

Advanced Methods in Restoration Science for High School Teachers

Cold Spring Harbor Laboratory DNA Learning Center

NATIONAL SCIENCE FOUNDATION ITEST DRL 1759006 (CD00006463)

Curriculum and Community Enterprise for Restoration of a Keystone Species in New York Harbor

DNA Teacher Training Workshops

The *Urban Barcode Project (UBP)* is a science program spanning the five boroughs of New York City and the surrounding metropolitan area. Just as a unique pattern of bars in a universal product code (UPC) identifies each item for sale in a store, a DNA barcode is a DNA sequence that uniquely identifies each species of living thing.

Trained teachers will be eligible to assemble student research teams in grades 9 to 12 and submit an original research proposal using our proposal submission guidelines. Teams with accepted proposals will receive supplies, equipment, and scientific support needed to conduct experiments during the school year.

DNA Barcoding Workshop

Just as the unique pattern of bars in a universal product code (UPC) identifies each consumer product, a “DNA barcode” is a unique pattern of DNA sequence that identifies each living thing. DNA barcoding provides a powerful way for biology faculty to lead CUREs, which have been shown to increase student retention and success when provided early in undergraduate programs. Barcoding integrates ideas from molecular biology, genetics, bioinformatics, ecology, and biodiversity—while at the same time providing the flexibility to address a variety of student-driven questions. Barcoding can be mastered in a relatively short time, allowing students to generate new data and reach a satisfying research endpoint within a single course. Furthermore, undergraduate students often have limited patience for bioinformatics, and DNA barcoding provides a wet-lab or field-based “hook” to increase engagement. Bioinformatics analysis of DNA barcodes generated via Sanger sequencing are conducted in the user-friendly DNA Subway Blue Line, an open-access, browser-based pipeline.

DNA Metabarcoding Workshop

Workshop participants learn all the biochemical and bioinformatics techniques required to implement DNA barcoding or metabarcoding, including the use of the DNALC's sequence analysis tools. Workshop seminars introduce key concepts ("big ideas"), CURE development, management and evaluation, data science, methods to work with diverse student populations, workforce development, and details about the project. Seminars include insights from project Co-PIs, including DNALC's experts; faculty leading JMU's curriculum, which engages 800 students and 20 instructors in DNA barcoding each semester; and City Tech and Bowie State faculty who lead DNA barcoding and metabarcoding with diverse student populations. The competencies required for bioinformatics, genome science, and biological data sciences are also presented.

Faculty who complete the workshops receive travel support, a stipend, and have year-round mentoring and support from project Co-PIs as they implement barcoding CUREs. Those implementing CUREs receive free reagents and DNA sequencing for student research. DNA barcoding workshop participants from the previous year are eligible to attend metabarcoding workshops—any remaining spots will be filled competitively. Select faculty will be invited to mentor other faculty, building a network of educators implementing DNA barcoding CUREs.

Faculty are asked to participate in a series of evaluation activities throughout the project, beginning with workshop evaluation. Faculty who go on to implement CUREs are enrolled in additional evaluation activities centered on their experiences as well as those of their students. Select schools will be asked to participate in additional longitudinal evaluation of students.

DNA Barcoding Protocol: Isolating DNA

Protocols Video:

<https://dnalc.cshl.edu/resources/dnatoday/140715-isolating-dna.html>

DNA Barcoding Protocol: Isolating DNA by Precipitation

Protocols Video:

<https://dnalc.cshl.edu/resources/dnatoday/120511-barcoding-protocol.html>

Classroom Activities & Exploration (Teachers and Students):

The *Urban Barcode Project*: Explore New York City's DNA!

<https://dnalc.cshl.edu/resources/dnatoday/110309-urban-barcode-project.html>

Virtual Lab Experiments in Biotechnology: Bacterial Transformation

<https://dnalc.cshl.edu/resources/dnatoday/2020-virtual-lab-bt.html>