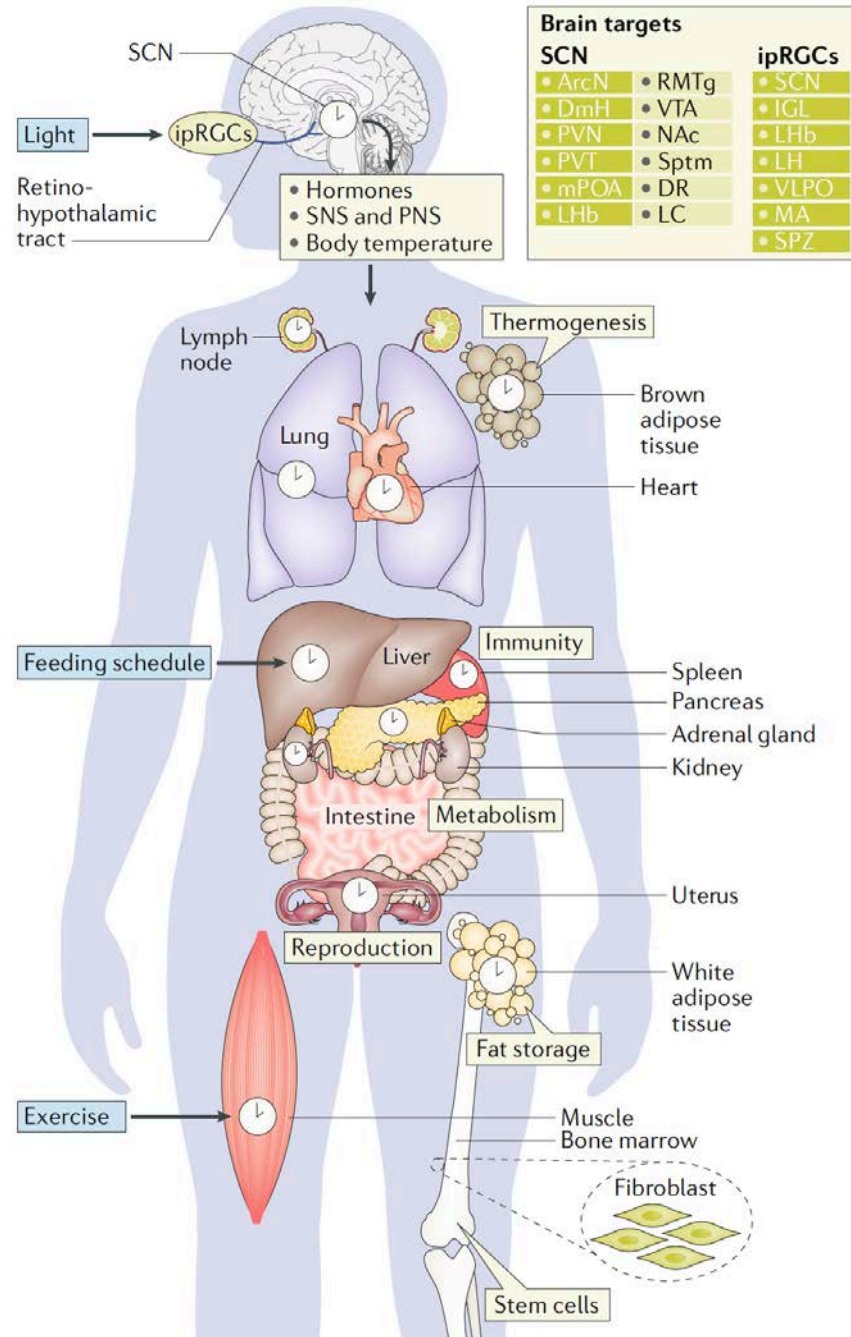


What is a circadian Rhythm and how is it generated?

