

# 2-Process Model of Sleep Regulation



## Sleep is regulated by two key processes

Sleep is controlled by two processes that help us to be awake during the day and asleep at night. The 2-Process Model of Sleep Regulation is comprised of Process C (Circadian Rhythms or Body Clock) and Process S (Homeostatic Sleep Drive).

### Process C: Circadian Rhythms

Circadian rhythms are the body's ~24-hour biological clock. Circadian rhythms control various physiological processes, including body temperature rhythms and melatonin production, which work together to produce a sleep-wake cycle. The circadian pacemaker, or master clock, coordinates the millions of clocks in all cells of your body.

Light is the major timekeeper of our circadian rhythms and helps them synchronise with the day and night cycle. This ultimately allows us to sleep at night and be most alert during the day. Getting lots of sunlight or bright light during the day and having low levels of light in the evenings (i.e., dim or orange/red lighting) are important regulators of our circadian system and help our bodies to know when it is day and night. Regular sleep-wake times are important for keeping our circadian rhythms synchronised (see our 'How to maintain a consistent sleep-wake schedule' Fact Sheet)

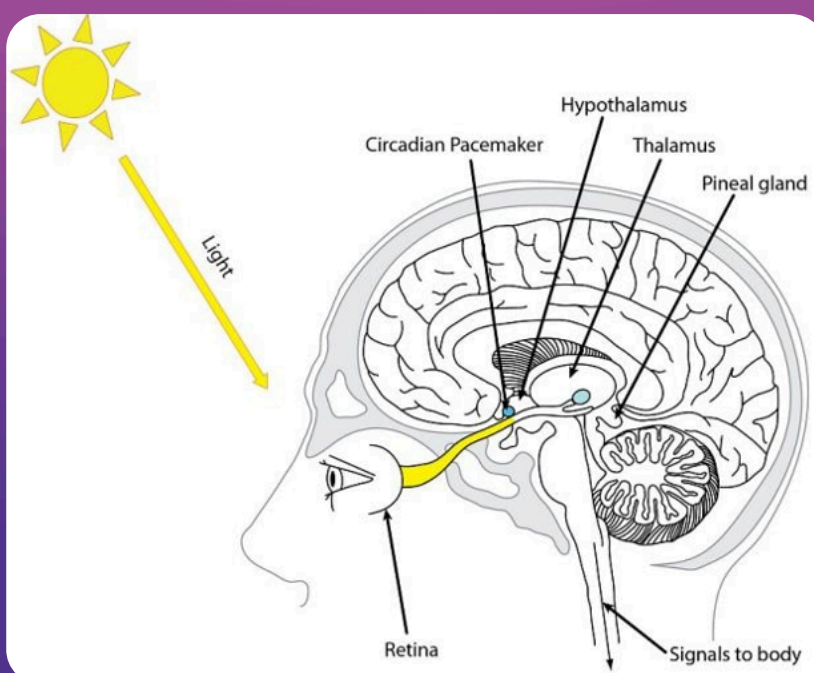


Figure 1. Light enters the eyes, stimulating a signal in the back of the retina and down a nerve tract to the circadian pacemaker in the brain. Image adapted from National Institutes of Health and BSCS. 2003. Sleep, sleep disorders, and biological rhythms. From NIH publication no. 04-4989.

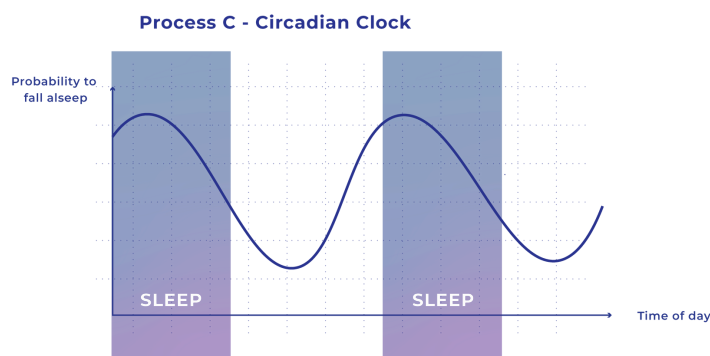


Figure 2. Process C. Circadian rhythms are ~ 24-hour rhythms controlled by the brain. They help us to feel sleepy at night and alert during the day. See this YouTube Video for more information <https://www.youtube.com/watch?v=zLHP6ovkbKw>

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### Process S: Homeostatic Sleep Drive

The longer we go without sleep, the sleepier we get.

