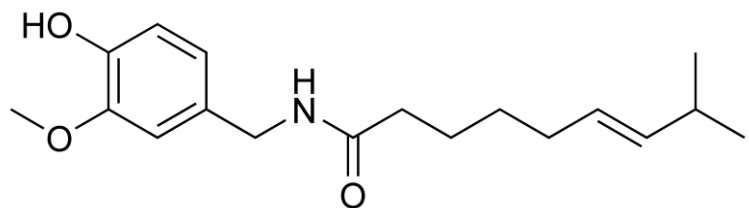
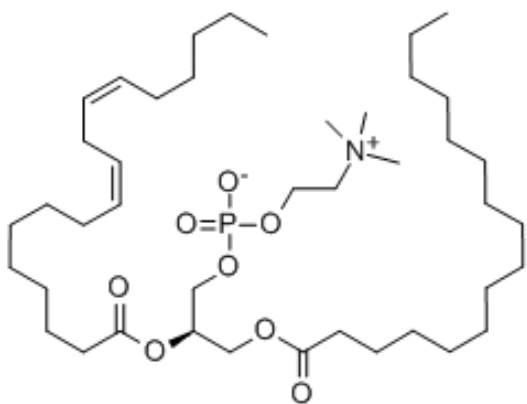
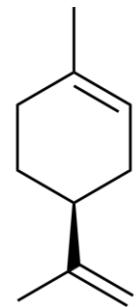
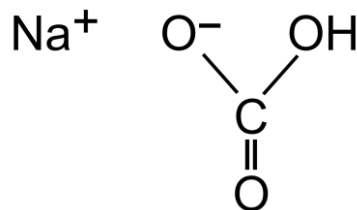
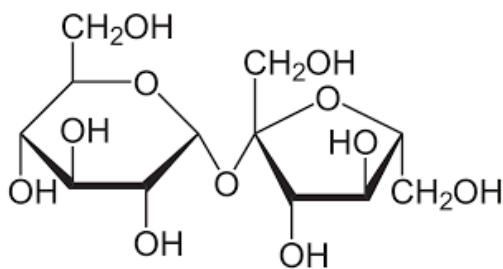


# Culinary Chemistry Concoctions

Recipes from Millersville University

Culinary Chemistry Fall 2023



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# APPETIZERS, SOUPS, AND SIDES

## Fried Okra

Submitted by: John Coleman

Based on: <https://www.tasteofhome.com/recipes/southern-fried-okra>

If I had one type of food I would eat for the rest of my life, it would have to be soul food. In the African American community, soul food isn't just a variety of incredible southern based dishes and recipes, but something that also brings the community together. Food has always done this for different cultures throughout generations. When soul food is brought up, most people would think of mac and cheese, fried chicken, or cole slaw. For me, fried okra has always held a place in my heart. I still remember the time and place where I first tried it. Whenever I get the chance to, I tell as many people as I can about it. So, when I looked up this recipe, I didn't realize how super simple this recipe was, especially when most of the ingredients can be found right at home. I am also a person who loves hot sauce. I put this on pretty much everything. So, for my experiment, I wanted to see what would happen if I modified the experiment and added some hot sauce. My hypothesis was that hopefully, I would be able to not only just that crunchy taste from the fried okra, but also a bit of heat from the hot sauce added in.

### Ingredients:

1-1/2 cups sliced fresh or frozen okra, thawed.  
3 tablespoons buttermilk / or two cracked eggs  
2 tablespoons all-purpose flour  
2 tablespoons cornmeal  
1/4 teaspoon salt  
1/4 teaspoon garlic herb seasoning blend  
1/8 teaspoon pepper  
Oil for deep-fat frying or air fryer  
Additional salt and pepper, optional

### Directions

Pat okra dries with paper towels. Place buttermilk or eggs in a shallow bowl. (for spicy okra, add your choice of hot sauce here) In another shallow bowl, combine the flour, cornmeal, salt, seasoning blend and pepper. Dip okra in buttermilk, then roll in cornmeal mixture. In an electric skillet, deep-fat fryer, or air fryer, heat 1 in. oil to 375°. Fry okra, a few pieces at a time, for 1-1/2 to 2-1/2 minutes on each side or until golden brown. Drain on paper towels. Season with additional salt and pepper if desired.

As a reflection of this specific recipe, I was not only surprised with the way the fried okra turned out, but the taste of the modified okra as well. The taste was not extremely spicy but had a nice little kick to it, which is the way I like my spicy food, mild. I have made fried okra before, but this

time around, I wanted to try the buttermilk method instead of the eggs. I results were ok, but after doing it again, I found that the method using eggs was much better in taste and texture. In Culinary Chemistry, with learned about various kitchen appliances, food, and different ingredients. We were also taught about how certain ingredients are important to a dish because of how they interact with other molecules, what their structure looks like, their flavor. Three examples I chose were salt, eggs, and pepper. Salt is known as sodium chloride (NaCl) and because of the way it is structured, it is very soluble in water, which is why salt is used in lots of different foods from soup to pizza. The specific ingredients used to make okra saltier. Eggs are very special to a dish solely because an egg's molecular structure is made up of various proteins, lipids, and water. This was used to make batter to dip and fry okra in. As mentioned before, you can also your buttermilk for dipping your okra into. Pepper, although it is not used for every dish, is made from peppercorns that are grinded up. Pepper is made up of elements such as fiber, oils, and minerals. This was used in addition with hot sauce to make the okra spicer. The purpose of the pepper wasn't to give it a lot of spice. I wanted that hot sauce to mainly contribute most to the spice and flavor.

We have also discussed many different types of heat transfer: convection, conduction, and radiation as well as different chemical changes and physical properties that happen to food when cooking. The specific type of heat transfer used in this recipe was conduction because conduction as the hot oil cooks the food when it comes into direct contact with heat, or if using an air fryer, the air and heat. A chemical change that occurs when making fried okra is that the batter being created after will turn into a crispy crunchy coating. A physical property of fried okra is how the okra form will be cut into tiny pieces instead of its longer original form. This way it can be easily eaten in bite-sized pieces.

The kitchen materials I would use for this recipe would be three containers, two are used to make the "batter" with the choice of eggs or buttermilk and if you want to add hot sauce. The other container is to add your seasonings after you're done putting your okra in the buttermilk or eggs. I would also recommend using tongs to grab to okra once it is done in the seasonings and done frying.

# Spätzle

Submitted by: Kenzie Sawadski

## Ingredients

200g flour

2 eggs (or 3 for more protein \*altered recipe\*)

¼ tsp salt

Roughly 2.5oz water (add more or less depending on dough consistency)

1-2 tbsp butter to pan fry after boiling

\*\*\*\* spätzle maker is a required cooking tool (unless you find another way on google\*\*\*\*)

## Directions

Put flour in a big bowl, add salt, eggs, and water. Beat batter until smooth and bubbles form.

Bring water in a large pot to boiling, add salt, spread portion of batter on Spaetzle-maker over pot, when Spaetzle come up, remove them to a colander and rinse with cold water, drain and fry in the butter in a frying pan. Repeat in portions with the other batter.

Pair with a roast or just gravy

## Reflection

This recipe is a German dish (typically a side for a meal) that we make in my family. I used the recipe that my dad adjusted from my Oma (grandmother). It is a relatively simple dish to make since it has very few ingredients. I was curious to see what would happen if I added an additional egg. Typically it is 1 egg to every 100g of flour. I assumed that the batter would be looser due to the extra egg as it would throw off the flour balance. I had no idea if it would even shape and boil properly. Upon conducting this experiment, I saw from a surface level that adding the extra egg did not make a huge difference. I decided to include both recipes since it would be more personal preference on what you would want in a dish since they both turned out successful (and I enjoyed both). There were a few minute differences between the two batches though. Due to the flour to egg/water ratio being different, the batch with the additional egg was a slight bit looser and less sticky (not too noticeable but it was a little easier to push through the spätzlemaker than the standard batch). It was also less structurally dense after boiling than the standard batch due to there being more flour to less egg to create a stronger gluten structure in the spätzle. While the dish has few ingredients, they play important roles. The flour has gluten which creates the dense structure. In addition to that it also adds some protein and so does the egg (the extra egg adds extra protein and extra fat, about 6g protein and 5g fat respectively). The extra egg also made it able to create almost 200g more of the final product. The standard batch made 359g total and the experimental batch made 549g total. This dish utilizes two different cooking methods: conduction and convection. First used is convection to boil the spätzle, second is conduction to pan fry them. They both boiled about the same, however the experimental batch was slightly more difficult to fry up. I used the same amount of butter for both so perhaps it was due to the butter not being able to go as far for the amount of the second batch, or there being more moisture in the batch from the second egg, or just the fact I had already used the pan to fry the first batch and some stuff was already stuck to it. The kitchen equipment needed is a large bowl, a large pot, a pan for frying, a spätzlemaker (there's a few

varieties and they can be purchased on amazon), a wooden spoon to mix (DO NOT USE A WISK OR A MIXER, it needs to get whipped by hand to get the correct consistency), and measuring utensils/a food scale. Enjoy 😊

# Bread with and without egg

Submitted by: Jonathan Spear

## Recipe:

4 1/2 to 5 cups (540g to 600g)  
1 tablespoon (11g) granulated sugar  
2 1/4 teaspoons instant yeast  
2 1/2 teaspoons (15g) table salt  
1 2/3 cups (379g) water, lukewarm (90°F to 110°F)  
yellow cornmeal, for coating the pan

## And

4 1/2 to 5 cups (540g to 600g)  
1 tablespoon (11g) granulated sugar  
2 1/4 teaspoons instant yeast  
2 1/2 teaspoons (15g) table salt  
1 2/3 cups (379g) water, lukewarm (90°F to 110°F)  
yellow cornmeal, for coating the pan  
1 Large egg

## Reflection:

I analyzed the comparison between making bread with eggs and without eggs (dough enhancer), exploring the distinction of the recipes, the impact of key ingredients, and the physical and chemical changes occurring during the heat transfer process in preparation. I chose a basic white bread recipe, the King Arthur recipe, as the base for my experiment. The addition of an egg was the only change made, aiming to observe the influence of this ingredient on the final product. The modification involved introducing one beaten egg to the dough during the mixing process. I hypothesized that the egg would contribute to a flavor, making the bread fluffier, and improving gas production in the yeast activation. I anticipated a subtle yet noticeable difference in the final product when compared to the non-egg bread.

When both breads were done, the differences were noticeable. The bread with eggs was bigger and more aerated. It was evident that the eggs had played a role in enhancing the overall texture and taste as well. The version without eggs was denser. While both versions were well-received, personal preference leaned towards bread with eggs for its taste and texture appeal. Three key ingredients in the bread-making process are flour, yeast, and eggs. Flour, primarily composed of proteins, gluten, provides structure to the bread. Yeast acts as a leavening agent, producing carbon dioxide and making the dough rise. Eggs, rich in proteins and fats, contribute to the overall structure, moisture, and flavor of the bread. The proteins in eggs coagulate during baking, making more structure, and the fats contribute to tenderness and richness. The fats in the egg yolks, particularly lecithin, act as emulsifiers. Lecithin has a hydrophilic head and a hydrophobic tail, allowing it to interact with both water and fat molecules. This allows the lecithin to create a stable emulsion by dispersing fat droplets in the water phase of the dough.



Several physical and chemical changes occur during the bread-making process. The primary physical change is the rising of the dough, driven by the production of carbon dioxide gas from the yeast fermentation process. Additionally for chemical changes, during baking, the Maillard reaction takes place, resulting in the browning of the crust and the development of complex flavors. Chemically, the proteins in flour and eggs undergo denaturation and coagulation and contribute to the structure of the bread.

The cooking process involves the transfer of heat from the oven to the bread through convection. Convection, the movement of hot air around the bread, ensures even baking and the development of a crisp crust. The transfer of heat also can happen from the heating of the pan it is in and then to the bread, conduction. Also, heat transfer could facilitate to the Maillard reaction, contributing to the appealing color and flavor of the final product.

