Emma Keeler

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Research Interests

Viromics, virus and host genomics, emerging viruses, virus discovery from meta-omics

Education

Ph.D. in Microbiology, *Yale University*, In progress

M.S. in Biology, *University of Pennsylvania*, 2023, GPA 4.00
Thesis, "Viruses of protozoan parasites and commensals: virus hunting using meta-omics"

B.A. in Biology, *University of Pennsylvania*, 2023, GPA 3.99, *summa cum laude*
Honor's thesis, "Origins of viruses in humans: *Entamoeba gingivalis* hosts the replication of human-associated redondoviruses"

Research Positions

Laboratory Research Assistant, Sept. 2019 to Aug. 2023
Perelman School of Medicine, Microbiology Department, Dr. Frederic Bushman and Dr. Ronald Collman
- Characterized the cellular tropism of redondoviruses using bioinformatic analysis, metagenomic sequencing, and molecular techniques
- Developed bioinformatic pipelines to identify and annotate novel viruses from raw metagenomic and metatranscriptomic data

Clinical Research Volunteer, Apr. 2020 to Apr. 2021
Children's Hospital of Philadelphia, Division of Infectious Diseases, Dr. Brian Fisher and Dr. Jeffrey Gerber
- Analyzed data for a longitudinal, seroepidemiological study of SARS-CoV-2 antibody responses in healthcare workers
- Performed a retrospective chart review to study clinical amoxicillin treatment failures due to *S. pneumoniae* resistance

Laboratory Research Assistant, Apr. 2017 to Aug. 2019
Woods Hole Oceanographic Institution, Department of Geology and Geophysics, Dr. Virginia Edgcomb
- Isolated and taxonomically characterized fungi from the deep-sea, hydrothermal sediments of the Guaymas Basin
- Screened the antibacterial activities of all fungal isolates against *E. coli, S. aureus,* and *Pseudomonas aeruginosa*

Published Work

Keeler, E., Rosenbach, M., Vukmirovic, M., Yan, X., Gulino, K., Ghedin, E., Kaminski, N., Bushman, F.D., Sullivan, K.E., Collman, R.G. (2022). Metagenomic sequencing of the bronchoalveolar lavage extracellular virome and cellular transcriptome of sarcoidosis patients does not detect rubella virus. *Sarcoidosis Vasc Diffuse Lung Dis.* 34(4); doi: 10.36141/svdld.v39i4.13407.

Keeler, E., Merenstein, C., Reddy, S., Taylor, L., Cobián-Güemes, A., Zankharia, U., Collman, R.G., Bushman, F.D. (2022). Widespread, human-associated redondoviruses infect the commensal protozoan *Entamoeba gingivalis*. *Cell Host Microbe.* (31); doi: 10.1016/j.chom.2022.11.002. Featured in a *Nat Rev Microbiol* Research Highlight, doi: 10.1038/s41579-022-00844-4.

Taylor, L.J.[†], **Keeler, E.[†],** Bushman, F.D., Collman, R.G., [†]Co-first authors. (2022). The enigmatic roles of *Anelloviridae* and *Redondoviridae* in humans. *Curr Opin Virol.* 55:101248; doi: 10.1016/j.coviro.2022.101248.

Keeler, E., Burgaud, G., Teske, A., Beaudoin, D., Mehiri, M., Dayras, M., Cassand, J., Edgcomb, V. (2021). Deep-sea hydrothermal vent sediments reveal diverse fungi with antibacterial activities. *FEMS Microbiol Ecol.* 97:8; doi: 10.1093/femsec/fiab103.

Keeler, E.[†], Taylor, L.J.[†], Abbas, A., Collman, R.G., Bushman, F.D., [†]Co-first authors. (2021). Rengasvirus, a circular replication-associated protein-encoding single-stranded DNA virus-related genome that is a common contaminant in metagenomic data. *Microbiol Resour Announc*. 10:e00273-21; doi: 10.1128/MRA.00273-21.

Contributed Talks

Keeler, E. (2023). Human-associated redondoviruses infect the oral protozoan *Entamoeba gingivalis* [Poster presentation]. *University of Pennsylvania Research Symposium: Philadelphia, PA.*

Keeler, E. (2023). Origins of viruses in humans: *Entamoeba gingivalis* hosts the replication of redondoviruses [Poster presentation]. *The Biology of Viral Infection: Replication, Host Interactions and Pathogenesis GRC*: Barcelona, Spain.

