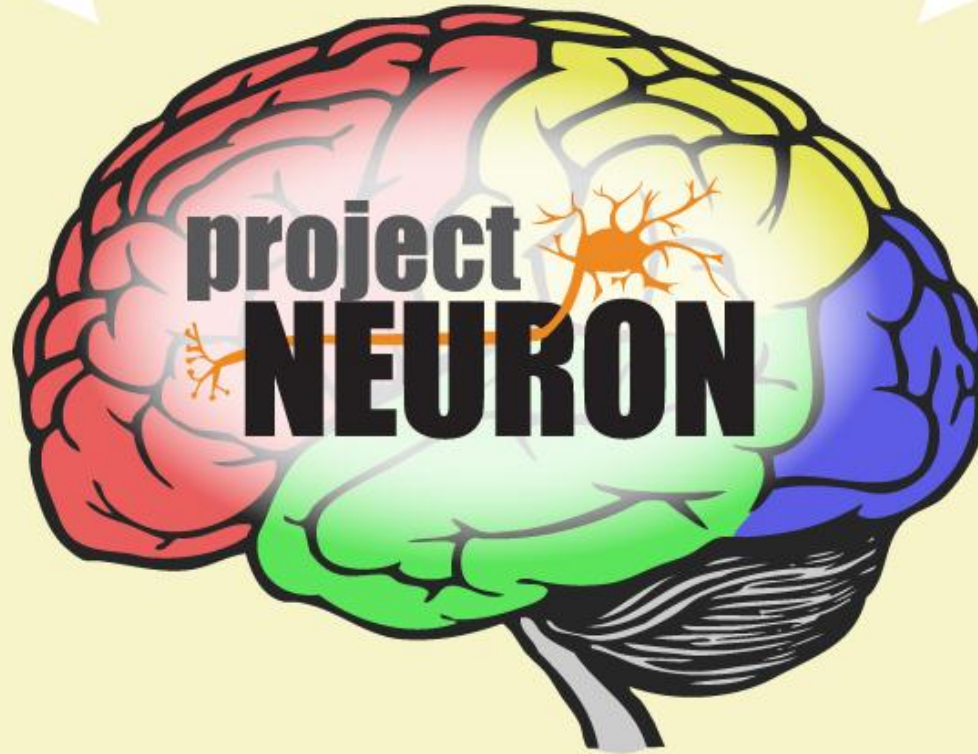


Investigating the Biology of Circadian Rhythms



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What is Project NEURON?

- A curriculum development group at the University of Illinois Urbana-Champaign
- A professional development group that invites teachers to our Summer Teacher Institutes
- Comprised of science educators, research scientists, neuroscience graduate students, education graduate students, and undergraduates



- Dedicated to bringing engaging inquiry-based units to high school science classrooms, using neuroscience research as a context



Project NEURON Curriculum Units

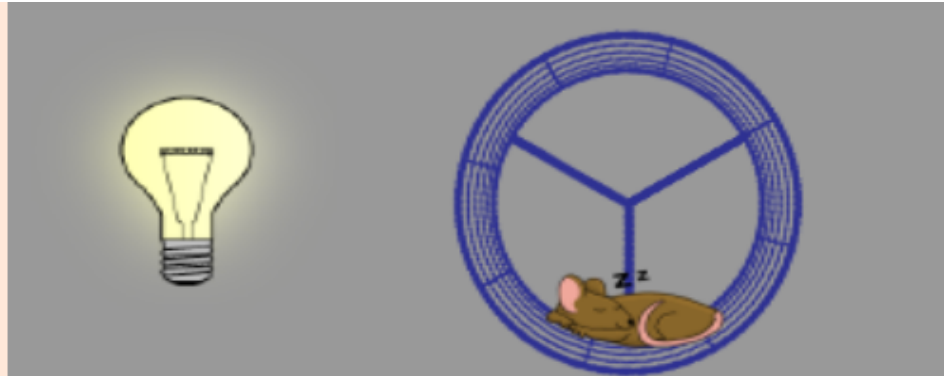
All available at <http://neuron.illinois.edu>

- Do you see what I see?
 - *Light, sight, and natural selection*
- What can I learn from worms?
 - *Regeneration, stem cells, and models*
- What makes me tick...tock?
 - *Circadian rhythms, genetics, and health*
- Why dread a bump on the head?
 - *The neuroscience of traumatic brain injury (TBI)*
- What changes our minds?
 - *Toxicants, exposure, and the environment*
 - *Foods, drugs, and the brain*



What makes me tick...tock?: An Investigation of Circadian Rhythms

- Connections to disciplinary core ideas
 - Investigating how genetics and environment affect the circadian rhythm
 - Examining how circadian rhythm disruptions can have negative short-term and long-term health effects



