ESSAY 1

Answers must be written out in paragraph form. Outline form is not acceptable. Labeled diagrams may be used to supplement discussion, but a diagram without a written explanation will not receive credit. You must cite the source of all outside information you include. Include the page number of information from the course textbook or the web address of information found online.

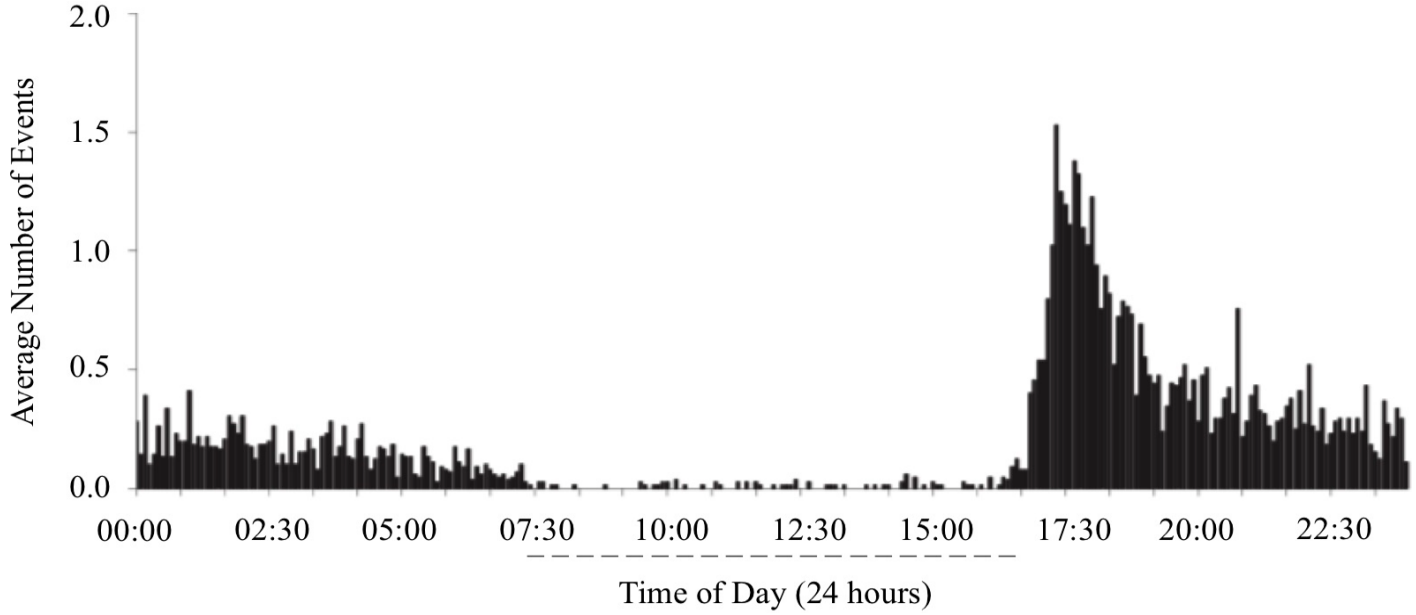

Figure 1. Mean activity of hibernating *M. nattereri* recorded at Greywell Tunnel, United Kingdom, over a 24-hour day in January 2008, 2009, and 2010 combined. On a 24-hour clock, 00:00 denotes midnight and 12:00 denotes noon, with morning hours ranging from 00:00 to 12:00 and afternoon/evening hours ranging from 12:00 to 24:00. Activity was measured by infrared motion detectors. Data are binned in 5-minute blocks. The dashed line indicates the longest period between sunrise and sunset.

Biological (circadian) rhythms in which individuals remain entrained to environmental changes exist in many organisms. Some hibernating mammals maintain biological rhythms even during deep torpor, a state of decreased physiological activity associated with reduced body temperature and metabolic rate. Researchers used infrared motion detectors to study activity during hibernation in a species of bats (*Myotis nattereri*) inhabiting a temperate maritime climate over three consecutive winters using infrared motion detectors (Hope & Jones, 2013). The average number of events recorded by the motion detectors over the course of a 24-hour day are shown in Figure 1.

(a) One hypothesis proposes that foraging occurs during hibernation season and that *M. nattereri* show the highest daily activity levels when risks from predators are reduced (Jones & Rydell, 1994). **Explain** how natural selection most likely resulted in a common daily cycle of activity among most individuals in the population.

(b) **Propose** a hypothesis regarding the effect of light on the activity of hibernating *M. nattereri*. **Describe** the negative control treatment in an experiment that could be performed to test this hypothesis. **Explain** how the control treatment would increase the validity of the results. **Justify** the researchers' decision to average the number of events detected by the motion sensor per 5-minute block over January 2008, 2009, and 2010.

(c) **Identify** a one-hour window during the 24-hour day that *M. nattereri* is most likely to be actively foraging. Using the data, **provide support** for the claim that hibernating *M. nattereri* display nocturnal activity.

(d) A student claims that the genetically controlled circadian rhythm in *M. nattereri* is less than 24 hours, but that exposure to a daily cycle of light and dark entrains the bats to a 24-hour cycle of activity (Johnson, Elliott, & Foster, 2013). To test this claim, a group of hibernating *M. nattereri* was moved to an artificial environment under constant darkness where their activity was monitored using infrared motion detectors over 31 days in the month of January. **Predict** the observed activity pattern that would support the student's claim. **Provide reasoning** to support your prediction.

References

Hope, P. R. & Jones, G. (2013). An entrained circadian cycle of peak activity in a population of hibernating bats. *Journal of Mammology*, 94(2), 497–505.

Johnson, C. H., Elliott, J. A., & Foster, R. (2013). Entrainment of circadian programs. *Chronobiology International*, 20(5), 741–774.

Jones, G. & Rydell, J. (1994). Foraging strategy and predation risk as factors influencing emergence time in echolocating bats. *Philosophical Translations of the Royal Society B*, 346, 445–455.