

## Of Bobtails and Bacteria: Intro to Experimentation and the GeneLab Data Repository

Worksheet  
Teacher Materials

### OVERVIEW

This activity presents the symbiosis of the bobtail squid and its microbes, and provides an introduction to accessing the GeneLab data repository. Students will make observations using video clips and should have familiarity with the vocabulary of independent and dependent variables in a scientific experiment.

### KEY CONCEPTS

- Symbiosis describes the physical interaction between two or more different living organisms.
- Biotic factors affect the survival of organisms.
- Data is derived from experiments and experimental studies and can be publically shared.

### OBJECTIVES

- Students will be able to state objective observations without anthropomorphizing the organism.
- Students will be able to identify at least one example of a symbiotic relationship.
- Students will be able to describe relationships between variables using real, publically available data.

### TEACHING TIPS

- You may do this worksheet as a guided activity with your students, such as by showing the videos to a class, or as an individual worksheet where students individually (or in small groups) watch the videos.
- Part I as written is scaled to support high school students working on English Language Acquisition, but it can be scaled further down to be a middle school lesson or up by modifying the types of questions and information probing.
- This worksheet could be positioned in an introduction to symbiotic relationships or at the end of a lesson on experimental methods and variables.
- This worksheet can provide formative assessment as to whether prior teaching about experimental variables have been effective.
- Address the misconception that the term symbiosis is used synonymously with mutualism.
- Students with little or not graphing experience will need teacher guidance for Part III, or teachers may choose to replace that section with a different type of graphing interpretation exercise.

# CASE STUDY: Symbiosis

## PART 1. Getting to know your Bobtail Squid

1. Write **five observations** about the image below. Try to include an estimate of the size of the organism using the scale provided and the hand included in the photo.



Image used with permission from M.J. McFall-Ngai, University of Hawaii at Manoa

*Answers may vary. Observations could/should include color, size, body shape, eye location, etc. Students should not include judgements of the organism, such as "cute".*

2a. Watch the video clip: [https://www.youtube.com/watch?v=p91OZVo\\_1a0](https://www.youtube.com/watch?v=p91OZVo_1a0)

2b. Describe what you saw in the video clip.

*Answers may vary, and as in the previous question, should only include observations, rather than behavioral attributions or anthropomorphisms.*

3a. Watch the video clip: <https://www.youtube.com/watch/x5-VcJyZrc4>

3b. What organism has a symbiosis with the squid that causes the squid to light up?

*A bacterium called *Vibrio fischeri**

4a. Watch this video clip: <https://www.youtube.com/watch?v=3OGEXs27kRs>

4b. What is the scientific term for the light that is emitted by living things?

*Bioluminescence*

4c. Describe the relationship between the bobtail squid and the *Vibrio fischeri*.

*Target answers should include that the *Vibrio fischeri* live inside of the squid and emit light. The bacteria receive safe housing and the squid develops a light camouflage because they produce less of a shadow*

5. Write a testable, scientific question regarding the squid and its symbiosis with *Vibrio fischeri*.

*Answers may vary. Example responses could resemble: "Does the removal of the bacteria in the light organ affect burrowing behaviors of the squid?" or "Does the presence of antibiotics in the bobtail squid habitat affect the quantity of light emitted?"*

*Responses should NOT resemble: "Why do the squid have the bacteria?" (Valid question, but is not directly testable as stated) or "Can bobtail squids be kept as pets?" (Not a relevant scientific question)*

5. List dependent and independent variables that would be addressed by your question in the previous step.

*Answers may vary depending on questions posed, such as quantity of presence of bacteria and luminosity, location of greatest concentrations of *Vibrio fischeri* in the squid body, quantity of time buried vs unburied in relation to presence of bacteria, etc.*

## **PART II. Accessing Squid Research**

These squid have been an organism of interest to many researchers, including Dr. Jamie Foster who is at the University of Florida and works with NASA Ames Research Center for space biosciences.

1. Navigate to the website: [genelab.nasa.gov](http://genelab.nasa.gov) >> Click on **Data Repository** >> and in the search bar, type "squid".



