Microbiomes for All: The Research Experiences in Microbiomes Network

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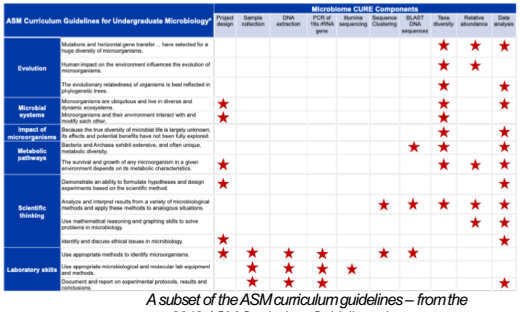
Abstract

The study of microbiomes has skyrocketed over the last ten years. This growth has been driven by advances in DNA sequencing technologies, and by a paradigm shift in the field of microbial ecology sparked by culture-independent and metagenomic techniques. We saw in these rapid changes an opportunity to bring the excitement of microbiomes and metagenomics to students by providing training in the scientific process through their engagement in research. Using a course-based undergraduate research experience (CURE) model, we established the Urban Microbiome project at The City University of New York. Microbiome research allows students to conduct experiments that reveal the diversity and complexity of local environmental microbiomes and requires problem solving and quantitative skills. As the use of microbiome data in courses increases, there is a need to 1) set community standards, 2) adapt new technologies for use in microbiome CUREs, 3) provide training resources, and 4) to make available the growing microbiome datasets and analysis tools to students. We have established a national model for microbiome research and that provides support to faculty interested in incorporating the exploration of microbiomes into their courses. This is the perfect time for integrating microbiome studies as the tools for culture-independent study of microbial communities and for DNA sequencing are increasingly accessible and affordable.

Objectives:

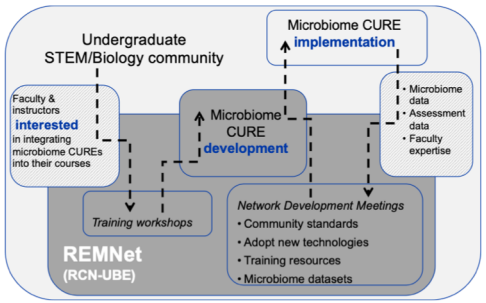
- Support a network of interested and experienced faculty.
- Train faculty and students with free and public resources.
- Advise project development to align with current curriculum guidelines.
- Implement successful microbiome



A subset of the ASM curriculum guidelines – from the 2012 ASM Curriculum Guidelines document.

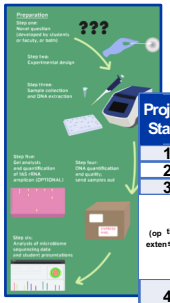
Methods:

- Creating a network that is distributed and community supported



Community College Introductory Biology students extracting DNA from their samples collected from around campus.

- Developing resources from successful microbiome projects, including methods robust for novice students and faculty.
  Ex: Sampling and DNA extraction video



Students sampling (top) & extracting DNA (right)

Project Stage	Topic	Class Time Estimate
1	Experiment Design	30 min
2	Sampling	15 min
3	DNA Extraction	90 min
(optional extension)	DNA Quantification	15 min
	16S rRNA PCR set-up	30 min
	Thermocycler run	90 min*
	Gel Electrophoresis	90 min
4	Microbiome Sequence Analysis	60 min – 120 min
5	Data Interpretation	30 min

Resources

Microbiome Research Tutorial Videos

- Introduction to Microbiome Research Projects
- Excel Data Organization & Summarization
- R Data Import, Organization, & Analysis

Reduced DNA Sequencing Costs

Wright Labs (Huntingdon, PA) offers Illumina 16S rRNA sequencing for $50/sample in 4 weeks!

Microbiome Lesson Materials

Journal articles are available with brief discussion guides as well as videos communicating main topics.

Training Workshops

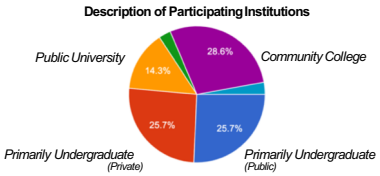
Associated with national meetings there are project development events.

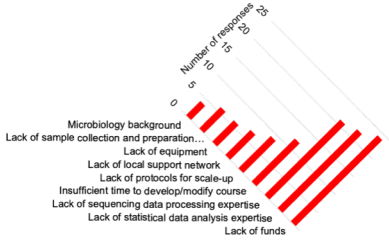
Community Networking powered by QUBES hub

https://qubeshub.org/community/groups/remnet

Discussion

Faculty have many hurdles to overcome to implement a course-based microbiome research project identified (2019 anonymous survey of REMNet participants). The network currently provides opportunities that may be otherwise unavailable at larger universities or departments. Therefore, the is effort to continue to fill the gap as a network for both financial and skill deficits.





This network targets faculty and instructors who are new to microbiome research as well as implementing course-based research. Through their experience the expertise of the network will develop. Then, the strength of the network will feed back into the individual faculty and instructors, empowering them to share their new knowledge and further develop independent projects they can accomplish with their classes.

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