

Science Education Alliance  
Phage Hunters Advancing Genomics and Evolutionary Science  
2020 Program Announcement

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## Overview

We invite colleges and universities to join the HHMI Science Education Alliance and offer the SEA-PHAGES project to your undergraduates. Our goal is to enable undergraduate students, at all types of colleges and universities, to engage in discovery-based research early in their academic tenure. In 2018-19, more than 5,500 undergraduates from over 100 2- and 4-year schools participated in the HHMI SEA-PHAGES project. A list of participating schools is available at [seaphages.org/institutions](http://seaphages.org/institutions).

HHMI is committed to supporting and growing this inclusive Research and Education Community, and encourages you to consider joining the Science Education Alliance. Schools interested in beginning to offer the SEA-PHAGES project in the 2021-2022 academic year can submit an application any time before Oct 31, 2020.

We anticipate accepting 20 institutions as the 14<sup>th</sup> cohort, and recommend that institutions interested in joining the program begin the application process as early as possible. Early applicants benefit from additional opportunities to revise and resubmit their applications, and once accepted, to begin scheduling the course and securing intramural and/or extramural support.

The application can be found on the [SEA website](#).

Applications are accepted by email to [SEA@hhmi.org](mailto:SEA@hhmi.org)

Please send questions regarding the program or the application process to Vic Sivanathan (Program Officer) or Billy Biederman (Senior Program Assistant) at [SEA@hhmi.org](mailto:SEA@hhmi.org)

## The SEA-PHAGES Project

The SEA-PHAGES project is a discovery-based course-based research experience that spans two semesters. It is aimed at undergraduates who are new to college level science and have had little or no research experience. Students should be concurrently enrolled in introductory undergraduate biology and/or chemistry courses; there are no other pre- or co-requisites. At many institutions, the SEA-PHAGES course replaces the standard introductory biology laboratory course.

The research goal of the PHAGES project is to uncover the genetic diversity and evolution of bacteriophages. In the first semester, students begin by isolating bacteriophages from local environmental samples that they themselves have collected. They then purify and characterize their phages, and extract DNA for further analysis. By the end of the first semester, the students will have selected phages for whole genome sequencing. During the break between semesters, the DNA is sequenced and the sequence is then returned to the students. In the second semester, the students employ a suite of bioinformatics tools to annotate their phage's genome sequence. After quality control checks, the students' annotated sequence is submitted to the National Center for Biotechnology Information GenBank database, with students listed as authors for the submission, and where it becomes available to the wider scientific community. At the end of the school year, a student and a faculty member from each SEA school will be invited to the annual SEA-PHAGES Symposium, which is a student-centered scientific meeting, to share their discoveries and learn from others in the program. Students and faculty are co-authors on many publications resulting from their SEA-PHAGES research ([seaphages.org/publications](http://seaphages.org/publications)).

## Course Implementation

HHMI supports participating schools by providing:

1. Instructor Training and Support
  - hands-on training for course instructors from each new SEA school, including the costs for travel and living. There are two training workshops:
    - (i) the Phage Discovery workshop is a week-long workshop conducted in the summer of 2021 at the University of Maryland Baltimore County; and
    - (ii) the Phage Genomics workshop is a week-long workshop conducted in December of 2021 at HHMI headquarters in Chevy Chase, MD.;
  - an online community platform that includes resources such as forums and video tutorials;
  - year-round technical support from program staff
  - formative feedback for each semester based on the PITS Survey
2. Instruction and Research Resources
  - instructor-vetted course manuals for the first semester (Phage Discovery) and the second semester (Phage Genomics);
  - sequencing of the genomic DNA isolated by the students at each SEA school;
  - bioinformatics software; quality control checks of DNA sequence and genome annotation;
  - invitations to the annual SEA-PHAGES Symposium, held at the Janelia Research Campus in Ashburn, Virginia, including travel, accommodations, and meals. Each SEA school will be invited to send one student and one faculty member to the Symposium;
  - Invitations to attend HHMI-sponsored meetings dedicated for SEA faculty.