- Circadian rhythms are biological processes that endogenously oscillate (cycle within the organism) over approximately 24 h.
- Can have **biological markers** and **behavioral markers**
 - Core body temperature
 - Secretion of the hormones melatonin (helps to induce sleep) and cortisol (primary stress hormone)
 - Sleep/wake cycles
 - Rest/activity rhythms
- This rhythm is driven by a molecular clock and can be synchronized with, but does not necessarily rely upon, external cues (e.g., light, temperature, and feeding patterns).

a Circadian timing system



- Why do we need circadian rhythms?
 - Prepares the body for events that occur throughout the day.
 - Hormone secretion
 - Renal blood flow
 - Body temperature fluctuations
 - Sleep/wake cycles
 - Metabolic processes involving digestion, glucose metabolism

Logan RW, McClung CA. Rhythms of life: circadian disruption and brain disorders across the lifespan. *Nat Rev Neurosci.* 2019 Jan;20(1):49-65. doi: 10.1038/s41583-018-0088-y. PMID: 30459365; PMCID: PMC6338075.

Major disruptions to Circadian Rhythms

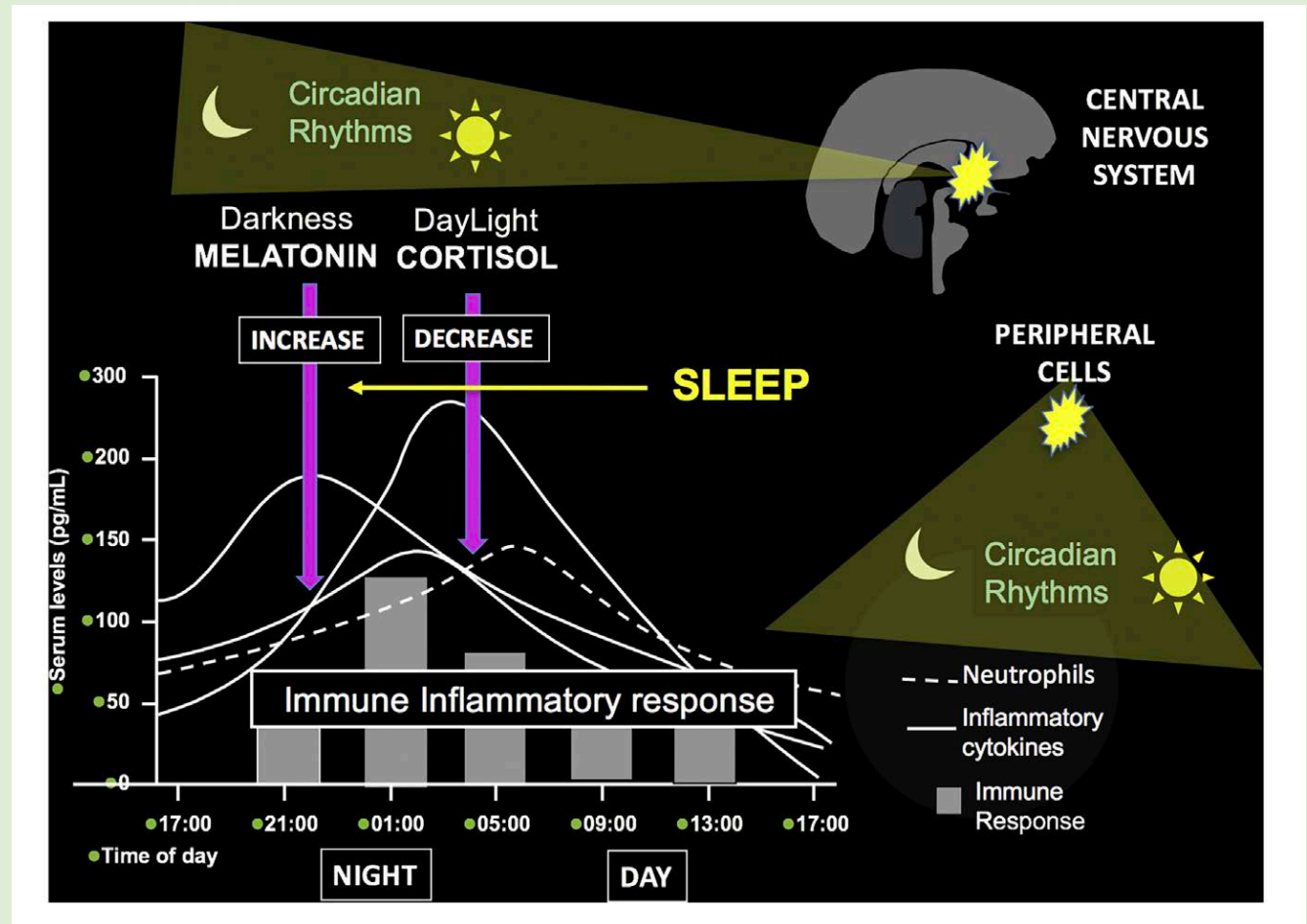
- Disruption of circadian rhythms in humans can be the result of many lifestyle factors, with shift work and traveling between time zones being some of the most obvious causes.
- However, other factors contribute can contribute including:
 - light exposure at night (e.g., use of light emitting electronic devices), which can alter rhythmicity via inputs from the eye directly to the SCN.
 - Ayurveda recommends putting away electronics an hour or so before bed.
- Time of eating close to or during the rest period (i.e., typically within 2h of the normal rest time) can effectively uncouple central circadian rhythms from those in the intestine and liver.
 - Ayurveda recommends eating around 6:30-7 so there are a couple of hours between eating and bedtime.
- Diet composition
 - Alcohol consumption disrupts central circadian rhythms.
 - Ayurveda recommends limiting alcohol intake.
- Social jet lag, where daily schedules are altered on work-free days compared to work days a leading to disruptions in circadian rhythms. For example, sleeping in on the weekend.
 - Ayurveda recommends maintaining regular sleep/wake cycles throughout the week, even on the weekends.