You should see the following study listed:

Search results for: **squid** using filter(s):

Total Search Results Found: 1

Sort by Relevance 25

### [Effect of microgravity on an animal-bacteria symbiosis](https://genelab-data.ndc.nasa.gov/genelab/accession/GLDS-119)

<https://genelab-data.ndc.nasa.gov/genelab/accession/GLDS-119>



Spaceflight imposes numerous adaptive challenges for terrestrial life. The reduction in gravity or microgravity represents a novel environment that can disrupt homeostasis of many physiological processes. Additionally it is becoming increasingly clear that an organism's microbiome is critical for host health and examining its resiliency in microgravity represents a new frontier for space biology research. In this study we examine the impact of microgravity on the interactions between the squid ...

Organism: *Euprymna scolopes* Factor: Simulated Microgravity Assay Type: transcription profiling Accession: GLDS-119 PI/Contact: Giorgio Casaburi, Ja...  
Release/Publication Date: 28-Apr-2017

Click on the hyperlink title in your browser or click on this: "[Effect of microgravity on an animal-bacteria symbiosis](https://genelab-data.ndc.nasa.gov/genelab/accession/GLDS-119)".

2. Look in the **Protocols** tab by clicking on it, specifically in **sample collection**. In what temperature and lighting conditions were these squid kept? How long is the developmental cycle of the squid?

*23°C and 12 hour light/dark cycle. Bobtail squid developmental cycles last about 21 days.*

8. Two groups of squid were created: **aposymbiotic** and **symbiotic**. What is being compared between these two groups?

*Aposymbiotic: no symbiosis competent bacteria (teachers may further break down what this means)*  
*Symbiotic: with symbiosis competent bacteria*

9. What platform was used for the **nucleic acid sequencing**?

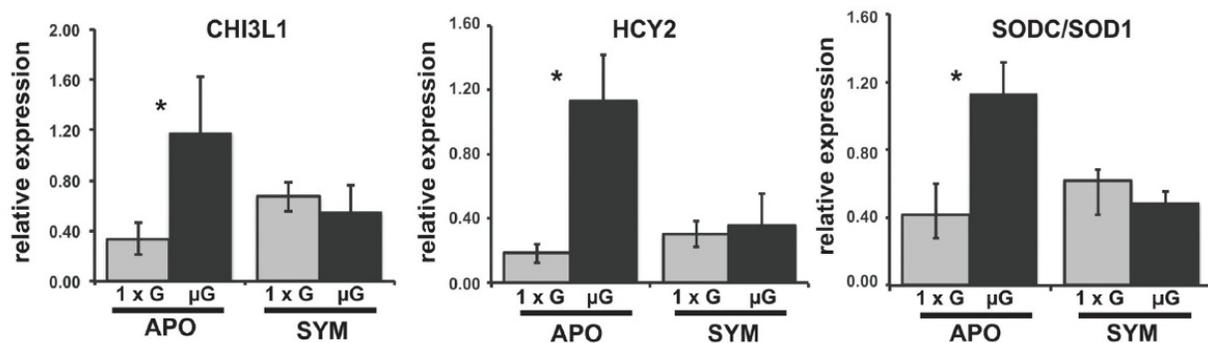
*Illumina NextSeq 500*

10. Look in the **Samples** tab. How many samples were taken? (You might need to scroll through in order to count.)

*22*

### **PART III. Extending Meaning to Squid Research**

Examine these graphs that were retrieved from the published squid study:



1. Describe objectively what you see in these graphs, such as axis labeling, abbreviations, etc.

*Answers may vary depending on prior student experience with graphs. This question is intended as an introductory examination for students to describe basic attributes including axes, color, relative height of bars in the graph, titling of the graphs, relative size of error bars (which might or might not be recognized) abbreviations of 1xG and μG, etc.*

2. Describe what the contents of the graph mean, specifically interpreting what you described in the previous step.

*Answers may vary depending on prior student experience with graphs. Basic responses might indicate that μG has an effect on relative expression or that three factors for relative expression were examined in the study. Advanced responses may describe something like there is greater relative expression of the CHI3L1 gene under microgravity situations of the aposymbiotic bacteria.*

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