

2023 AP Daily: Practice Sessions



AP Biology

Session 8 – FRQ (Question 6: Analyze Data)

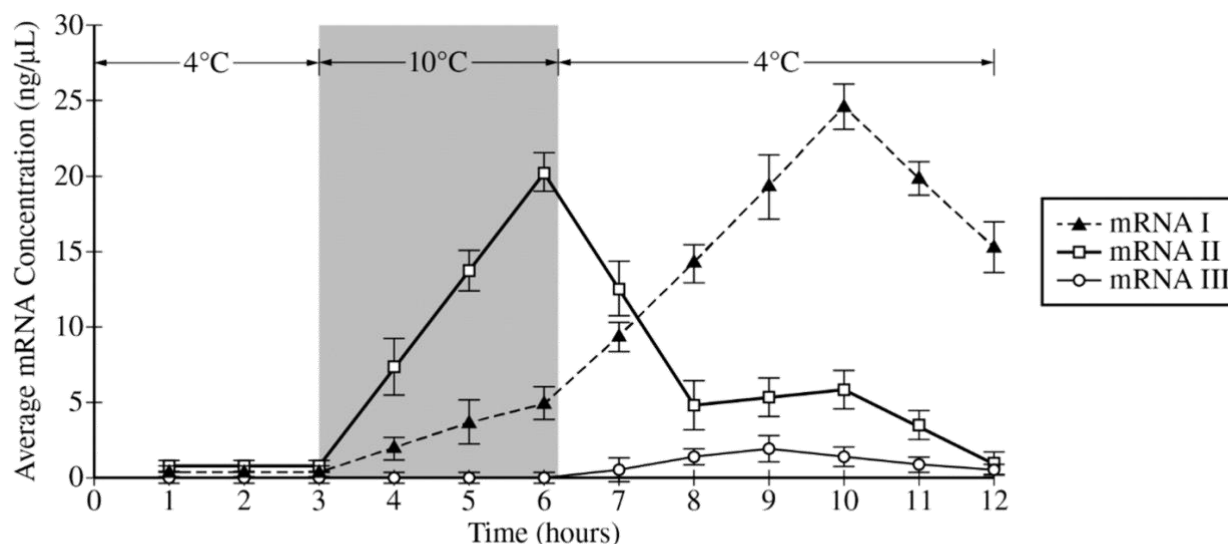


Figure 1. Average concentration of three mRNAs (I, II, III) transcribed from *hsp* genes in krill heat shocked at 10°C. Error bars represent $\pm 2SE_{\bar{x}}$.

The small invertebrate krill species *Thysanoessa inermis* is adapted to cold (4 C°) seawater. Over the past ten years, there has been a gradual increase in the water temperature of the krill's habitat. A sustained increase in water temperature may ultimately affect the ability of the krill to survive.

One effect of higher temperatures is protein misfolding within cells. Krill have several *hsp* genes that code for heat-shock proteins (HSPs). These proteins help prevent protein misfolding or help to refold proteins to their normal shapes.

Scientists conducted experiments on *T. inermis* to detect changes in the expression of *hsp* genes when the krill were exposed to temperatures above 4°C. An experimental group of krill was maintained in tanks with 4 C° seawater and then placed into tanks with 10 C° seawater for approximately three hours. The krill were then given a six-hour recovery period in the 4 C° seawater tanks. A control group of krill was moved from a tank of 4 C° seawater to another tank of 4 C° seawater for approximately three hours and then returned to the original tank. The scientists analyzed *hsp* gene expression by measuring the concentrations of three mRNAs (I, II, III) transcribed from certain *hsp* genes in both the heat-shocked krill (Figure 1) and the control krill. For the control krill, no transcription of the *hsp* genes was detected throughout the test period (data not shown).

- a. Identify the *hsp* mRNA that has the slowest rate of concentration increase in response to heat-shock treatment.
- b. Describe the trend in the average concentration of mRNA I throughout the experiment.
- c. The scientists hypothesized that the heat-shock protein (HSP) translated from mRNA I plays a greater role in refolding proteins than does the HSP translated from mRNA II. Use the data to support the hypothesis.
- d. mRNAs I and II are transcribed from the same gene. Explain how a cell can produce two different mRNAs from the same gene.