

How can an educational system be designed to respect circadian rhythms and chronobiology?

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Life Between Clocks



Sun clock

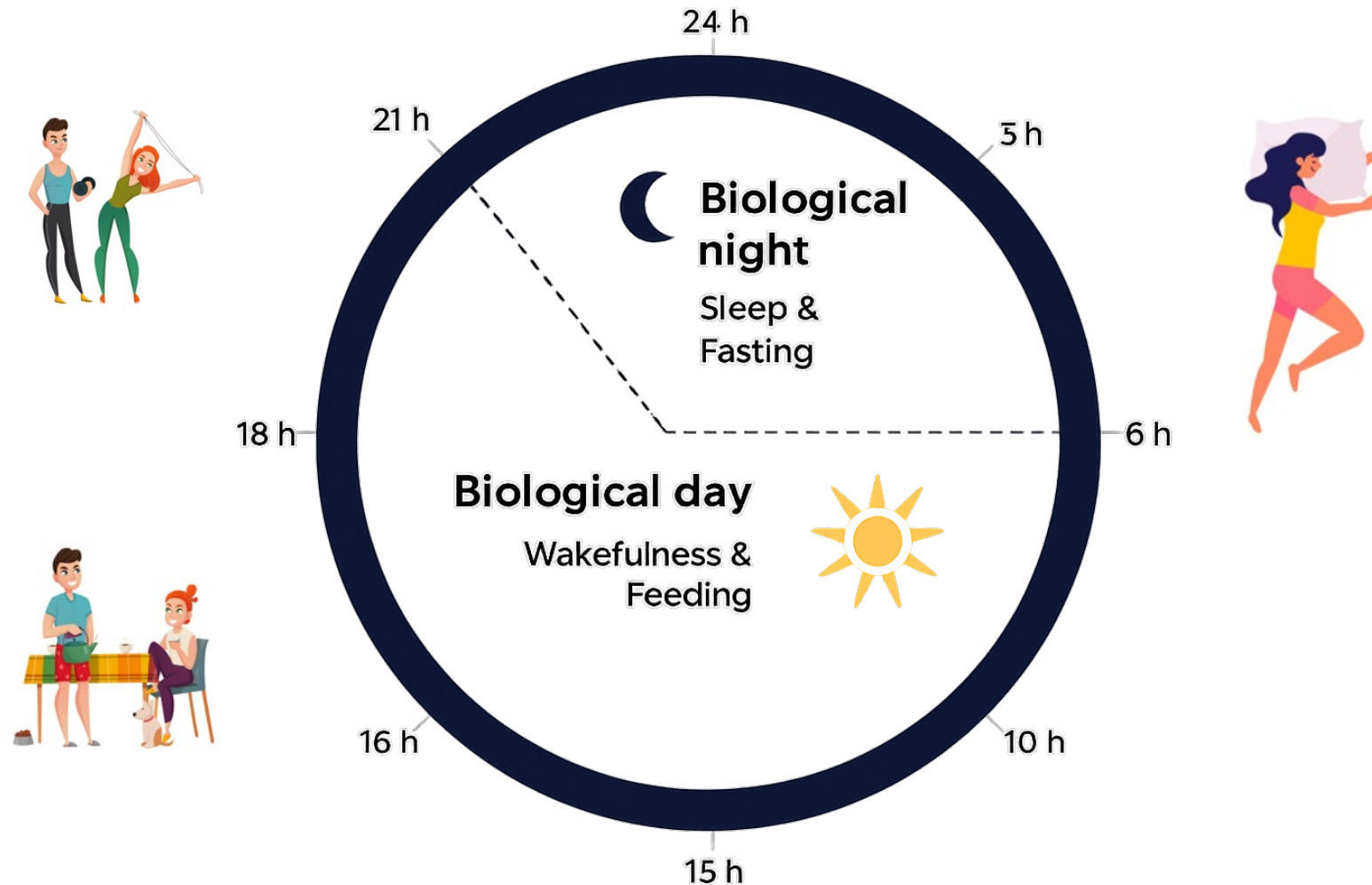


Biological clock
or "circadian system"