Keeler, E.[†], Beus, J.M., Hayes, M., Zorc J.J., Metjian, T., Ku B.C., Hamershock, R., Gerber, J.S., Chiotos, K., [†]Presenting author. (2021). Evaluating an amoxicillin dosing regimen for community-acquired pneumonia [Poster presentation]. *Infectious Disease Society of America ID Week*: Virtual.

Keeler, E. (2021). Hunting for microbes at the bottom of the ocean [Podcast episode]. *Microbe Talk Hosted by the Microbiology Society*: Virtual.

Keeler, E.[†], Burgaud, G., Teske, A., Edgcomb, V., [†]Presenting author. (2021). Deep-sea hydrothermal vents: reservoirs of clinically relevant fungal diversity [Poster presentation]. *Microbiology Society Annual Conference*: Virtual.

Keeler, E. (2021). Utilizing metagenomic pipelines to mine microbial dark matter [Oral presentation]. *University of Pennsylvania Dipping into Data Science Series*: Virtual.

Keeler, E. (2020). Computational prospecting in the viral dark matter in search of redondoviruses [Poster presentation]. *American Society for Microbiology Infection and Immunity Forum*: Virtual.

Laboratory Techniques

Wet-lab techniques: culture methods (protozoa, fungi, bacteria); microscopy (fluorescence, light, scanning electron); polymerase chain reaction (qPCR, PCR, RT-qPCR, RT-PCR,); blotting (Western, Southern); DNA and RNA manipulation (extraction, purification, cloning, transfection, chromatin capture); sequencing (RNA sequencing, whole genome sequencing, shotgun sequencing); virome analysis (virus-like particle isolation, imaging, enumeration)

Dry-lab techniques: programming (BASH, Python, R); sequence alignment (pairwise sequence alignment, multiple sequence alignment); phylogenetic analysis (phenetic methods based on pairwise distance, cladistic methods based on maximum-likelihood); viral genome annotation (protein prediction, motif finding); meta-omic data analysis (contig construction, *de novo* genome assembly, taxonomic classification, viral sequence prediction); bioinformatic pipeline construction

Select Honors

Neysa Cristol Adams Award, May 2023
Awarded by the Biology Department at the University of Pennsylvania for academic performance and research excellence.

Phi Beta Kappa, Apr. 2023
Awarded by the Delta Chapter of Phi Beta Kappa for academic excellence.

Gruber Science Fellowship, Feb. 2023
Awarded by Yale University for academic performance and excellence in research; Provided stipend and research funding.

Dean's Scholarship, Feb. 2023
Awarded by the University of Pennsylvania for academic performance and intellectual promise.

Goldwater Scholarship, Apr. 2021
Awarded by the Barry Goldwater Scholarship and Excellence in Education Foundation for research in natural sciences, engineering, and mathematics; Provided a partial scholarship for two years.

Translational Research Fellowship, Apr. 2021
Awarded by the National Institutes of Health to support research on the host tropism of redondoviruses; Provided a stipend and access to educational seminars for one summer.

University Scholarship, Mar. 2021
Awarded by the University of Pennsylvania to support research on virus discovery and virome annotation; Provided research funding for three years and access to educational programming.

Presentation Award at the Philadelphia Infection and Immunity Forum, Dec. 2020
Awarded by the American Society for Microbiology for work on the annotation of the human virome.

College Alumni Society Research Grant, Apr. 2020
Awarded by University of Pennsylvania to support research on the empiric treatment of S. pneumoniae infections; Provided research funds for one year.

Teaching

Teaching Assistant for University of Pennsylvania Biology Department, Jan. 2022 to May 2023
Held weekly recitations and problem-solving sessions for BIOL-1101 Introduction to Biology I [undergraduate-level, Fall 2022]; review biology concepts with students before exams.

Selected literature, wrote and graded exams, and held weekly recitations for BIOL-4016 Molecular Mechanisms of Infectious Disease [graduate-level, Spring 2022 & 2023]; lectured for 3-hr class period on occasion.

Writing Tutor in the University of Pennsylvania Critical Writing Program, Jan. 2021 to May 2023
Tutored undergraduate and graduate students through the Critical Writing Program with a focus on scientific writing and communication; co-teach a writing class, WRIT-0110 Writing Seminar on Global Health.

Outreach

Independent Artist, Jun. 2021 to Present
Create embroidered, linoleum-printed, and painted pieces inspired by viruses to sell at a local farmers' market and on commission.

Vaccine Hesitancy Conversation Volunteer, Jan. 2021 to May 2023
Engaged in dialogue with Philadelphia community members relating to the safety and efficacy of the COVID-19 vaccines as part of the COVID-19 National Scientist Volunteer Database.