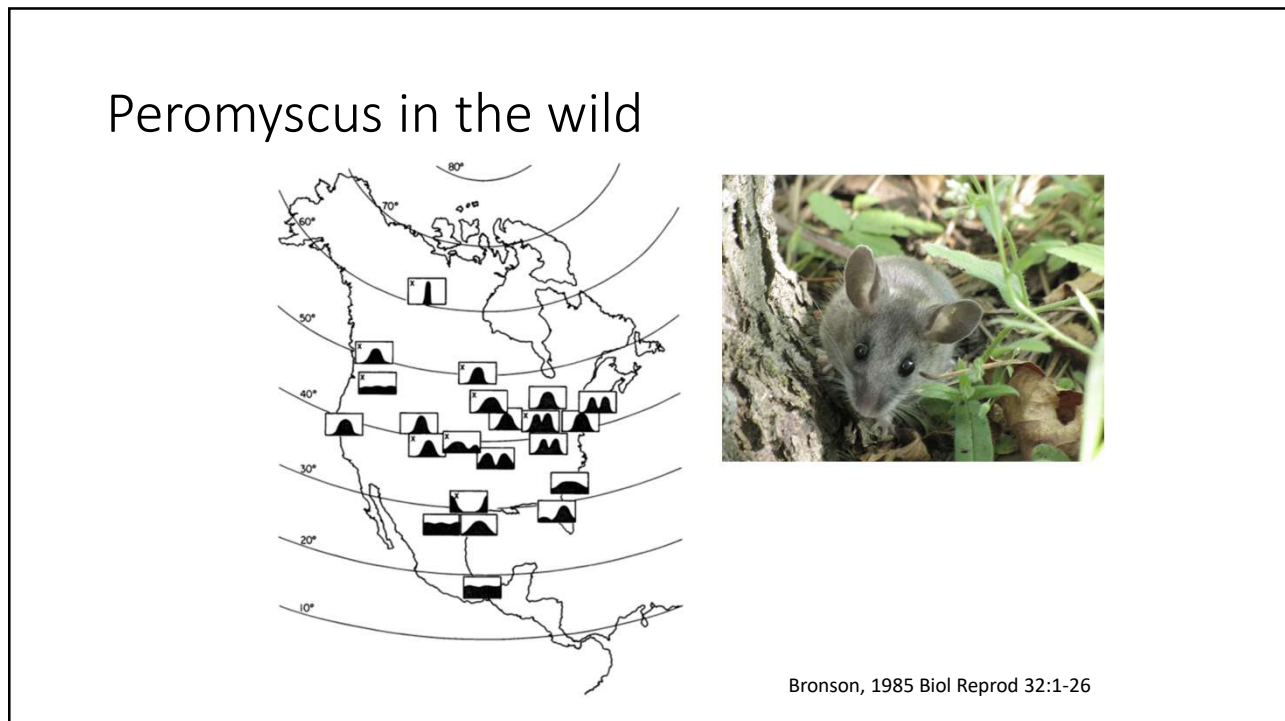
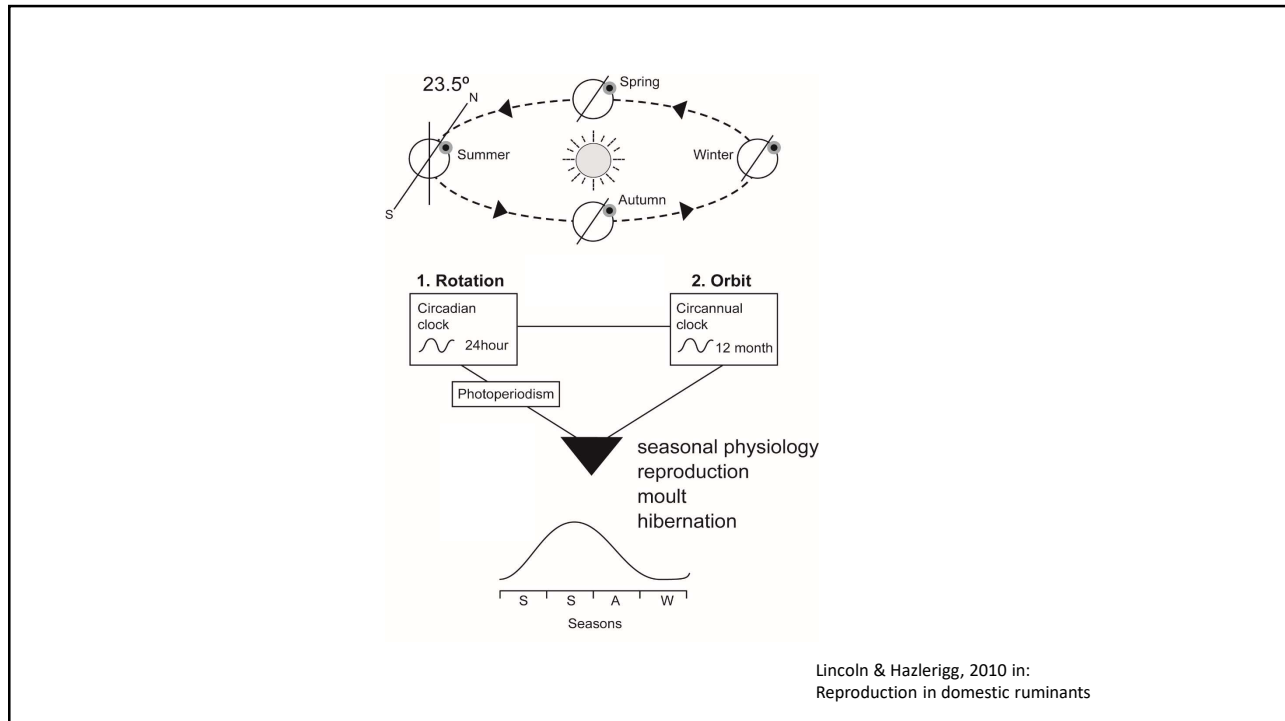
Kronobiologi og viktigheten av biorhytmer