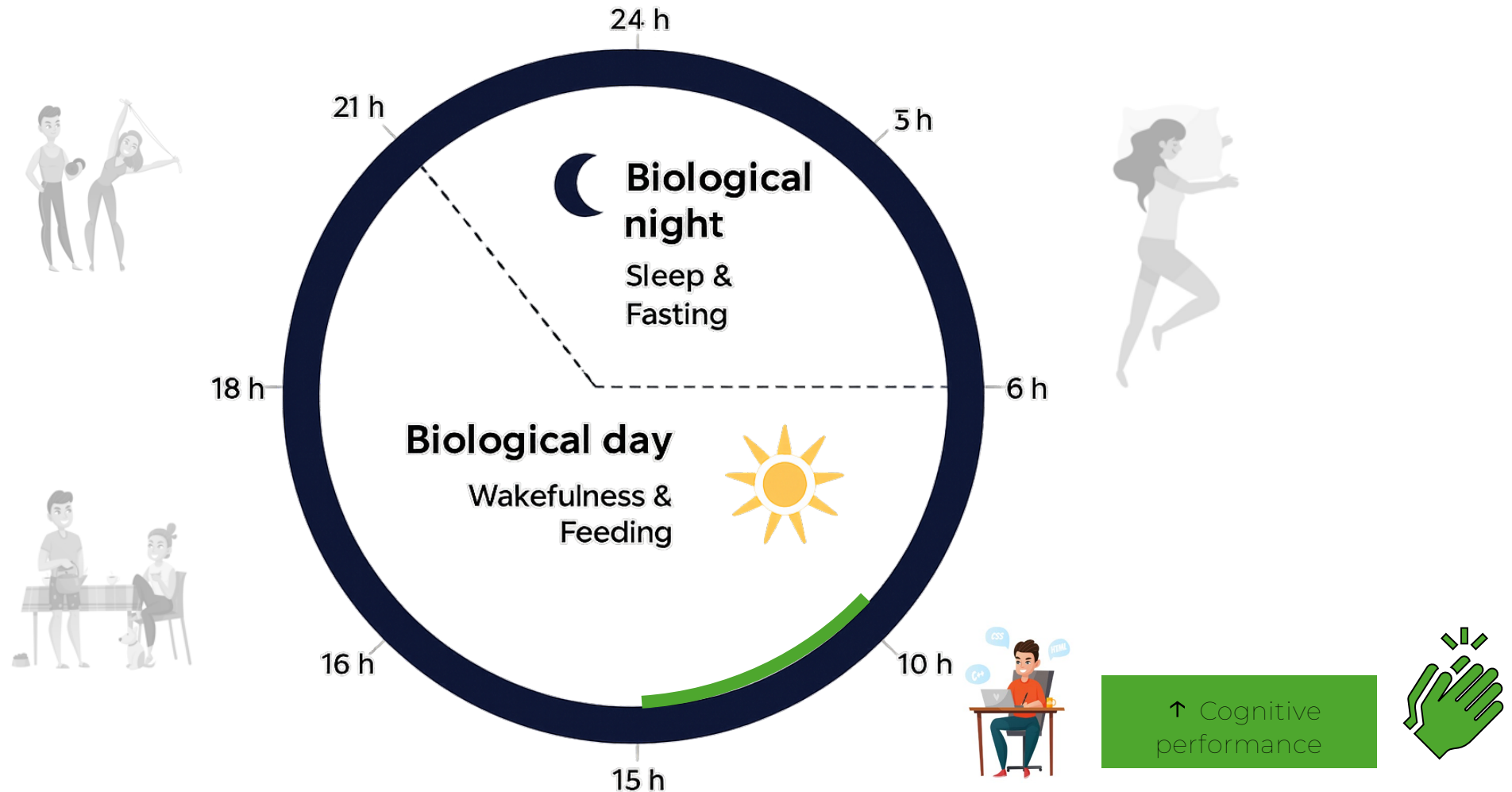


Social clock
Local time
(e.g. school schedules)

