CAMEOS Fellows’ Research Helps Students Meet the Challenges of Scientific Inquiry

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Introduction

The strength of CAMEOS (Coastal, Atmospheric, and Marine Environmental Observing Studies) comes from fellows’ use of their diverse research experiences to teach students how to conduct scientific investigations.

The different research projects of the graduate fellows provide models for how to implement the scientific method and provide material with which students can practice scientific skills, including:

- Developing scientific questions
- Experimental design and analysis
- Communicating science

Developing Scientific Questions

Dale Trockel uses his own experiences of finding a research question for his graduate studies to illustrate how students can formulate their own interesting and testable questions.

Learning Goals:
- Formulate interesting questions
- Determine if questions are testable
- How to refine questions

Choose a topic of interest

Because of his interest in math, Dale chooses questions that can be answered through numerical modeling. He has students think about what tools they would like to work with.

What is interesting and unknown?

Since less is known about internal waves than surface waves, Dale looks for questions in this field. Students spend time searching for topics that are more obscure but still interesting to others.

Develop a testable focused question

Students record data, and graphically analyzed their results to help with turtle conservation.

Communicating Science

Lisa Komoroske studies the impacts of pollutants on the health of sea turtles in order to help with turtle conservation.

Student Questions investigated:
1. Do turtles have more red blood cells or white blood cells?
2. Is the amount of each cell type different between sexes?

Turtle health is assessed via blood cell counts and other metrics. Students count blood cells on preserved slides from Lisa’s field sites.

Experimental Design and Analysis

Taking advantage of the experimental amenability of his study organism, the woolly bear caterpillar, Patrick Grof-Tisza developed an activity to introduce concepts germane to experimental design and analysis.

Activity: experimentally testing the effect of temperature on caterpillar movement

Relevance to Research:
- Understanding collaboration benefits
- Role of scientists in public & engaging communities in conservation efforts

Learning Goals:
- How to collect data
- Purpose of controls
- Generating graphs
- Interpreting results

Importance of replication

Purpose of controls

Generating graphs

Interpreting results

CAMEOS Interdisciplinary Research

CAMEOS (Coastal, Atmospheric, & Marine Environmental Observing Studies) is a GK-12 program based at the UC Davis Bodega Marine Laboratory that promotes scientific inquiry and increases ocean literacy. http://bml.ucdavis.edu/education/cameos/

CAMEOS fellows come from diverse research disciplines:
- marine and terrestrial ecology
- applied mathematics
- evolutionary biology
- computer science
- ecotoxicology
- geology
- oceanography

CAMEOS Participants
- National Science Foundation
- 16 Graduate fellows
- 9 Teachers
- 1081 Students
- UC Davis and CSU Sonoma Faculty
- Bodega Marine Laboratory

Conclusion

Learning from a fellow and his or her real, unfinished, messy, and interesting science engages students in a way that their textbooks simply cannot.

Through this collaboration, students:
- Gain insight into the scientific process
- Develop the skills needed to pursue scientific questions
- Learn how to overcome the obstacles that arise in the process

Acknowledgments:
We thank the NSF GK-12 program (Grant No. 0841297) for its support; Ocean Discovery! and the students and teachers of participating Sonoma and Marin County schools.

Data Table

<table>
<thead>
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Learning Goals:
- How to refine questions
- Formulate interesting studies to illustrate how students can formulate their own interesting and testable questions.

Importance of

Purpose of controls

Generating graphs

Interpreting results

Average No. Cells

<table>
<thead>
<tr>
<th>Turtle Sex Categories</th>
<th>Male</th>
<th>Female</th>
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</thead>
<tbody>
<tr>
<td>Red Blood Cells</td>
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<td>32.96</td>
</tr>
<tr>
<td>White Blood Cells</td>
<td>24.45</td>
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- Role of scientists in public & engaging communities in conservation efforts
- Importance of communicating results to public & engaging communities in conservation efforts

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<td>650.0</td>
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