In conclusion, the choice between making bread with or without eggs is a matter of personal preference, with each version offering a distinct experience or purpose. The addition of eggs introduces complexity, richness, and airier texture. Understanding the molecular properties and functions of ingredients clarifies the complexities of bread-making.

# Low-Fat Pancakes

Submitted by: Brendan Corpus

## Recipe:

1 ¼ cups all-purpose flour  
¼ cup sugar  
1 teaspoon baking powder  
¼ teaspoon salt  
1 egg  
1 tablespoon canola oil  
1 1/3 cups nonfat milk  
1 teaspoon pure vanilla extract

## Reflection:

For my final project, I decided to make pancakes. I chose this recipe because it needed to use nonfat milk specifically. I wanted to use a recipe with nonfat milk because I wanted to see if there would be any difference between a recipe with milk and with water while also being able to take out the factor of fat. The absence of fat in the milk allowed the water and milk to be similar in terms of fat content, so I wanted to see how the other contents of milk would affect the outcome of the pancakes. I found my recipe on *thespruceeats.com* when searching for recipes throughout multiple websites. The recipe calls for nonfat milk but I replaced it with water in my second batch of pancakes. Using this pancake recipe was easy because after I had chosen my recipe, I realized that it used ingredients that I already had at home, so I did not need to buy anything new. So, while this recipe was interesting to me as it is a food I really enjoy, it was also very convenient! I thought that by replacing the milk in the pancake batter with water, the pancakes would be much thinner and not as rich as the original recipe with nonfat milk. This is due to the water's lack of carbs and protein, as these will help to provide some structure to the pancakes in the original recipe. Due to this lack of structure, the pancakes with water will not be as airy, as there is not as much structure to hold the air bubbles in.

When cooking the original recipe of pancakes, the sugars and the amino acids reacted with the Maillard Reaction. This caused the pancakes to turn brown, and for the texture on the outside to become crunchy. This reaction also helped to add flavor to the pancakes. I noticed that with the recipe which used water, the pancakes were a lot lighter in color and did not have the same crunchy texture as the pancakes of the original recipe. This is due to the lack of sugars and amino acids that the milk provided in the original recipe. Since water does not have the carbohydrates and amino acids that milk has, these reactions had no way of occurring. The lack of these reactions contributed to the lighter color in the pancakes. With the heat being transferred to the pancakes through conduction (with direct contact with the pancake and the pan), the pancake batter turns from a liquid to a solid. This change would be considered a physical change.

The results of this experiment went how I thought they would. The pancakes with water turned out 'gummy' and were a bit chewy in terms of texture. I think that this is because there was no air that was maintained in the pancakes. The lack of air prevented the fluffiness that pancakes normally have. The modified pancakes were much lighter in color than the original ones, which I expected, due to the lack of sugars and amino acids to produce a Maillard reaction. The modified pancakes were also more bland than the original recipe. I preferred the original recipe based on the

fluffier texture, the crunchier outside, and the taste. Some significant ingredients include egg, vanilla extract, and canola oil. The egg provides a source of fat and protein while adding flavor and structure to the batter, allowing it to hold air bubbles and help to make the pancakes fluffy. The vanilla extract is a phenolic aldehyde and adds flavor to the pancakes. Finally, the canola oil is composed of monounsaturated fats, contributes to the texture and color of the pancakes, and makes sure the pancakes don't end up being too hard. Overall, the original recipe was delicious and had great texture throughout, with a combination of crunchiness as well as fluffiness.

# Bread

Submitted by: Hailey Hess

## Recipe:

- 2 cups warm water (105-115 degrees)
- 1/2 Teaspoon active dry yeast
- 1 teaspoons salt
- 3 1/2 cups all-purpose or bread flour\*

## Directions:

- Prepare the dough: In a large bowl or stand mixer add the yeast, water and a pinch of salt. Allow to rest for 5-10 minutes until foaming and bubbly. (This is called “proofing” the yeast, to make sure it is active. If it doesn’t foam, the yeast is no good, and you need to start over with fresh yeast).
- Add 1 cup of flour. Mix to combine.
- Add another cup of flour and mix to combine. With the mixer running add more flour, 1/2 cup at a time, until the dough begins to pull away from the sides of the bowl. The dough should be smooth and elastic, and slightly stick to a clean finger, but not be overly sticky. Add a little more flour, if needed.
- First Rise: Grease a large bowl with oil or cooking spray and place the dough inside, turning to coat. Cover with a dish towel or plastic wrap and allow to rise in a warm place\* until doubled in size, about 1 1/2 hours.
- Punch the dough down well to remove air bubbles.
- Knead the dough: Mix the dough for 4-5 minutes on medium speed (or knead with your hands on a lightly floured surface, for 5-8 minutes).
- Divide into two equal portions. Shape each ball into long logs and place onto a baking sheet.
- Bake: Preheat oven to 425 F. Put tray of water in the oven at this time. Bake bread for about 30-33 minutes, or until golden brown on top. Give the top of a loaf a gentle tap; it should sound hollow.
- Invert the loaves onto a wire cooling rack. Brush the tops with butter and allow to cool for at least 10 minutes before slicing.
- Once cool, store in an airtight container or bag for 2-3 days at room temperature, or up to 5 days in the refrigerator.

## Reflection:

I want to be able to save money and make things in my house, a healthier way. One way to do this is to make homemade bread. A simple bread recipe has 4-6 ingredients usually. However, storebought bread can have 10-15 ingredients, many of which are preservatives. I have made bread before, and it usually turned out good. I got my recipe from a woman on TikTok. I struggle to digest gluten, so I wanted to try to make gluten free (GF) bread using rice flour instead. After I mixed the ingredients together, I had to keep the GF bread in a bread pan and not shape it into logs. This is because the gluten free bread did not have as much structure as regular bread and did not shape well. After I baked the gluten free bread and let it cool, I tried it. It had a texture similar to cornbread but was dense and hard. It didn’t rise much or change color. I was expecting the

gluten free bread to rise very little and to be dense as well, due to the lack of glutenin or gliadin proteins since I used rice flour. However, I was not expecting it to be as dense as it was. It came out of the oven like a brick. I prefer the regular bread recipe because at least the bread was eatable and not so hard or dense.

Some of the key ingredients in this recipe include flour, yeast and water. The yeast works as a leavening agent. It is a microorganism that feeds on the sugar in the flour. During aerobic respiration it releases carbon dioxide and causes the bread to rise. The water in the recipe activates the yeast and supports the leavening agent. If the water is too hot it will kill the yeast, and if it is too cold it will not do anything. It must be around 105°F to be productive. Water is polar and made of hydrogen and oxygen molecules. The flour is another key component in this recipe. It works as a sugar compound. The starch in the flour is a polysaccharide, which is a sugar chain. This sugar is important for the rise of the bread. The yeast needs something to eat, and the sugar provides that. It also helps with the coloration of the bread. The sugar and the protein in the flour, along with the heat of the oven create a Maillard reaction. A Maillard reaction is when the outside of the bread gets a golden-brown color. When I did the substitute of rice flour, I had to add honey to the mix because rice does not have much sugar in it. This was needed to feed the yeast. When cooking in the oven, the bread receives heat and energy through convection transfer. This is when the heat circulates by a fan and moves the hot particles around. When the hot particles bump into the cold particles, the energy is passed along.

# Cranberry Sauce

Submitted by: Carlie King

Recipe from: Clean Food Crush, Rachel Maser

## Ingredients

1 lb. fresh or frozen cranberries  
½ cup water  
½ cup honey or pure maple syrup  
Zest of 1 organic lemon (about 2 teaspoons)  
1 tsp vanilla extract  
1/4 tsp ground cinnamon

## Instructions

1. Place a medium saucepan over medium heat. Add in your cranberries, water, honey OR maple syrup, lemon zest, vanilla extract and ground cinnamon.
2. Bring this mixture to a boil, then reduce the heat to medium-low. Cook, stirring constantly, until the cranberries have popped and the sauce has thickened, about 6-8 minutes.
3. Remove the pot from the heat and allow your sauce to cool as this sauce will continue to thicken.
4. Keep refrigerated for up to 1 week.

## Reflection

I tried the original recipe with the lemon zest, and it was tarter than when I tried the one with the clementine which was sweeter. I thought the cooking aspect of all of this turned out to have the same outcome except for the two different citrus flavors one tart and one sweeter.

# Gluten Free Biscuits

Submitted by: Alyssa Houde

## Recipe:

2 cups gluten free all-purpose flour 2 cups gluten free all-purpose flour  
4 teaspoons baking powder 2 teaspoons baking powder  
1 teaspoon sugar 1 teaspoon sugar  
1/2 teaspoon salt 1/2 teaspoon salt  
1/4 teaspoon baking soda 1/4 teaspoon baking soda  
1/3 cup butter 1/3 cup butter  
3/4 cup milk 3/4 cup milk  
3 eggs 3 eggs

## Reflection:

I chose this recipe because I make it a lot. I wanted to see what the biscuits would be like if they did not rise as much as they normally would. The change I made to the recipe is reducing the amount of baking powder by half. My hypothesis was that the biscuits would not rise as much and that they would be denser. I like the original recipe better because the biscuits are fluffier and have a better texture.

Three key ingredients in this recipe are eggs, baking powder, and butter. Eggs are made of lipids, proteins, and water. They bind the other ingredients in the recipe together. Baking powder is made from sodium bicarbonate, an acid like cream of tartar, and a neutralizer like cornstarch. It is important in this recipe and many other recipes because it is a leavening agent. Butter is a fatty acid. In this recipe it adds to the flavor and creates a flaky texture.

One physical change in this recipe is mixing the dry ingredients together. This is a physical change because the process can be reversed and there was no chemical reaction that occurred. A chemical change in the recipe is mixing wet and dry ingredients together. This is chemical because the process cannot be reversed. Another chemical change is baking the biscuits. While baking a new product is formed and it cannot be reversed so it is a chemical change.

The method of heat transfer in this recipe is convection. The hot air in the oven cooks the biscuits. Heat is also transferred by conduction. Heat is transferred from the pan to the bottom of the biscuits, causing the Maillard reaction to occur and giving them a brown, caramelized color. The pan used to bake the biscuits was an aluminum cookie sheet with a silicone baking mat on it. The baking mat distributes heat better than parchment and is better for the environment.

# Gluten Free Pancakes

Submitted by: Mya Houde

## Recipe

1 cup flour  
2 tbsp sugar  
1 tbsp baking powder  
1 tsp baking soda  
½ tsp salt  
1 egg  
2 tbsp vegetable oil  
¾ cup homemade 'buttermilk' (1 tbsp vinegar in measuring cup and fill milk until ¾ cup)  
1 tsp vanilla extract

## Reflection:

I chose to make pancakes because I wanted to find good, fluffy gluten free pancakes. I have tried gluten free pancake mixes, but they were not fluffy. Then I tried this original recipe, and they turned out okay, but still had the wrong texture. So, I decided to change the recipe for this project to see if they would have a better texture than other gluten free pancakes. The change I made was to add more baking powder, some baking soda, and use buttermilk instead of plain milk. My hypothesis was that the pancakes will be fluffier and more tender because of having more baking powder and having the reaction between the baking soda and vinegar in the batter. The result of the experiment was that the pancakes rose better when they were cooking, and they were fluffier than the original recipe. I prefer the new recipe because they had a better texture and were more like 'regular' pancakes than the other gluten free mixes and recipes.

Three key ingredients in the recipe are baking powder, sugar, and vanilla. The baking powder is a leavening agent, its function to help the pancake rise and give it that signature fluffy texture. A property of baking powder is that it is a weak acid, being a mixture of sodium bicarbonate, cream of tartar(acid) and cornstarch to prevent early neutralization. Sugar is important because it gives the batter a little sweetness, but also helps the Maillard reaction occur. The properties of sugar are that it is a polar molecule, water soluble, and is called sucrose. Vanilla gives the pancakes flavor and, with sugar, a sweeter aroma. Vanilla is a phenolic compound, vanillin, and is less volatile. A physical change is mixing the dry ingredients together. There are more chemical changes in the recipe. One is mixing the dry and wet ingredients together to form the batter. The vinegar will react with the baking soda and the wet ingredients will incorporate with the flour. Cooking pancakes is also a chemical change. The heat from the pan together with the sugar and proteins in the batter will cause a Maillard reaction, helping the outside of the pancake brown and form a little crisp on the edges. They will also rise while cooking, especially when they are flipped, because of the leavening agents, baking powder and baking soda.