Kunnskap fra andre virveldyr

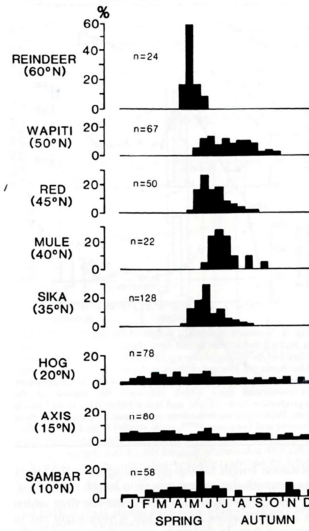
David Hazlerigg, UiT

Essential point 1

- Innate circadian clocks and biological calendars are ancient, ubiquitous, adaptive features

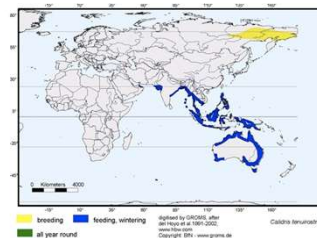
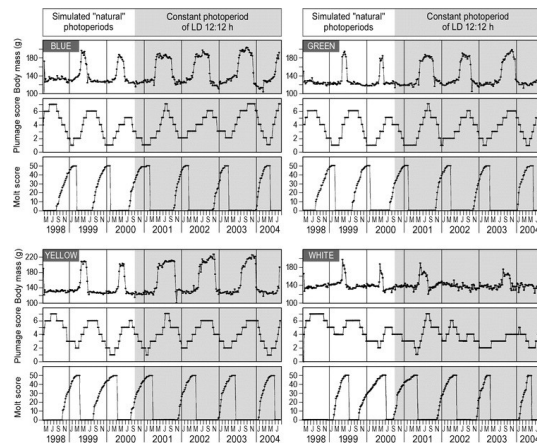


