

The Science of Sleep-Aviation Rest and Fatigue Regulations for Pilots

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April 1, 2014
Icarus: Northwestern University

Agenda

- Sleep science
- Rationale for the rule
- Key elements of FAR 117
- Q/A



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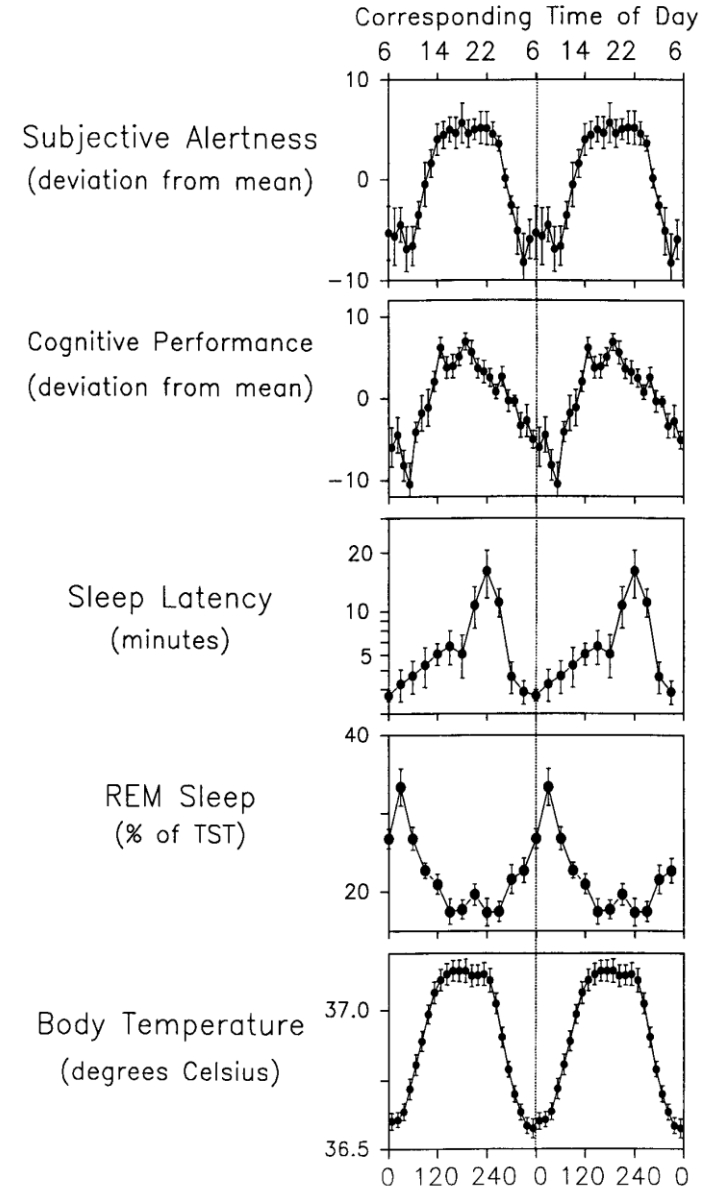
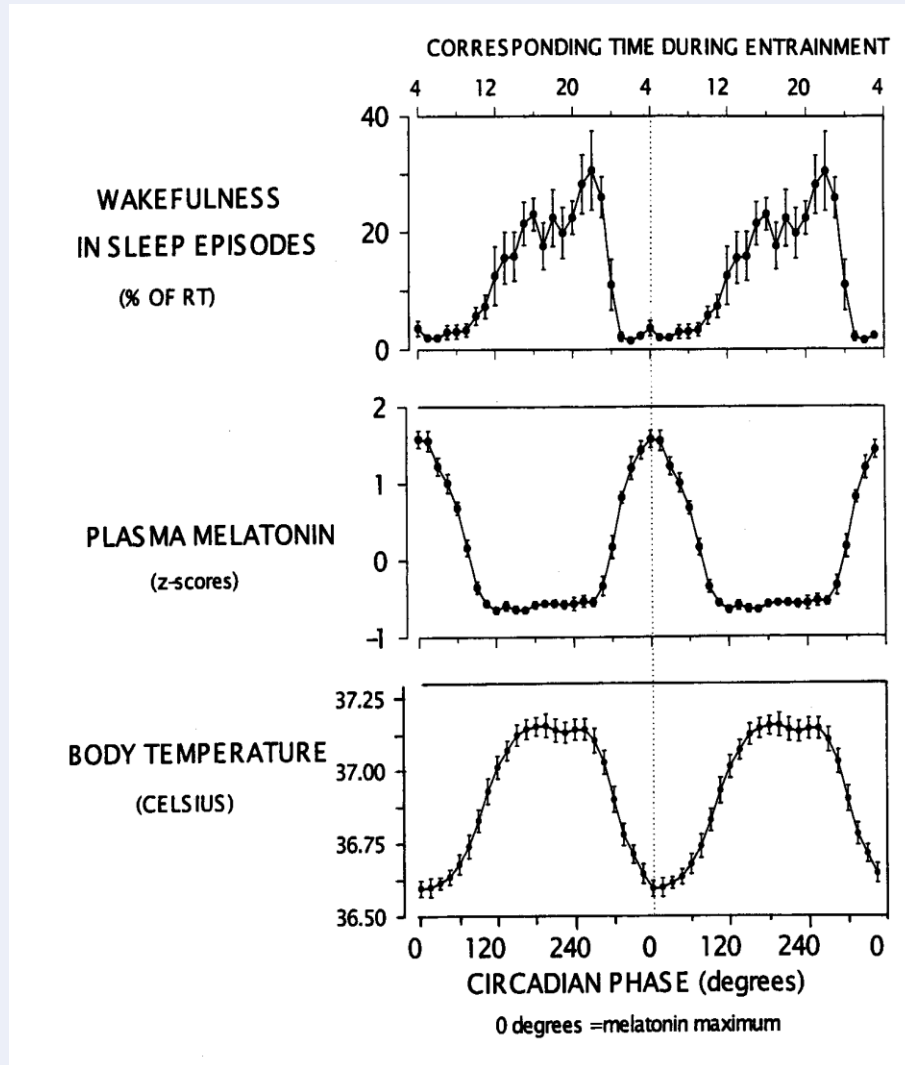
Objectives: Why are there RULES?

