



Mousing Around the Clock: Exploring a Mouse's Circadian Rhythm

Adapted from	https://petsintheclassroom.org/wp-content/uploads/2015/08/A-Study-of-the-Circadian-Rhythm-of-a-Mouse-Goodney-6th-8th-Small-Animal.pdf	
Pet: mouse	Class:	6-9

Brief Overview: In this engaging science project, students will embark on a journey to uncover the secrets of a mouse's circadian rhythm. By monitoring the mouse's movement using an electronic bicycle speedometer, students will explore how changes in light and dark cycles can influence the mouse's nocturnal behavior. Through a controlled experiment, students will manipulate light-dark conditions and observe how the mouse adjusts its activity patterns. This hands-on exploration will help students gain a deeper understanding of circadian rhythms, their role in animal behavior, and the impact of environmental factors on physiological processes. Easily adapted to other pets	Lesson Breakdown Lesson 1: What is a circadian Rhythm? Lesson 2: Gathering Baseline Data (5 min/day for 1 week) Lesson 3: Gathering Experimental Data
Essential Question How does the circadian rhythm of a mouse influence its activity patterns?	

Subjects

- ☒ Science
- ☒ ELA
- ☒ Math
- ☒ STEM
- ☐ Art
- ☐ Other

Stem Connections

Science: effect of environment on growth, development and behavior

Technology: electronic bicycle speedometer

Engineering: drawing a model of circadian rhythms

Math: understanding correlation and causation; calculation of the distance traveled by the mouse

Performance Expectations/ Standards**NGSS**

MS-LS1-5: Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

MS-LS2-1: Analyze and interpret data to provide evidence for the effects of environmental factors on the growth, development, and survival of organisms.

MS-PS4-2: Develop and use models to predict and explain phenomena.

CCSS

ELA.7.W.5: Write an informative/explanatory text to examine and convey complex information, using evidence from multiple sources.

ELA.7.SL.2: Participate in discussions with peers about a range of topics, using evidence to support their thoughts and responding respectfully to the thoughts of others.

7.SP.4.2: Know that correlation does not imply causation.

I CAN statements

- explain the concept of circadian rhythm and its role in regulating biological processes.
- design and conduct a controlled experiment to investigate the effects of environmental factors on animal behavior.
- collect, analyze, and interpret experimental data to draw conclusions about the relationship between light and dark cycles and mouse activity.
- communicate my scientific findings clearly and concisely, both in written and oral form.

Materials

Mouse

rodent exercise wheel

electronic bicycle speedometer

[Mousing Around the Clock Student Worksheet](#)

[The Rhythm of Life: Unveiling the Mysteries of Circadian Rhythms](#)

Teacher Background

Exploring the Circadian Rhythm of Mice

Mice, like humans, possess an internal biological clock known as the circadian rhythm, which regulates various physiological processes, including sleep-wake cycles, hormone production, and metabolism. This intricate mechanism aligns an organism's internal processes with the external environment, ensuring optimal functioning and survival.

Circadian Rhythm in Mice

Mice are nocturnal animals, meaning they are primarily active at night. Their circadian rhythm exhibits a distinct pattern of activity and rest, with peak activity occurring during the dark phase and minimal activity during the light phase. This nocturnal adaptation allows mice to forage for food, avoid predators, and engage in other behaviors that are best suited for low-light conditions.

Environmental Influences on Circadian Rhythm

The circadian rhythm of mice, like that of humans, is influenced by environmental cues, particularly the light-dark cycle. Exposure to light during the day suppresses melatonin production, a hormone that promotes sleepiness. Conversely, darkness triggers melatonin release, signaling the onset of sleep.

Disrupted Circadian Rhythm and Consequences

Alterations in the light-dark cycle can disrupt the circadian rhythm, leading to various behavioral and physiological consequences. Mice exposed to irregular light patterns may experience fragmented sleep, increased anxiety, and impaired learning and memory. These disruptions can also affect hormone levels and metabolism, potentially contributing to health problems.

Investigating Circadian Rhythm in Mice

The study of circadian rhythms in mice provides valuable insights into the biological mechanisms underlying animal behavior and the impact of environmental factors on physiological processes. By observing mouse activity patterns under different light conditions, researchers can gain a deeper understanding of circadian entrainment, the process by which an organism's internal clock synchronizes with external cues.

Educational Implications

Exploring the circadian rhythm of mice offers a captivating and meaningful learning experience for middle school students. Through hands-on experiments, students can investigate the relationship between light and dark cycles and mouse activity, gaining a deeper appreciation for the intricate interplay between organisms and their environment.

