

project NEURON

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Novel Education for Understanding Research On Neuroscience

Project NEURON brings cutting-edge science to middle and high school students through inquiry-driven activities based on research conducted at the University of Illinois.

For materials and information visit
<http://neuron.illinois.edu/>

What makes me tick...tock? *Circadian rhythms, genetics, and health*

Lesson 1: What is a circadian rhythm?

In this introductory lesson to the unit, students conduct an in-class survey to learn about the circadian rhythms and biological clocks of their peers. Using this survey, students identify the owls and the larks in their classroom. In addition, students generate questions related to what they would like to know or learn about biological rhythmicity. These questions will be generated as a whole class and will be referred back to in the upcoming lessons. At the end of the lesson, they learn about some concepts related to circadian rhythms as they watch a video.

Lesson 2: Why do scientists study fruit flies to find what makes us “tick”?

Following the introduction of basic principles and key terminology of circadian rhythmicity in Lesson 1, this lesson begins with students discussing model organisms and how scientists use them; *Drosophila melanogaster* is used as a model for the study of circadian rhythms. Students also use four NetLogo models to examine how light affects a fly's behavior. Students make connections between these models and the length of daylight.

Lesson 3: How can genetics change your clock?

The goal of this lesson is to teach the students about how changes to circadian genes can have physiological affects that may or not have circadian phenotypes. Students construct a model of a circadian gene, Period 2 (*per2*). Using this model, students explain how changes in the nucleic acid sequence can change protein structure and, ultimately, alter protein function.

Lesson 4: Tick tock...Broken clock

Using a case study format, students investigate the source of a fictional character's sleeping problems. Students are presented with information that they must utilize to progress through four “checkpoints” throughout the course of the lesson. Each checkpoint will give the student groups access to additional information based on current research regarding the nature of the patient's sleep difficulties. This information is presented as records collected by a hospital case investigation team for review by the students as case investigators. After completing all of the checkpoints in the order of their choosing, students teams to come to a final consensus on the patient's diagnosis.



What makes me tick...tock?

Circadian rhythms, genetics, and health

Lesson 5: How do environment and modern society influence our rhythms?

Students apply what they have learned about circadian processes to issues relevant to human light exposure, species biology and ecology. Students use light meters to examine light exposure differences around their school to illustrate the possible influences of habitat/workplace on light exposure, and they read and discuss a series of short articles that exemplify the interaction between environment and circadian rhythms. Through these two activities, students explore how cues from the environment entrain their biological daily clocks. In addition, they examine examples of how endogenous circadian clocks in different species have adapted over time to allow the species to survive in their light environment.

Lesson 6: What happens to humans when normal rhythms are disrupted?

This lesson focuses on the circadian rhythm and its connection to humans. Students will analyze the average results of their sleepiness scale and compare it to others. They will examine multiple instances where circadian rhythms have an impact on real life scenarios in humans. This lesson will be applicable to the students' lives and will consist of topics that they are familiar with.

Lesson 7: How can epigenetics change your clock?

The goal of this lesson is to teach the students about how changes to circadian genes can have physiological affects that may or not have circadian phenotypes. Using the period 2 gene sequence, students will play the Epigenome Game to learn about how changing the secondary structure of DNA can up- or down-regulate expression of genes.

Lesson 8: When should the school day begin?

During this lesson, students debate the most appropriate starting time of the school day using the relevant information learned throughout the unit as their evidence for claims they make. Groups will be required to pull from knowledge they acquired from throughout the unit, including sleepiness scale data and experimental results, as well as information gathered from popular media and scientific journal articles, to formulate their argument.