- The sleep science
 - Impact of Circadian Rhythms
 - Regulation of sleep-wake
 - Consequences of sleep loss
 - Impact of shift work
 - Impact of Jet lag

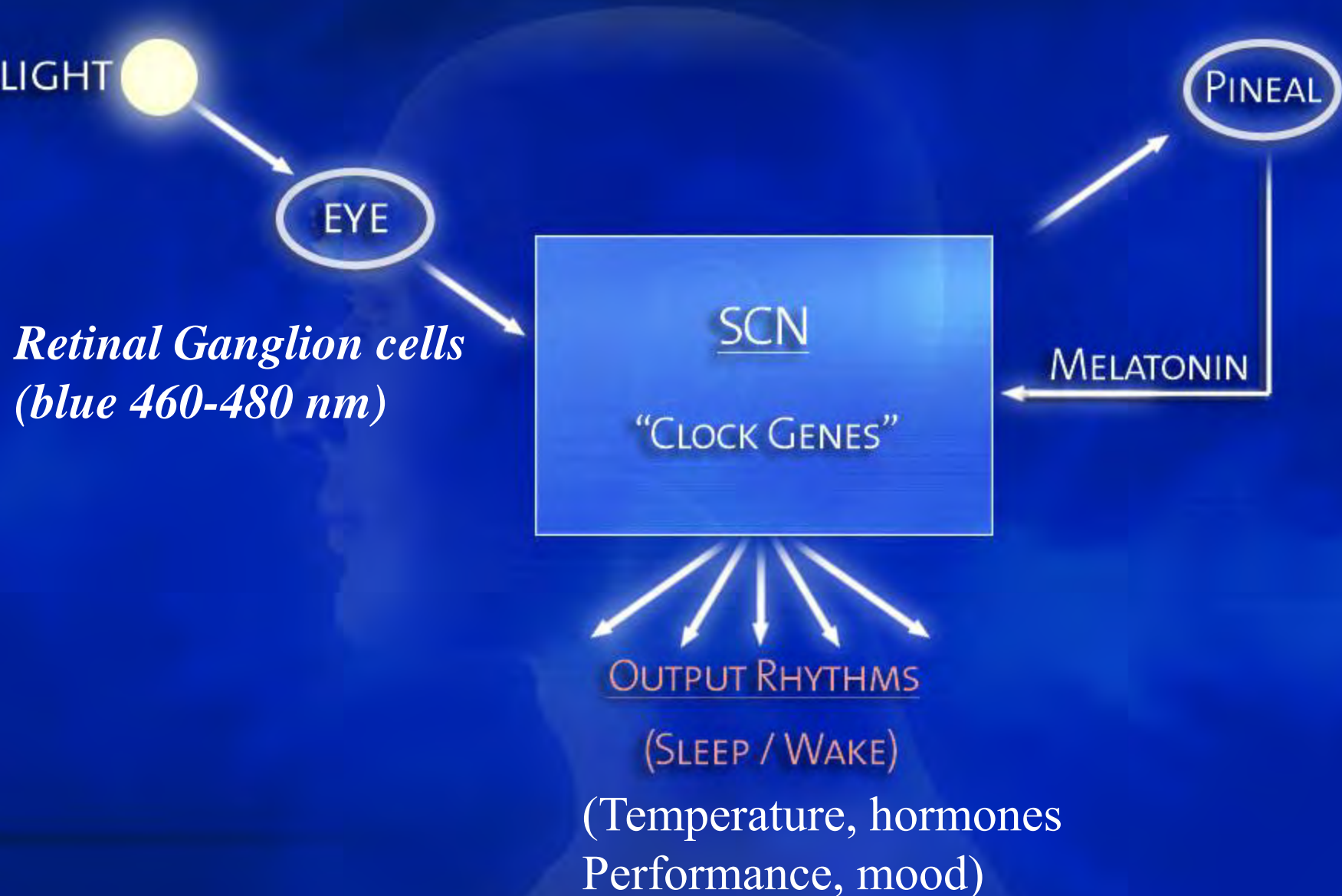
Duty hours

- **Why does the duty hours rule differ by time of day**
 - Daily duty hours 8 or 9 hours
- **Why is there a cumulative hours rule?**
 - Cumulative duty hours 100 or 1000 hours

