Application link: MRGA Application

In students' own words, provide a research proposal in 400 words or less. There must be a minimum of 100 words written in this section.
Proposal must include: introduction, objective, methods (planned or in progress), and significance or potential impact.

Restaurants dispose of 2.5 to 3 billion pounds of used cooking oil every year, the majority coming from small and medium-sized establishments, who make up 90% of the industry. Although large establishments have fixed contracts with waste oil recycling companies such as Targray, smaller establishments do not produce a sufficient quantity of waste oil to justify a collection service. Properly disposing this oil can cost establishments up to $0.50 per pound, straining tight margins and missing a remarkable opportunity for sustainable energy production. BioCycle, a novel open-source biodiesel reactor, targets this widespread problem. BioCycle uses ultrasonic cavitation alongside immobilized lipase enzymes to effectively convert waste cooking oil into a sustainable biodiesel fuel that restaurants can easily reuse.

Our primary objective is to cut costs and complexity for restaurants seeking a greener way to repurpose their used oil. The resulting system will be 3D-printable, have minimal production costs, and easily be managed by all restaurant staff.

To create the reactor, we will 3D-print the basic structural components using ABS and carbon fiber filament. Next, we will embed ultrasonic transducers around the reaction chamber. Finally, a simple Arduino controller will be used for temperature and stirring automation, as well as enzyme release. Specifically, we have identified 2 specific immobilized lipase enzymes that would be ideal for our reactor due to their safety and cost: Novozym 435 and Candida sp. 99–125 lipase immobilized on a textile membrane. Mr. Lockett will ensure that we comply with ASTM D6751 standards by monitoring flash points, viscosity, and potential glycerin levels, ensuring the final biodiesel product is safe for use in engines powering heaters, generators, or even food trucks.

Also, two Seattle restaurants have agreed to pilot our reactor, allowing us to properly measure metrics like reaction rate, final yield, and biodiesel purity, factors we will then compare to typical standards. An objective based on our preliminary research is to exceed 90% conversion of waste oil into biodiesel in <1 hour.

By converting a typically viewed "waste product" into a viable biofuel, BioCycle will significantly reduce hauling costs for restaurants while promoting sustainable energy production within the restaurant industry.

Through our open-source documentation, detailed CAD files, and assembly guides, our reactor would be easily replicable by small businesses across the country seeking a compact, affordable, and eco-friendly solution, something that would be possible with the MRGA funding.

Please provide a brief recommendation (3-5 sentences) for this student/student group. Upload your W-9 Form. If you are not able to submit it now, you may send it to the contacts above prior to January 15 if you choose.

This recommendation is to affirm that Aarnav and Piyush will participate in the Sigma XI research competition and the National Geographic Slingshot challenge, and will present their work in progress at a New York Tech campus remotely. Aarnav and Piyush are both academically advanced students, currently in their second year of the IB Diploma which they are doing a year ahead. Their skills complement each other for this project, with Piyush excelling in research (awarded a 7 in IB Chem), and Aarnav excelling in the business side of things (received 6 in IB Bus Man).