The method of heat transfer used is conduction because the pancakes will receive indirect heat from the stove through the pan. The equipment used to make the pancakes was a whisk, wet and dry measuring cups, a mixing bowl, a nonstick pan, and a spatula. Both wet and dry measuring cups were used to get the correct amount of ingredients in the batter. The recipe could not have worked well if the wrong amount was used. The whisk is used to mix the wet ingredients together



and then both wet and dry to make sure all the ingredients are fully incorporated. The nonstick pan is to make sure the pancakes do not stick, and that they form a little crisp on the edges.

# MAIN COURSES

## Chicken Stir Fry

Submitted by: Coby Conway

### Ingredients

- 1 lb boneless, skinless chicken breast cut into 1 inch cubes
- salt and pepper to taste
- 2 tbsp olive oil divided
- 2 cups broccoli florets
- 1/2 yellow bell pepper cut into 1 inch pieces
- 1/2 red bell pepper cut into 1 inch pieces
- 1/2 cup baby carrots sliced
- 2 tsp minced ginger
- 2 garlic cloves minced

### Stir Fry Sauce

- 1 tbsp corn starch
- 2 tbsp cold water
- 1/4 cup low sodium chicken broth
- 3 tbsp low sodium soy sauce
- 1/4 cup honey
- 1 tbsp toasted sesame oil
- 1/2 tsp crushed red pepper flakes

### Instructions

1. In a medium size bowl, whisk together corn starch and water. Add remaining ingredients (chicken broth, soy sauce, honey, and toasted sesame oil, red pepper flakes) and whisk to combine. Set aside.
  2. Add one tablespoon of olive oil to a large skillet or wok and heat over medium high heat.
  3. Add chicken (in batches if necessary) and season with salt and pepper. Cook for 3 to 5 minutes or until cooked through. Remove from skillet.
  4. Reduce heat to medium and add remaining tablespoon of oil to the skillet.
  5. Add broccoli, bell pepper, and carrots and cook, stirring occasionally, just until crisp tender. Add ginger and garlic and cook for an additional minute.
  6. Add chicken back into the skillet and stir to combine.
  7. Whisk stir fry sauce and pour over chicken and vegetables and stir gently to combine.
  8. Bring to a boil, stirring occasionally, and let boil for one minute.
  9. Serve with rice and/or chow mein if desired.
-

The main reason I chose this certain chicken stir fry recipe is because I had used it before to make meals freshman year of college when I found it on Instagram. It worked out well and was easy to make, so I've used the same recipe many times. The change I made to the recipe was grilling the chicken and vegetables, rather than frying them like the original. My roommate made Kabobs on the grill that consisted of grilling chicken, peppers, and onions. This made me wonder, how would chicken stir fry taste if the chicken and vegetables were grilled? This led me to my hypothesis that grilling the chicken and vegetables will give a crunch to the stir fry that frying it won't. When frying chicken or vegetables, the food will produce a crispy exterior and moist interior because of its immersion in oil during the cooking process. This is contrary when grilling chicken or vegetables because the radiation heat transfer results in a drier texture with charring. There is also a smokey flavor that is distinct to this cooking process. The charring from grilling will be key to the crunch that I mentioned in the hypothesis.

My hypothesis was right in the fact that grilling the chicken and vegetables gave the meal a crunch that it didn't have before. The only problem I found when I grilled it is that it was almost too much crunch. In the end, I didn't like it more than the original recipe, which was a surprise to me. I think the crunch would have been a great addition with that grilled/charred flavor, but it was too overpowering and masked the sauce.

Three key ingredients in making this chicken stir fry are olive oil, honey, and minced ginger. The first ingredient to discuss is the olive oil. The main chemical properties of olive oil are triacylglycerols (triglycerides or fats) and small amounts of free fatty acids, glycerol, and phosphatides. It is also not soluble in water and is a homogenous mixture. Olive oils' purpose in the recipe is to facilitate the Maillard Reaction in the vegetables and chicken by providing moisture and allowing better heat transfer. The next ingredient to discuss is honey. The chemical formula for honey is  $C_6H_{12}O_6$ . It is made of hexose sugars like fructose and glucose. It is soluble in water and a homogenous mixture. Honey's purpose in the recipe is to thicken and sweeten the sauce. It also contributes to the Maillard Reaction in the chicken because of the glucose and fructose it contains reacts with the amino acids. The final important ingredient to discuss is the minced ginger. Ginger is abundant in active constituents, such as phenolic and terpene compounds. The phenolic compounds are mainly gingerols, shogaols, and paradols. Ginger is also soluble in water and a homogenous mixture. The minced gingers' purpose in the recipe is to add a slightly sweet and spicy taste to the dish. It's added at the same time as the garlic, so the flavors mix when frying the vegetables and chicken.

One of the chemical changes that occurs in this recipe is the Maillard Reaction. This occurs multiple times with different ingredients throughout the cooking process. It occurs with the olive oil on the vegetables and chicken and with the honey on the chicken. Another chemical reaction that occurs is Caramelization. The peppers and broccoli go through Caramelization due to sugars in the recipe such as the honey in the sauce. The only physical reaction that really occurs in this recipe is the mixing of the ingredients that make the sauce.

A heat transfer that occurs in this recipe is conduction when cooking the chicken and vegetables. The food is making direct contact with the hot pan resulting in conduction. The other heat transfer, that is used in the recipe that I didn't prefer, is radiation when I grill the chicken and vegetables instead on frying them. This is occurring because there is not direct contact between the heat source and the food. The materials that I used for this recipe are a solid and liquid measuring cup, stainless steel skillet, wooden spoon, kitchen knife, and a whisk.

# Chicken Sausage Pasta with Asparagus and Balsamic Glaze

Submitted by: Connor Fiadino

## Recipe:

1 (16 ounce) package dried rigatoni pasta  
5 tablespoons olive oil, divided  
2 links chicken sausage, sliced up  
¼ teaspoon garlic powder, or more to taste  
salt and ground black pepper to taste  
1 bunch slender asparagus spears, trimmed, cut on diagonal into 1-inch pieces  
1 clove garlic, thinly sliced  
¼ cup grated Parmesan cheese

## Reflection:

I chose this recipe because as an athlete you must be eating whole good foods that fuel you, and pasta and chicken are two main sources for that. I used to always just have it sort of plain, with just olive oil on the chicken and pasta. My grandmother introduced me to chicken sausage as a different source of protein, as it was so much different than plain old chicken and had so much flavor. My mother introduced me to balsamic glaze, which I've never had seen before. It was the perfect combination of sweetness and a bit of tang to add to a dish. So, the result from plain chicken with olive oil, to chicken sausage with balsamic glaze had a huge difference. The glaze made a huge difference, while it is primarily used with salads or cheeses, I felt it tied together the whole meal, but didn't overwhelm the rest of the elements in the dish. While cooking, conduction was the process of heat being transferred between objects through direct contact in this dish. During this cooking process, I used a few different types of kitchen equipment. To start, I used an aluminum pan to cook and fry the chicken sausage and vegetables in, and in a small aluminum pot I used to cook and boil the rigatoni in. To help mix around and cook, I used wooden kitchen spoons. I used wooden ones, so it doesn't scratch the pans and the surface, and I prefer the design and aesthetic of them. The pasta went through a physical change, the protein and starch interactions are manipulated to get that perfect rigatoni. While the pasta is cooking, water is absorbed by the starch particles, which in turn form a gel that makes the pasta soft and somewhat gummy. When cooking the chicken sausage, it is done when it's cooked to 165 degrees Fahrenheit all the way through. When this happens, its color should change from a translucent pink to white and opaque, with a crisp brown exterior. Overall, I wanted to try this out and do my own little recipe and try out to see how big a difference these changes would make in a dish. I felt the adding of the chicken sausage and then balsamic glaze added a new dimension to the meal, and made it feel like it was straight out of a restaurant, and as an Italian made me right at home.

# Chicken Stir Fry

Submitted by: Coby Conway

## Ingredients

- 1 lb boneless, skinless chicken breast cut into 1 inch cubes
- salt and pepper to taste
- 2 tbsp olive oil divided
- 2 cups broccoli florets
- 1/2 yellow bell pepper cut into 1 inch pieces

1/2 red bell pepper cut into

# Breaded Garlic Steak Bites

Submitted by: Briana Cole

## Recipe:

### Ingredients-

1 tablespoon olive oil

1½ pound sirloin steak (cut into bite-size pieces, or strip loin, tenderloin, strip steak, or rib eye)

½ teaspoon salt (or to taste)

½ teaspoon pepper (or to taste)

2 tablespoons butter (unsalted)

4 cloves garlic (minced)

¼ teaspoon red pepper flakes

1 tablespoon parsley (fresh, chopped)

### Instructions-

1. Add the olive oil to a large skillet and heat it over high heat. Make sure the olive oil is hot, then add the steak pieces to it after dipping in egg and flour. Season them generously with salt and pepper.
2. Cook for at least 2 minutes before stirring the steak pieces. You want to make sure you get a good fry to them. Continue cooking for another 2 minutes until they're golden brown. If your skillet isn't big enough, you may need to do this batches.
3. Transfer the steak bites to a plate and in the same skillet add the butter. Turn the heat down to a medium and after the butter has melted, add the garlic. Cook for about 30 seconds while stirring, just until the garlic becomes aromatic and starts to brown.
4. Pour the garlic butter over the steak bites and toss well. Garnish with parsley and serve.

Source- <https://www.jocooks.com/recipes/garlic-butter-steak-bites/> (Edited to fry and not sear)

## Reflection:

I had originally found this recipe on TikTok and thought that it would be perfect for me to choose. This recipe was a bit out of my comfort zone, and I wanted to challenge myself by making these steak bites again, as I had only made them one other time and that was without the addition

of frying them instead of what the recipe calls for by pan searing them. I will cook the bites by cutting my steak into tiny cubes, covering them in flour and egg, and then frying them in my wok pan with olive oil and spices/herbs, and then adding the garnish at the end.

I found my recipe at, <https://www.jocooks.com/recipes/garlic-butter-steak-bites/> and will just be adding the extra step of breading and frying to the recipe. I expect to see there to be a change to the bites by being thicker, and crunchy with the added breading and frying process, which is true with the final result. Normally I prefer the original recipe without the breading because I feel as though the bites are juicier and more tender, but with the addition of frying is not bad either, just definitely dryer and more crunchy. The addition of the breading helps any condiments like steak sauce stick more easily though.

Moving on to the three key ingredients in this food are the protein, which is steak which adds the fats, moisture, and base for the dish, and parsley which is an herb that adds flavor and is a garnish to the dish that I added at the end. It is often said to accentuate the flavors of other ingredients in the meal. The third ingredient is of course garlic, which is an herb that amplifies the taste of a food and is the main taste of the dish other than the steak. Garlic can also be called a spice due to the chemical allicin that causes its pungent taste and scent.

A chemical change to the ingredients is the Maillard reaction when the flour browns in the frying process, and emulsification with the fryer oils and moisture inside the steak when they mix. A physical reaction would be the cooking and searing of the steak within the breading through the heat from the boiling oil on the outside. Moving on to the method of heat transfer during the cooking process, frying is a form of conduction that happens internally to the food, and convection is caused by the oil from the outside. I used a wok pan in order to cook the bites as it is deep enough to hold the oil, and has plenty of room for the bulk of the oil and steak to be inside, and they were handled and flipped with a silicone spatula.