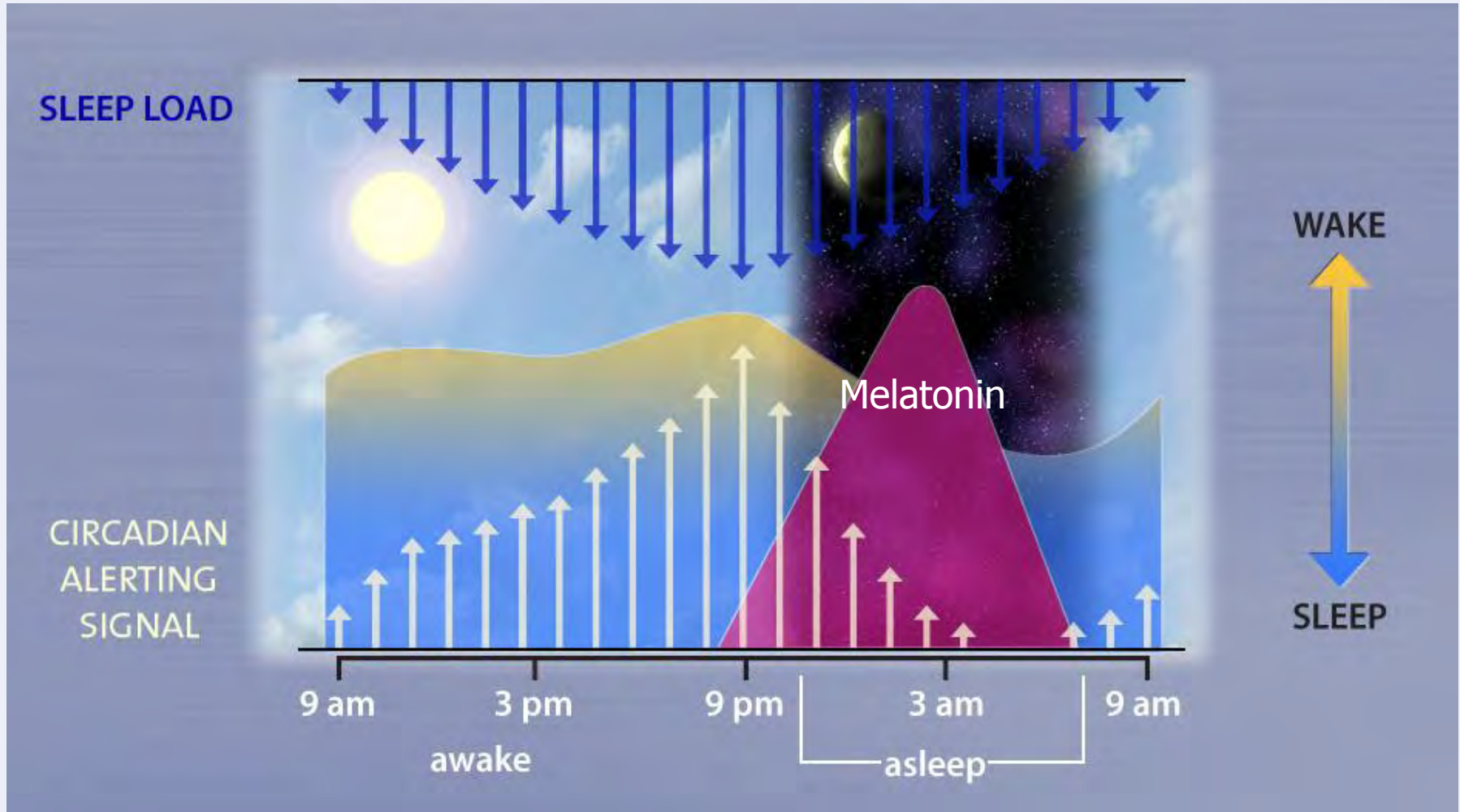
Circadian Rhythms



Circadian Timing System



Circadian and Homeostatic Regulation of Sleep

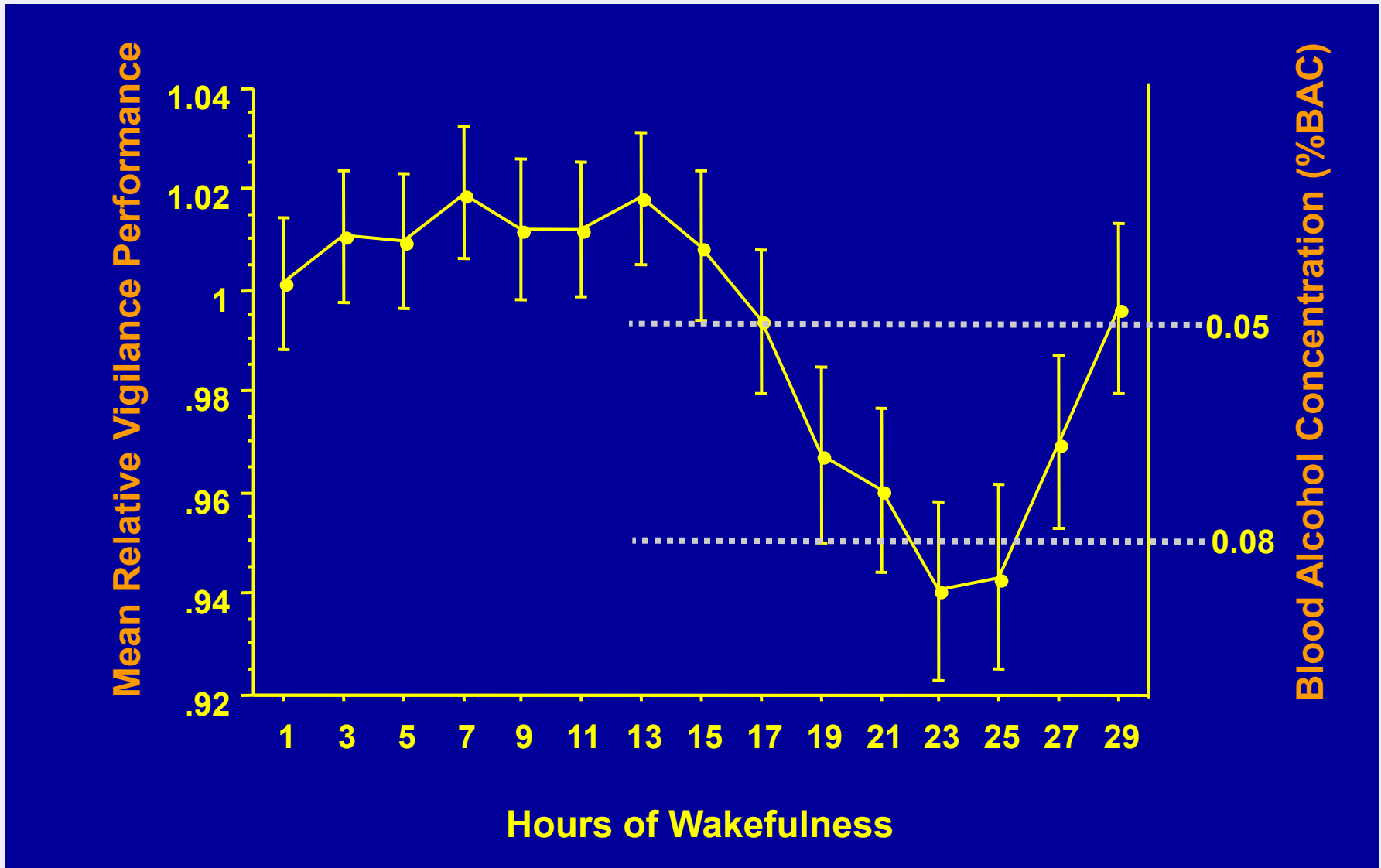


