Providence College
DigitalCommons@Providence

Biology Student Scholarship | Biology

4-26-2023

Circadian Rhythms Effect on Brain Metabolism in Mutant Flies

Olivia Kozub
Providence College

Follow this and additional works at: https://digitalcommons.providence.edu/bio_students

 Part of the Biology Commons, and the Entomology Commons

Kozub, Olivia, "Circadian Rhythms Effect on Brain Metabolism in Mutant Flies" (2023). *Biology Student Scholarship*. 54.
https://digitalcommons.providence.edu/bio_students/54

This Poster is brought to you for free and open access by the Biology at DigitalCommons@Providence. It has been accepted for inclusion in Biology Student Scholarship by an authorized administrator of DigitalCommons@Providence. For more information, please contact dps@providence.edu.

Circadian Rhythms Effects on Brain Metabolism in Mutant Flies

Olivia Kozub and Pamela Snodgrass-Belt, Ph.D. Providence College, Providence, RI 02918

Introduction:

Drosophila have circadian clocks which regulate behavioral and physiological systems within the body. This "biological clock" is synchronized to their environment via temperature or light cycles. Small fluctuations in day length or temperature trigger a reset of circadian clocks daily. Having this ability to predict the environment and prepare for it, rather than reacting in an energy expensive way, is so critical to survival that this ability has been conserved from single-cell organisms to humans. Circadian rhythms can be measured at the gene, protein, cellular, and tissue level, all the way to oscillations in behavior. Measuring the metabolic activity of normal fly brains at different times of day will chart the rhythm of metabolic activity in a circadian manner. By comparing the rhythms of animals with mutated circadian clock genes, we seek to understand how the molecular clock governs brain metabolic activity.

Significance:

The results of these experiments will begin to characterize how basal metabolism is altered over the day and how alterations to the molecular clock change their regular pattern. As we share a similar 24-hour cycle of rest and activity to drosophila, this data can help us understand more about how basal metabolism is altered throughout the day in humans. We hope this data can provide insight into human metabolism, stress, and its adverse effects when circadian clocks are shifted irregularly. This research could also provide us with more insight on Alzheimer's disease patients who experience sundowning, a syndrome characterized by irritability and restlessness as daylight fades, which is linked to circadian rhythms.

References:

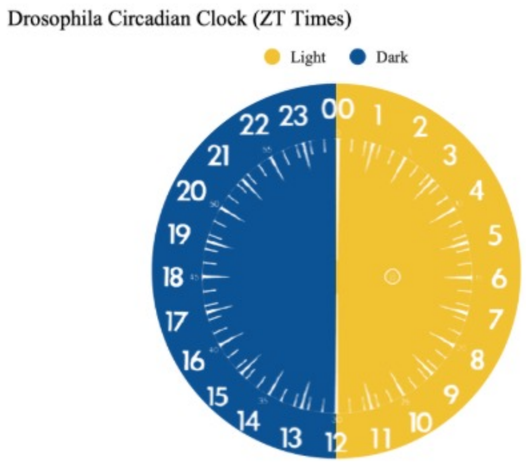
American Academy of Sleep Medicine. (2017, June 5). Social jet lag is associated with worse mood, poorer health and heart disease: Delaying your sleep schedule on weekends has health consequences. *ScienceDaily*. Retrieved March 24, 2021 from www.sciencedaily.com/releases/2017/06/170605085326.htm

Hall, J. C., Rosbash, M., & Young, M. W. (2020). The 2017 nobel prize in physiology or medicine. *Verfügbar unter: https://www. nobelprize. org/prizes/medicine/2017/press-release/(Zugriff am: 26*.

Neville, K. E., Bosse, T. L., Klekos, M., Mills, J. F., Weicksel, S. E., Waters, J. S., & Tipping, M. (2018). A novel ex vivo method for measuring whole brain metabolism in model systems. *Journal of neuroscience methods*, *296*, 32-43.

Peek, C. B., Ramsey, K. M., Levine, D. C., Marcheva, B., Perelis, M., & Bass, J. (2015). Circadian regulation of cellular physiology. *Methods in enzymology*, *552*, 165–184. https://doi.org/10.1016/bs.mie.2014.10.006

Methods:



Seahorse Bioflux

The Seahorse Bioflux analyzer provides a novel method of measuring whole-brain metabolism from dissected brains using the Agilent XFe96 metabolic analyzer (Neville et al. 2018). This analyzer allows us to record the oxygen consumption (OCR) and the extracellular acidification (ECAR) rate of living drosophila brain cells every 1 minute for seven cycles. This method requires a microtissue restraint (seen in the image to the right). These measurements of cellular respiration will allow us to plot the metabolic activity of the fly brain over a complete circadian cycle (24 hours). Using the Seahorse data, we will directly compare brain cellular respiration over a 24-hour cycle in wild-type flies with those from flies with genetic alterations in their clock genes. This will allow for a fuller understanding of the role of circadian rhythms in brain cellular respiration.

Genetically Mutated Flies

In 2017 Jeffrey Hall, Michael Roshbash, and Michael Young won the Noble Prize for discovering the molecular mechanisms that control circadian rhythms. Using flies with mutations in these clock genes, we will study how perturbations in the molecular clock alter the circadian metabolic function in the fly brain. Wild-type flies, and four mutant fly colonies live on a 12/12 light-dark cycle. We will remove brains at lights on (zeitgeber time 0), 3 hours after lights on (ZT 3), 6 hours after lights on (ZT 6), 9 hours after lights on (ZT 9), Lights off (ZT 12), 3 hours after lights off (ZT 15), 6 hours after lights off (ZT 18), 9 hours after lights off (ZT 21). Zeitgeber time (ZT) is a standardized 24-hour notation of the phase in an entrained circadian cycle. ZT 0 indicates the beginning of day, or the light phase. ZT 12 is the beginning of night, or the dark phase.

Seahorse Bioflux Data: