

Resource Exchange: The Great Engineering Bake Off Summer Camp for Rising 3rd-5th Graders

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Overview

This resource exchange paper describes a week-long summer camp program that has been running since the summer of 2021 as a collaboration between the Wake Forest engineering department and the local science museum, Kaleideum. The camp, The Great Engineering Bake Off, sets daily engineering learning themes to baking/food-related challenges that rising 3rd-5th grade campers complete with a partner. Most students make decisions about pursuing STEM by the 4th grade. The goal of the camp is to introduce young people, at a pivotable age, to engineering concepts in an accessible way that invites creativity, encourages teamwork, and promotes the idea that engineering is everywhere.

Camp Format and Logistics

The five-day camp follows The Great British Bake Off (GBBO) format with daily, themed challenges that introduce campers to an engineering concept alongside the baking challenge.

- The ~20 campers are in pairs or at most groups of three at 10 work stations
- Teams compete in quick-fire challenges to start each day, the daily “show stopper” challenge, and “extra” activities during baking/setting times that are tied to the theme
- Challenges are judged and points awarded: 1-2 groups awarded gold (5 points), 1-2 groups silver (4 points), all other groups bronze (3 points)
- Total points are tallied for the final Gold, Silver, and Bronze awards at the end of camp
- Camp activities are conducted from 10am-12pm and 1pm-3:30pm
- 1 museum summer staff, 1 engineering faculty, 1-2 students/volunteers facilitated camp
- Infrastructure at the museum included an oven, sink, microwave, and AV. Camp materials cost ~\$500 for 10 work stations and consumables for all 20 campers
- Campers completed a “what is an engineer” drawing and word cloud activity on the first and last day of camp

Learning Goals

While each day of camp has its own engineering concept theme, the overarching learning goals of the camp include:

- Campers will be introduced to basic engineering concepts (units, force, materials, etc)
- Campers will use the Engineering Design process to complete food-related challenges
- Campers will work in a team to complete daily challenges
- Campers will be introduced to Engineering tools (e.g. 3D printers and materials testers)

Since 2021 the general daily schedule has remained the same, with some variation in the activities. The descriptions that follow are based on the most recent camp in 2025. Facilitation guides, slides, materials, and scoring can all be found by scanning the QR code.

Monday: Units and Measurements

Tuesday: The Engineering Design process

Wednesday: Newton’s Laws, Force, Stress and Failure

Thursday: Chemistry of Recipes

Friday: Food Fight Catapults

QR CODE FOR RECIPE CARDS, DAILY SLIDES, SCORE SHEETS AND MORE



Units and Measurements

Quick Fire Challenge: Five “Guess How Much” pictures from Estimation180.com.

Show Stopper Challenge: Create A Measurement Device - Using an assortment of repurposed containers and craft tools, campers were challenged to design a single measuring device they would use later in the day for an undisclosed recipe (a basic sugar cookie recipe was revealed upon completion). Concepts covered and judged in their design included: measuring accuracy, unit conversion, and utility of their design. Campers then made the sugar cookie recipe using their device. Sugar cookies were judged for taste, texture, and appearance. Campers shared what worked well and what didn't work well with their design.

Engineering Design Process

Quick Fire Challenge: Five “Guess the Object” from video clips of making cut rock candy.

Show Stopper Challenge: Create your own Slice and Bake Cookies - Campers were given a simple 5-step design process to work through (Ask, Imagine, Plan, Create, Improve) to design a slice and bake cookie (where a 2D image is revealed in the cross-section of a sugar cookie "log"). Campers were given design criteria including the use of at least three colors and maximum dimensions. Campers ideated with their partner and used Engineering paper to draw their cross-sections to scale. They then used the grid on the Engineering paper to determine percentages of each color required of their dough. Play-doh prototypes were used to allow campers to iterate and improve on their design. Campers then completed their final slice and bake cookies where they were judged on how they implemented the design process and the creativity of their final product.

Newton's Laws, Force, Stress, and Failure

Quick Fire Challenge: Campers guess the order (strongest to weakest) of 5 candy bars that we placed in a 3-point bend test (Pasco). We discuss Newton, the unit of force (using 100g apples), and introduce stress by discussing how we compare forces on the candy bars of different sizes. We also discuss how some of the candy bars had brittle versus ductile failure and how different materials (i.e. plastics, metals, ceramics) also have these differences.

Show Stopper Challenge: Rice Krispy Treat Beams - With these concepts in mind, campers create Rice Krispy treat beams to see which group could make the strongest treat. Campers could use various, edible additives (e.g. cookies, peanut butter, melted chocolate) in their beams. Each group had to create a 2"(w)x1.5"(h)x4"(l) beam and test it under the 3-point bend test on the Pasco tester. Points were awarded to the strongest beams.

Chemistry of Recipes

Quick Fire Challenge: Campers guess which ingredients are needed in a recipe and which food contains the most calories (best of 5).

Show Stopper Challenge: Best in Bread - Campers learn how gluten is formed in bread dough by kneading water into wheat flour. They compare how stretchy wheat flour is compared to rice flour (with no gluten) and how different methods of kneading can alter bread texture. They are then introduced to how yeast is used as a leavening agent allowing bread to rise by blowing up a balloon with sugar, warm water and yeast. Equipped with this knowledge, campers make a basic bread recipe that is judged on rise, texture, and flavor.

Food Fight Catapult

Campers practice the Engineering design process again to design and build a catapult capable of completing 5 challenges: Distance of a marshmallow (best of 3 attempts), accuracy of a cookie (closest of 5 attempts), consistency of performance (distance of 5 unknown food objects), cheese ball catch (best of 5 attempts to launch and catch with their mouth), and hitting a moving target (best of 3 attempts to hit the poncho-ed Faculty). Each group is given the same set of supplies. Design requirements included, no bigger than a 12"x12" base, it had to be stand alone (catapult not slingshot), and one repair during competition. Points were awarded for each challenge, best overall, and best design process.

The Extras

During bake/set/cooling times campers completed other activities including: designing their own 3D printed cookie cutter that we 3D print on site, mix a pancake recipe to make in our pancake printer, mash a ~100g apple over a 1m x 1m square of plastic to feel 1Pa of pressure, whip whipping cream by hand to learn about fat globules that are hydrophobic, and chocolate welding to make chocolate girders we test with the 3-point bend test and compare to plank.