Deer in London Zoo

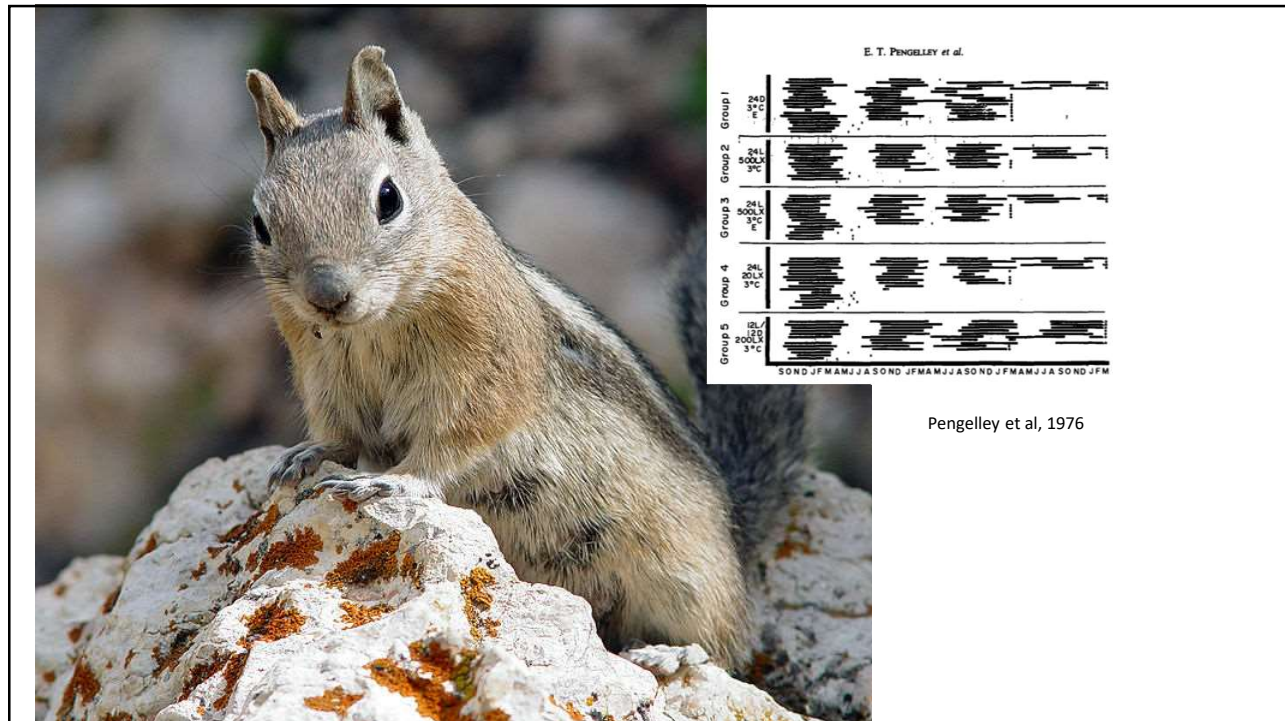


Lincoln, 1985 R Soc NZ bull 22:165-179

Circannual rhythms in trans-equatorial migrants - g. *Calidris*



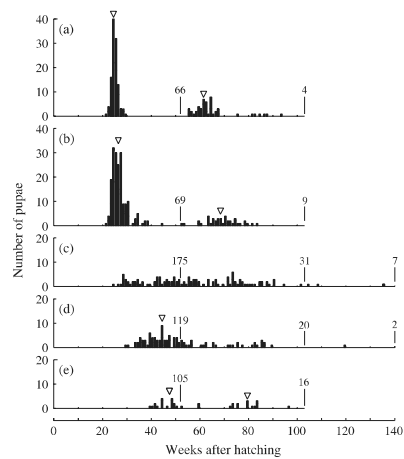
Piersma et al, 2008 *The Auk*



Circannual rhythm in the varied carpet beetle *Anthrenus verbasci*

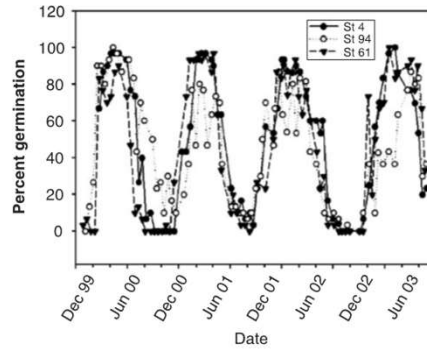
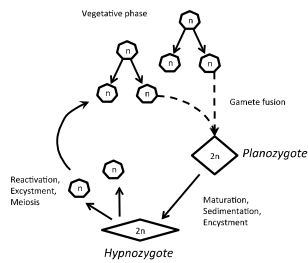