# General Tso's Chicken

Submitted by: Maxine Fairall

## Recipe:

- 1 1/2 lbs. boneless skinless chicken thighs cut into 1-inch pieces.
- 2 eggs lightly beaten.
- salt and pepper to taste
- 1/2 cup all-purpose flour
- 1/2 cup corn starch
- vegetable oil for frying
- 2 teaspoons sesame seeds
- 2 tablespoons green onions sliced.

## Sauce:

- 2 teaspoons vegetable oil
- 2 teaspoons minced fresh garlic.
- 1/2 teaspoon crushed red pepper flakes or more to taste.
- 3/4 cup low sodium chicken broth
- 2 tablespoons hoisin sauce
- 2 tablespoons brown sugar
- 1/4 cup low sodium soy sauce
- 1 tablespoon corn starch

## Steps:

1. Place the eggs in a bowl; add salt and pepper to taste.
2. Mix together the flour and corn starch and place in a shallow bowl or on a plate.
3. Heat 3 inches of oil in a deep pot to 350 degrees F.
4. Dip each piece of chicken into the egg mixture, then coat in the flour mixture. Repeat the process for all of the chicken pieces.
5. Fry 8-9 pieces of chicken at a time for 5 minutes or until browned. Repeat with all the remaining chicken.
6. While the chicken is cooking, make the sauce.
7. Heat the 2 teaspoons of vegetable oil in a saucepan over medium heat. Add the garlic and crushed red pepper flakes and cook for 30 seconds.
8. Whisk together the chicken broth, hoisin sauce, brown sugar, soy sauce and corn starch.
9. Add the liquid mixture to the pan and bring to a simmer. Cook for 2-3 minutes or until sauce has thickened.
10. Add the chicken pieces to the pan and toss to coat with the sauce. Sprinkle with sesame seeds and green onions and serve.

## Reflection:

When it comes to cooking Chinese dishes, I find it difficult. It is hard for me to get that crunch that one desires from Chinese food. I chose this General Tso's recipe because it is a dish that I enjoy eating frequently, but I can never get the crunch right. General Tso is also a Chinese dish, and Chinese is my favorite food, so I thought I would give it a shot. Before this class, I did not cook entrees like this often, and this class really helped me open my eyes to attempting to cook meals like this one. I got this recipe online at: <https://www.dinneratthezoo.com/general-tsos-chicken/>. This recipe calls for frying the chicken in oil, I decided to cook it in the air fryer to see if it gives us that crunch, we have been looking for because I think frying in the pan with oil is the reason, I can never get that crunch, it makes it soggy. You may be wondering, is this recipe a chemical or physical change? Both? This recipe has a mixture of both chemical and physical changes. Some of those include the cooking of chicken, which is chemical, the cooking of the rice is also chemical, and the beating of the eggs would be a physical. The difference between the two is that with a chemical change, it changes the structures of the ingredient, while during a physical change, the structure stays the same, it just might look different. For example, the eggs. Beating the eggs together is a physical change because the structure did not change, but it looks different than it did before beating. I hope that makes sense and furthers your thinking when cooking. If you try this recipe or any other recipe, try deciding which parts of the process are chemical changes and physical changes!

Okay, back to seeing the results of cooking in the air fryer rather than the pan. After the cooking process, it was a failed attempt. The breading did not stick, and the chicken was very dry. I believe this could have been a mistake on my end, but I do not recommend the air fryer unless you want very dry chicken, stick to the pan with oil! Both methods are convection, which means there is direct heat transfer, so give it a shot and let me know which one you prefer! Cooking the rice was done through radiation because it was microwavable rice, so I would not recommend cooking your chicken in the microwave. Overall, the flavor of the dish was very good. The sauce was very delightful and rich, and in the case with the air fryer, it helped hide that dry chicken! All I did was take the cooked chicken out of the air fryer, and I sprinkled sauce on top. Easy peasy! You may be wondering, what makes up these ingredients? Let's start with flour. Flour and its molecular properties are gluten and starch. What about corn starch? Its molecular properties are that it is not soluble in water, and it contains carbon, hydrogen, and oxygen. Lastly, Canola oil and its molecular properties are that it is hydrophobic. Understanding the molecular properties of items and ingredients that we use almost every day will help us better understand why we use them in recipes, so I hope this helps you! When plating, I used a paper plate, because it was convenient for me to use at the time. I cooked the rice in a ceramic bowl because I did not want to get plastic into the food! I recommend if you are microwaving anything, stick with glass or ceramic ware. I used the air fryer, which I am unsure what that would be labeled as, and lastly, I used silicone tongs to remove the chicken from the air fryer. I hope this recipe helped you learn something new and remember, let me know which method you prefer! Thank you!



# Baked Ziti

Submitted by: James Kirk

## Recipe:

- 16 oz -Ziti
  - 12 oz Pasta sauce
  - 2 c shredded mozzarella cheese
  - ½ garlic powder
  - ¼ tsp black pepper
  - 3 tbs Parmesan cheese
1. Preheat the oven to 375 degrees.
  2. Cook the ziti according to package instructions and drain.
  3. In a small bowl mix 2 cups mozzarella, basil, salt, and pepper.
  4. Toss the cooked ziti in 12 oz of marinara sauce.
  5. Spoon half of the pasta mixture into a 9x13x2-inch baking dish. Top it with the cheese mixture. Add the remaining pasta and 1 cup mozzarella and grated Parmesan.
  6. Cover the with aluminum foil and bake it for 25 minutes, remove the foil, and bake it for 5 minutes more.

## Reflection:

I made baked ziti. As a college student on a fixed income, baked ziti is my go-to meal each week. I make a tin of baked ziti every Sunday night so I have an easy meal to reheat during the week. A box of pasta is less than \$2, the cheese is \$3, and the jar of pasta sauce is about \$4 – so the whole thing costs less than \$10 and gets me through the week. When I first started making the ziti, I followed the box recipe which called for an egg and ricotta cheese. Due to cost and taste, I change the recipe to skip the egg and replace the ricotta cheese with mozzarella cheese.

I didn't really understand the difference in the recipe, except for cost and tastes, until taking this class. My hypothesis now was that the recipe without the egg was going to have less structure because the egg binds water, fat, and starch.

For the purposes of this project, I made the recipe the way the box called for and the way I eat it each week. After making the dishes, I compared the structure and what they looked like after being cooked. Below are photos of the outcome. The photo on the left shows the original recipe with egg and ricotta cheese and the photo on the right shows just noodles with mozzarella cheese. As you can see, the original recipe with the egg is held together and has more structure. The ziti on the right just fell apart when I put it on a dish. In the original recipe, the egg acted as an emulsifier to hold the dish together and give it more structure and texture. I tasted both ways again and decided I still like the way I make the ziti without the egg and ricotta cheese. I am not sure it is the egg that is the difference, just the flavor of the cheese. I also use less pepper than the recipe calls for because I don't like too much flavor.

In both recipes, there were physical and chemical changes that took place during preparation and cooking. Boiling water is a physical change. When uncooked pasta is added to the boiling water, the noodles soften because the starch (amylose) leaks out and a chemical change takes place. Once you mix the cheese with pasta and heat it in the oven, the cheese melts and spreads. This is a physical change as the proteins in the cheese start to uncoil. Finally, when you remove the aluminum foil, the proteins from the cheese mix with the sugar from the noodles which causes them to brown, which is a chemical change (Maillard Reaction).

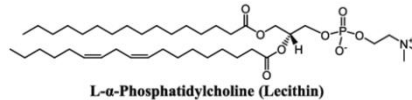
The types of heat transfer that occurred during the cooking were convection and conduction. Boiling water is convection (heat moved within the water) and conduction (transfer of heat between the stove and the pot to heat to the water). Baking the ziti in the oven is convection (air moving around to heat the ziti) and conduction (the pan is getting hot and cooks the ziti).

To make this dish, I used a disposable baking pan because I don't like to do dishes, and a ceramic pot for boiling water, wooden spatula, and plastic spoons because that is all I had in my kitchen.

Below are three key ingredients for the recipes”

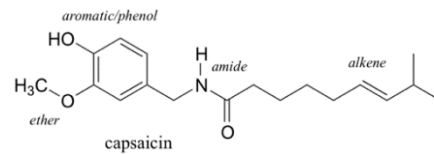
### Egg

- Egg is an emulsifier that bonds with the water and fat molecules.
- Polar and non-polar
- Carboxyl and phosphate groups
- Phospholipid



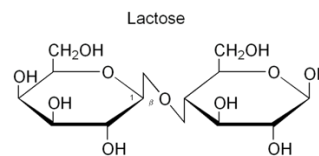
### Pepper

- Spice to add flavor
- Pungent Alkyl Amides
- Has a Phenol Base
- Activates TRPV1 Sensor - only felt in the mouth



### Cheese (Lactose)

- Used as a binding agent
- Lactose is a sugar that is soluble in water
- Lactose is hydroxyl group
- Lactose is a disaccharide



# Japanese Chicken Wings

Submitted by: Caroline Griffin

## Recipe

4 Boneless Chicken Breast

1 egg

1/3 cup flour

1 cup butter

## Sauce

3 TBSP. Soy Sauce

3 TBSP. Water

1 cup White Sugar

½ cup Vinegar

Cut the chicken breast in slices. Dip in slightly beaten egg and then in flour. Fry in butter until deep brown and crisp. Place in a shallow roasting pan. Mix all the sauce ingredients together over the stove top. Warm sauce slowly until all sugar has dissolved. Pour over chicken. Bake at 350 degrees F (180 degrees C) for 30 minutes. Baste the chicken with sauce during cooking.

## Reflection

After looking at many different dishes and recipes, I decided to pick the one dish that everyone in my family loves. My mom has made this chicken for many years for our family and friends. It is definitely a fan favorite after I cooked this chicken for my roommates during exam week. After reading over the assignment, I had a good idea of what was needed, and this recipe fit perfectly for the assignment.

The change that I made was to warm up the sauce before putting it on the chicken. I thought this would help the sugar dissolve because sugar needs to be warmed up to dissolve. I have found in the past that the sugar goes to the bottom of the tray. This makes the chicken just sit in the sugar. My hypothesis was that if the sauce were warmed up, then the flavors would be better. I was correct in my hypothesis. I found that warming the source did make the chicken taste better, and I believe that is because the sugar was dissolved. I would recommend making this change in the recipe. With that said, both ways of making the chicken were delicious.

Three essential ingredients that are needed for this recipe are eggs, flour, and sugar. The egg allows the flour to stick to the chicken. The molecular properties of eggs are proteins, lipids, and small amounts of carbohydrates. Proteins are found in the yolk and the clear liquid part of the egg white. The lipids are primarily found in the egg yolks. Vitamins A and D are also found in eggs. Once the chicken was dipped into the egg, it would get tossed in flour. The flour allows for the chicken to fry. The molecular properties of flour are starch, a complex carbohydrate; proteins, gluten-forming proteins; and enzymes. The sugar in this recipe sweetens the top of the chicken. The molecular properties of sugar are sucrose, caramelization, and solubility.

During the cooking time, there were many physical and chemical changes. The first physical change was the change in color and texture. Another physical change was that the shape of the chicken changed when it was cut into slices. Another physical change was the rise in temperature of the chicken. The first chemical change was caramelization. This happened with the

sauce and sugar. The other chemical change was the maillard reaction which created the brown pigment. This reaction occurs between reducing sugars and proteins when heat is involved.

When preparing this recipe there were two methods of heat transfer being used. The first method was conduction. This was used when frying the chicken before the chicken was put in a pan to go into the oven. The method was also used when changing the recipe to warm the sauce. The second method that was used was convection. This was used when cooking the chicken in the oven. The materials that I used when making Japanese Chicken Wings were a ceramic frying pan, togs, freezer bags, stainless steel pan, ceramic pot, and mixing bowl.

# Chicken Cutlet

Submitted by: Vincenzo Ferranti

## Recipe:

Wash thinly sliced chicken breast. Pat dry the chicken. Beat 2 eggs with yolk on a separate bowl. In another bowl mix together breadcrumbs, grated parmesan, salt & pepper, garlic powder, and parsley. Dip the chicken in the beaten eggs and then in the breadcrumb mixture. In a pan, heat up vegetable oil at 350 degrees Fahrenheit and cook for 2 minutes each side.

