



**CALIFORNIA STATE SCIENCE FAIR  
2003 PROJECT SUMMARY**

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<b>Project Title</b> Designed to Fly	
<b>Abstract</b> <b>Objectives/Goals</b> To compare the design and performance of birds and airplanes. <b>Methods/Materials</b> I searched several books and websites, and selected 25 birds and 25 airplanes. For each bird and airplane, I recorded the weight ( $W$ ), the wing area ( $S$ ), and the flight speed ( $V$ ). From the first two parameters I calculated the wing loading ( $W/S$ ). I looked for trends in the relationship between $W$ and $W/S$ and in the relationship between $V$ and $W/S$ . <b>Results</b> Birds and airplanes are very similar in their design. There are two main differences between birds and airplanes: (1) Birds flap their wings; airplanes do not. (2) Birds use their wings to produce lift and thrust; airplanes use their wings to produce lift only and have engines or combinations of engines/propellers to produce thrust. My data analysis pointed out two similar trends in the two groups; (1) Heavier birds & airplanes have higher $W/S$ . (2) Faster birds & airplanes have higher $W/S$ . <b>Conclusions/Discussion</b> Birds and airplanes follow the same flight principles. Both push air down to produce lift and push air back to produce thrust. Birds have small, flexible wings and can flap them. Airplanes have big, heavy wings, which are impossible to flap. Airplanes glide just like birds but cannot flap their wings like birds. $W/S$ tells us how much lift a wing generates per unit area. A higher $W/S$ means the wing is more efficient in generating lift. The graphs show that as $W$ increases, so does $W/S$ because as birds and airplanes get heavier, their wings have to be more efficient in producing lift, otherwise they would be huge. A huge wing gives you more lift but it also gives you more drag and weight. This makes flight more difficult because higher drag requires more thrust. The graphs also show that faster birds and airplanes have higher $W/S$ . A high $W/S$ means a smaller wing for a given weight. This makes sense because when a bird or airplane flies fast, it generates most of its lift from speed (Bernoulli effect), so it does not need a large wing area. Moreover, a smaller wing makes long flights at high speeds more efficient because it generates less drag.	
<b>Summary Statement</b> This project compares the design and performance of birds and airplanes.	
<b>Help Received</b> Father pointed out some of the references I used.	