Photo: André Karwath



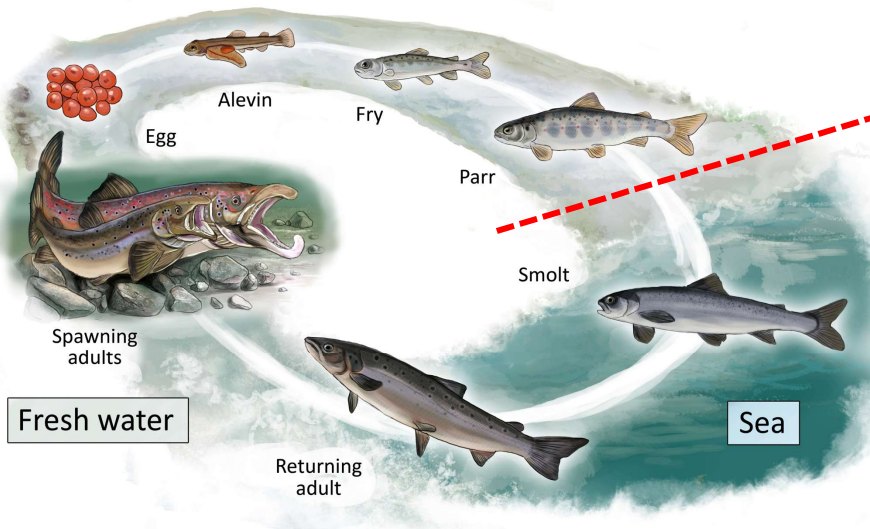
Nishimura & Numata, 2003

Circannual emergence of marine dinoflagellate cysts (*Alexandrium*)



Matrai et al, 2005

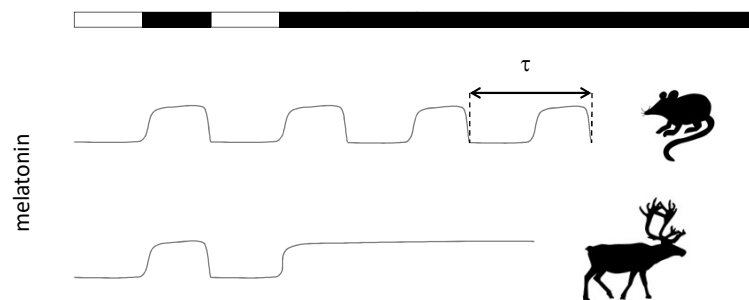
Atlantic Salmon (*Salmo salar*) Life Cycle