Lesson 1: What is a Circadian Rhythm?

Time	Materials	Activity
10 mins	The Rhythm of Life: Unveiling the Mysteries of Circadian Rhythms	<p>Ask if anyone has ever traveled to a different time zone and experienced jet lag. Why did this happen?</p> <p>Ask the students why they are more active in the day time than in the night. Introduce the concept of circadian rhythms in both humans and mice.</p> <p>After slide 8, ask the students why they think it would be beneficial to the mice to be nocturnal. How does this adaptation help them in the wild?</p>
5 mins		<p>Review the procedure for the experiment with the students.</p> <p>Explain to the students that they will be measuring the distance the mouse travels during the night compared to during the day. They will first need to determine the baseline activity of the mouse.</p> <p>To do this, they will attach an electric bicycle speedometer.</p> <p>Before attaching the speedometer, be sure that the students understand how to read and interpret the data it displays.</p>
10 mins	electronic bicycle speedometer Mousing Around the Clock Student Worksheet	<p>Review the procedure for the experiment with the students.</p> <p>Explain to the students that they will be measuring the distance the mouse travels during the night compared to during the day. They will first need to determine the baseline activity of the mouse.</p> <p>To do this, they will attach an electric bicycle speedometer. Before attaching the speedometer, be sure that the students understand how to read and interpret the data it displays.</p>
15 mins		<p>Once the speedometer is set up, have the student practice calculating the distance the mouse will travel with one re</p> <p>To accurately measure the distance traveled by your pet rodent on their exercise wheel, you need to adjust the speedometer's settings to match the wheel's circumference.</p> <p>If the speedometer is calibrated for a wheel with a 66 cm</p>

		<p>diameter, and your pet rodent's exercise wheel has a 6.6 cm diameter, you need to divide the distance reading by 10 to get the correct distance traveled.</p> <p>This adjustment is necessary because the smaller wheel will complete more revolutions than the larger wheel for the same distance traveled.</p> <p>Have the students measure the diameters of the speedometer and the wheel to determine the conversion factor.</p>
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Lesson 2: Gathering Baseline Data

Time	Materials	Activity
5 min/day	Mousing Around the Clock Student Worksheet	The first thing the students will need to determine is the mouse's baseline activity. To do this, have the students record the mouse's distance traveled for several days

Lesson 3: Gathering Experimental Data

Time	Materials	Activity
10 mins	Mousing Around the Clock Student Worksheet	<p>Have the students work in small groups to come up with an experimental procedure to test how light levels will affect the mouse's activity levels.</p> <p>Students would write up their procedure on their worksheets and be prepared to present it to the class.</p>
15 mins	Mousing Around the Clock Student Worksheet	<p>Have the small groups present their ideas and then choose which of the procedures to conduct. (For example, you might decide to leave the lights on all evening, or to leave the classroom in darkness for a longer</p> <p>As a class, determine a way to collect the data and create a data chart, similar to the one used to collect the baseline data.</p>
10 mins	Mousing Around the Clock Student Worksheet	Students will then complete the hypothesis, and identification of variables on the worksheet. Have the

	Worksheet	students copy their data collection table into their worksheet.
10 mins	Mousing Around the Clock Student Worksheet	Once the data has been gathered, allow the students to reflect on their results and complete the worksheet and model drawing

Differentiation

For students who need more support, provide additional guidance during the experimental setup and data collection process.

For advanced students, challenge them to design and conduct additional experiments to investigate the effects of different light intensities of light spectra on the circadian rhythm of mice.

Assessment				
Criteria	4 - Exemplary	3 - Proficient	2 - Developing	1 - Beginning
Data Table	All data is accurately recorded	Most data is accurately recorded	Some inaccuracies in data recording	Major inaccuracies or missing data in the data table
Graph	Graph is accurately constructed and	Graph is mostly accurate and well-constructed	Some inaccuracies in graph construction	Major inaccuracies or missing graph construction
Analysis Questions	Thorough and insightful responses demonstrating deep understanding of concepts and implications	Adequate analysis with some insightful points Clear understanding of concepts and implications	Superficial analysis with limited insight	Minimal or no analysis; demonstrates lack of understanding

Overall Presentation	Neat, well-organized with attention to detail	Mostly neat and organized with attention to detail	Somewhat neat and organized	Messy, unorganized, or incomplete presentation
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Extension

- Research the impact of circadian rhythm disruptions on human health and behavior.
- Explore the role of melatonin, a hormone involved in regulating circadian rhythm, in sleep regulation and overall well-being.
- Investigate the adaptations of nocturnal animals to maximize their activity levels under low-light conditions.