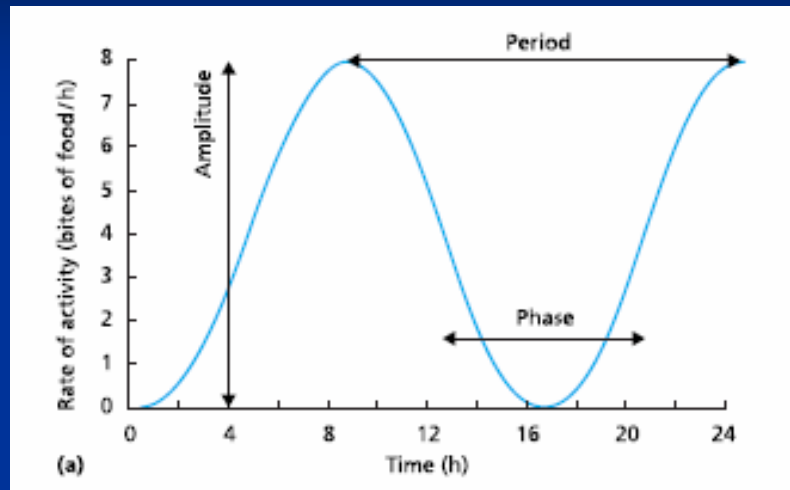


BIORITME *(Biorhythm)*

*Mengapa bisa berulang
secara teratur ??*

Rhythmic behavior:



Prinsip dasar :

- ✓ Sistem saraf & endokrin: kombinasi kontrol perilaku jangka pendek & jangka panjang
- ✓ Adanya keterlibatan pengaruh lingkungan secara siklik (*daily light – dark cycle – seasonal*).
- ✓ Selama rentang evolusioner: pengembangan variasi fisiologis endogen & ritme perilaku yang secara periodik selaras dengan ritme lingkungan.

Biological clocks:

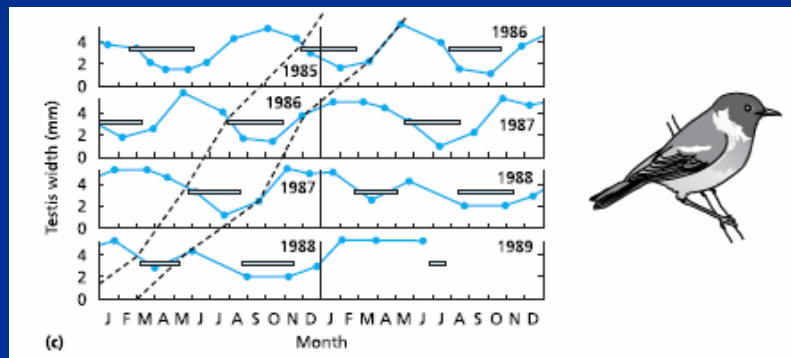
Perangkat atau mekanisme internal yang dapat menghasilkan aksi perilaku secara ritmik (teratur)
(Scott, 2005)

Zeitgebers \longleftrightarrow Pacemaker



BIORITME

keep on track



CIRCADIAN

- ✓ Have a period of roughly 24-h (18 – 28 h, under constant condition in which slightly dependent on temperature)
- ✓ Function on the cellular level and are heritable
- ✓ Sensitive to lithium ions which lengthen the period in many organisms
- ✓ Environmental cues: daily light – dark cycle, as provided by variations in light intensity

CIRCANNUAL

- ✓ Entrained to the annual seasonal cycle
- ✓ Particularly for reproductive & dormancy
- ✓ Seldom exactly a year
- ✓ Example: hibernating ground squirrels

CIRCALUNAR (Circasynodic)

- ✓ Entrained to the 29-day lunar month
- ✓ Examples: Sexual phase *Platynereis dumerlii*
Reproductive palolo worms

CIRCATIDAL

- ✓ Hewan-hewan di zona intertidal.
- ✓ Fluktuasi paparan air dan udara terbuka saat pasang naik & surut.
- ✓ Eg: polychaetas, kontraksi anemons, filtrasi bivalvia.
- ✓ Pada hewan-hewan pesisir, berlaku ***circasyzgic*** (semilunar) rhythm --- pasang surut 2-mingguan
- ✓ Eg: *Littorina rudis*, kepiting

Mekanisme kontrol:

- 1) Secara internal, perangkat utama bukanlah sistem saraf & endokrin, melainkan perangkat *endogenous clock* (EC) .
- 2) Melibatkan lebih dari satu EC yang dapat saling berinteraksi, mengaktivasi sistem saraf & endokrin.
i. e: hewan-hewan empat musim, dgn perubahan panjang hari
- 3) Di mana letak EC & bagaimana kerjanya?