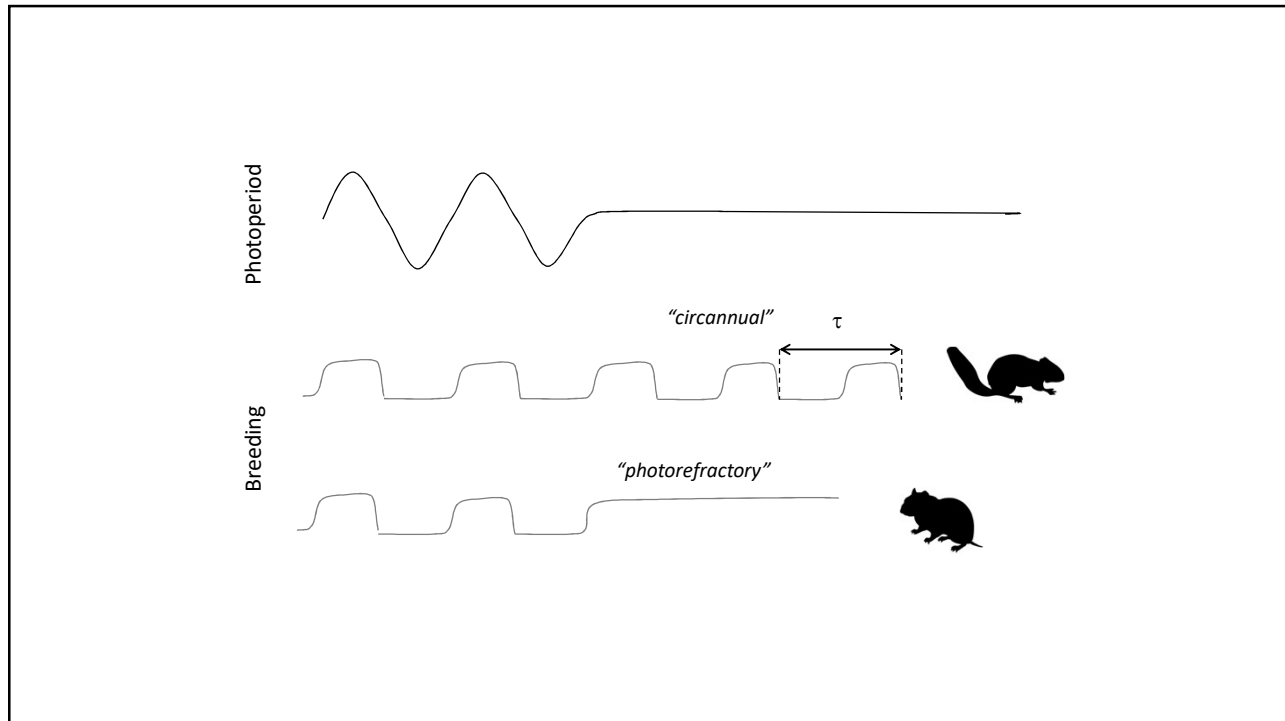


Artwork by Jayme van Dalum

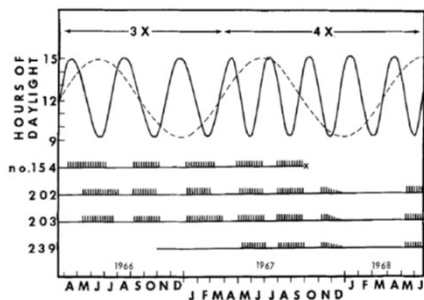
Essential points 2/3

- The light / dark cycle synchronises daily biological clocks and seasonal biological calendars
- An *oscillation* does not require an *oscillator* AND *clock function* does not necessarily depend on an oscillator





There is a limit to how fast you can drive an annual rhythm.....



«Temporal Inertia»

Essential point 4

- Clocks and their outputs should not be confused

Transplanted Suprachiasmatic Nucleus Determines Circadian Period

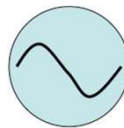
MARTIN R. RALPH,* RUSSELL G. FOSTER, FRED C. DAVIS,
MICHAEL MENAKER

SCIENCE 247:975

Synchronising signals
(Zeitgebers)



CLOCK



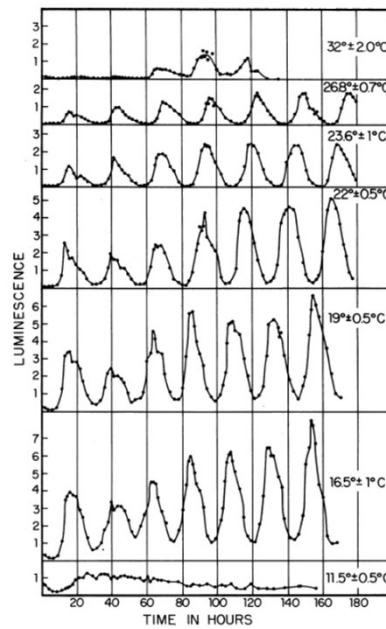
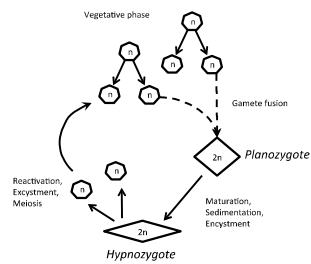
Outputs



See also: Hazlerigg & Tyler PLOS Biology 2019

Essential point 5

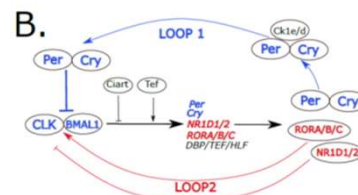
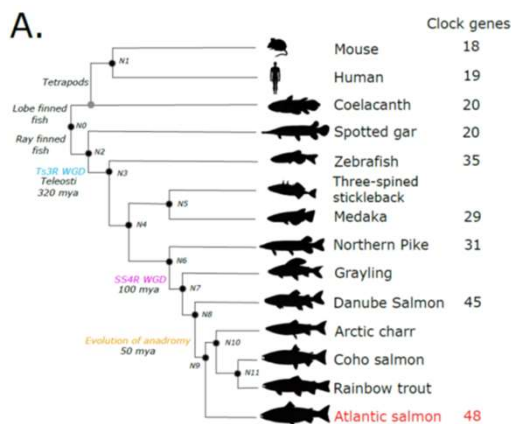
- Clocks are *temperature compensated*