Choose a Light/Dark Cycle

12:12 light-dark ▾



COPY

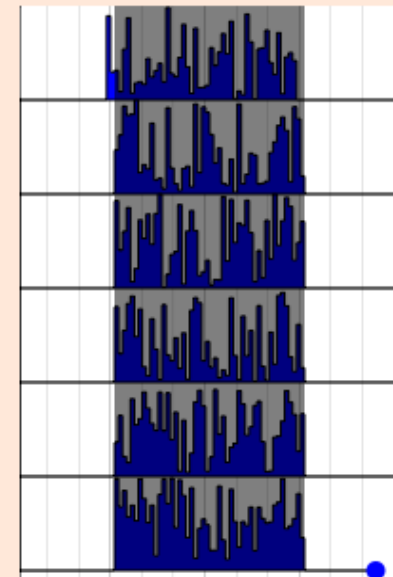
CLEAR

The mice experience 12 hours of dark and 12 hours of light in a 24 hour day cycle. You can drag the bar above the actogram to change the start time of the dark period.

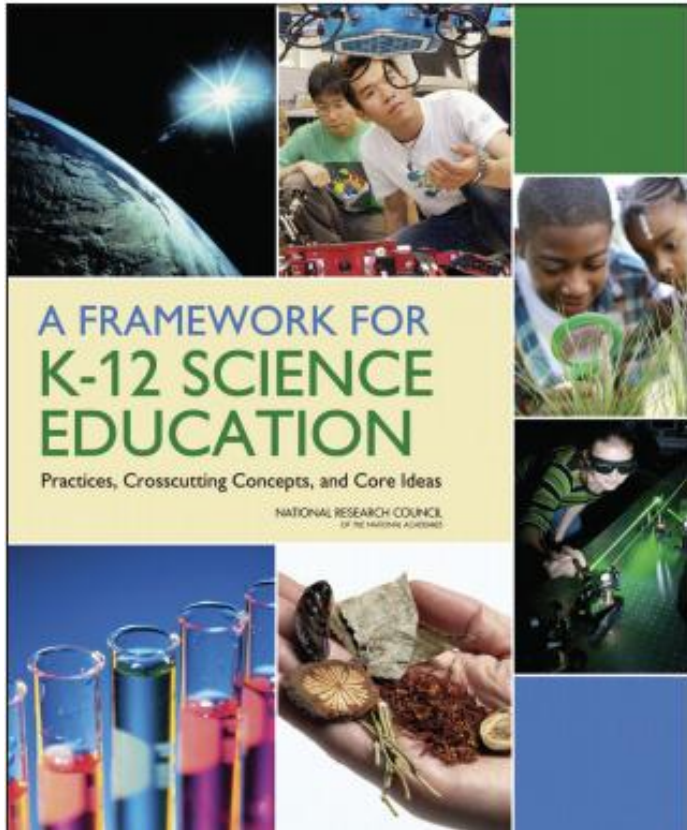
Light-Dark Cycle in Hours



0 6 12 18 24



Developing and Using Models



- *The Framework for K-12 Science Education* outlines eight scientific practices students should develop and grow as they progress through their science courses
- A key practice that we highlight is **Developing and Using Models**
- Students come to the classroom with an initial model of how something functions, and leave with a more sophisticated conception of how the phenomenon occurs if given an opportunity to engage in scientific modeling



Lesson 1: What is a circadian rhythm?

- Students explore their own ideas regarding their sleep/wake cycles
- Identify what is a circadian rhythm along with other vocabulary such as zeitgeber, free-running, subjective day and night, endogenous cue
- Discuss Michel Siffre, a French scientist who lived in a dark cave for 6 months to study circadian rhythms
 - He was able to stay awake and fall asleep without exposure to light