## Reflection:

For this assignment, I chose to make 2 alterations of chicken cutlets. The first recipe, I fried the chicken cutlets. For the second recipe, I let them in a cast iron pan to sauté without oil. I chose this recipe of chicken cutlets because my family is from Sicily, and so chicken cutlets is a very popular meal in all of Sicily. I grew up eating chicken cutlets as well, so it was a natural choice to use this for my project. To start, I expected the chicken to be juicier for the sauteed version, but it would lose some of the crunchiness from not having as much oil. The result was that the chicken cutlets were less crunchy due to the fact that they weren't fried. However, they weren't as juicy and flavorful as the fried versions of the chicken cutlets. The fried version was much more flavorful, and had a crunchier and more complex flavor profile compared to the sauteed version of the chicken cutlets. The kitchen equipment I used for the chicken cutlet recipes were metal tongs, and I used a cast iron skillet to fry, and I used an aluminum pan for sautéing the chicken cutlet in my altered recipe. There are 3 ingredients in the dish that had a form of chemical function in the recipes. The breadcrumbs in the dish gave the crust to the chicken cutlets, allowing them to be crunchy and have a distinct taste with the spices added to the breadcrumb mixture. The breadcrumbs are carbohydrates. The second ingredient was the chicken itself. The chicken in the recipe serves as the base star of the dish, where the meat undergoes the cooking process and is the essential component of the dish. The chicken is a protein. Finally, the last key ingredient is the eggs. The egg is also a protein. The eggs serve as the emulsifier in the dish that allows the coating from the breadcrumb mixture to stick onto the chicken, allowing for the famous crust for the chicken cutlets to stay on the chicken when cooking. The physical reaction that occurs in this dish is the moisture and water getting released from the chicken as the chicken is being heated and cooked. The chemical reaction in this recipe for chicken cutlets is the Maillard Reaction from the browning of the crust in the cooking process. The breadcrumb mixture crust of the chicken cutlets starts to cook and brown as it is heated, causing the crunchy sensation that makes the lovely dish. This concludes my project for culinary chemistry on chicken cutlets. Overall, I really enjoyed this final project, and I believe that there is many different alterations of a variety of dishes that would be great at determining a multitude of chemical and physical reactions. The reactions in my project were very cool to see happen in my reaction, and I feel that I saw the dish through a different lens when cooking and seeing the reactions taking place.

# Pasta Primavera

Submitted by: Greta Vieland

## Recipe:

[www.cookingclassy.com/pasta-primavera/](http://www.cookingclassy.com/pasta-primavera/)

## Spaghetti squash recipe for substitution:

[www.loveandlemons.com/how-to-cook-spaghetti-squash](http://www.loveandlemons.com/how-to-cook-spaghetti-squash)

## Reflection:

I picked this recipe since I'm a vegetarian and because of this I cooked for myself from an early age. Basic vegetables and pasta were my go-to easy meal so I consider myself to be someone who has mastered the craft of cooking veggie pasta. When I learned this was an actual dish, I thought it would be perfect for this project. The change I made for this recipe was substituting the pasta for spaghetti squash. I did this to create a version of the recipe for people who don't tolerate gluten well, or maybe someone just wants a lower calorie option. I theorized that this would probably taste similar to the original dish, but the texture might be more crispy and less soft. While I do enjoy spaghetti squash, I think I do prefer the traditional version since it feels a little more balanced. The ingredients in this recipe have important molecular functions! Here are three ingredients and their functions listed. Salt is used in pasta recipes to stop the pasta from sticking when boiling, it also adds flavor to the dish. Salt has a crystalline structure and is known as sodium chloride. Onion is used for texture, flavor, and the choice of red onion adds color to the dish as well. Onion is full of polyphenolic substances and phenolic acids. Lemon juice is an acid and is used for extra flavor, I personally think lemon juice compliments the flavors in vegetables really nicely. Some of the equipment I ended up using was stainless steel pots and pans, a silicon spatula(I like using silicon since it doesn't scratch pans), an aluminum baking sheet, a wooden spoon for mixing, as well as a wooden cutting board.

# Cheesy Chicken Cups

Submitted by: Natalie Eberly

## Recipe:

2 cans of cream of chicken soup  
2 rolls of Pillsbury crescent dough  
1 bag of shredded cheddar cheese  
1 bag of frozen vegetable of choice (optional)  
1 tsp of salt  
1 tbsp of pepper  
1 tbsp of parsley  
1 tsp of paprika

Roll crescent dough out and cut into 4 rectangles, then mold to form in cupcake tins or cupcake wrappers. Then combine all other ingredients in a large mixing bowl. Then add fully combined mixture to dough forms and bake for 10-15 minutes at 350 degrees or until golden brown.

## Reflection:

I chose this recipe because it is one of my family's favorites. It is perfect for the wintertime, and I was always excited as a kid when my mom made these. I chose to make a change in the dough used for the cups, switching from croissant dough to biscuit dough. I predicted that this would create a denser cup and need to be cooked slightly longer because of that. The recipe made with a denser dough requires the cups to be cooked for approximately 4 minutes longer on the same heat. This dough was also more suitable for the filling because it was denser and did not get as soggy. I still love the croissant version, but the ones made with biscuit dough were easier to get out of the cupcake tins and they held up when eating them. One of the key ingredients was cream of chicken soup which is classified as a carbohydrate, lipid, and protein and it contains polar elements. It is the base for the filling and adds creaminess to the recipe. Another ingredient is the cheddar cheese which is classified as a protein with lipid properties and is polar. The cheese helps for a slight crust on the cups and adds to the texture of the dish after it is melted. The final ingredient is the dough which in one case was croissant dough. This dough is classified as a carbohydrate also it contains protein chains and polymer (glucose) chains. It is used to contain the filling and help form a cup for all of it to go. The 2 biggest physical changes in this recipe are the melting of the cheese and the cooking of the chicken which both significantly alter the taste of the recipe. One of the chemical changes included is the rising of the dough to become a puffy pastry like cup for the filling. The method of heat transfer in this recipe is through convection because it is only cooked in the oven. There are few materials needed for this recipe, only a mixing bowl to mix the filling and a muffin/cupcake tin to be able to form the cups and cook them in a shape.

# Chicken Veggie Soup

Submitted by: Aneesah Brailford

## Recipe:

5 chicken breast  
1 onion diced  
2 cloves garlic minced  
2 medium potatoes peeled and diced  
3 ½ cups beef broth  
28 ounces canned diced tomatoes with juice  
1 can condensed tomato soup  
2 teaspoons Worcestershire sauce  
1 teaspoon Italian seasoning  
1 bay leaf  
Salt and pepper to taste  
3 cups mixed vegetables

## Reflection:

My first thought when picking a recipe was to do a sweet treat. A desert felt like an easy get-out-of-work card. After sitting and thinking about nothing for about 20 minutes, I started to think about how hungry I was. Two things came to mind; the first was a burger because who does not love a good burger, and then I started thinking about how cold it was. One of the best soups when it is cold outside is chicken noodle soup. The idea hit me as I thought about how random my taste pallet was. I looked up hamburger soup, and unsurprisingly, it was a real thing, so naturally, I picked that as my dish. Hamburger soup is a hearty and flavorful soup made with ground beef, potatoes, carrots, onions, and various seasonings. It is a comforting dish perfect for cold weather and often served with crusty bread or crackers. The soup is easy to make and can be customized to include your favorite vegetables and seasonings. For example, I had corn in my version. It is a delicious and satisfying meal that will warm you up on a chilly day. While hamburger soup was now my chosen recipe, I needed to elevate the recipe by making a significant change. I returned to the thought that chicken noodle soup is one of the best soups for the cold and realized the ingredients are slightly similar to hamburger soup. With that in mind, I exchanged the beef in the recipe for chopped chicken breast. Using chicken breast over beef was a bold flavor decision. Without the flavorful fats from the beef, the soup will appear more subtle and light. When comparing the flavor profiles between the two soups, the original version had a high, hearty flavor and feel that was filling. Beef is a versatile protein that offers a delicious and nutritious addition to any meal, especially this one. With its rich combination of proteins and fats, beef contributes not only to the flavor of a dish but also to its nutritional value, making it a great choice. While the original had a better kick, the chicken version of hamburger soup was light with a warm, homey feeling. The chicken version felt like you could return to it multiple times and still feel warm inside. The tomatoes in the dish help everything form together. The most prominent features of tomatoes are water, carbohydrates, and organic acids. When used as a base in this dish, they contribute to the overall flavor by providing a slight acidity.



The tomatoes help build flavor, but the potatoes give the soup a warm feeling. Potatoes are known for their high starch and sugar content, which make them a valuable ingredient for enhancing the texture and thickness of dishes. The starch in potatoes also contributes to creating a sturdy foundation. As the soup thickened, evaporation happened. While the soup simmers, the liquid content decreases through steam. This reduction concentrates the flavors, resulting in a more flavorful and concentrated broth. Another change that is overlooked is the Maillard reaction. This chemical reaction happens in meat, resulting in the browning and development of complex flavors. Three cooking methods were used to cook the meat and the soup. Radiation from the fire will help heat the pot, which will cause conduction. The conduction method will heat the ingredients in the pot to create the final heat transfer, convection. Convection will happen when the steam from the soup is released.

# Shrimp Pasta

Submitted by: Chloe Wheeler

Recipe: BEFORE separating the shrimp for the experiment:

- Put Shrimp in a bowl and have shrimp be in cold water for a few minutes
- Get a pot and put it onto the stove. Heat up for 10 minutes until the water starts to boil
- While pot is boiling, put on 2 pans (nonstick pans) on MEDIUM heat.
- When water starts to boil in the pan, put 2 packs of ramen in the pot.
- Stir for 5 minutes until the ramen unsticks together.

## Separate cooked shrimp evenly

The first half of the shrimp will have Marinara Sauce.

- Pour a little bit of the sauce in with the half of shrimp
- Add a few pinches of salt, seasoning salt, and pepper in with the Marinara Sauce.
- Let that sit for about 3 minutes.

## Half of shrimp without sauce:

- When the pan heats up, put a little bit of butter (I Can't Believe It's Not Butter) in the pan. Stir for a few seconds until it has melted all the way
- Then, put the shrimp in one of the non-stick pans and then add HALF of the Ramen Noodles in there as well.
- Cook around 5 minutes

## Half of shrimp with sauce:

- When the pan heats up, put a little bit of Olive Oil in the pan.
- Then, put the shrimp in one of the non-stick pans and then add HALF of the Ramen Noodles in there as well.
- Add a little bit of the Marinara Sauce in with the shrimp and pasta.
- Cook around 5 minutes

## Reflection:

When doing this experiment, my hypothesis was right. I predicted that the shrimp that did NOT have the sauce in it would stick with the noodles and would not be as flavorful. WITH the sauce, it was easy for me to stir around and there were a lot of flavors from the sauce and the other ingredients that I put in there as well. I learned that it's better to add liquid or solid that turns into a liquid when you're cooking with a pan for there to be flavor and it would be easier to cook.