- 1) Circadian *Cockroaches* : serabut besar ocellus (ocellar) yang memanjang dari sel-sel lobus optik menuju sel-sel neurosecretory di saraf torak.
- 2) Moth: cerebral clock dan hormonal
- 3) Seasonal rhythmicity Molluscs: perubahan ion haemolymph & sel-sel saraf.
- 4) Burung, mamalia : *suprachiasmatic nuclei* (SCN), mata, & pineal gland --- set (*phase shifted*) by light pulses

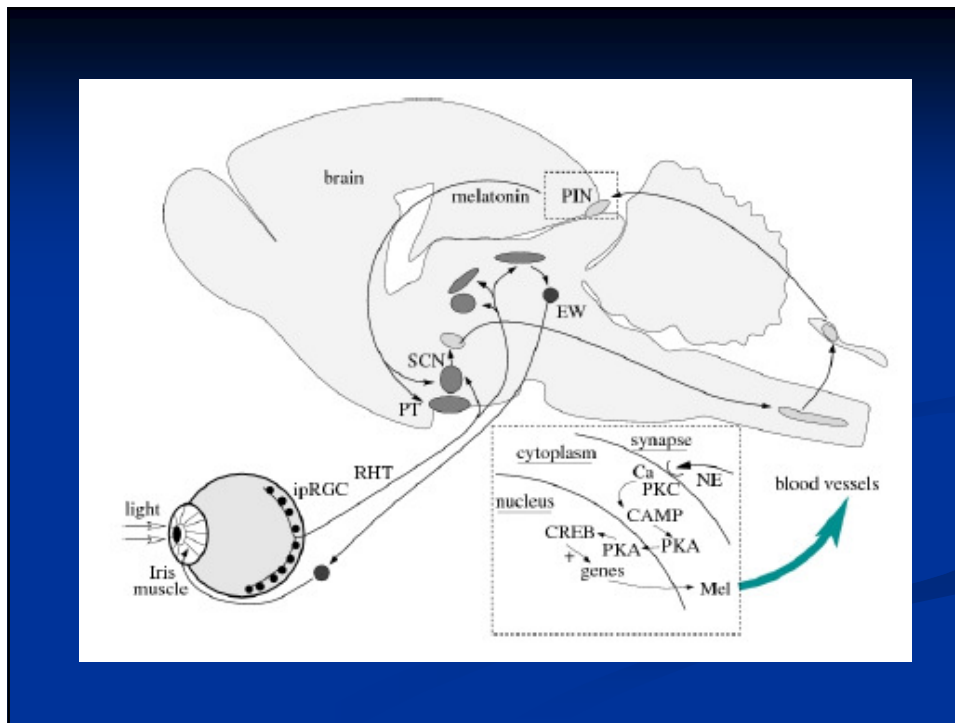


Figure 3. Circadian centres and pathways in mammals.

Light is perceived in ipRGC cells of the retina (intrinsically photosensitive Retinal Ganglion Cells). Signals from them arrive at the suprachiasmatic nucleus, SCN, the main biological clock in mammals. SCN couples – by sympathetic innervation - to the pineal, PIN, depicted in the main figure and in the inset. Melatonin is produced in the pineal, enters the blood stream and affects both the SCN and PT (pars tuberalis, center for photoperiodic control). The melatonin production in the pinealocytes, see inset, takes part via norepinephrine (NE), signalling. The signal cascade involves calcium ions and PKC (protein kinase C), increasing cyclic AMP. PKA (protein kinase A) phosphorylates CREB (transcription factor to bind DNA) in the nucleus, activating gene regulated melatonin production. Melatonin reaches the blood vessels. A special pathway from retina via the EW (Edinger-Westphal) area actuates the papillary light reflex and the iris muscle.

