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Get Wet Report
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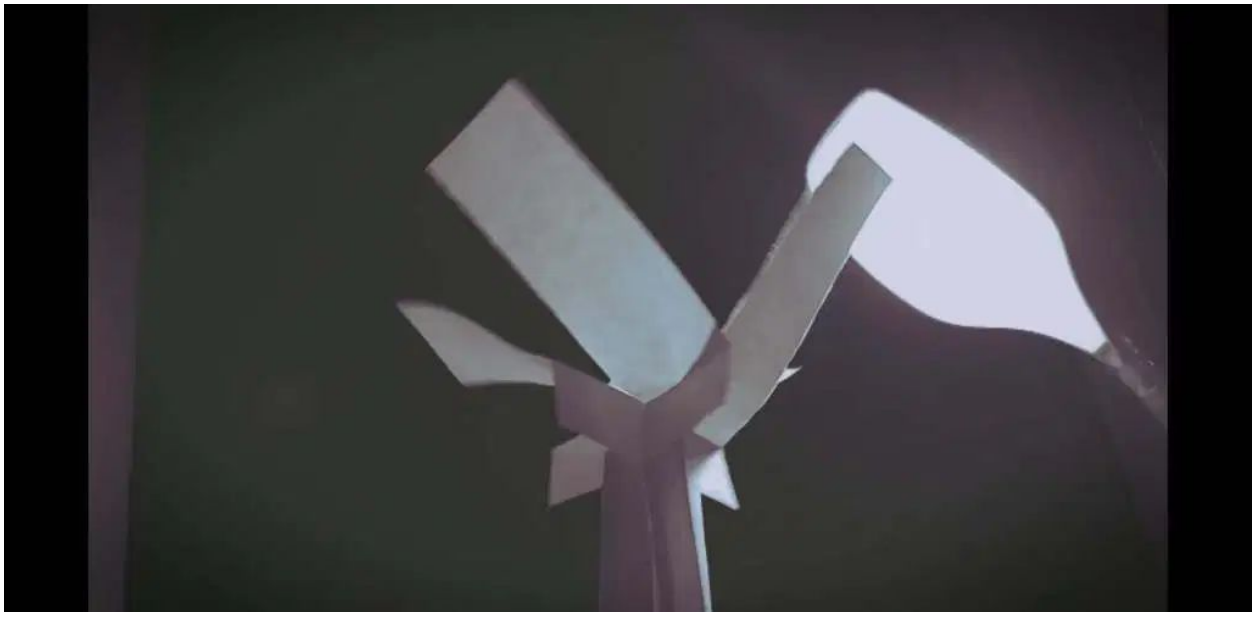
Paper Helicopter Lift Force



This video was for our very first assignment which was intended to get us comfortable with taking photos/videos of fluids. For this initial assignment, I decided to create a paper helicopter and tie the bottom of it to an electric fan. For a particular speed setting on the electric fan, this allowed the paper helicopter to stabilize and maintain itself in the air while rotating at a very high speed. I then shut off all the lights in the room and placed an LED lamp over the helicopter to allow the helicopter to be the primary focus of my shot. For this paper helicopter project, I wanted to show the lift force which was created when air is pushed up against the wings of the paper device.

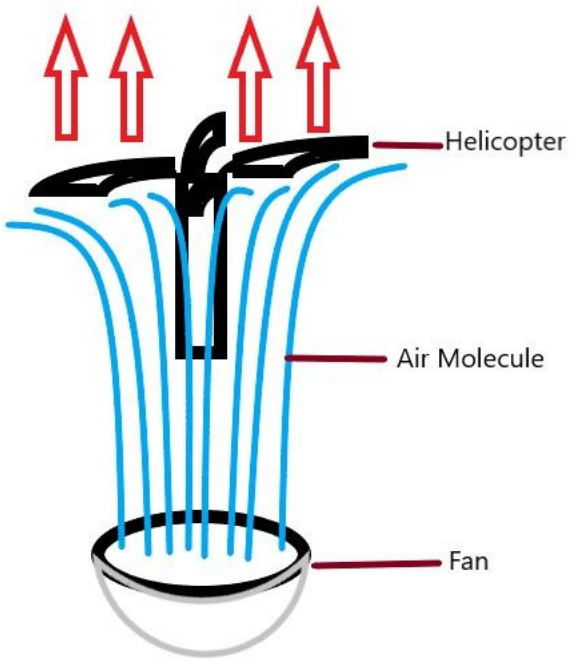


Figure 1: A diagram showing my setup of the objects.

The flow apparatus used in the image is the lift force which is created when a fluid moving at a high velocity makes contact on a surface, which induces a force onto the object in the direction in which the fluid was going. The lift force equation can be described as..

LIFT EQUATION

$$L = C_L \times d \times \frac{V^2}{2} \times A$$

L = Lift **d = Density of Air**

C_L = Lift Coefficient **V = Velocity of Air**

A = Wing Area

In figure 1 I show the set up which was used in order to get my paper helicopter stationary and floating strictly from the lift force and the string which was tied at the bottom of the helicopter.

Due to the symmetry and angle at which the wings are at, this allows the paper helicopter the spin and stabilize while the air fluid is pushing it upwards.

The visualization technique used in the video was to create a dark background, and an led light which was focused on the paper device. The helicopter was made out of white paper in order to create contrast between the dark background and have the main focus on the white paper helicopter. The fan was an ordinary electric fan which was pointed upwards in order to propel the aircraft upwards.

The photograph technique in this video was to shoot it at a high frames per second. This was done using a Samsung Galaxy s9 shooting in super slow mo at 960 frames per second shot at 1280x720.. All other settings were automatically adjusted by the phone. The phone was held about 6 six inches away from the helicopter while it was spinning at a high rate per minute. The final cut of the video was edited and pieced together on PowerDirector which is a mobile app for editing videos. The contrast was increased, as well as the brightness, and the tint was shifted towards the cool spectrum in order to give it a calmer finish.

The image reveals the flow over the helicopter wings as the air fluid passes it. It's possible to see that there are air currents going past each paper wing, and as the wing goes over the air currents they are lifted upwards in the same exact spot for each rotation. Something to improve on would be to show these air currents by allowing some sort of smoke to go through the fan in order to see the path in which the air takes when it touches the wings of the paper helicopter. I would do this buy getting a fog generator and allow it to consistently put fog through the surrounding air. Another aspect to improve on would be to light the subject up with more lights and choose a darker background to stray away from other distractions in the video.

Sources:

"The Lift Equation." *NASA*, NASA, www.grc.nasa.gov/WWW/K-12/airplane/lifteq.html.