An Investigation Into the Ideal Impeller for a 3D-Printed Ventricular Assist Device

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Due to the high prevalence of heart failure, as well as the limited availability of donor hearts, many devices exist that strive to temporarily replace heart function until a replacement is found. This project's purpose is to expand on this by creating a cost-effective, 3D-printed artificial heart device. It builds on last year's experiment, which found that the second prototype best promoted blood distribution but failed to meet necessary flow and pressure ranges. The engineering goal this year is to design and implement an impeller with the ideal blade count (4, 6, or 8), allowing the artificial heart device to pump at 5 liters per minute against 110 mmHg of pressure. The procedure employed programs including Tinker Cad and Cinema4D to design the various impellers to be attached to a functional centrifugal heart pump model, in order to measure the flow rate and pressure of the blood-like fluid during experimentation, to calculate Reynold's number. Expected results were that the 6-bladed design would be most efficient at propelling blood, as the 4-bladed impeller lacks sufficient force and the 8-bladed design would increase drag, impeding flow. Reynold's number was expected to be the lowest for 6 blades due to efficient flow. The hypothesis was partially supported, as the 6-bladed prototype had the numbers that best fit the range, however, there was no statistically significant difference between 4 and 6 blades, and Reynold's number was lowest for the 8-bladed prototype since it had the lowest flow rate.

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