The Metagenomics Education Partnership: Involving High School Teachers and Students in a Citizen Science Project Assessing Microbial Diversity in Western New York Waterways.

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Jacobs School of Medicine and Biomedical Sciences
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SEPA SCIENCE EDUCATION PARTNERSHIP AWARD
SUPPORTED BY THE NATIONAL INSTITUTES OF HEALTH

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Aim 1. Partnerships will be developed and strengthened between local high schools, colleges, biotechnology companies, and local not-for profit organizations. This will serve as a pipeline for recruiting students to scientific and health-related careers, with an emphasis on those from underrepresented groups.

- Departments of Biotechnical and Clinical Laboratory Sciences, Family Medicine and Biochemistry in the University at Buffalo Jacobs School of Medicine and Biomedical Sciences,
- University at Buffalo Center of Excellence in Bioinformatics and Life Sciences,
- NY State Area Health Education Center System
- Buffalo Niagara Waterkeeper
- School districts in a 14-county region of Western New York.

Aim 2. To utilize citizen science involving metagenomic analyses of water samples in Western New York with underserved high school students, empowering them to assist in safeguarding local water resources for present and future generations.

- Collect water and metadata related to water collection modeled after Reddington, et al.
- Sequential filtration to collect bacteria (~ 1.2 µM pore followed by 0.22 µM pore)
- Extract DNA from 0.22 µM pore filter and prepare a library for sequencing
- Sequence on Flongle flow cells in a MinION Mk1b/MinION Mk1c.
- Use EPI2ME What's In My Pot workflow to assign phylogeny. MG-RAST-based interface to be implemented to run on local servers.

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Metagenomics

Water Collection (20 minutes)

Water Filtration by teachers **at UB** (2-3 hours)

Metagenomic DNA Extraction (45 min)

1.5 hours

Quantitation and PCR set up (30 minutes)

5.5 hours

All in one visit

If the PCR is done at UB, we will also clean up and quantitate it for you

PCR (2.5 hours)
we can take the reaction back to UB or run it in your classroom

PCR Clean up and quantitation (40 min)

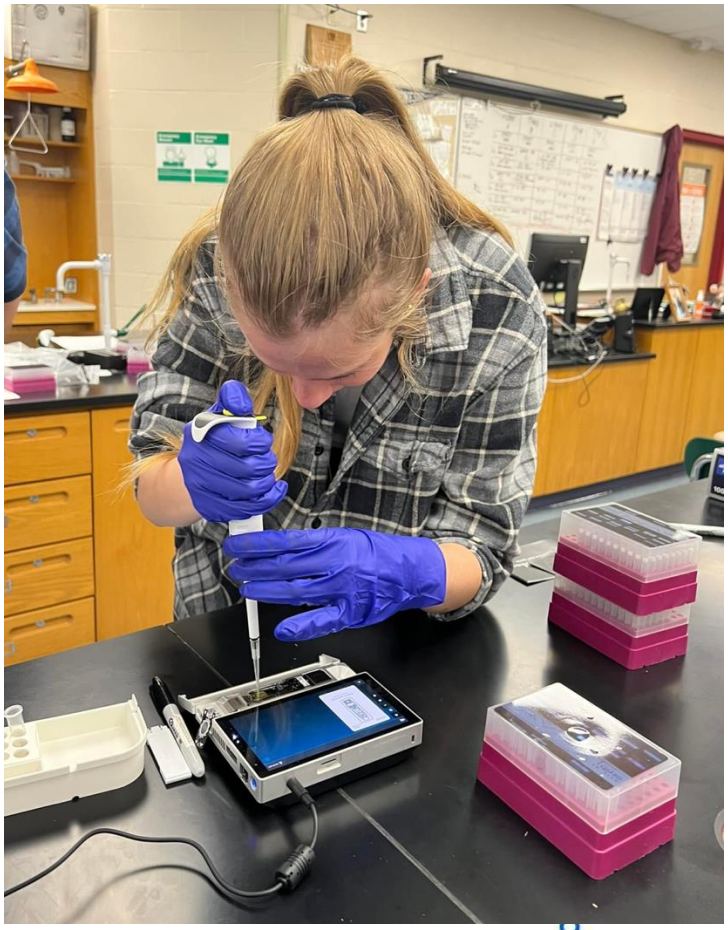
35 min

Sequencing Preparation and Loading (35 min)

Nanopore Kits

Product Code: **SQK-RPB004**
Description: **Rapid PCR Barcoding Kit**
Batch Number: **SD04.10.0017**
Store at -20°C 0050 Box 1 of 2


My Device
Start
Sequencing overview
Experiments
System messages
Host settings
Application settings
Connection manager
Start sequencing
Analysis
Flow cell check
Hardware check
Sample sheet import



