

NH CREATES—An In-service STEM Teacher Program – Amato-Wierda, et al. Appendix B. Example RM&B Project Vignettes.

Project 1: Cryopreservation

Settings: 9th Grade Physical Science, Coastal NH (suburban), 2021 and 10th-12th Grades Combined STEM Class, Northwestern NH (rural), 2022

These projects introduced students to cryopreservation as a strategy for safeguarding organs or biofabricated tissues during transport. In one classroom, students applied core concepts of solutions and concentrations to design their own cryoprotectant formulation, which they tested with pieces of beet root tissue that were frozen in the solution. After conducting research, students picked which solutions they tested, exemplifying how student voice and choice can be integrated into lab experimentation. Using a spectrophotometer, students quantified the amount of beet pigment released from the frozen samples, allowing them to evaluate the effectiveness of each solution in minimizing freeze-induced damage. In a second classroom, a combined chemistry, physics and engineering course at a different school, students constructed an ice recrystallization inhibition (IRI) apparatus to measure the rate of ice crystal formation in aqueous solutions containing different cryopreservants when frozen with liquid nitrogen. Students concluded the project by presenting a cryopreservation apparatus and experimental findings to an expert in the regenerative medicine industry. In both classrooms, students engaged in multiple iterative cycles to refine either their cryopreservant solutions or to adjust the IRI apparatus. This exemplifies how the process of critique and revision plays a critical role in projects with sustained inquiry.

Project 2: Vascular Vexation

Setting: 9th-12th Grades, Combined STEAM Class, Eastern NH (rural), 2021

Motivated by a university researcher's work discussed during the 2021 Teacher Institute, this teacher sought to investigate the process of using plant tissue as a bioscaffold for heart tissue regeneration. The teacher, after seeking input from the original research team, designed a hands-on project in which students decellularized spinach leaves and recellularized them with engineered *E. coli*. Students performed each step in this process: growing spinach hydroponically, removing the plant cells with a detergent solution, and recellularizing the leaves with fluorescent *E. coli* bacteria, simulating stem cell repopulation (Figure B1). Student voice and choice were evident as students designed and conducted their own experiments with decellularized spinach leaves, testing variables such as detergent type, exposure time, and concentration that influenced the decellularization process. Students presented their work to UNH faculty and the original research team, who subsequently invited the class to visit their laboratory for additional activities. The diversity of activities in this project and the classroom's engagement across multiple interactions with the original researchers exemplifies robust sustained inquiry.

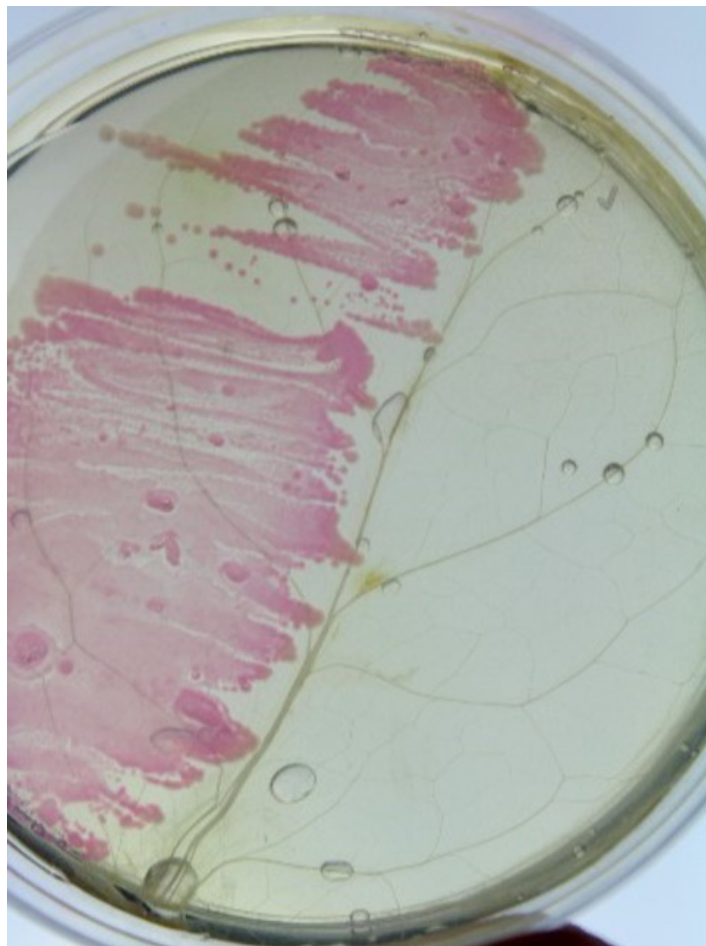


Figure B1. A Decellularized & Recellularized Spinach Leaf.

Project 3: Algae to the Rescue

Setting: 7th & 8th Grade Science, Central NH (rural), 2023

This project exemplifies students engaging in authentic and community relevant scientific investigations connected to current environmental and biomedical research. In this classroom, students investigated the health of a local stream by conducting water quality assessments. They collected and analyzed macroinvertebrates, including planarian worms, and learned that these organisms serve as indicators of ecosystem health. The project then shifted to a controlled classroom experiment in which student groups examined if the addition of oxygen-generating algae influenced the regeneration of planaria. Toward the end of their experimentation, students were visited by university researchers who were studying how algae support the growth of human liver cells in a laboratory environment. Oxygen is a limiting factor during the regeneration of complex tissues because diffusion through engineered scaffolds is restricted. Placing oxygen-producing algae close to human cells in a bioreactor or on a scaffold maintains higher oxygen levels, which are critical for cell survival and growth. Students' observations of how algae impacted *Planaria* regeneration provided a creative way to link their investigation to research happening in university labs. Students' interactions with the researchers also added impactful feedback to their experimentation.