Adapted from Edgar et al. *J Neurosci.* 1993



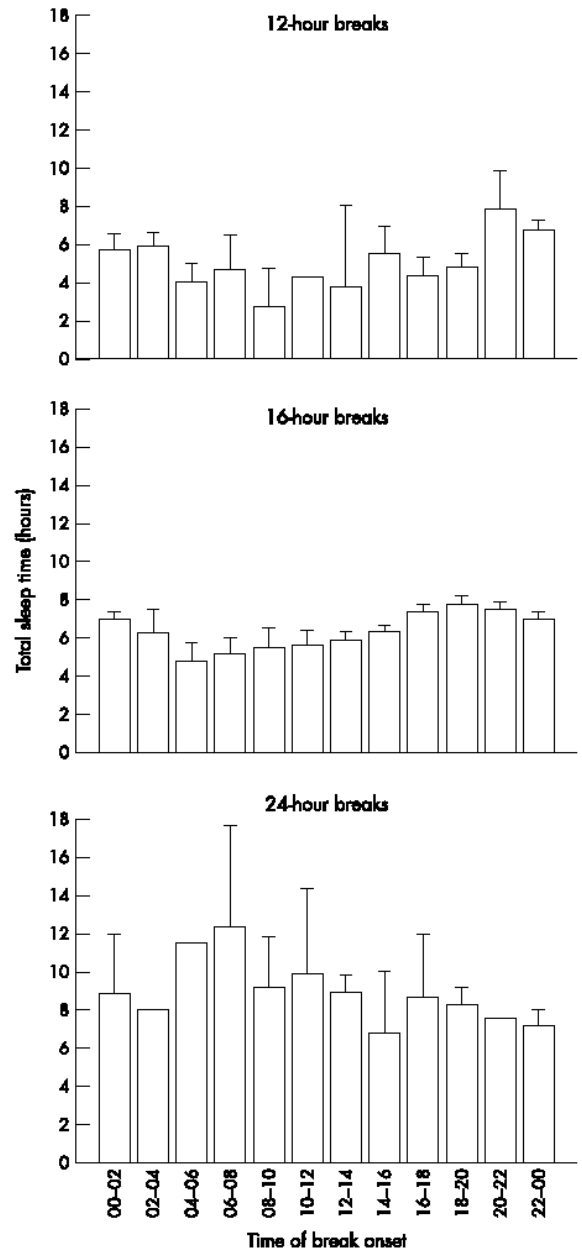
How tired is too tired?

Expressing the performance impairment due one night of sleep loss as a Blood Alcohol Equivalent

