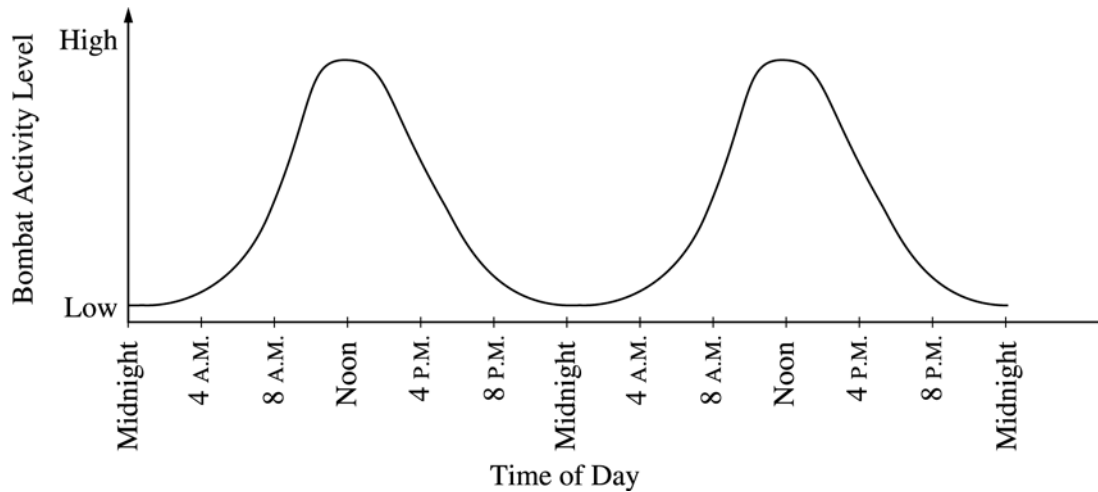


2002 AP® BIOLOGY FREE-RESPONSE QUESTIONS

2. The activities of organisms change at regular time intervals. These changes are called biological rhythms. The graph depicts the activity cycle over a 48-hour period for a fictional group of mammals called pointy-eared bombats, found on an isolated island in the temperate zone.



- (a) **Describe** the cycle of activity for the bombats. **Discuss** how **three** of the following factors might affect the physiology and/or behavior of the bombats to result in this pattern of activity.
- temperature
 - food availability
 - presence of predators
 - social behavior
- (b) **Propose** a hypothesis regarding the effect of light on the cycle of activity in bombats. **Describe** a controlled experiment that could be performed to test this hypothesis, and the results you would expect.
3. The complexity of structure and function varies widely across the animal kingdom. Despite this variation, animals exhibit common processes. These include the following.
- transport of materials
 - response to stimuli
 - gas exchange
 - locomotion
- (a) Choose **two** of the processes above and for each, **describe** the relevant structures and how they function to accomplish the process in the following phyla.
- Cnidaria (e.g., hydra, jellyfish)
Annelida (e.g., earthworm)
Chordata (e.g., mouse)
- (b) **Explain** the adaptive (evolutionary) value(s) of the structural examples you described in part a.

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Question 2

2. (a) A maximum of 5 points

Description of the cycle of activity (1 point)

A student could earn a point if he/she accurately summarized the graph. A simplistic statement such as, “Bombats are active during the day and quiet at night” which ignored the shape and obvious peaks and valleys of the graph did not receive the point. To earn this point, the student had to identify the peak of activity at “noon,” “midday,” or “12:00 p.m.,” AND indicate a lower activity at “night.” The student could also be specific about the lowest activity being at “midnight,” or “12:00 a.m.” The description had to be clearly distinguishable from the rest of the answer and not simply implied in another part of the response.

Discussion of how THREE factors might affect the physiology and/or behavior resulting in the cyclic activity pattern (1 point each)

To earn points here, each of the descriptions had to (a) be biologically plausible and consistent with typical mammalian behavior and physiology (no fictional biology); (b) indicate a cause and effect relationship beyond a simple restatement of the question. This had to include at least a very brief indication of how or why the factor had any effect at all on the bombat — or in some cases its prey; and finally, the discussion could not be inconsistent with the part of the curve described or time of day referenced in the explanation.

Elaboration on any one of the three factors (1 point)

Here the readers were looking for exemplary descriptions of physiology and/or behavior that reflected an unusual depth of understanding and clarity of expression. With special regard to temperature, a student who demonstrated an understanding that the activity curve was different from a temperature curve or that mammal physiology, unlike that of ectotherms, is typically insensitive to temperature could earn an elaboration point.

2. (b) A maximum of 7 points

Hypothesis (1 point)

The student was required to indicate that a CHANGE in the light (intensity, duration, wavelength) causes a CHANGE in the cycle of activity or biorhythm. There also could be a prediction of a change of light having no effect on the cycle of activity. Like the description of the curve above, the hypothesis statement had to be clearly distinguishable from the rest of the answer and not simply implied in another part of the response. The student may have failed to earn this point if the experiment he/she designed below clearly used a different light characteristic (independent variable), and/or produces a different result (dependent variable) from the ones indicated in his/her hypothesis.

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Question 2 (cont'd.)

Experimental Design (5 points maximum)

If the experimental design used a factor other than light for the independent variable, AND it satisfies AT LEAST THREE of the following standards, the answer was still allowed to earn 1 point total for this and the “Description of Results” section combined.

- 1 point** Specified an appropriate control group for comparison. In this control, the environmental conditions had to be very similar to the natural conditions in which you find the bombat population, and not simply placing them into the dark, etc.
- 1 point** Indicated that the independent variable (light) was manipulated. This was usually a change in light intensity or photoperiod.
- 1 point** Held confounding variables constant or indicated that all variables other than the independent variable are held constant. To earn the point for listing the variables being held constant, the student had to list at least two.
- 1 point** Verified results with reasonable sample size (at least two bombats in each group), and/or repeated trials. With repeated trials, the point was not awarded if the same bombat was used over and over.
- 1 point** “Measured,” “recorded,” etc. (using quantitative terminology) bombat activity levels (dependent variable). If the student used the verb “observe,” then some measurement activity had to be specified.
- 1 point** Included a mathematical and/or statistical comparison of control and experimental groups, or of observed and expected results. A specific kind of inferential statistic (chi square, t-test, etc.) did not need to be mentioned. A comparison of slopes of curves on a graph was also acceptable.

Description of results (1 point)

If the student had earned AT LEAST 3 POINTS in the *Experimental Design* section above, he/she became eligible for 1 point earned for a graph, data table and/or description of results **consistent** with the experimental design.