Homeostatic sleep drive relates to the build-up of 'sleep pressure' or 'sleep drive' that occurs the longer you have been without sleep. Process S builds up throughout the day as your body accumulates a chemical called adenosine in the brain.

Basically, the longer you have been without sleep, the more your body starts to need it. It is like our hunger drive; the longer we go without food, the hungrier we get. The longer we go without sleep, the sleepier we get.

This natural build-up of sleep pressure at the end of the day is what helps us get to sleep at night. For example, after around 16 hours of wakefulness, we build up enough sleep pressure to fall and stay asleep for ~8 hours.

Figure 3 displays how our homeostatic sleep drive builds up during the day and then dissipates at night while we sleep. The diagrams on the following pages show how our sleep drive is impacted by naps, sleeping in, and earlier or later bedtimes.

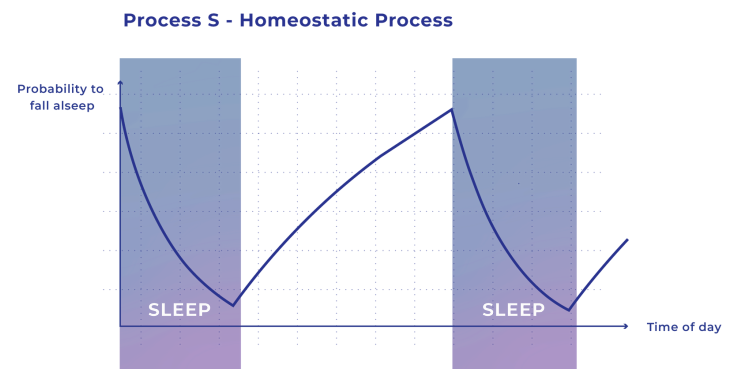
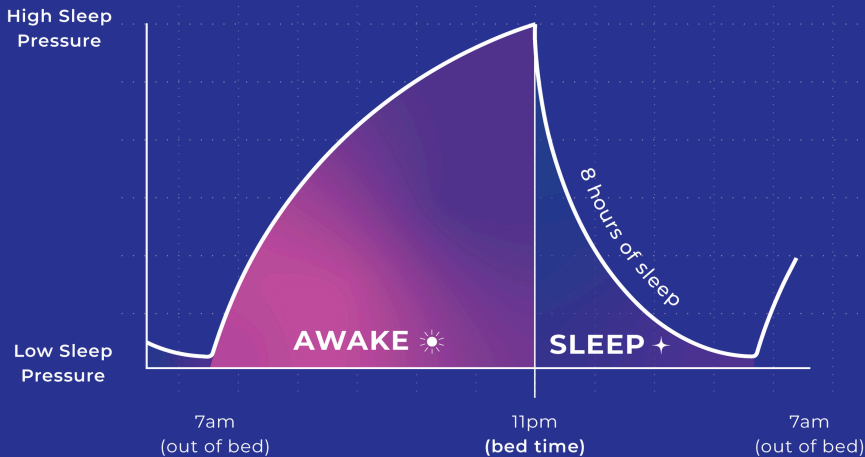


Figure 3: Process S - Homeostatic sleep drive. Our propensity to sleep increases as we are awake during the day and decreases as we sleep.

See this YouTube Video for more information  
<https://www.youtube.com/watch?v=zIHP6ovkbKw>