Water Collection Sites 2022-2023 and 2023-2024

https://www.google.com/maps/d/u/0/viewer?mid=1Z_aZGBRBX0zlvl71s5TT2m0SnUQ9XFs&g_ep=CAISDTYuMTE3LjEuNjI5MjAYACDdYipILDk0MjI0ODE5LDQ3MDcxNzA0LDQ3MDY5NTA4LDk0MjE4NjM1LDk0MjAzMDE5LDQ3MDg0MzA0LDk0MjA4NDU4LDk0MjA4NDQ3QgJVUw%3D%3D&g_st=i&ll=43.122138623737 12%2C-

Or

https://tinyurl.com/3za3pb9a

Aim 3. To sequence and analyze a microbial genome supporting high school students' explorations of Big Data, STEM and health-related careers.

- Grow colonies of bacteria backflushed from a 0.22 µm filter on Tryptic Soy Agar plates
- Students select colonies of interest at random to grow in liquid culture and extract high molecular weight DNA
- Prepare a library for sequencing and sequence DNA on Flongle flow cells.
- Use EPI2ME FASTQ Custom Alignment to assess coverage of the genome, with the ultimate goal of building draft of the genome for analysis.

Whole Genome Sequencing

Plating and incubation (done by the teacher during water filtration)

↓

Colony Selection (We will send a picture of the plate for you to select a colony)

↓

4.5 hours to complete in one visit

Genomic DNA Extraction and Quantitation (1.75 hr)

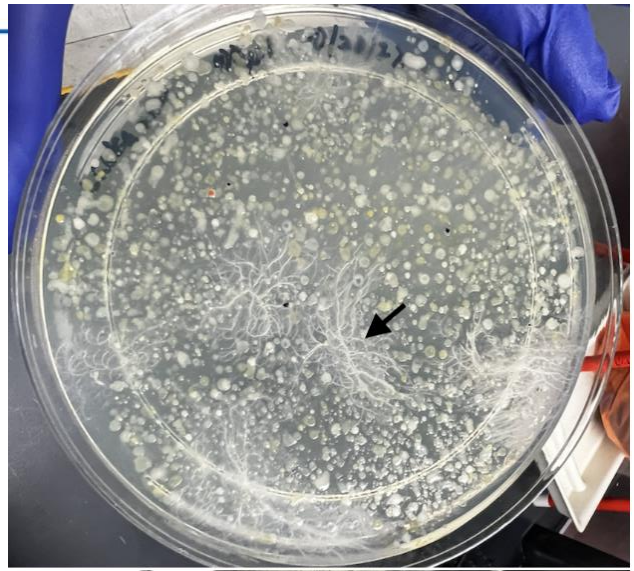
↓

If the first and last steps are split into 2 visits, this step will be done by us at UB

Short Read Elimination (1 hour, 20 min)
This section contains a 30 min and 20 min waiting time

↓

Preparation of Library, Gel Electrophoresis, and Sequencer Loading (1.5 hour)
The gel is run while prepping the sample for loading.



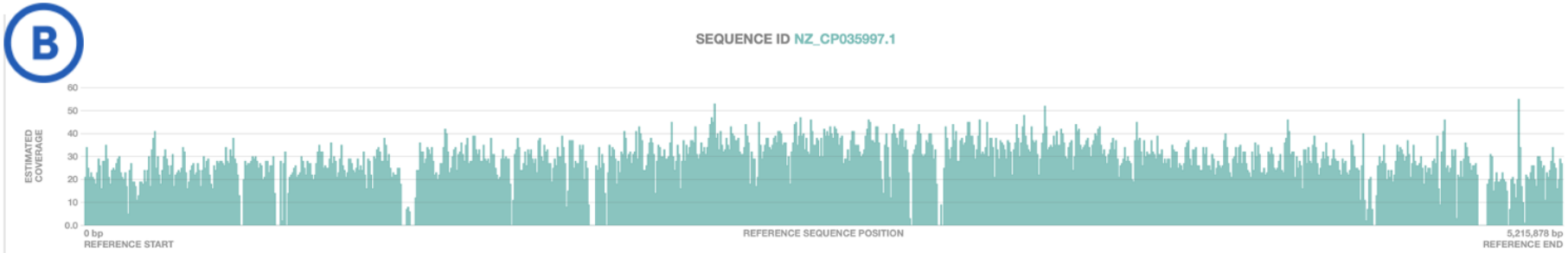
A

Taxa at Rank: Species

Filter...