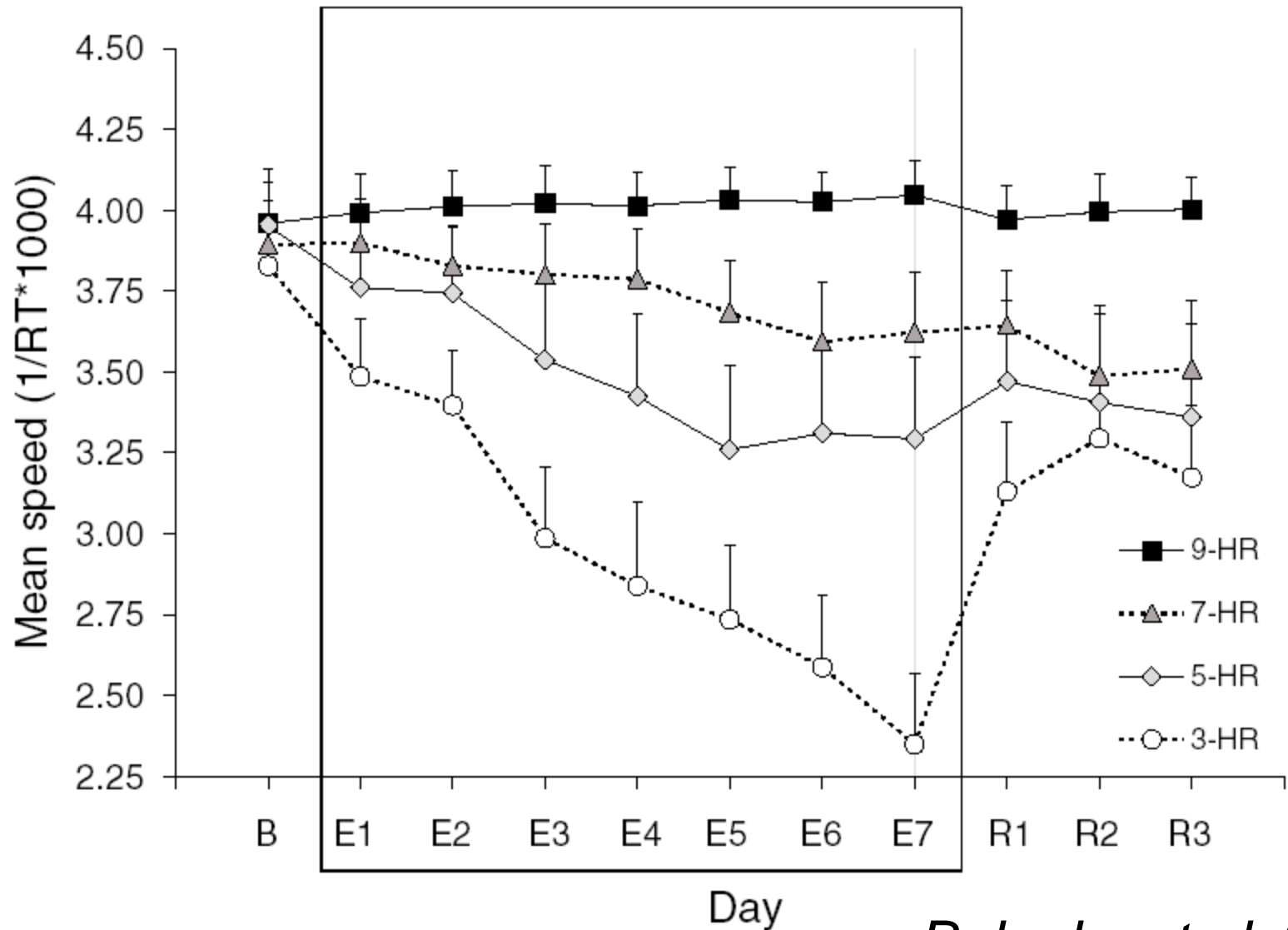


Rest Duration

- **10 CONSECUTIVE HOURS** minimum and may not be reduced.
 - This rest must provide a minimum of eight uninterrupted hours of sleep opportunity.



