Daphnia longicephala is a freshwater crustacean that can detect chemical cues produced by the predator Notonecta glauca. Researchers raised Daphnia clones and observed that those exposed to Notonecta chemical cues during their development produced larger protective crests, as described in Figures 1 and 2. Crest height and width are measured as ratios to body length. The increase in the size of the crest width and height is not associated with a corresponding change to the Daphnia’s genome. Researchers hypothesize that growing a crest is energetically costly, so Daphnia do not develop the large crests in the absence of Notonecta.

Figure 1. Comparison of Daphnia that developed in the absence (left) and the presence (right) of Notonecta chemical cues
Figure 2. Comparison of mean relative crest height and width between control Daphnia and Daphnia exposed to Notonecta chemical cues during development. Error bars represent ±2SE.

(a) Describe the factors that influence an individual’s phenotype.

Please respond on separate paper, following directions from your teacher.

(b) Explain how the presence of Notonecta chemical cues affects gene expression in the Daphnia.

Please respond on separate paper, following directions from your teacher.

(c) As a follow-up experiment, researchers placed the Daphnia that were exposed to the
Unit 5 FRQ: Conceptual Analysis

Notonecta chemical cues into a tank without chemical cues. The Daphnia reproduced asexually, and the offspring developed in the tank without chemical cues. Predict the relative size of the crest height and width of offspring raised in the tank without chemical cues as compared to the parent Daphnia.

Please respond on separate paper, following directions from your teacher.

(d) Provide reasoning to justify your prediction in part (c).

Please respond on separate paper, following directions from your teacher.

Part A

Select a point value to view scoring criteria, solutions, and/or examples and to score the response.

| 0 | 1 |

The factors that influence an individual’s phenotype include both of the following.

· Genetic information

· Environmental influences

Part B

Select a point value to view scoring criteria, solutions, and/or examples and to score the response.

| 0 | 1 |

The response includes the explanation that the presence of Notonecta chemical cues enhanced
expression of genes associated with crest development in the *Daphnia*.

**Part C**

Select a point value to view scoring criteria, solutions, and/or examples and to score the response.

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The response includes a prediction that the relative size of the crest height and width of the offspring will resemble that of the original population.

**Part D**

Select a point value to view scoring criteria, solutions, and/or examples and to score the response.

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The response includes both of the following criteria.

- The reasoning that the *Notonecta* chemical cues only affected the phenotype of the *Daphnia* parents during their development, leaving the genotype unchanged
- The reasoning that because there was no change to the heritable genetic sequence of the parents, the offspring are not expected to exhibit the larger crest heights and widths in the predator-free environment