

## Project Year

2016-2017

## Project Title

Building on the work of others: A searchable archive of student projects in Phage Hunting

## Project Team

Emily Fisher, Krieger School of Arts & Sciences, Biology, Faculty

Ashley Yuen, Krieger School of Arts & Sciences, Biology, Fellow

Andrew Shiau, Whiting School of Engineering, Computer Science, Fellow

## Audience

*Project Lab: Phage Hunting* is a year-long inquiry-based laboratory course in the Biology department. It is part of the Howard Hughes Medical Institute(HHMI) SEA PHAGES program that connects over 80 schools throughout the US. The purpose of the course at Hopkins is to introduce freshman undergraduates to a real-life research environment. Students during the first semester isolate novel bacteriophages (viruses that infect bacteria) and in the second semester they annotate the sequenced genomes of newly-found bacteriophages. Since 2012, we have offered nine sections of the bioinformatics second semester course and have included 156 students total. We intend to offer two sections of the course each year for the future. This project will impact students in Phage Hunting II immediately and (~24 per year), if expanded to other courses, could impact many more.

## Pedagogical Challenge

Students spend the final weeks of the semester proposing, designing, and executing a self-directed project with faculty guidance. Students may choose to continue bioinformatics investigations of the genomes that were annotated or return to the lab and investigate the biology of JHU phages. We work with a document provided by HHMI which outlines suggested experiments. Students define the parameters, then plan and perform the experiments over several weeks. Results are presented in a final paper or poster at the end of the semester. One important aspect of designing a project is to investigate the scientific literature for “what is known” so as to identify a novel and interesting hypothesis for study. Presently, it is difficult for students to know what experiments have been done by students in previous years, what has worked, what phenotypes may be common to many bacteriophages, or what is yet unknown about these phages. Typically, these small projects are not published in scientific journals.

## Solution

Students would benefit from a searchable database of projects from previous years. The hypotheses, protocols, and results obtained should be available to current students as they design their experiments. With the knowledge of previous work, students will be able to identify interesting scientific questions and use their work to make broad conclusions about phage biology in general.

## Assessment Strategy

Students submit their project proposals for approval before they begin and their results (or progress) are detailed in a final paper or poster. The student-directed project proposals and results will show evidence of the influence of previous work. Additionally, we have begun surveying students about the inspiration for their project and what resources were used to plan their research. We expect to see an overall increase in the reliance on the work of others by monitoring the following:

1. Evidence of forethought in proposal document
2. References to previous work in papers/posters

Impact on the course will be assessed by surveying students about what resources they use when designing projects. In 2016 only one student used the scientific literature as inspiration for his project. One measure of success of this project will be if students use the database as a resource. Another measure will be an increase in references to prior work when students write their end-of-term assignments. These data can be quantified for longitudinal analysis.

## Faculty Proposal

We aim to create a searchable database of student projects performed in the Phage Hunting II course in the biology department. These projects occur during the final weeks of the second semester of a year-long course in which students isolate and characterize a novel phage (a virus that kills bacteria), then annotate a sequenced genome. Students propose, plan, execute, and then interpret the results of a short phage project. Some students return to the lab and study the details of how the phages infect their bacterial targets. Other students continue to analyze the sequenced genomes.

Currently, students propose projects based on their own interest and with faculty advice, but they do not have a sense of what has been done in the past. Consequently, we see similar experiments repeated every year and the results are narrow and have limited impact. Projects would be greatly improved by a broader perspective. Students could make conclusions based on comparative analysis of different phages if they had access to the work of their predecessors.

Ashley Yuen has been involved in the phage lab course for three years and is well situated to mine previous students' work to populate a database of protocols and results. She is familiar with PhagesDB.org which is the main resource for the multi-school phage discovery endeavor of which this class is a part. PhagesDB is based on the free and open-source Django platform.

One important aspect of the database will be a form in which students can input their own project summary and results so that the database will remain current. Curation will continue by Emily Fisher in the future. The database will be hosted on JHU web servers.

This database could expand beyond our course to other schools in the SEA PHAGES community. Alternatively, the database could expand to include student-run projects in the Developmental Biology lab at JHU which has included similar projects for several years.