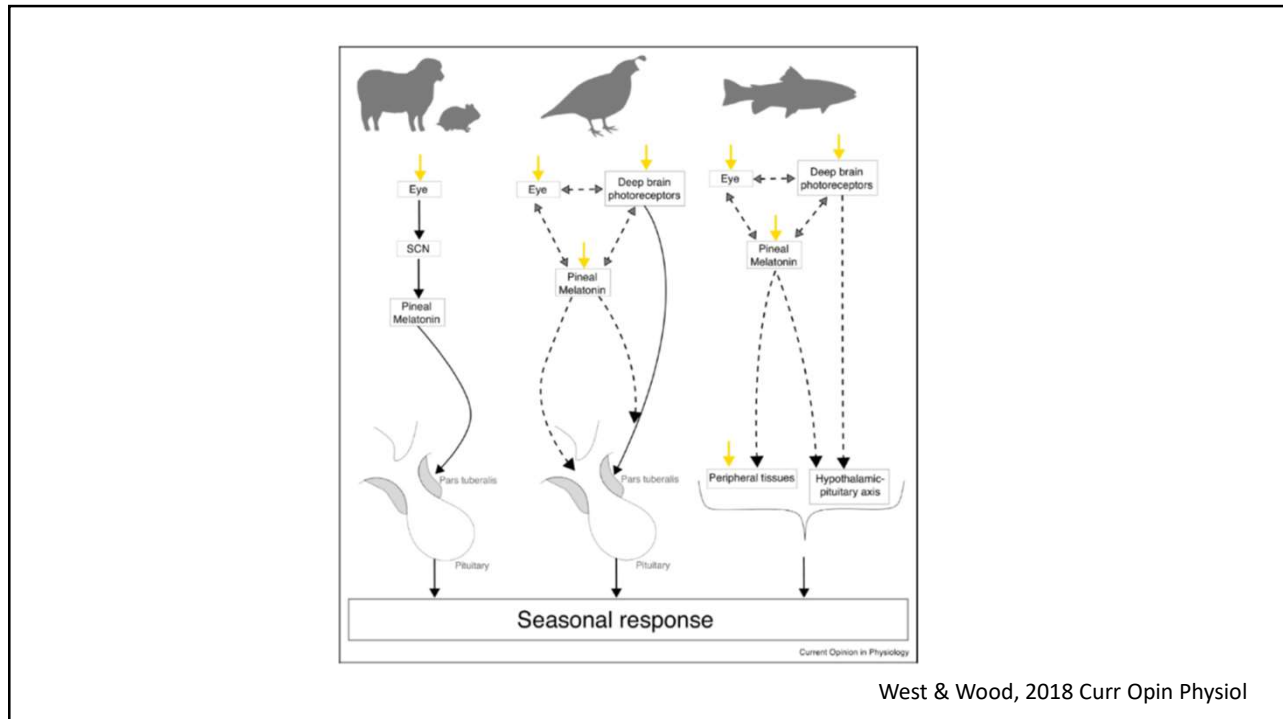


Essential point 6

- Clock mechanisms in fish, birds and mammals are *comparable* but not the same

