Nathaniel Thompson
Senior Division Physics
The Dynamics of Induced Hovering Flight in an Oscillating Airflow at Various Frequencies

The experiment was conducted to analyze and observe the flight of tissue paper "wings" in an oscillating flow above a sound speaker, which is used to model insect flight. Ten wings with a surface area of sixteen square centimeters were cut out of Japanese tissue paper. This product was used since it is very thin, yet durable. A wind chamber was constructed above a twelve inch subwoofer speaker. The wings were placed in the chamber and were monitored at a range of frequencies between five and seventy-five hertz at both half and full amplitude. Maximum hovering height and overall maximum height were recorded for all wings at all frequencies at both amplitudes. The data was graphed according to maximum height and hover height over the various frequencies. The ideal wing design determined was a wing that was both structurally stable, yet allowed for flapping and a parachute effect. Wings that were stable didn't flail during flight. The parachute effect of the better wings allowed air to push up under the wing, yet when air was drawn back into the chamber, the wing could shed off the incoming air without losing much of its height. The ideal frequency for most wings was between five and thirty hertz, which wasn't expected since it is unlike the rapid flapping of insects. From this project, generalities learned about oscillating flight and wing structure can be used to understand insect development. Aircraft and possibly nanobots can then use these principles.