

Gluten Balloons

The purpose of this demonstration is to provide hands-on examples of the nature of gluten, beyond being something that causes allergic reactions. Gluten is not one compound, but a group of proteins found in flours that, when activated, gives doughs their elastic qualities. Higher gluten content flours, such as enriched wheat flours (white flour or baking flour), tend to make more flexible doughs.

This experiment provides a novel demonstration of the elasticity that gluten provides by making balloons out of flours with varying gluten contents. Gluten content can either be varied by using different types of flours or by adding a pure gluten extract (which can be purchased in bulk at most health markets or online).

For the approach with varying flours, using plain white flour as one of the options is highly recommended, as it has by far the highest gluten content of any commonly available flour. Whole wheat and barley flours offer some gluten content, but they are far lower, and most other alternative flours have negligible gluten content.

The materials needed for this experiment are flour, gluten extract (optional), water, and a pump of some kind (ball pumps are ideal, but bike pumps function in a pinch). Each participant then mixes flour, water, and gluten. The ideal mixture is about 4 Tbsp. flour, 1 Tbsp. gluten, 2 Tbsp. water, and a pinch of salt. Then, on a floured countertop and with floured hands, the participants knead their dough ball to develop the gluten. Allow the participants to vary the time spent kneading. When they feel that they are ready, mold the dough around the nozzle of the pump, and start pumping gently, forming a balloon.

Burst dough balloons can be recycled, as the participant can add more gluten, flour, or water and continue kneading. The goal is to produce the largest balloon possible.

On the microscopic level, the kneading process stretches out the gluten compounds into elastic strands. These strands have an increased surface area, allowing them to bond to other strands easier, increasing the strength of the dough.

The costs for the experiment are approximately as follows (prices from Winco Foods online catalog):

- White Flour: \$0.40 /lb
- Vital Wheat Gluten: \$2.70/lb
- Salt: \$0.68/lb

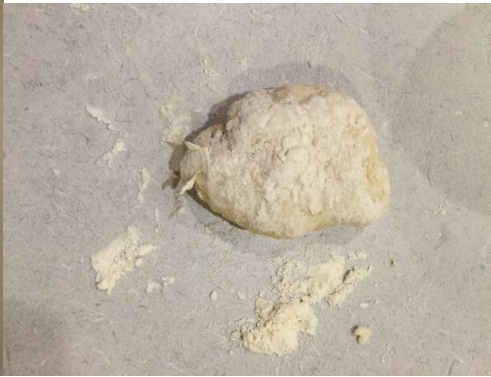
Additionally, a ball pump can be purchased for approximately \$10 at any supermarket or sports supply store. One experiment will use approximately \$0.03 of flour, \$0.04 of gluten, and

less than \$0.01 of salt. This experiment should cost about \$2.50 per 30 kids, with the additional one-time investment in a pump.

This experiment was essentially made to model the demonstration in this video: <https://youtu.be/zDEcvSc2UKA?t=2m21s> . While this balloon is much larger than you can expect students to be able to reproduce, it provides an excellent goal to shoot for.



(Fig 1: unmixed flour and gluten)



(Fig 2: kneaded dough, with flour for more kneading)



(Fig 3: dough sealed around pump)



(Fig 4: dough being pumped into a balloon)