Temporal Organization of the Body in a 24-h Period

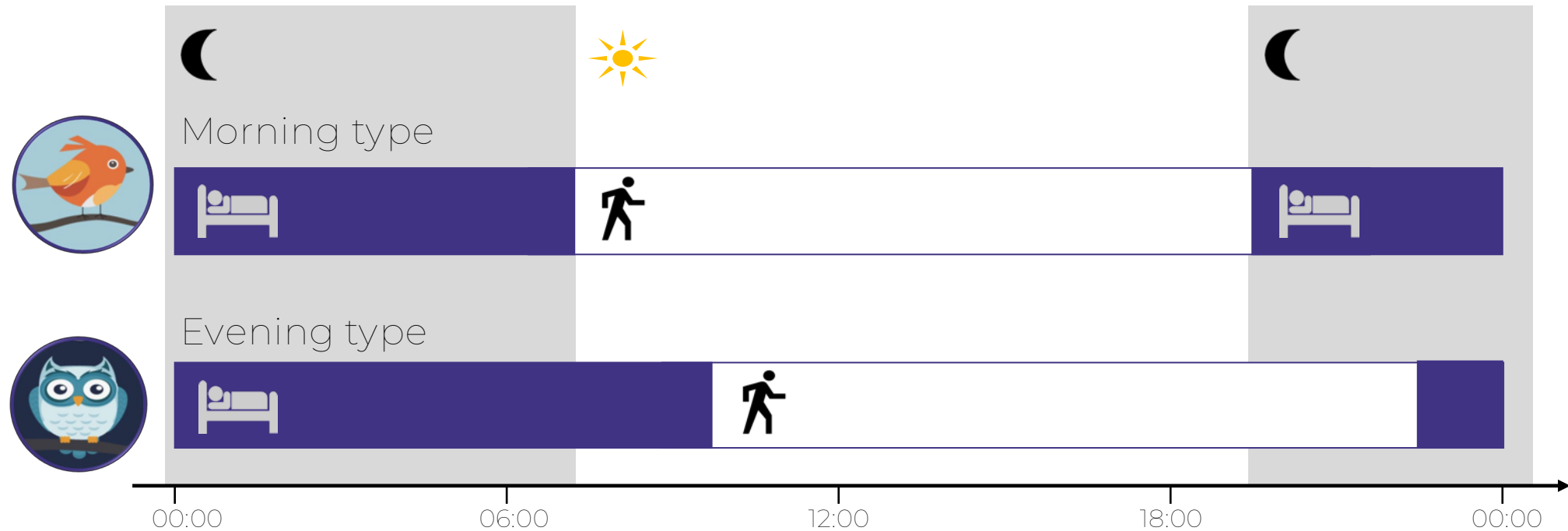


Temporal Organization of the Body in a 24-h Period

