

APPENDIX D
Science Investigative Project
Project Proposal Form

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Topic of investigation :	Effects of cooking with heat in water on volume of GRBs
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A	<u>Observations made</u> I noticed that when uncooked glutinous rice balls (GRBs), also known as tangyuan and yuanxiao, are first placed in the pot of water to cook, they sink to the bottom. As the water comes to a boil and heats the GRB, the GRB began to float to the top of the water. Cooks teach that the change in positions means the GRBs are entirely cooked. GRBs that were removed from the heat faster, before floating, were partially raw. Bigger GRBs and GRBs cooking in water of lower temperatures took longer to float. This phenomenon of sinking then floating is observed in dumplings and meatballs as well.
B	<u>Research Question</u> Does the process of cooking affect the volume of GRBs?
C	<u>Hypothesis statement</u> The higher the temperature during cooking, the faster the rate of expansion of the GRBs until they float in water.
D	<u>A short summary of research done on the area of investigation</u> Nutritional labels for GBRs claim they are mostly carbohydrates, with some protein, in accordance with how they are made of rice flour. When such starches are heated with water in cooking, individual grains absorb water and expand in a process called gelatinisation. This happens around 55 to 80°C and is irreversible. This expansion also increases the volume of the food, as seen in the use of corn starch to thicken sauces. If an object's mass is constant while its volume increases, its density (ρ) will decrease. An object which sinks in water, $\rho=1$, has a higher density than 1 and if its density decreases to below 1, it will start to float. When an object is submerged in water, an upwards force called upthrust will acting on it and the amount of upthrust is proportional to the weight of water displaced. Hence if that object expands and displaces more water, more force will be pushing it up than before. When an object expands, its surface area also becomes larger and surface area to volume ratio smaller. An increase in surface area is proportional to how efficiently it absorbs heat. Out of two foods with the same volume and mass but different shape, the food with the larger surface area will be cooked first.
E	<u>Bibliography (Please refer to RS Students' Handbook in RS Folder on Inet regarding APA Style Format)</u> Adam-Day, S. (2012). <i>Upthrust and viscosity</i> Retrieved May 20, 2012, from http://alevelnotes.com/Upthrust-and-Viscosity/113 The engineering toolbox. (n.d.). <i>Water-density and specific weight</i> Retrieved May 20, 2012, http://www.engineeringtoolbox.com/water-density-specific-weight-d_595.html

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