Biosorption and bioaccumulation of critical metals by algae

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The United State has identified a list of 50 critical minerals that are essential to support the current technologies in our high-tech economy. We target to develop effective recycling technologies and processes to recover material already in circulation. Our work in Summer 2025, supported in part by the Science Undergraduate Laboratory Internship program, explored effective recovery methods for metals from wastewater systems using a phosphorus-rich algae strain previously isolated from a wastewater treatment system. Algae can grow in wastewater and take up phosphorus, usually well above their nutritional need, allowing algae to store the phosphorus as polyphosphate. Polyphosphate is known to bind to metals. This led the team to explore the alga's ability to effectively uptake different metals. These metals included cobalt (Co^{2+}), dysprosium (Dy^{3+}), neodymium (Nd^{3+}), praseodymium (Pr^{3+}), and samarium (Sm^{3+}). To analyze the alga's metal compatibility, we tested several concentrations of metal with the alga. We were then able to identify the toxicity of the metals to the alga. We found that several of the metals tend to precipitate from the solution, preventing binding with the alga. Which then led to exploring different conditions to avoid precipitation. The future direction will be placed on the understanging each strain and conditions on selectivity for metal ions and identifying whether polyphosphate matrix is causing the algae and metals to bind.

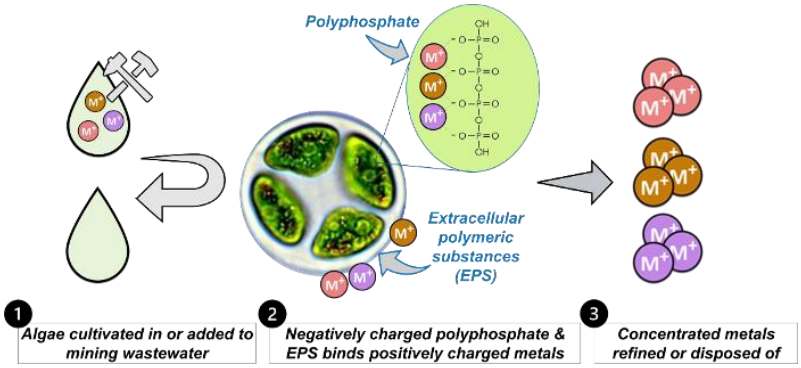

Figure 1. Concept diagram of the experiment on biosorption and bioaccumulation of critical metals with microalgae.