

## ESSAY 4

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.

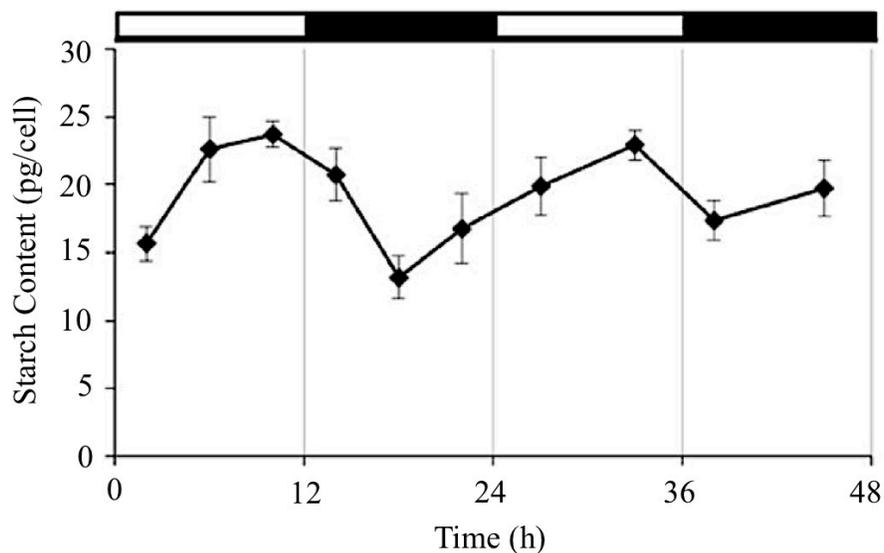


Figure 1. Changes in cellular starch content of *D. salina* cells grown under alternating light and dark conditions over a 48-hour period. Cells were exposed to light during hours 0–12 and 24–36 and kept in darkness during hours 12–24 and 36–48. Cultures were grown at 25°C with continuous shaking (100 rpm) and the light intensity during the light periods was 200  $\mu\text{mol photons m}^{-2} \text{s}^{-1}$ . All cultures were set up in triplicate. The data represent the means  $\pm 2SE_{\bar{x}}$ .

The green microalga *Dunaliella salina* survives in a wide range of conditions. To explore the effect of light period and light intensity on the regulation of growth, photosynthesis, and respiration, *D. salina* cells were cultured under a range of light/dark periods within a 24-hour cycle and different light intensities (Xu, Ibrahim, & Harvey, 2016). Photosynthesis and respiration of the cells was monitored in relation to light conditions by analyzing the starch content of the cells (in picograms per cell). Figure 1 shows the changes in starch content under an alternating cycle of 12 hours of light and 12 hours of darkness. Table 1 shows the changes in starch content at different light intensities.

TABLE 1. CELLULAR CONTENT OF *D. SALINA* CELLS UNDER DIFFERENT LIGHT INTENSITIES

Light Intensity ( $\mu\text{mol photons m}^{-2} \text{s}^{-1}$ )	Starch Content (pg/cells)	$SE_{\bar{x}}$
200	23.71	0.85
500	20.64	3.67
1000	21.86	2.55
1500	20.72	1.06

- (a) **Describe** the structure of a specific membrane in the cells of the microalga related to ATP production and **explain** how the structure of the membrane contributes to the generation of ATP molecules.
- (b) **Construct** an appropriately labeled graph to illustrate the effects of light intensity on starch content of *D. salina* cells. **Describe** the effect of increasing light intensity on the cellular starch content.
- (c) Based on Figure 1, **identify** the cellular process responsible for the change in starch content between hours 12 and 18. **Provide reasoning** to connect the cellular process you identified to the change in starch content.
- (d) In a separate investigation, *D. salina* cells are grown in water labeled with a radioactive isotope of oxygen,  $^{18}\text{O}$ , and provided with abundant  $\text{CO}_2$  and constant light. **Predict** the product of photosynthesis that is most likely to contain  $^{18}\text{O}$ . **Make a claim** about the role of water in the production of starch in *D. salina* cells.

## Reference

Xu, Y., Ibrahim, I. M., & Harvey, P. J. (2016). The influence of photoperiod and light intensity on the growth and photosynthesis of *Dunaliella salina* (chlorophyta) CCAP 19/30. *Plant Physiology and Biochemistry*, 106, 305–315.

