



**CALIFORNIA STATE SCIENCE FAIR  
2002 PROJECT SUMMARY**

<b>Name(s)</b> <b>Larry D.W. Schmidt</b>	<b>Project Number</b> <b>S0521</b>
<b>Project Title</b> <b>The Effect of Ingredients on the Structure of Chocolate Chip Cookies</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> This project demonstrates the roles of the various ingredients in the structure of a chocolate chip cookie.</p> <p><b>Methods/Materials</b> I baked eight batches of cookies, a control, a batch each with more and less butter, more and less sugar, cake flour (low protein), bread flour (high protein), and baking powder. Then, I went to UC Davis and performed texture analysis tests, where an arm moves through the cookie for a distance of 25 mm and measures the resistance against it. I then photographed a top view and a cutaway view of each cookie.</p> <p><b>Results</b> The cookies with more sugar never really formed into cookies and the cookies with less sugar were more pale and watery, since there was not enough sugar to absorb the water. The cookies with more butter were flat and brown, while the cookies with less butter were thicker and pale, since butter lubricates the dough and controls the spread of the cookie as well as helping with browning. The cookies with bread flour were tough and brown, since a stronger network was formed, while the cookies with cake flour were softer and flatter, since a weaker network was formed. Cookies made with baking powder were very thick coming out of the oven, but baking powder was too strong of a leavening agent, so the cookies collapsed in on themselves.</p> <p><b>Conclusions/Discussion</b> I discovered that butter, sugar, and flour play the most vital roles in the structure of the cookie: the flour providing the network that is the basic structure of the dough, the sugar preventing the structure from becoming too strong by absorbing water, and the butter lubricating the dough.</p>	
<b>Summary Statement</b> I varied the ingredients in the recipe for chocolate chip cookies and measured the effects they had on the texture of the cookies.	
<b>Help Received</b> My mother drove me to UC Davis, where I used equipment and research materials from Dr. Charles Shoemaker, chairman of the Department of Food Science and Technology	