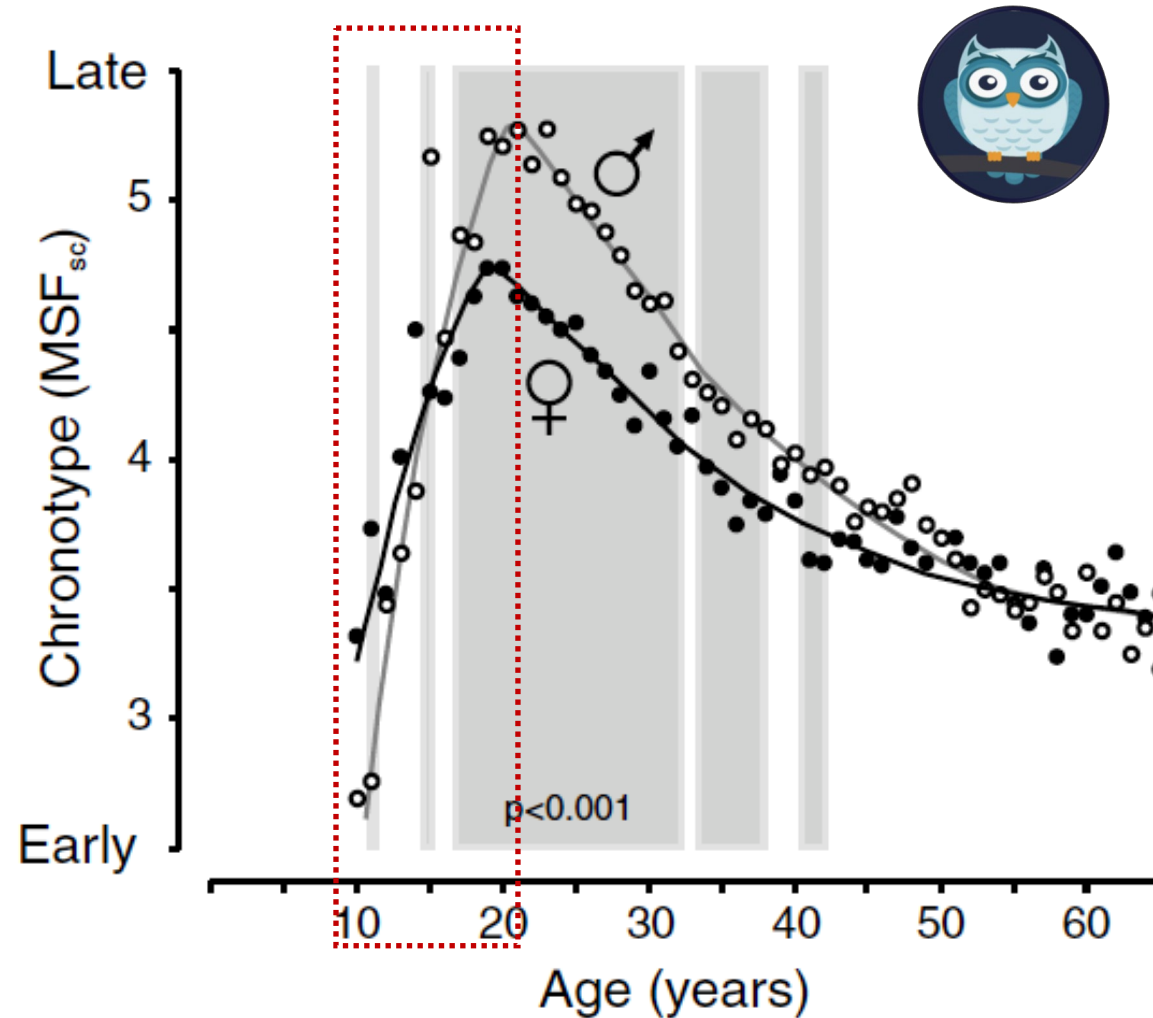


Chronotype

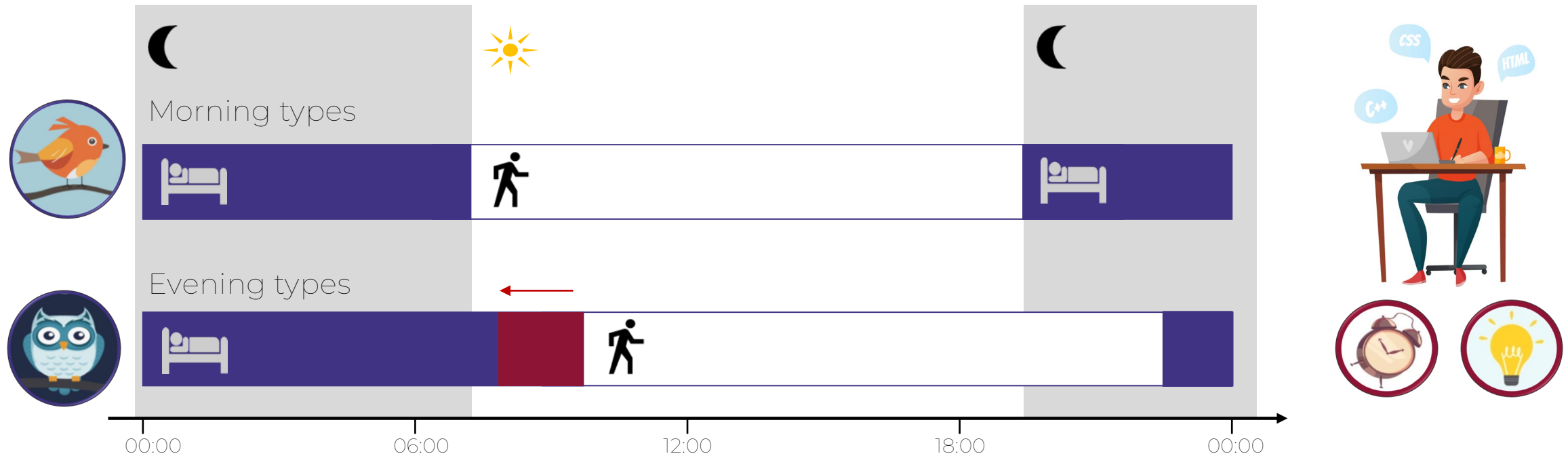
Defines an individual's preference for a particular time of day