Partial Sleep Debt: Impact on Performance



Belenky et al, 2003

Onboard Crew Rest Facilities

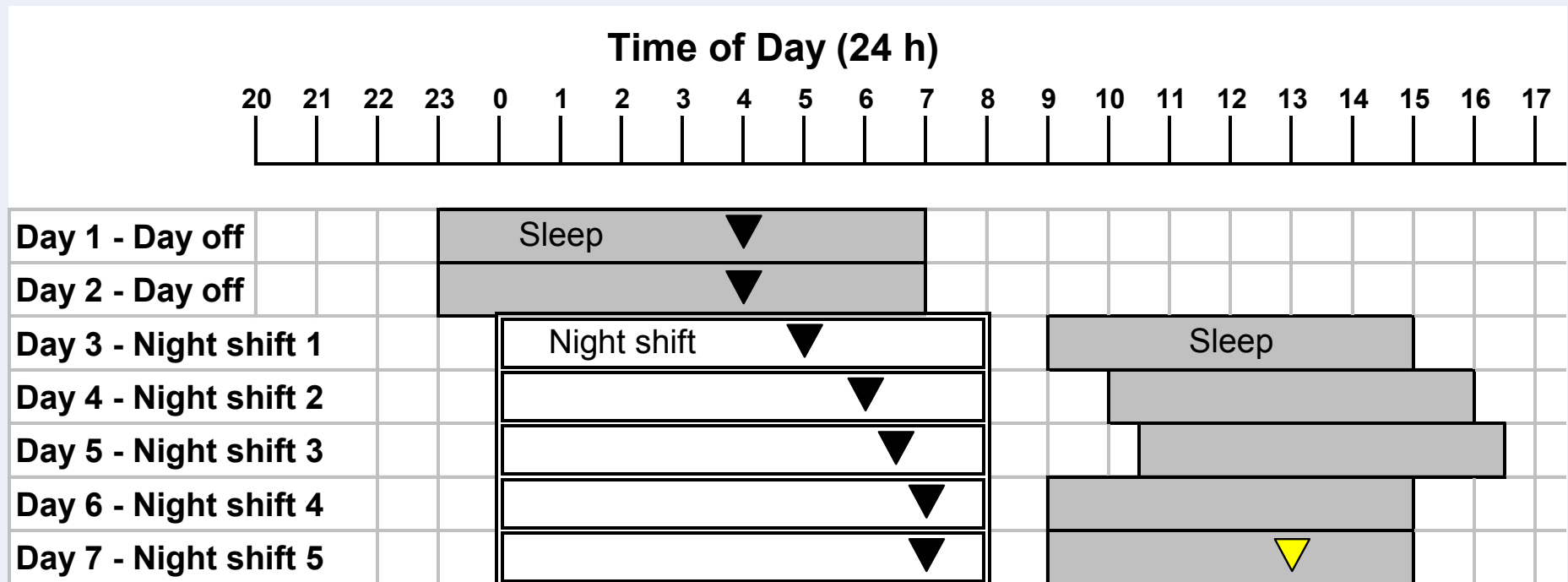
Why do we care?