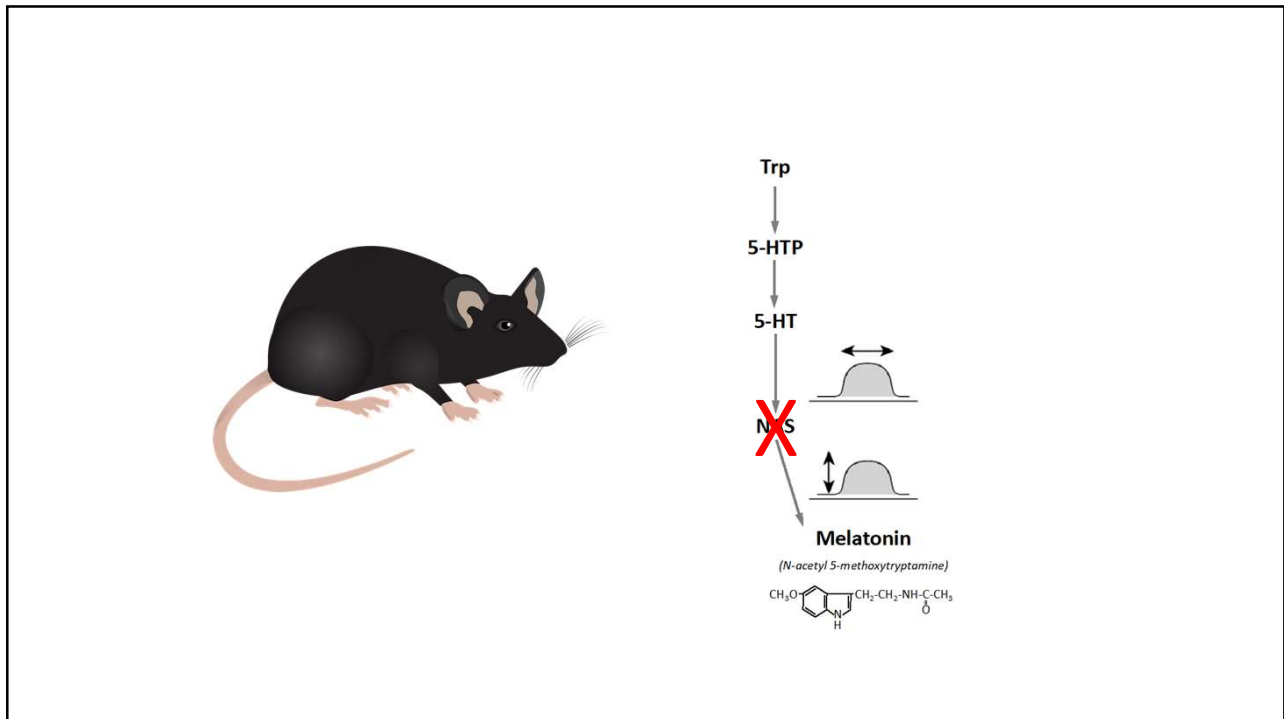
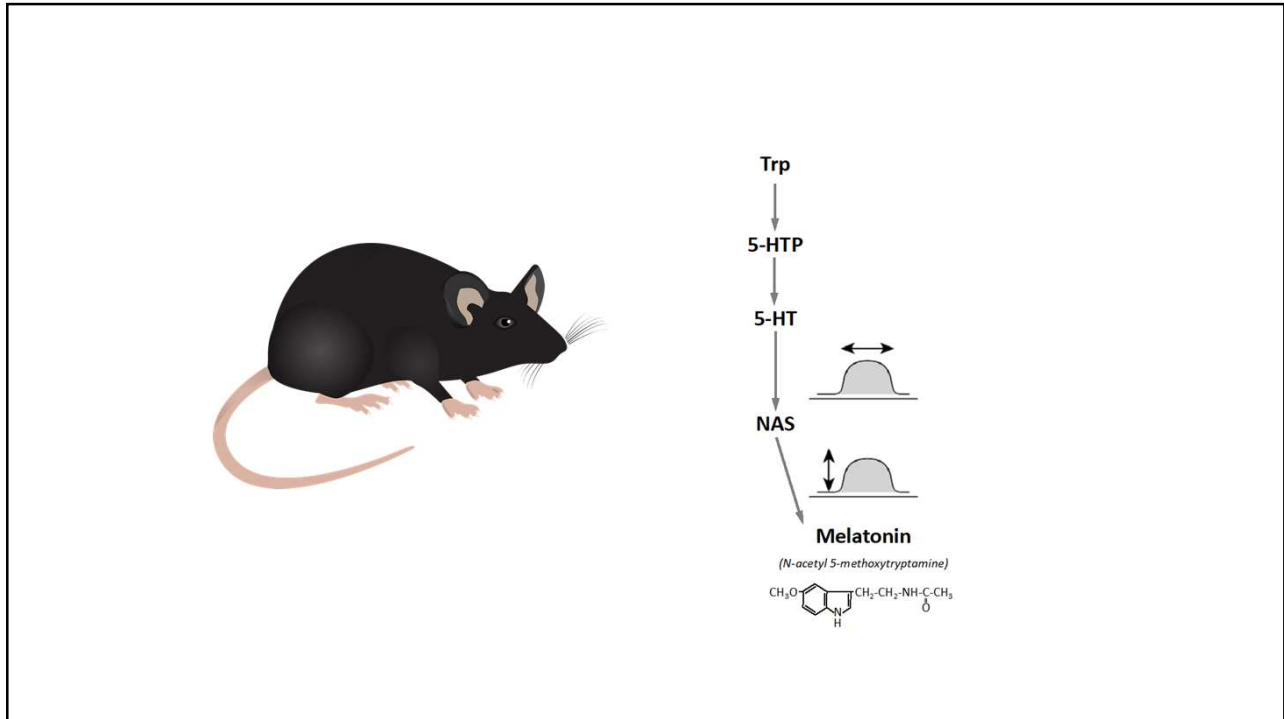
Circadian clock complexity