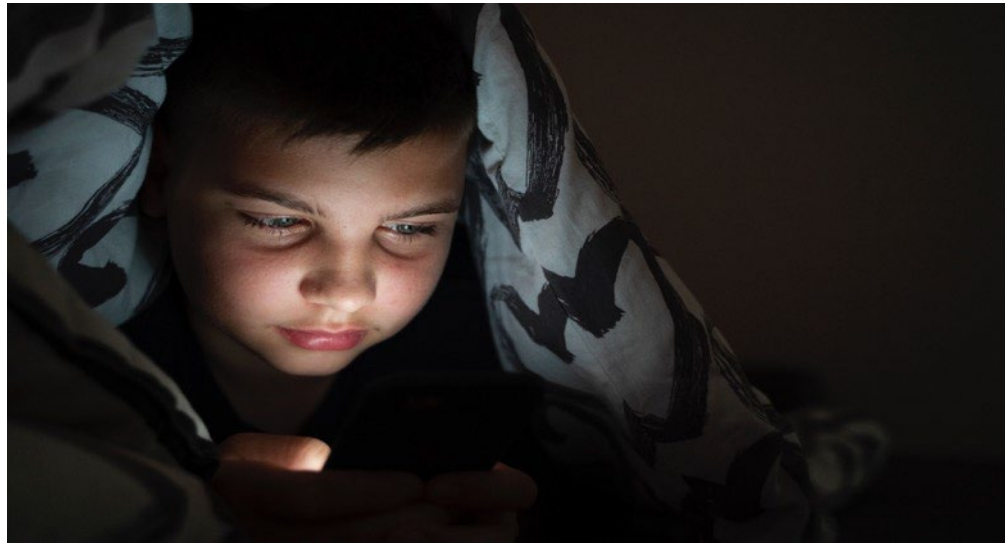


Chronotype: A Marker of the End of Adolescence



Chronotype and its Interaction with Lifestyle Factors







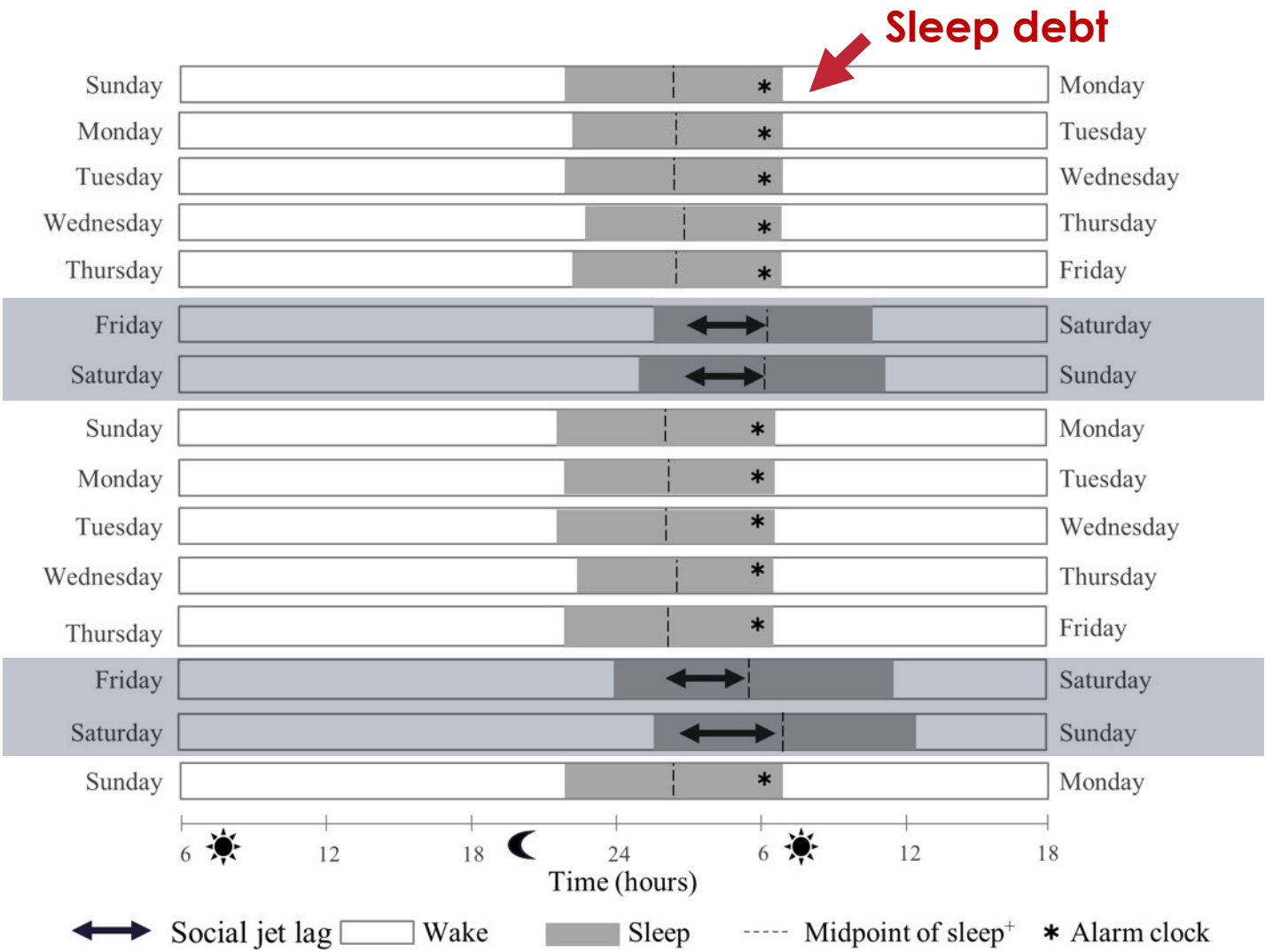
Eveningness in School-Aged Children

- ↑ Daytime sleepiness
- ↑ Exposure to artificial light at night
- ↓ Sleep duration
- ↓ Day-night contrast
- ↑ Social jet lag

“... Daytime sleepiness is associated with alterations in behavior, mood, and performance in school-aged children...”



Social Jet Lag



Eveningness is Associated with Sedentary Behavior and a Lower Well-Being in Adolescents

“...Daytime sleepiness is greater in adolescents.”

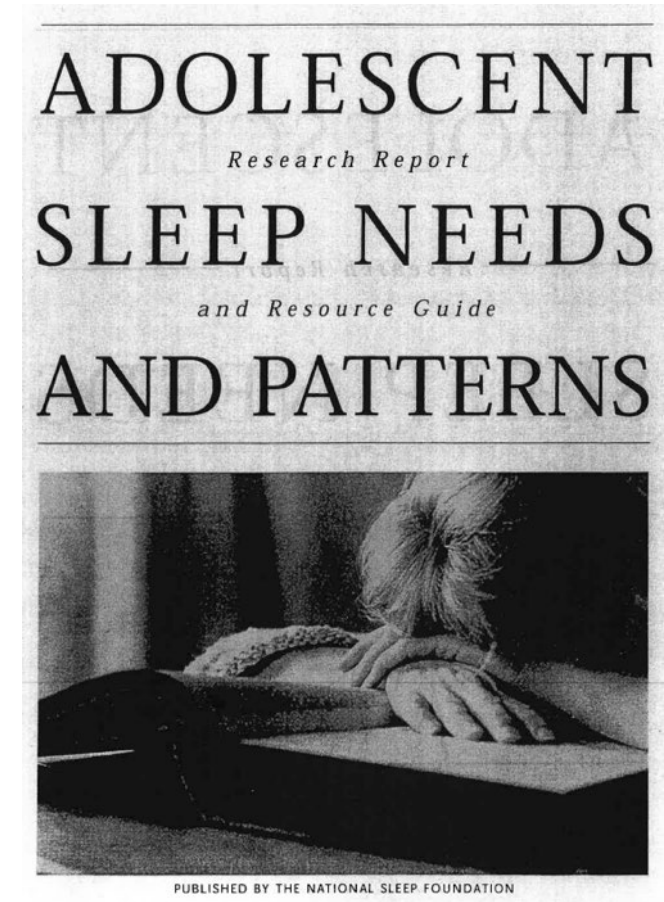
Wildom et al. *JAMA Pediatr.* 2020; 174:697-704

“...Mood and sleep quality worsen in adolescents with an evening chronotype”

Lang et al. *Front Psychiatry* 2022; 13: 785079

“...Physical activity levels are lower in adolescents with an evening chronotype”

Olds et al. *Sleep.* 2011; 34:1299-1307; Merikanto et al. *Sleep Med* 2020; 74:189-198.





POLICY STATEMENT

School Start Times for Adolescents

“The American Academy of Pediatrics strongly supports school districts' efforts to optimize student sleep and urges middle and high schools to seek start times that allow students the opportunity to achieve optimal sleep levels (8:30 to 9:30).”



... Lower daytime sleepiness and more punctuality..."

Berry et al. *J Adolesc Health*. 2021; 69:831-837

... Greater sleep duration and a lower sleep debt..."

Wildom et al. *JAMA Pediatr*. 2020; 174:697-704

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Delaying school
start times by one
hour helps
adolescents align
with their
biological clocks
and manage
extracurricular
schedules.



RESEARCH GROUP

Precision Nutrition and Chrononutrition



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