- To sleep well there are several sleep hygiene rules to follow - those related to the sleep environment include:
 - cool
 - dark
 - quiet
 - Recumbent (lying down)

Further Challenges: Shift work & Jet Lag

Night work

- Circadian misalignment makes working at night and sleeping during the day difficult



temperature minimum = time when most sleepy

Major complaints of shift workers

- sleep disruption
- reduced sleep duration & quality
- increased fatigue
- reduced alertness
- reduced performance
- increased psycho-social problems
- increased health problems
- increased risk of accidents

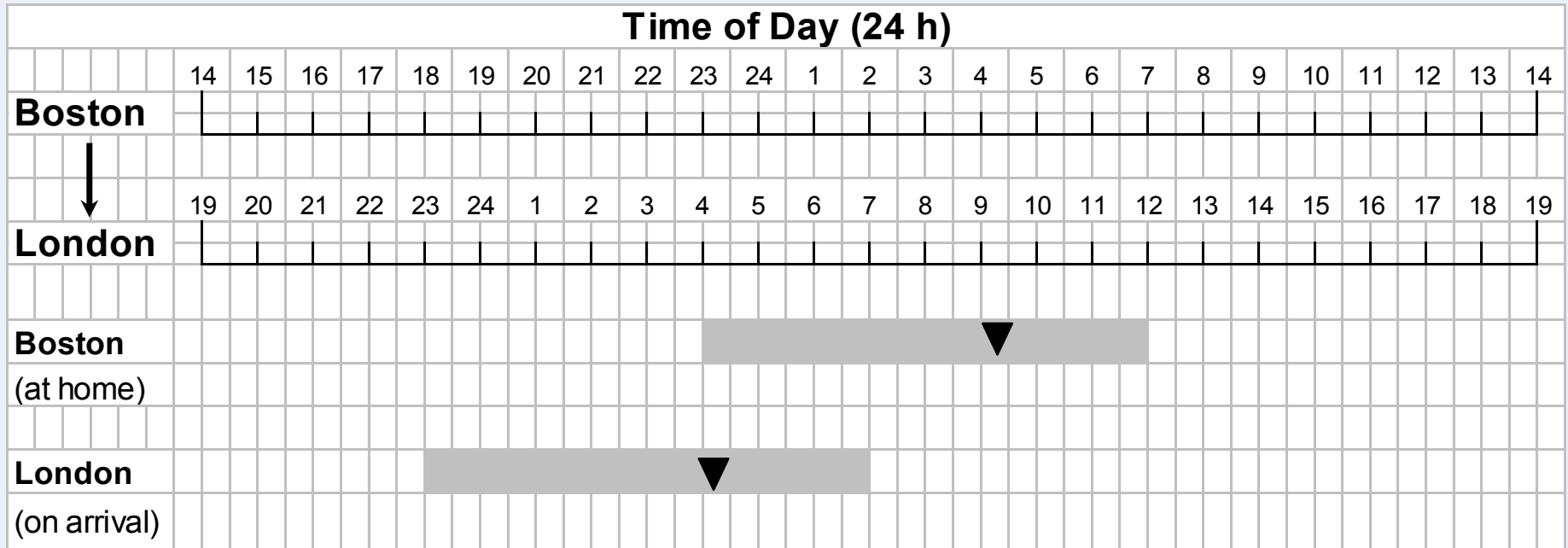
Jet Lag

Acclimation & Theater

- Jet lag is associated with travel across multiple time zones
- Results in misalignment between the internal circadian clock and the external light-dark and sleep-wake cycle
- Results in impairment of daytime function, general malaise, or somatic symptoms such as gastrointestinal disturbance within one to two days after travel.