# Chicago-Style Deep Dish Pizza

Submitted by: Jesse Krafsur

## Recipe (Sally's Baking Addition)

### For the crust:

Flour + cornmeal + salt + sugar + yeast to bowl

Add warm water and  $\frac{1}{4}$  cup of melted butter

On low speed, beat or stir the ingredients until everything becomes moist

Knead with mixer or by hand

Move dough from bowl and form into a ball

Place into a lightly greased large mixing bowl with olive oil

Make sure all sides are coated in oil

Cover bowl and allow dough to rise in warm environment until doubles in size

Once ready, lightly flour the worksurface and remove dough from bowl

Gently punch down dough to remove air bubbles and roll dough into large rectangle

Spread corner cup of softened butter atop the dough and roll up lengthwise

Cut dough long in half and form two pieces of dough in balls

Place back in greased bowl and allow for a second rise in fridge

### Assemble the pizza:

Roll out the dough on a lightly floured worksurface

Work it into a 12-inch circle

Place over 9-2 inch deep dish cake-pan, and press dough into the cakepan

Trim excess dough off

Brush the top edges of dough with a little bit of olive oil

Fill pizza with  $\frac{1}{2}$  cheese, then desired toppings

Pour about 1  $\frac{1}{4}$  cups of sauce evenly on top

Sprinkle it with  $\frac{1}{4}$  cup of grated parmesan cheese

### Bake the Pizza:

Preheat oven to 425 degrees Fahrenheit

Place cakepans atop a large baking sheet and bake for 20-28 minutes or until crust is golden brown

Once done, remove pan from oven and allow to cool for 10 minutes

### Reflection:

For my recipe, I chose to make a deep dish pizza. The reason I chose to make this was for two reasons: I like the taste of pizza and I also wondered how it would taste homemade. The recipe I found was online and it was obtained from Chicago-Style Deep Dish Pizza - Sally's Baking Addiction ([sallysbakingaddiction.com](http://sallysbakingaddiction.com)).

In this recipe, I decided to not put any sugar in it. My reason for doing so is because I hypothesized that it would not let the yeast rise in the dough. Without sugar for the yeast to feed off of, it wouldn't rise. If I were to repeat this again, I wouldn't get rid of sugar next time.

The three key ingredients in this recipe are cheese, tomato, and bread. The cheese was used on top of the crust. The molecular makeup of the cheese includes caseins and it functions as the main

structural component. The tomato was used as part of the sauce. The molecular makeup includes minerals, vitamins, proteins, amino acids, carotenoids, and phytosterols. It functions as a sauce that prevents the pizza from being too dry while baking. The yeast is part of the dough, and the molecular makeup is mainly composed of microorganisms and polysaccharides such as glucans, mannans, and chitins. It functions as a leavening agent for the dough.

There are several physical and chemical changes that occurred during the recipe process. Physical changes included a bigger crust and tomatoes that formed into a sauce. Chemical changes include Maillard reactions that let amino acids in sugar react to heat and turn the crust brown. Another chemical change is the yeast rising, creating air bubbles and thus CO<sub>2</sub> pockets. During the baking process, heat transfer was occurring in two ways. The method heat transfer I used in the heating process are the heat in the oven going into the cake pan the pizza is in. The heat from the pan then went into the pizza. Another example of heat transfer was the stove flame going onto the metal pot the sauce is in. The heat from the pot then went into the tomato sauce.

The type of equipment I used included a couple of bowls, one made of plastic, the other glass. There was no particular function for the materials – even though they were used to carry the dough and let it sit in them during both of their rises, accompanied with some aluminum foil to cover the top of them and prevent moisture from escaping. I also used a spatula and put a little bit of oil on it so that the dough wouldn't stick to the spatula. The spatula was made of rubber. The rubber on the spatula was helpful in keeping the dough from not sticking. For the sauce I used a pot with a lid. The pot was made of metal and the lid was made of glass. The metal was used for the stove flame to go up to and help heat the sauce. The lid prevented moisture from escaping and keeping heat in. For the pizza itself, I used a metal cake pan. The reason the pan was metal was so that heat would go into the pan for the pizza. The top was uncovered to allow the crust to crisp up.

# Shrimp Skillet

Submitted by: Aleena Albright

## Recipe:

1 bag frozen shrimp- any size, tails off (I got mine at target)  
1-2 onions sliced however you like  
1-2 green, red and/or yellow peppers sliced  
1 package sliced mushroom of your choice (I used baby bella)  
Old bay  
1-2 sazon seasoning packets (orange)  
Olive oil  
Rice of your choice (I used jasmine)  
Cast iron skillet  
Wooden spoon/spatula

1. Thaw shrimp, slice onions and peppers. Rinse mushrooms.
2. Heat skillet on medium heat until hot. Add mushrooms to pan and cook until all the moisture is gone. Add peppers and onions.
3. Add olive oil and saute until brown to your liking. Add packet of sazon and mix around until well coated.
4. Add shrimp, old bay and continue to cook until done.
5. Serve over rice of your choice!

## Reflection:

After thinking about the recipes that I know, the easiest to make one change to was this Shrimp Sheet Pan. There is not a link for this, I didn't pull it off the internet. My wife and I enjoy throwing a bunch of things onto a sheet pan and seeing what all melds the best together and this is one of those recipes!!

The original recipe calls for baking the ingredients on a sheet pan in the oven. I chose to alter the way I would cook this dish and used my cast iron skillet instead! I believed that making it in the skillet would caramelize the peppers, onions, and mushrooms better as well as the shrimp. By switching from a convection method to a conduction method, I expected the Maillard reaction to occur. And I expected a different taste overall.

By changing the heat transfer method, the recipes' steps changed. I started off first by heating up my cast iron. I enjoy cooking things in my cast iron because I like the flavor profiles you end up with. I am a really big fan of 'frying' or "crispin' up food in it. When cooking in my cast iron I always pair with a wooden utensil, I don't trust anything plastic or silicone in them due to the materials and melting risks. The key when heating your cast iron is to do it slowly. Turn your stove on medium heat until its nice and hot and then start adding your ingredients!

In the skillet version of this recipe I added the mushrooms first! When you add mushrooms to the hot cast iron with no oil, your product at the end is a nice 'crisp' cooked mushroom. Which ended up being a key factor in the result of this dish. As the mushrooms cook, amino acids along with the sugars they are releasing mix, resulting in the maillard reaction. The mushrooms released enough moisture to brown on the outside while ensuring the inside remained spongy and delicious. Not soggy like in the original recipe.

Once the mushrooms were cooked, I added the peppers and onions. The peppers and onions add flavor to this dish on all accounts as well as some added moisture. The onions cook up very nicely and give the dish a little sweeter taste when made this way. adding A dash of olive oil to the mixture added the “fat” portion. You’ll want to add sazon to the mixture and cook for a few minutes longer. When adding the protein -shrimp, there ended up being too much liquid, so the shrimp did not get to sauté with the vegetable mixture. Instead I had to reduce the liquid by letting it slow boil for a few extra minutes to create a nice sauce, which paired with the rice very well. Overall, the recipe turned out great and I really enjoyed making this dish. I liked the cast iron skillet method over the sheet pan because of the way the vegetables cooked up and didn’t get super mushy even when there was too much liquid. The Sheet Pan Shrimp was good, but the Skillet Shrimp is a must try.

# Vegetarian Italian Chopped Salad

Submitted by: Tiara Pontz

I selected the "Vegetarian Italian Chopped Salad" recipe from Cookie and Kate (<https://cookieandkate.com/vegetarian-italian-chopped-salad-recipe/>), intrigued by its vibrant mix of fresh ingredients. To personalize the dish, I incorporated grilled chicken marinated in balsamic vinegar, elevating the salad with an additional layer of savory goodness! My love for salads, particularly those incorporated with protein like grilled chicken or tuna, led me to experiment with this recipe.

Diverging from the original, I opted for a different variety of lettuce and introduced a medley of vegetables that diverged from the prescribed list as well. The versatility of the recipe allows for creative adaptations, making it a go-to option for my salad meals. Typically relishing it as either a hearty lunch or a satisfying dinner, the amalgamation of flavors and textures never fails to appease my taste buds.

The most important alteration I introduced was grilling the chicken instead of resorting to conventional baking or employing pre-cooked cold chicken. Envisioning a warmer, tangier, and juicier profile, the grilled chicken seamlessly melded with the salad, contributing a delightful contrast to the crispness of the vegetables. Personally, I find that grilled chicken surpasses its cold or baked/fried counterparts, providing a richer and more robust flavor profile.

In terms of key ingredients, I believe the lettuce, chicken, black olives and red bell peppers forms the foundation of this particular salad creation. The synergy of these components imparts a satisfying and wholesome character to the salad, making it a truly fulfilling meal. Examining the physical transformations during the grilling process offers insights into the culinary alchemy at play. Prior to grilling, the chicken exhibits a soft and moist texture. As it undergoes the cooking process, the proteins in the chicken undergo changes, resulting in a firmer consistency.

The Maillard reaction, a pivotal chemical reaction between amino acids and reducing sugars in the presence of heat, contributes to the browning of the chicken's surface, lending it the characteristic golden-brown hue. Additionally, the grilling process causes the chicken to lose moisture through evaporation, leading to a reduction in size and weight.

Delving into the chemical changes, the Maillard reaction emerges as a critical player, enhancing both the flavor and aroma of the dish. The high temperatures during grilling induce the evaporation of water content in the chicken, a dual physical and chemical change that influences the overall juiciness and tenderness of the meat. In terms of the method of heat transfer, I opted for the stove-top burner, utilizing a non-stick Teflon pan for its ease of cleanup. The cooking ensemble included a rubber spatula for flipping the chicken, my hands for delicately shredding the chicken, a metal fork for eating, and a white glass plate for the final presentation.

This culinary exploration not only broadened my understanding of the intricate transformations occurring during the cooking process but also reaffirmed the joy derived from crafting a personalized, flavorful dish. The "Vegetarian Italian Chopped Salad" recipe from Cookie and Kate, with its adaptable nature, continues to be a staple in my cooking, offering a delightful canvas for culinary experimentation.

# Salmon Bowl

Submitted by: Gabriel Flocco

## Recipe:

- 1) Thaw one Alaska Keta Salmon filet in the fridge for 8 hours
- 2) To a cold frying pan heat 2 tablespoons of olive oil for 2 minutes
- 3) During the heating process, measuring out into two small containers
  - a) 1 tablespoon of ground paprika ( $\frac{1}{2}$  into each bowl)
  - b) 1 tablespoon of garlic powder ( $\frac{1}{2}$  into each bowl)
  - c) 1 tablespoon of onion powder ( $\frac{1}{2}$  into each bowl)
  - d) 1 tablespoon of salt ( $\frac{1}{2}$  into each bowl)
  - e) 1 tablespoon of black pepper ( $\frac{1}{2}$  into each bowl)
- 4) Measure out 1 cup of water and pour into a saucepan
- 5) Heat the saucepan on high until water is boiling
- 6) Once boiled, pour 1 cup of rice into the water and remove from heat
- 7) Cover saucepan with a lid and move to the side
- 8) Once the oil in the pan is heated, place the skinned filet into the pan
- 9) Cook the first side for 3 minutes and then flip
- 10) Cook the other side for 3 minutes
- 11) Continue this process until the filet has been heated for 15 minutes
- 12) Once the salmon is fully cooked, remove from heat
- 13) Spoon the rice into a bowl
- 14) Shred the salmon and place on top of the rice
- 15) Cut one half of an avocado into squares and place on top of the salmon
- 16) Garnish the bowl with soy sauce, kewpie mayonnaise, and yum yum sauce
- 17) Finish off with sesame seeds

## Reflection:

For my final project I did a Salmon Bowl recipe. This recipe is one that my girlfriend uses all the time and I thought it would be pretty good to use. Basically what the Salmon Bowl consists of is chopped up salmon, rice, avocado, soy sauce, kewpie mayonnaise and yum yum sauce. Before I had met her I had no idea how good of a mixture that all would be. For the proposed significant change I fried the rice with eggs and hoisin sauce instead of leaving it as plain white rice and changed the soy sauce to hoisin sauce. My hypothesis was pretty basic but it was that it would have a different look to it and it might taste better but of course that depends on who is eating it. I'd say the three key ingredients were the rice, salmon and avocado. For the method of cooking I did decide to throw the salmon in the oven to save space on the stove for everything else but everything else was cooked in a pot or pan. I think overall everything came out very good and it did meet my hypothesis and expectations.



# SWEET TREATS

## Walnut Kiefies (kifli, kiflie, kolacky, kolache, etc)

Submitted by: Liz Anderson

### Ingredients

Dough:

- 1 ½ cups flour
- 1 stick unsalted butter
- 3 med egg yolks
- ¼ cup sour cream

Filling:

- 3 med egg whites
- 1 ½ cups sugar
- 1 ½ cups walnuts (ground or finely chopped)

Coating: 2 cups powdered sugar

Makes ~24

### Recipe

Dough:

1. Prepare dry ingredients: Using a food processor or a pastry blender, blend the butter into the flour, creating a coarse, crumb-like consistency (you can also just use your hands if you soften and cut up the butter).
2. Prepare wet ingredients: Mix the egg yolks and sour cream in a large bowl.
3. Make the dough: Add the flour mixture to the egg mixture. Blend and knead lightly until the consistency is like a pie dough. Shape into small, walnut-sized balls (I made 4), cover (I put them in saran wrap), and refrigerate for at least an hour or up to a day (I ended up doing ~18 but it will make it a little harder to separate into 24 pieces by hand, I'd recommend a butter knife to make that easier).

Filling (make before you're ready to assemble so don't do it right away if you're letting it chill overnight if that makes sense):

1. While the dough is in the fridge, beat egg whites until fluffy (can be done by hand, but I highly recommend using a mixer if you have one). Add 1/3 of the sugar at a time and beat until well blended and the mixture is stiff. \*Add in lemon zest or vanilla here!
2. Gently fold in ground nuts.

Assemble:

1. Coat the dough balls: Whisk together two tbsp of all-purpose flour and two tbsp of sugar in a medium bowl. Take half the dough balls out and roll them in the flour-sugar mixture (I broke them into little balls first and then coated each one – 12, then 12). Keep the other half chilled (It's not the

end of the world if you don't, they just may get nearing too soft to mold depending how long it takes from fridge to shaped on cookie sheet).

2. Roll the dough: Roll the coated dough balls out on a small amount of the flour-sugar mixture into a thin circle.

3. Fill the dough: Place a heaping teaspoon of filling onto each dough circle and roll it up into a crescent shape (it will look like too little – it's not! The filling really spreads). Pinch the ends tightly – place seam-side down on a parchment-lined or greased cookie sheet (my family does a more wrapped shape as seen in the photo but either work!).

4. Repeat with all the dough balls

5. Bake the cookies: Bake kiefliies in an oven at 350 F for 12 to 15 minutes. Cool slightly.

6. Coat the cookies: Roll the warm cookies in a bowl of powdered sugar and you're done.

Notes: You can store them in a Tupperware for around 7 days in a cool/room temperature place.

They can be frozen (don't add the powdered sugar) and then when you want to eat them let them thaw until room temperature before putting on some powdered sugar.

Reflection:

Kiefliies are a traditional Polish "cookie" that my extended family usually has at Christmas as well as other major holidays. Most of my extended family settled down near South Bend, Indiana and mostly all the kiefliie recipes I know are from Indiana. The one I found online to base my project on was even originally from a local South Bend newspaper – The South Bend tribune (<https://www.all-thats-jas.com/polish-walnut-kiflies/>). That being said, I also found some recipes in my grandma's old cookbooks, and one of those recipes utilizes yeast in the dough. I found that sort of odd since the dough for kiefliies doesn't need to rise at all, so I was curious to see what difference, if at all, it made. After completing the two batches, the addition of yeast didn't seem to do much. I think it made the dough a bit more flakey but at the cost of the filling more frequently bursting through the sides of the dough despite me rolling them the same. So, it's up for debate about whether you think the additional flakey-ness to the dough is worth the filling being properly encased in the wrap... for me it's not worth it and I'm usually not expectant of my kitchen having yeast so I prefer the non-yeast recipe.

Following the linked recipe, there were a couple materials that not every kitchen may have such as a mixer, a food processor, a wooden roller, and a metallic cookie sheet (plus parchment paper!). I got away with not having a food processor since it is fairly easy to cream butter into flour with just your hands if it's softened and cut up. Whipping the egg whites with just a metal whisk is doable but not something I wish upon any person provided a mixer is available to you, so I highly recommend having one or being mentally prepared for an intensive 10 minutes on your arms. The beating of the egg whites is one of many physical changes in the preparation process as it converts the consistency of the egg whites from a sort of viscous liquid that is pale-yellow/clear to a whipped cream-like solid that is white and fluffy. Another physical change is the sugar dissolving into the whipped egg whites upon mixing. A chemical change that happened in the yeast recipe was the formation of gluten when the flour and the water were mixed. The kiefliies of both recipes underwent Maillard reactions due to the sugars and amino acids in the dough resulting in browning (albeit they don't get that dark – like maybe a shade darker than the raw dough). To allow for Maillard reactions though it also requires heat. The type of heat transfer is mechanical convection since an outside force is circulating the heat, in this case, the oven fan. The three ingredients that were in both recipes were egg yolks, sour cream, and butter. All three are high in fat content. The

egg yolks also contain iron, vitamins, thiamin, and lecithin (makes it an emulsifier for the older yeast recipe) which adds structure to the dough. The sour cream makes the dough moister and richer as well as aiding in making the dough easy to mold and shape. The butter adds flavor and allows the dough to spread when baked.

Overall, both dough recipes were easy to follow and did work out, but I preferred the no yeast dough as it was easier to work with (felt more like play-doh while the yeast dough still sort of stuck to you even after the chilling process) and the filling was less likely to break through the sides of the kieflye. They both taste pretty similar to me as they have the same filling so it's really up to preference on the dough!

# Pioneer Brownies

Submitted by: Samantha Grubel

## Ingredients:

2 cups (400g) granulated sugar  
½ cup of butter, melted  
2 large eggs  
4oz unsweetened chocolate, melted  
2 tsp vanilla.  
1 cup all-purpose flour  
1 cup chopped walnuts (excluded due to nut allergy)

## Method:

Preheat oven to 325°F.

Fashion a parchment paper sling within a 9x13-inch pan, greasing the exposed two sides of the pan.

Beat together sugar and butter.

Using a whisk add the eggs one at a time beating smooth after each addition.

Whisk in the chocolate followed by the vanilla.

Fold in the flour and then fold in the walnuts.

Turn into the parchment-lined pan and bake for 25-30 minutes.

Allow the brownies to cool completely in the pan then remove the brownies by grasping the sides of the parchment sling. Cut into bars.

## Reflection:

I chose this recipe because I personally love brownies and I received a cookbook called *“Baking Yesteryear: the best recipes from the 1900s to the 1980s”* by Dylan Hollis, for my birthday that is filled with recipes from the 1900’s to the 1980’s. The recipe I chose was called Pioneer Brownies (however I don’t believe that’s their official name). On the page of each recipe the author provides some background information on the recipe. On the page with the pioneer brownies recipe (page 40) it tells you “the first recipe marrying “brownie” unto the chocolate cakey bar with which we are familiar occurred in early 1900’s. For this we have one Fannie Merritt Farmer to thank.” (Hollis) The author continues to explain that Fannie is an American cooking instructor and pioneer of domestic science, nutrition and level measurements during the late 19<sup>th</sup> and early 20<sup>th</sup> centuries. The recipe in this book labeled as Pioneer Brownies “is arguably the first brownie (with crinkly skin included)” (Hollis).

The change I made in this recipe was to completely remove the sugar, I decided not to use a sugar substitute and instead remove the sugar entirely. Whenever I would tell someone my plan of removing the sugar their immediate response was to ask if I was substituting it for something else, of course I’d tell them no and instantly the look on their face was as if I’d just told them that I had murdered an entire litter of puppies. With the knowledge that I’ve acquired from this course of how sugar affects baking and the chemistry behind the process of baking, I knew that these entirely sugar free (with no sugar alternative) brownies were most definitely NOT going to taste good nor will they likely be edible. When I got home from campus on Wednesday night, I went right to do this project, I made a batch using the original recipe first then a second batch without sugar. The

most surprising part of this entire process was the texture and thickness of the batter for both batches, my mom often makes brownies using the Ghirardelli Triple Chocolate Brownie mix and when she does the batter is a liquid/gooey consistency while the batter for the pioneer brownies were more of a fudge like consistency which was strange to me. Once both batches of brownies were done baking, I found myself laughing at the obvious differences between the two. The first difference was in appearance, the original recipe was a light brown color with a flakey top while the second batch was a dark brown color. The second difference was the density, the original batch came out with a cake-like texture, they were about an inch thick while the second batch were practically flat and crumbled instantly in your hand. The last key and drastic difference was in the taste, while the first batch were more moist and sweet from the sugar, the second batch was extremely dry and tasted as though you were eating dirt or chalk (depending on which you think tastes more dry and gross), the moment I tried a piece of the sugar free ones it was as though my tongue, throat and tastebuds were screaming for water, while the original batch was yummy and had the perfect brownie taste. All-in-all I preferred the original recipe over the changed one because the original tasted very good but most importantly it was actually edible while the sugar free ones were not.

Three key ingredients, their molecular properties and function in the recipe are Sugar, Eggs, and Flour. Sugar's molecular properties are sucrose, hydroxide, and water soluble. Its function is to provide oxygen for Maillard reactions as well as sweetness, texture improvement, caramelization, Maillard reactions, moisture retention and preservation. Another key ingredient is Eggs, their molecular properties are a protein. Eggs function as an emulsifier to bind the dry ingredients with the butter. Additionally, eggs also provide structure and flavor to the brownies. Lastly the third key ingredient is the All-purpose flour. Its molecular properties are protein (gluten), Starch, and amylase enzymes. The function of all purpose flour in this recipe is to help provide structure, texture, assist in binding the ingredients and provides moisture control.

One physical change that occurred during the preparation process was the melting of ingredients. Before I could mix the sugar with the butter, I first had to melt the butter. Additionally, I had to melt the 4oz bar of unsweetened chocolate before whisking it into the butter, sugar, and eggs mixture. A chemical change that occurred during the process was the caramelization of sugar. When baking brownies the process of caramelization occurs as sugar undergoes a complex chemical transformation under heat. As the brownie batter heats in the oven, the sugar molecules begin to break down due to the heat, leading to a series of chemical reactions. Initially, sucrose hydrolyzes into its component sugars, glucose, and fructose. As the temperature continues to rise, these sugars undergo further transformations, ultimately undergoing caramelization. During caramelization, the sugars undergo a thermal decomposition, resulting in the formation of new compounds with a characteristic brown color and a rich, complex flavor that enhances the taste and texture of the brownies.

The method of heat transfer used was a combination of convection and conduction. Convection is the transfer of heat through the movement of a fluid—in this case, air. When brownie batter is placed in the oven, the heat generated by the oven's heating element or gas flame warms the air inside. The warm air then circulates around the brownie batter, transferring heat to the batter's surface and causing it to cook. Conduction also plays a role as the heat is conducted from the hot air to the brownie mixture, ensuring that the entire volume of the batter is evenly heated.

# Triple Chocolate Layer Cake

Submitted by: Jillian Blackburn

1 and 3/4 cups (219g) all-purpose flour (spooned & leveled)  
3/4 cup (62g) unsweetened natural cocoa powder  
1 and 3/4 cups (350g) granulated sugar  
2 teaspoons baking soda  
1 teaspoon baking powder  
1 teaspoon salt  
2 teaspoons espresso powder (optional)  
1/2 cup (120ml) vegetable oil (or canola oil or melted coconut oil)  
2 large eggs, at room temperature  
2 teaspoons pure vanilla extract  
1 cup (240ml) buttermilk, at room temperature  
1 cup (240ml) freshly brewed strong hot coffee (regular or decaf)

## Instructions:

Preheat oven to 350°F (177°C). Grease two 9-inch cake pans, line with parchment paper rounds, then grease the parchment paper. Parchment paper helps the cakes seamlessly release from the pans. (If it's helpful, see this parchment paper rounds for cakes video & post.)

Make the cake: Whisk the flour, cocoa powder, sugar, baking soda, baking powder, salt, and espresso powder (if using) together in a large bowl. Set aside. Using a handheld or stand mixer fitted with a whisk attachment (or you can use a whisk) mix the oil, eggs, and vanilla together on medium-high speed until combined. Add the buttermilk and mix until combined. Pour the wet ingredients into the dry ingredients, add the hot water/coffee, and whisk or beat on low speed until the batter is completely combined. The batter is thin.