# Sleep pressure

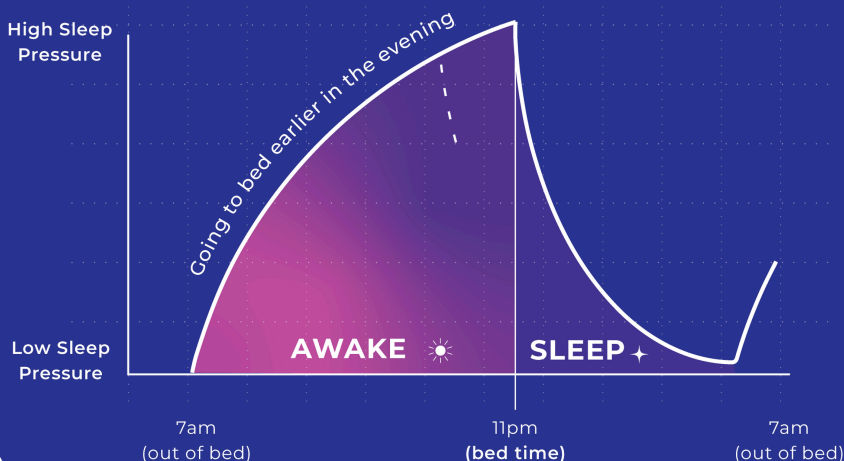
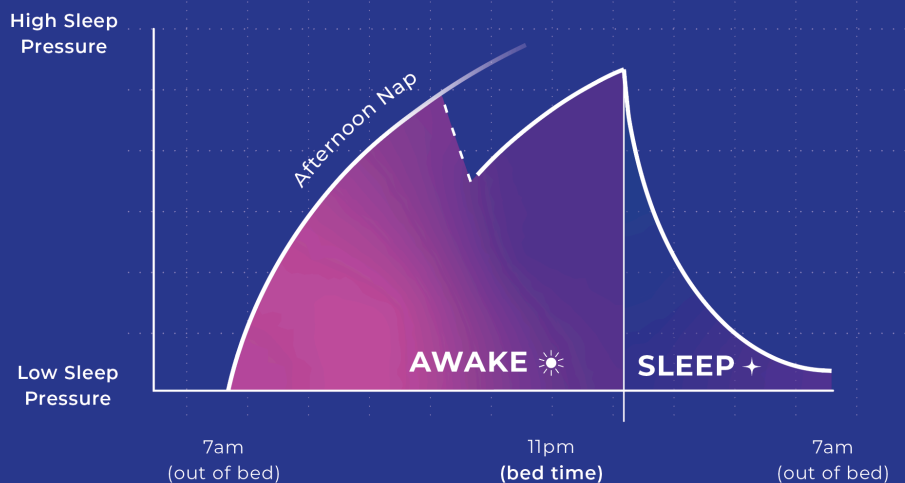


## Uninterrupted homeostatic sleep drive build-up

The longer we are awake during the day, the more sleep drive or pressure we build up. For most people, around 16 hours of wakefulness will build up enough sleep drive to be able to sleep for around 8 hours.

## Effects of an afternoon nap

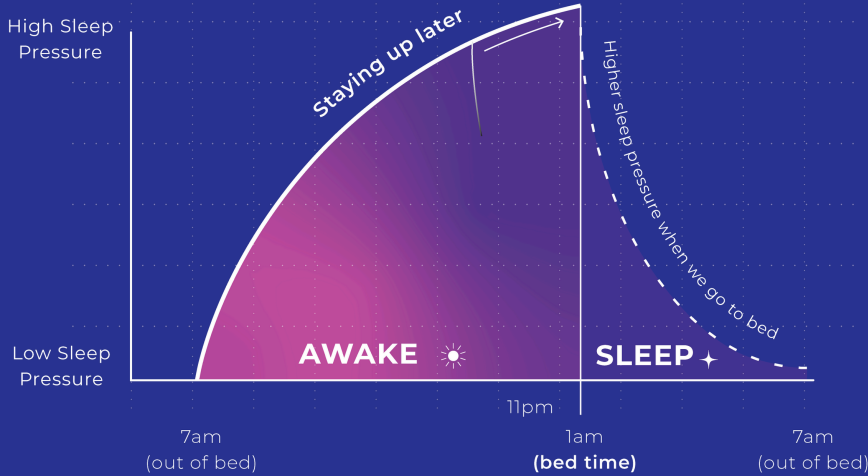
If we have a nap in the afternoon (especially a long nap) it will reduce our sleep pressure. This reduction in sleep pressure can make it harder to fall asleep at our regular bedtime.



## Effects of going to bed earlier

If we go to bed too early before we have built up enough sleep pressure, we may not be sleepy enough to fall asleep. A lower sleep drive can make sleep onset more difficult.