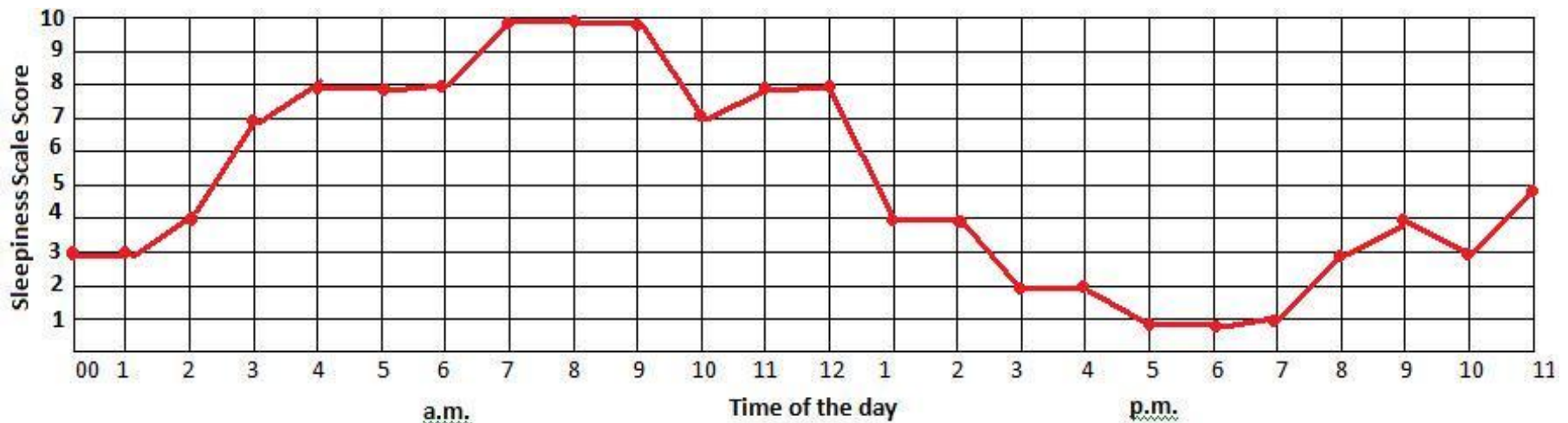


Sleepiness Scale Examples

Taylor's Sleepiness Scale



Tom's Sleepiness Scale :

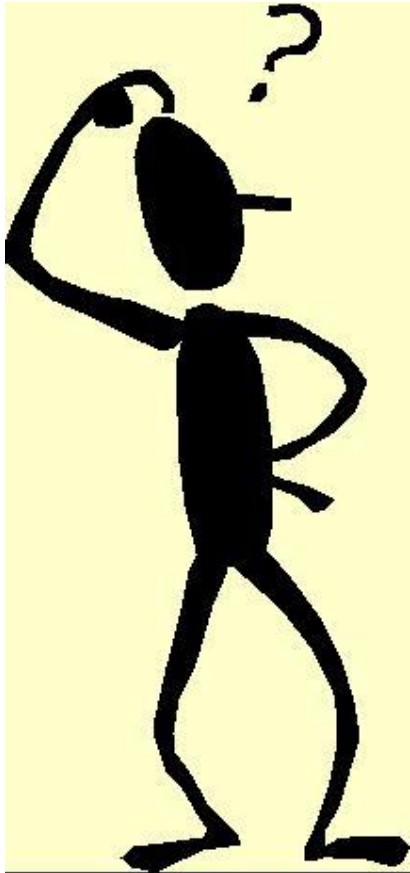


Are you an owl or a lark?

- Owls tend to stay awake late into the night
- Larks are early-risers
- Create a survey to assess if your partner is an owl or a lark
- Answer your partner's survey questions to see if you are an owl or a lark



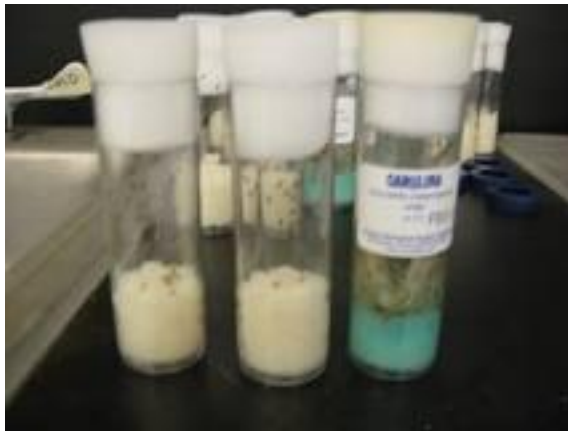
Lesson 1 Discussion



Describe/draw/diagram your initial model of what makes us tick...tock?



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



How can we replicate Siffre's experiments without using humans?

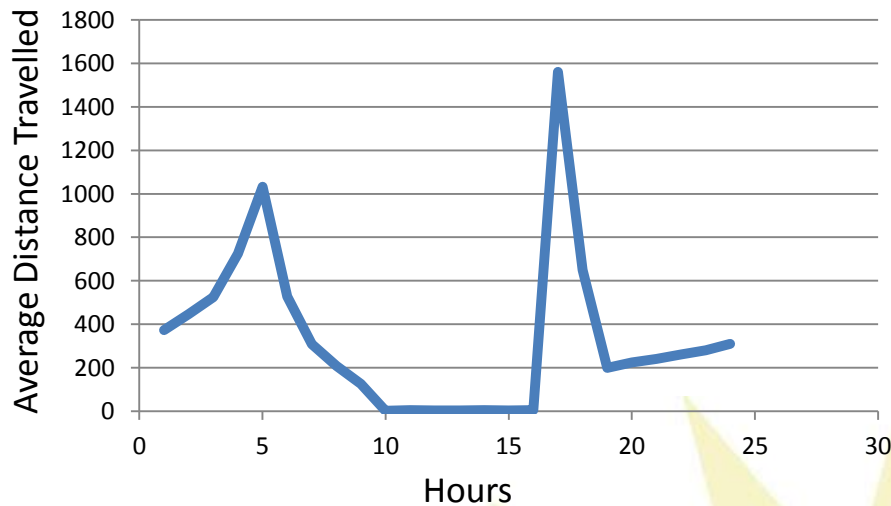
- We can use fruit flies as a model organism to replicate circadian rhythm experiments
- We can manipulate
 - Light
 - Temperature
 - *per* gene
- NetLogo simulation