Jet lag: The Cause

- Misalignment between the circadian clock and local time

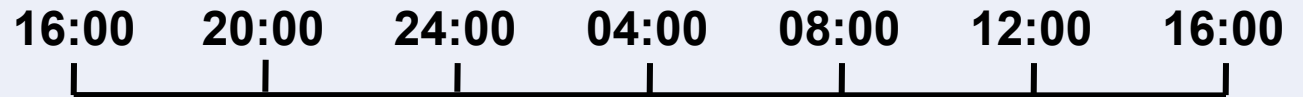


= when I expect to sleep ok

▼ = temperature minimum

Travelling East

Clock Time in Denver (hours)



Sleep time in Denver



Sleep time in London



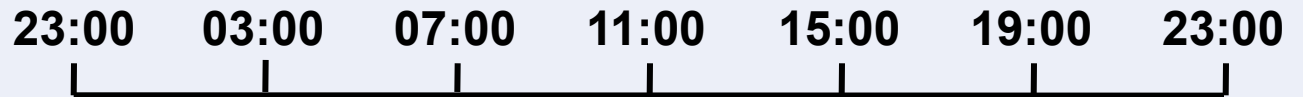
Light exposure



Sleep time in London

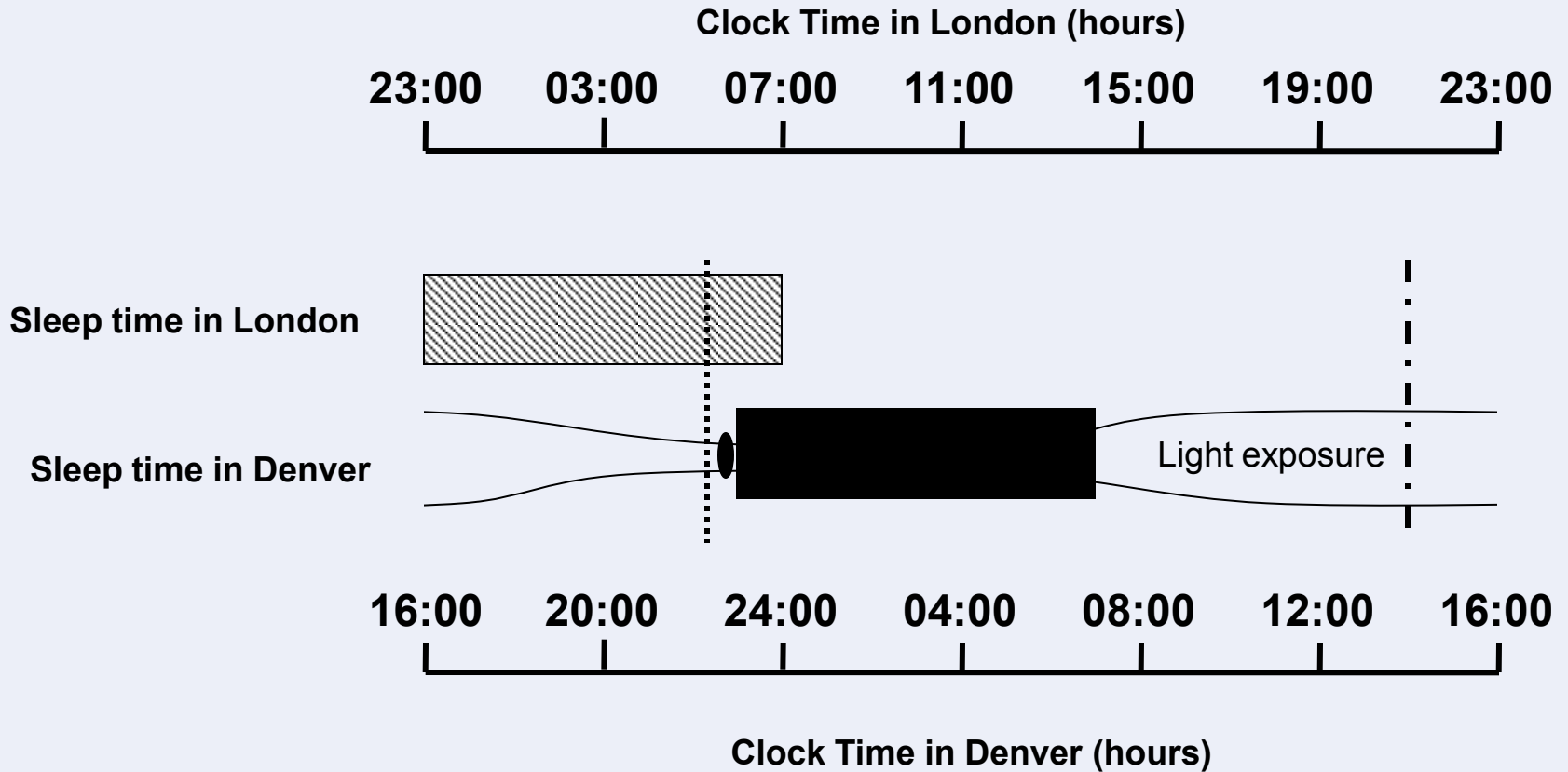


Light exposure



Clock Time in London (hours)

Travelling West





Thank you