

## Abstract

One important step towards becoming more environmentally conscious is addressing the harm that laundry detergents have on the environment. We plan to develop an enzyme-based process that can degrade laundry stains more effectively and sustainably than current cleaning agents.

## Introduction/Background

- **Background information:** Enzymes are often used in many laundry detergents due to their ability to break down molecules such as proteases, amylases, lipases, and cellulases. Increased lipid stain solubility limits the amount of laundry detergent needed, decreasing the amount of non biodegradable contaminants entering the environment. Oleic acid is a common natural fatty acid found in vegetable oils.
- **Objective:** Develop an enzyme-based process that can degrade lipid-based laundry stains more effectively and sustainably than current cleaning agents.
- **About our design:** We planned to add a hydroxyl functional group to increase solubility as it increases the polarity of the substance.

## Science Content

- During the experiment, we will use cotton cloth (the most common fabric used in clothes) and stain the clothing with olive oil (an all-purpose, widespread oil). We will wash the stained clothing in a salad spinner to mimic a washing machine. Our control variables include the washing method (time washed, vigor of washing) and amount of oil in stain, while our experimental variable is the concentration of enzyme.
- We will use RpOhy (from *Rhodococcus pyridinivorans*) and NAD<sup>+</sup> for the color change, and enzyme activity will be measured with a spectrophotometer.
- We originally planned to use a fluorescent microscope to measure the effectiveness of stain removal, but had no method of eliminating the subsequent product created. Through using a spectrophotometer, we can directly measure enzyme activity when coupled with an ADH. The enzyme is not easily accessible to us, so to produce enzyme for our assay, we will perform a transformation with vector pET-28.

## Team Introduction

We are a small team of two juniors! We meet each week to continue our research and experimental plan.



## Next steps:

- Carry out enzyme production transformation and purification
- Identify other types of common stains and the corresponding enzymes that may be able to degrade them
- Test impact of increased solubility of oleic acid on stain removal
  - Determine how long it takes hydratase to be effective
  - The effectiveness of the enzyme can be measured by stain reduction

## References and acknowledgements

We'd like to thank Dr. Steve Grant and Ms. Mary Liu.

### Works referenced:

Busch H, Tonin F, Alvarenga N, van den Broek M, Lu S, Daran JM, Hanefeld U, Hagedoorn PL. Exploring the abundance of oleate hydratases in the genus *Rhodococcus*-discovery of novel enzymes with complementary substrate scope. *Appl Microbiol Biotechnol*. 2020 Jul;104(13):5801-5812. doi: 10.1007/s00253-020-10627-7. Epub 2020 May 1. PMID: 32358760; PMCID: PMC7306040.