# Sleep Pressure



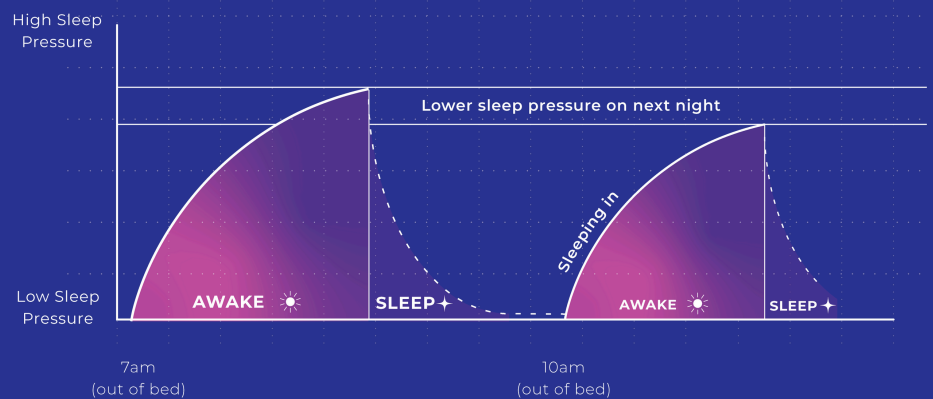
## Effects of going to bed later

If we stay up a bit later at night, we can build up more sleep pressure to make falling and staying asleep easier.

So if you have been struggling to fall asleep early in the evening, you might like to try going to bed a bit later.

## Effects of sleeping in

Sleeping in late in the morning can make it harder to fall asleep the next night. If we sleep in a few hours, we may have lower sleep pressure the following night because we haven't been awake for long enough across the day.

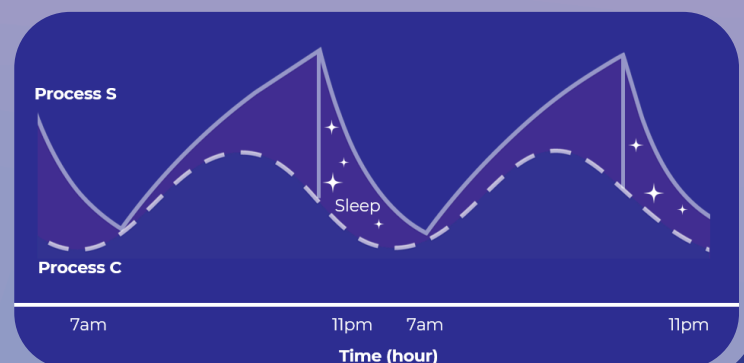


## Bringing the two processes together

Process S and Process C operate independently, but we get the best sleep when these two processes are working together in sync.

Process S pushes you to sleep as sleep pressure builds, while Process C ensures that this pressure aligns with the optimal time for sleep—in our biological night.

- If Process S and Process C are misaligned (e.g., due to jet lag, shift work, or late-night screen use), it can result in poor sleep quality or difficulty falling asleep, as your circadian rhythms (Process C) might signal alertness at a time when sleep pressure (Process S) is high.



# Where to find **more** information?

For more information on the Two-Process Model of Sleep Regulation, please see these two YouTube videos:

- 1) What makes us want to sleep? The two-process model of sleep regulation (Process C and Process S)  
<https://www.youtube.com/watch?v=zIHP6ovkbKw>
- 2) The 2-Process Model of Sleep by BioClock Studio  
<https://www.youtube.com/watch?v=k9iafVwln2Y>

Visit the Sleep Health Foundation for more information about sleep, treating sleep problems, and getting help for your sleep:

- <https://www.sleephealthfoundation.org.au/>

You can also get help at the University of Melbourne:

- Student Health and Wellbeing Digital Hub  
<https://students.unimelb.edu.au/student-support/health-and-wellbeing>
- University of Melbourne Counselling and Psychological Services (CAPS) <https://services.unimelb.edu.au/counsel>
- Health Promotion Program  
<https://students.unimelb.edu.au/student-support/health-and-wellbeing/university-health-promotion-program>