Schools offering SEA-PHAGES should provide the following:

1. Instructors and Scheduling:

- at least two instructors each semester who will be assigned to a section of the SEA-PHAGES laboratory course. HHMI recommends that teaching the SEA-PHAGES course represents a significant portion of each instructor's teaching load; per week, the instructor team should allot at least 4 hours of contact time with each section of students in the laboratory and at least 2 hours for laboratory preparation. The instructors teaching the Phage Discovery semester do not have to be the same as the instructors teaching the Phage Genomics semester. For new SEA schools, it is essential that instructors participate in the training workshops for Phage Discovery and Phage Genomics;
- course scheduling so that each laboratory section (excluding lecture) of the SEA-PHAGES course meets at least twice per week for at least 2 hours per meeting throughout the semester;

2. Space and Supplies

- appropriate lab space and equipment available to the needs of the SEA-PHAGES course;
- consumable laboratory supplies, which total approximately \$150-200 per student per year (see the detailed list of Supplies and Equipment, below. Contact [SEA@hhmi.org](mailto:SEA@hhmi.org) if you require assistance in acquiring some of the equipment);
- appropriate computer equipment and IT support;

3. Research and Programmatic Deliverables

- timely submission of isolated phages for archiving, DNA samples for sequencing, annotated sequences for quality control checking (see the list of program deadlines included in the Program Timeline);
- participation in the HHMI-designed assessments of SEA-PHAGES.

## Supplies and Equipment

The phage discovery portion of the course requires supplies and equipment found in most colleges and universities. The list below represents a reasonably complete list of supplies and equipment required to deliver the SEA-PHAGES project as a lab course/course-based research experience. This does not include consumables or “extras” such as lab notebooks, disposable lab coats, etc. For a more complete list, please email [SEA@hhmi.org](mailto:SEA@hhmi.org).

### Supplies:

- Baffled flasks (250-mL)
- Media bottles (100-mL and 250-mL screw capped)
- Micropipettors and tips (10-20  $\mu$ L, 20-200  $\mu$ L, and 1000  $\mu$ L)
- Pipettes, serological (5-, 10-, and 25-mL)
- Pipettor, automatic (e.g. Pipet Aid®)
- Racks (for various tubes see below)
- Thermometers
- Tubes (10-mL culture tubes, 15- and 50-mL conical tubes [e.g., Falcon®], microcentrifuge [e.g., Eppendorf®])
- Petri plates

### Equipment:

- Autoclave
- Balances (micro- and milligram ranges)
- Bunsen Burner
- Centrifuges (Table-top, high speed and microcentrifuge)
- Electrophoresis (agarose gel) equipment and supplies
- Freezer (-80°C and -20°C)
- Heating blocks
- Incubators (30°C or 37°C; shaking and non-shaking)
- Microwave
- pH meter
- Photography equipment and supplies
- Power supplies
- Refrigerator
- Spectrophotometer, fluorometer, or nanodrop
- Stir plates
- Transilluminator
- Vortexer
- Water baths
- The computer software for the Phage Genomics component requires the following minimum computer configurations: Windows XP/Vista/7 or Mac OS X 10.5; 1.6 GHz/x64 dual-core processor; 4 GB RAM; 128 MB video memory; 20 GB free hard-drive space.
- The software requirements are likely to require the support of the institution’s IT staff.

### Other Resources:

- Reliable high-speed internet access
- Transmission electron microscope access

## Program Timeline

*Timeline dates are for reference and are subject to change*

Application Deadline	October 31, 2020
Notification to Applicants	December, 2020
Acceptance Deadline	January, 2021
Identify 2020 Symposium Participants	March, 2021
Identify 2020 Phage Discovery Workshop Participants	March, 2021
Purchase Supplies and Receive Program Biologicals	March, 2021
SEA Symposium	June 4 – 6, 2021
SEA Faculty Meeting	June 6 – 7, 2021
Phage Discovery Workshop Option A	June 19 – 25, 2021
Phage Discovery Workshop Option B	July 10 – 16, 2021
Identify Phage Genomics Workshop Participants	October, 2021
Phage Genomics Workshop	December 6 – 10, 2021
Submit DNA Samples [Semester schools]	November, 2021
Submit DNA Samples [Quarter schools]	January, 2022
Submit Phage Lysates	February, 2022
Identify 2020 Symposium Participants	March, 2022
Submit a Student Abstract for the 2020 Symposium	May, 2022
Submit Annotations for Quality Control Review	May, 2022