Taxon	Cumulative Reads
Bacillus mycoides	**35,070**
Bacillus thuringiensis	682
Bacillus cereus	680
Bacillus pseudomycoides	554
Homo sapiens	410

B



ALIGNMENTS	ALIGNED YIELD	AVERAGE ACCURACY	AVERAGE IDENTITY
23,260	91.0 M bp	89.2%	95.3%

QC → WIMP → AMR Alignment

Export CSV | Copy URL | Print report

Reads per Exit Status

Showing the status of all the reads analysed

Key Figures

Screenshot

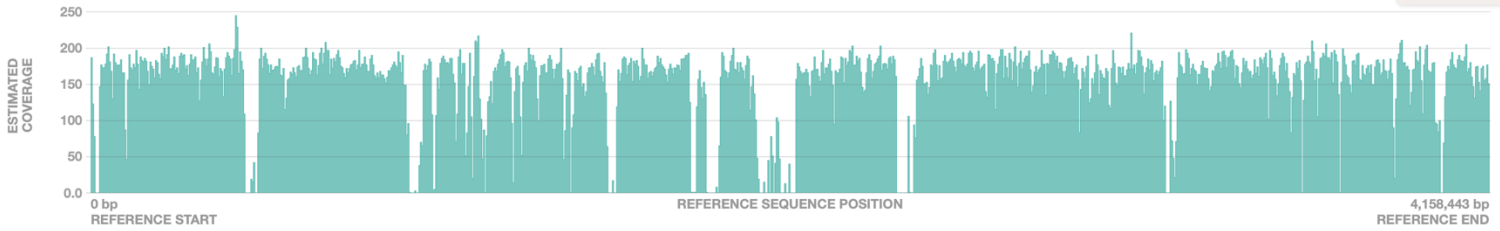
READS ANALYSED	TOTAL YIELD
160,991	487.0 Mbases
AVG QUALITY SCORE	**AVG SEQUENCE LENGTH**
11.89	3,025

Quality Score

EXPORT PNG

SEQUENCE ID CP033736.1

Screenshot



ALIGNMENTS	ALIGNED YIELD	AVERAGE ACCURACY	AVERAGE IDENTITY
133,055	383.0 M bp	85.1%	89.2%

Whole Genome Sequencing To Date

Whole Genomes Koury Lab	
School	**Genus/species**
Oatka Creek	
Barcode 9	*Shewanella sp. FDAARGOS_354*
Barcode 10	*Aeromonas sp. CA23*
Barcode 11	*Pseudomonas sp.*
Barcode 12a	*Pseudomonas orientalis*
Barcode 8	*Citrobacter sp?*
Brderick Park	
Barcode 11	*Pseudomonas koreensis*
Barcode 12a	*Aeromonas caviae*
Barcode 5	*Pseudomonas koreensis*
Barcode 7	*Pseudomonas sp. S1-A32-2*
Barcode 8	*Pseudomonas sp. S1-A32-2*
Janvi	
Scajaquada Creek	*Strenotrophomonas LM091*
Tanishka	
Scajaquada Creek	*Bacillus mycoides*

Whole Genomes 2023	
School	**Genus/species**
Avon	*Serratia marcescens*
da Vinci	*Pseudomonas fluorescens*
East Aurora	*E. coli (maybe mxed culture)*
Eden	*Proteus vulgaris*
Global Concepts	*Pseudonomas sp. S49*
Lackawana HS	*Chromobacterium vaccinii*
Niagara Falls HS	*Pseudomonas aeruginosa (need more sequence)*
Olmstead HS	*Pseudomonas sp (need more sequence)*
WEMCO BOCES	*Brevundimonas naejangsanensis*
West Seneca West	*Pseudomonas sp. OST1909*

Whole Genomes 2024	
School	**Genus/species**
East Aurora	*Shewanella baltica*
Eden	*Proteus vulgaris*
ERIE BOCES	*Chromobacterium*
Fairport	*Pseudomonas fragi*
Global Concepts	*Alcaligenes sp.*
Holland	*Alcaligenes faecalis*
Kenmore East 1	*Hafnia alvei*
Kenmore East 2	*Shewanella sp. WE21*
Lancaster	*Staphylococcus pasteuri*
Lyons	*Staphylococcus pasteuri*
North Tonawanda	*Bacillus thuringiensis*
Palmyra-Macedon	*Serratia marcescens*
West Seneca West - Jubulis	*Alcaligenes faecalis subsp. faecali*
West Seneca West - Rodemyer	*Aeromonas sp. CA23*

Links to Student Capstone Posters

2023 Capstone: https://drive.google.com/drive/folders/1-YjNyJwmm064Pd5ma89shInN4YtDOfle?usp=sharing or https://tinyurl.com/3d24bhnr

2024 Capstone: https://drive.google.com/drive/folders/1-3uC6wFZ9xwnGGB9S5w0dWHlj4DhAF-v?usp=sharing or https://tinyurl.com/4tpshanc

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