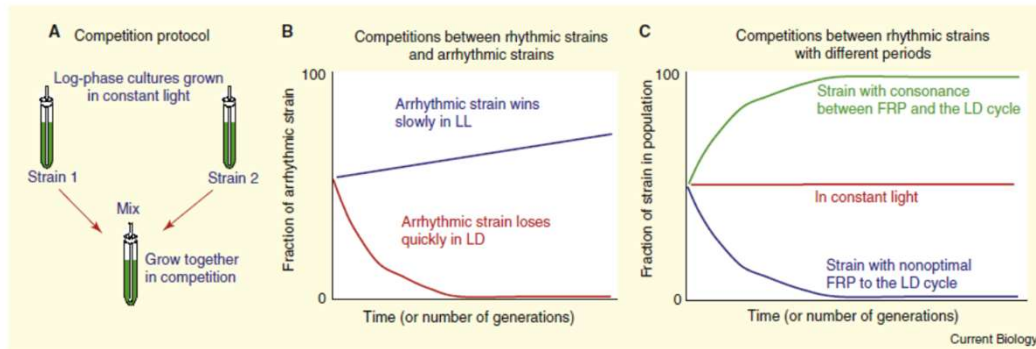


Essential point 7

- Clocks are subject to genetically based selection (natural / artificial / accidental)



Competition in Blue-green algae



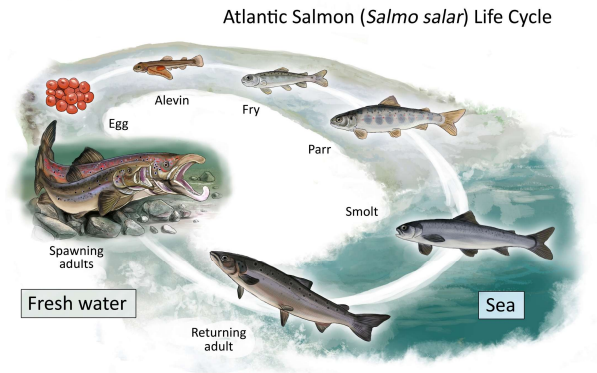
Carl Johnson

7 Essential points

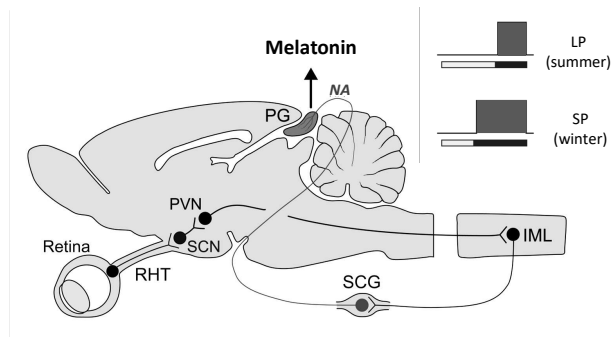
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- The light / dark cycle synchronises daily biological clocks and seasonal biological calendars
- An *oscillation* does not require an *oscillator* AND *clock function* does not necessarily depend on an oscillator
- Clocks and their outputs should not be confused
- Clocks and calendars are *temperature compensated*
- Clock mechanisms in fish, birds and mammals are *comparable* but not the same
- Clocks are subject to genetically based selection (natural / artificial / accidental)

ECOLOGICAL ASPECTS OF ENDOGENOUS RHYTHMICITY

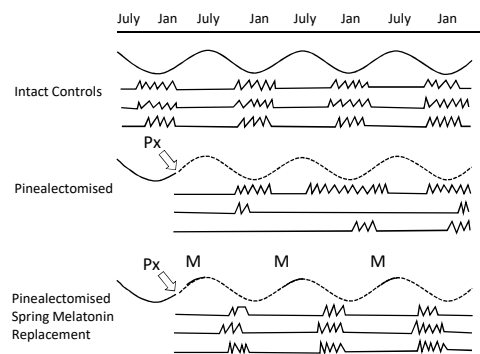
J. T. ENRIGHT¹
*Scripps Institution of Oceanography
University of California
La Jolla, California*



Melatonin is the “photoperiodic relay” in mammals



Melatonin Synchronises Internal Calendars



Woodfill et al, 1994