What are the consequences of disruptions in Circadian Rhythms?

- A number of studies have demonstrated higher rates of cancer (breast and prostate), cardiovascular disease, obesity, and psychiatric, and neurodegenerative diseases in shift workers.
- Individuals with a late chronotype (i.e. night owl) are at a higher risk for developing poor health outcomes than individuals with an early chronotype.
 - possibly because these individuals tend to eat close to the rest period, thereby uncoupling rhythms in the liver/intestine from the central pacemaker
 - Ayurveda recommends going to bed around 10pm.
- But why do these detrimental consequences occur?
 - One common feature among the diseases associated with circadian rhythm disruption is that they appear to be triggered or promoted by inflammation.
 - The gut microbiome is also disrupted.

Immune circadian rhythms

- Peripheral blood mononuclear cells and cytokine concentration undergo daily fluctuations.
- Night synthesis of and release of cytokines and chemokines.
 - Can be inflammatory mediators
- Other immune functions peak at night
 - Cell migration to inflamed tissue.
 - Phagocytosis-destruction of pathogens and infected cells.
 - Immune cell proliferation in response to pathogenic antigens.
- Pitta time from 10pm-2pm



Cutolo M. Circadian rhythms and rheumatoid arthritis. Joint Bone Spine. 2019 May;86(3):327-333. doi: 10.1016/j.jbspin.2018.09.003. Epub 2018 Sep 15. PMID: 30227223.

Dinacharya

- Sleep
 - Wake up 30-60 minutes before sunrise.
 - Avoid excessive sleeping during the day.
 - Go to bed around 10 pm.
 - Maintain a regular sleep/wake routine.
- Food
 - Eat your largest meal at noon.
 - Eat a moderate dinner between 6-7 pm.
 - Do not eat at night.
 - Modify your food choices with the season.