Beyond Dissection: Modifying a Traditional Crayfish Dissection Lab to teach Hypothesis Testing, Data Analysis, and Scientific Writing

Jessica L. Goldstein

Department of Biology, Barnard College, New York, New York 10027

Abstract

Traditional anatomy labs are designed to help students make connections between form and function. We found that our students focused on memorizing anatomical structures, but did not make higher-level connections about similarities and differences between particular structures. To help students think more critically, we modified our crayfish dissection lab to introduce concepts of organism variability and statistical methods to describe and compare this variability. We chose to focus on front claw size, a sexually dimorphic trait in many decapods. We also asked students to compare their findings to previous data in scientific literature and write a summary of their conclusions to teach scientific communication.

Teaching Goals

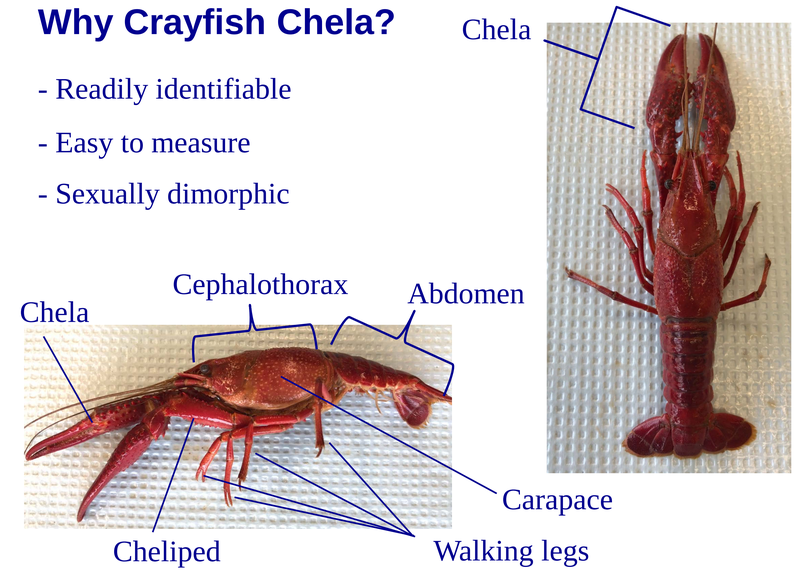
- Use statistics to describe individual variation within species
- Use data from scientific literature to form hypotheses regarding sex differences in chela size
- Collect and analyze data to test hypotheses
- Communicate findings in writing

Pre-Lab Information

- Basic stats: mean, standard deviation, t-test
- External anatomy: chela, cheliped, carapace
- Chela function: read scientific literature
  - Stein, R. A. (1976), *Behaviour*, 115(1), 100-113
  - Snedden, W. A. (1990*), Canadian Journal of Zoology*, 54 (2), 220-227

Why Crayfish Chela?

- Readily identifiable
- Easy to measure
- Sexually dimorphic



Student Discussion

- Based on function, why might chela by sexually dimorphic? Refer to assigned scientific literature.
- What data to collect to test hypothesis? Take into consideration that not all crayfish are the same size (e.g. normalize chela to body size).

Data Collection

Individual Data

Crayfish Sex	Chela Length (mm)	Carapace length (mm)

Pooled Class Data

Sex	Sample size	Mean chela length (mm)	Std dev chela	Mean carapace length (mm)	Std dev carapace
female					
male					

Data Analysis

Are chela sexually dimorphic in this sample?

- What values to compare?
- What statistical test to use?

Homework: Results + Discussion

Address the following questions:

- For either group (M or F), is there greater variability from the mean? Explain.
- Between the two sets of data (M or F), which group stats display greater reliability and why?
- Which chela is larger (M or F) or is there no difference?
- Considering the energetic costs of producing a larger chela, propose a biological rationale for this difference (if found). Refer to assigned literature.

Literature cited

Goldstein, J. and Flynn, D. (2011) Integrating active learning and quantitative skills into introductory biology curricula. *The American Biology Teacher*, *73*(8), 454-461.

Snedden, W. A. (1990). Determinants of male mating success in the temperate crayfish *Orconectes rusticus*: chela size and sperm competition. *Behaviour*, *115*(1), 100-113.

Stein, R. A. (1976). Sexual dimorphism in crayfish chelae: functional significance linked to reproductive activities. *Canadian Journal of Zoology*, *54*(2), 220-227.

Acknowledgments

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