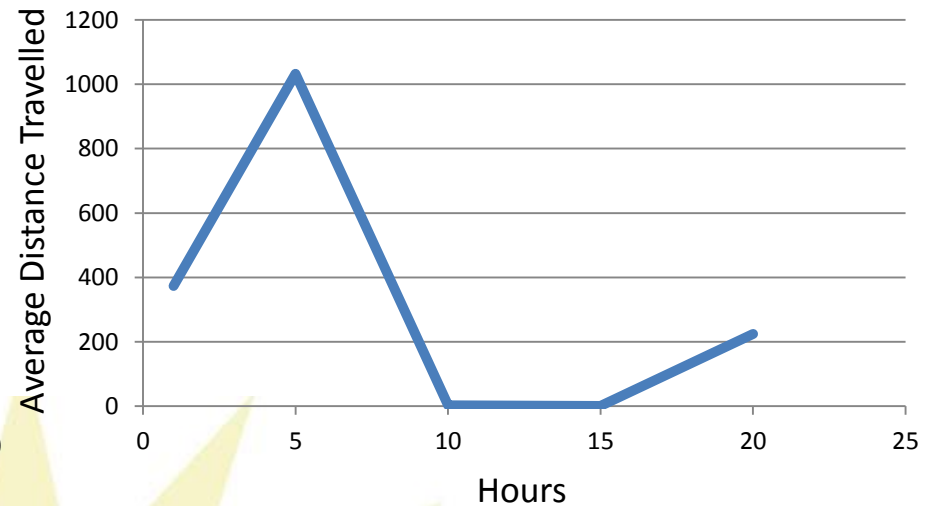
Fruit Fly Simulation Data

Data Collected: 18°C, 12:12 L/D cycle, same 24 hour period

Fruit Fly Activity over 24-hour Period



Fruit Fly Activity over 24-hour Period



What is different between these two graphs?



The Importance of Appropriate Data

Data Taken Every Hour

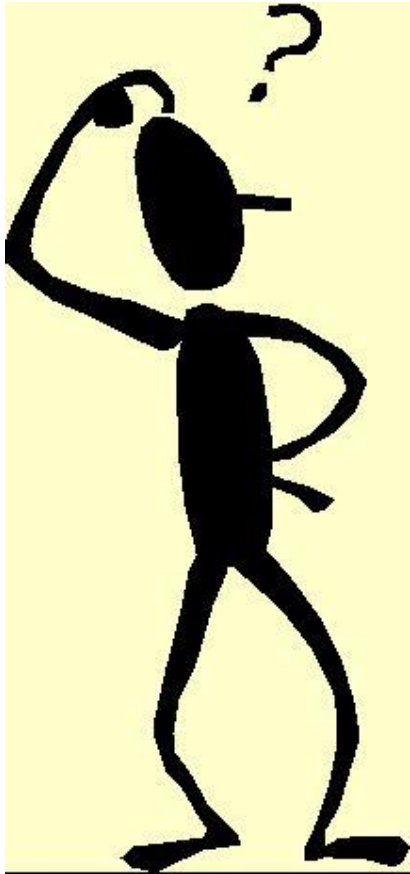
Hour	Average Distance Traveled
1	372.92
2	447.47
3	524.16
4	725.44
5	1032.65
6	527.13
7	308.23
8	208.1
9	125.61
10	2.75
11	5.16
12	4.02
13	3.54
14	5.06
15	4.1
16	5.9
17	1560.08
18	650.49
19	199.31
20	223.96
21	240.93
22	260.92
23	280.91
23.99	310.52

Data Taken Every 5 Hours

Hour	Average Distance Traveled
1	372.92
5	1032.65
10	2.75
15	1.1
20	223.96



Now, what makes us tick...tock?



- After completing the activities in Lessons 1 and 2, how would you revise your model of what makes us tick...tock?
- How could you use the NetLogo simulation in your classroom?
- How does the simulation compare to using live fruit flies?



Unit Discussion

- How could you use this unit in your class?
- How would you possibly modify it for your students?



Thank You!

For more information, check out our website
<http://neuron.illinois.edu>