Divide batter evenly between pans. Bake for 23-26 minutes or until a toothpick inserted in the center comes out clean. Baking times vary, so keep an eye on yours. The cakes are done when a toothpick inserted in the center comes out clean. (Note: Even if they're completely done, the cooled cakes may \*slightly\* sink in the center. Cocoa powder is simply not as structurally strong as all-purpose flour and can't hold up to all the moisture necessary to make a moist-tasting chocolate cake. It's normal!) Remove the cakes from the oven and set on a wire rack. Allow to cool completely in the pan. From: <https://sallysbakingaddiction.com/triple-chocolate-layer-cake/#tasty-recipes-68103>

I halved this recipe, making it in two separate bowls, rather than making two whole cakes. I used regular all-purpose flour in the first bowl and followed the above recipe. In the second, I used Bob's Red Mill Gluten-Free All-Purpose Baking Flour instead. I debated how I was going to provide the structure, considering using an extra egg, beating the batter for a longer amount of time, or even using flax or chia seeds, but eventually decided to go with the simple route and use xanthan gum. The package provided instructions for how much to put in; for cakes, it was 1/2 a teaspoon per cup of flour. Considering I split the recipe, it was just under a cup of flour for each half, so I just went ahead with the 1/2 teaspoon. Otherwise, I followed the directions the same. The batter for the

gluten-free cake was more clumpy than the regular batter, and just generally more sticky. It also took longer to mix than the regular batter.

Of course, I tasted the batter for each, as I was curious, and that's just what you do when cleaning baking dishes. The "normal" cake tasted pretty much like cake batter, nothing special. For the gluten-free cake, however, it had a slightly more bitter taste to it. I'd assume that has to do with using the xanthan gum, as I'm not sure how the gluten-free flour would have the same effect. Because of this though, I was worried the cake itself might be bitter, but decided to just bake it and see how it went.

As for the cakes themselves, the gluten-free cake (left in the pictures) sunk a little in the middle. The recipe did talk about this, and warned that for this particular recipe, that might happen and it was okay, but the regular cake didn't sink at all. Honestly, this very well could have been due to the dishes that I baked the cakes in. We didn't have two of the same small pans, and since I had split the recipe, the batter wasn't going to fit into a larger pan unless I wanted a very thin layer of cake. Instead, I decided to split the regular cake into two smaller glass dishes and bake them that way, which could have provided a little more structure and made sure the cake didn't sink.

Overall, the gluten-free cake was slightly gooey, rather than the fluffiness provided by the regular cake. You can see in the images that the regular cake had quite a few crumbs breaking off, all of which were light, but the gluten-free cake "crumbs" had to be scraped off the knife I used to cut the cake, and sort of clumped together into a blob. Both cakes tasted about the same, however, and there really didn't seem to be much difference, other than the slight texture changes. Both cakes turned out well, and all my roommates liked them, so I'd honestly call both cakes a success!

# Cheesecake Lemon Cookies with Lemon Glaze

Submitted by: Lindsey Husband

## Recipe

### Cookies:

½ cup unsalted butter  
¼ cup cream cheese, softened (brick-style, not 'spreadable')  
1 large egg  
1 cup granulated sugar  
1 tbsp lemon extract  
1 tbsp lemon zest  
2 cups all purpose flour  
2 tsp cornstarch  
1 tsp baking soda  
½ tsp salt

### Lemon Glaze:

1 cup confectioners' sugar  
2-3 tbsp lemon juice, or  
as necessary for consistency  
Lemon zest, for garnish

## Reflection

I had never made two batches of cookies at once before, so it took a lot longer than I was expecting. I do not bake often, so it was nice having this experience with my new chemistry knowledge. The cornstarch cookies were taller and darker while the non-cornstarch cookies spread more and were lighter. My hypothesis was correct that the cookies without cornstarch would spread more and be flatter. I thought my lemon cheesecake cookies tasted delicious, so this was a very nice and gratifying way to end the semester.



# Pound Cake

Submitted by: Madison Pennycoff

## Ingredients

- 1 ½ cups cake flour
- ¼ teaspoon baking powder
- ¼ teaspoon salt
- ¾ cups unsalted butter (room temperature), (3 sticks)
- 1 ½ cups granulated cane sugar
- 2 ½ large eggs, room temperature
- ¾ cup whole milk, room temperature
- ½ tablespoon pure vanilla extract
- ⅛ teaspoon pure lemon extract
- ⅛ teaspoon pure coconut extract (optional but yum)
- \*Shortening (for greasing the pan)

## Instructions

1. Preheat oven to 325 F. Grease a 10-cup bundt cake pan with a thin layer of shortening (I use butter-flavored shortening for this. It gives the crust a nice golden crunch and buttery flavor) and then very lightly coat it with flour. Set aside. (If using loaf pans use two 9.5 loaf pans) Set aside.
2. In a large bowl add flour, baking powder, and salt. Whisk together well to make sure all of the dry ingredients are combined. Set aside.
3. In another large bowl, cream together butter until creamy.
4. Gradually add sugar while mixing at low speed. Mix for about 3 minutes until creamy and combined. (set timer).
5. Mix in eggs one or two at a time, just until combined. Keep your mixture on low speed and do not overmix.
6. Mix dry ingredients into wet ingredients alternating with milk. Start and end with dry ingredients. Mix until batter is combined and fluffy. Keep the mixer on low speed. Be sure to scrape down the sides of the bowl regularly.
7. Stir in the vanilla extract, lemon extract, and coconut extract if using.
8. Spoon batter evenly into prepared bundt pan. Shake and tap the pan on the counter to even out the batter and release any air pockets.
9. Place on the middle rack and bake for 1 hour and 10-20 minutes (check on it at the 70-minute mark) or until a cake tester or toothpick inserted into the pound cake comes out clean. (Ovens vary and you may need to add a few more minutes) To be on the safe side, I peel up a piece of the cake to make sure it's done. Since this is the bottom of the cake nobody will see it.
10. Place pan on a cooling rack until it is cool enough to touch but still warm.
11. Carefully remove the cake from the pan and place it on a wire rack to cool.
12. Slice the cooled cake and serve. \*Remember pound cake is one of those desserts that gets even better the next day.

**Reflection:**

I decided to bake pound cake because I haven't had one in years. The last time I remember having homemade pound cake was when I was in middle school at my grandparent's house. I was hungry for pound cake, so I decided "why not?"

Pound cake is a simple recipe, "a pound of sugar, a pound of flour, a pound of butter and a pound of eggs." It's more than that, but that's the general gist of it. I decided to change what type of flour I wanted to use because I wanted to actually enjoy having two pound cakes rather than going through the trouble of baking a second cake that I'd have to throw out because it turned out wrong or inedible. I found the recipe after looking for a simple pound cake recipe and decided I'd half the recipe. This was because we don't have a very big bunt pan and having two large pound cakes would feel like way too much cake for four people to eat.

I decided to change the all-purpose flour used in the original recipe, switching it out with cake flour. My theory was that the cake flour would make the cake softer in texture. I know this will happen because cake flour has a lower percentage of protein (5-8%.) This means that the cake will be softer. All-purpose flour, in contrast to cake flour, has a higher percentage of protein (8-10%.) This means that the cake baked with cake flour will have a weaker gluten network and the cake will be softer, while the cake baked with all-purpose flour will end up having a stronger gluten network.

The real stars of the recipe were the flour, baking powder, and eggs. The flour is where the gluten is in the recipe. When combined with a liquid the flour will create a gluten network. Depending on the type of flour used, the network will be stronger or weaker. The baking powder creates pockets of air that help in giving the cake its light and airy texture. The eggs help to reinforce the structure of the batter, as well as stabilize it. The eggs also provide moisture to the cake. Another ingredient I would like to highlight is the lemon extract. Although it is the ingredient that is used in the smallest quantity, it really does enhance the flavor of the cake.

A physical change that occurred during the baking process was when I had to crack the eggs into the bowl of wet ingredients. A chemical change that occurred would be the baking of the cake batter. The main heat transfer was conduction. The metal bunt pan conducts heat while in the oven and cooks the cake batter. The metal bunt pan was used because I knew it wouldn't be hazardous to bake with, and the metal would conduct heat, which is a requirement for the baking process. I also used a rubber whisk when combining the extracts to the ingredients because it would be easier to clean later. I also used a rubber spoon/spatula to scoop the batter into the bunt pan for the very same reason.

# Chocolate Chip Cookies

Submitted by: Annie Morris

## Recipe:

1 cup unsalted butter

0.5 cups sugar

0.5 cups packed brown sugar

2 eggs (substitute for 1 egg: 1 tsp baking powder, 1 tbsp water, and 1 tbsp oil mixed in a separate bowl before adding)

1 tsp baking soda

1 tsp salt

1 tsp vanilla

2 cups all-purpose flour

1.5 cups milk chocolate chips

Preheat oven to 375°F. In a stand mixer, cream together butter, sugars, eggs or egg substitute, baking soda, salt, and vanilla. Mix in flour until dough is smooth. Add in chocolate chips and mix on low until evenly distributed. Using a small ice cream or cookie scooper, place dough on a metal cookie sheet about two inches apart. Bake for 15 minutes or until the edges are golden brown.

## Reflection:

One of my family's favorite treats to make is chocolate chip cookies. After my mother and I tried many different recipes from cookbooks and websites, we settled on the one I have detailed above. This recipe was found on the back of a bag of Baker's Corner Semisweet Chocolate Chips a few years ago, and I have had it saved on my phone since. When I first started baking, I was allergic to eggs, so in every baked treat my mom and I made, we had to use an egg substitute recipe she got from a friend that included baking powder, oil, and water. Because I have made so many cookies with and without eggs, I wanted to do a direct comparison of the two recipes. I hypothesized that the cookies made without eggs would produce more crumbs and have a crispier texture than those with eggs.

In most cookie recipes, eggs are a crucial ingredient. They provide polar ingredients like water and proteins, including ovalbumin, to the cookie dough. These proteins bind with the proteins in flour to create a solid cookie. Emulsifiers like lecithin are amphiphilic and help the hydrophobic and hydrophilic ingredients interact by attracting both as they break into small particles while the dough is mixing. Without eggs, the cookies will likely fall apart since they lack extra structure from the egg and wheat proteins binding.

Wheat flour is another important ingredient in making delicious cookies. The main function of flour is to provide structure to the dough. The gliadin and glutenin proteins found within flour contain thiol residues that will be oxidized in the presence of water from the eggs and create disulfide bonds. This makes a gluten mesh that will hold the cookies together during the baking process. Two other molecules, amylose and amylopectin, are polymers of glucose that make up starch and contain reducing sugars at their ends. The amine ends of gluten can react with starch and sugar in Maillard reactions to form a molecular complex that will break down into umami flavor molecules, giving these cookies a rich and savory taste.

Another ingredient that helps to shape the structure of chocolate chip cookies is baking soda. This is the main leavening agent that makes the cookies light in texture. Sodium bicarbonate in baking soda is a base that will react in a neutralization reaction when heated and mixed with acidic brown sugar. It will release  $\text{OH}^-$  into the dough, which gives it the properties of a base. After reacting, sodium carbonate, water, and  $\text{CO}_2$  will remain.  $\text{CO}_2$  will create air pockets in the dough, along with evaporated water, and this makes the cookies puff up.

To initiate some of the chemical reactions that occur while making cookies, you need heat. When placed in the oven, the cookie dough is heated by two methods. The first includes convection, where the fan in the oven will move hot air around the cookie dough to transfer the heat. The second is conduction, and this method utilizes a metal baking sheet that will get heated by the oven air and then transfer that heat by direct contact to the bottom of the cookies. These two processes start the Maillard and some of the neutralization reactions that give cookies their golden color and light texture. They will also create physical changes in the cookies, which include melting the butter to spread the dough flat and evaporating water to create air pockets in the dough to help leaven it.

After my family and I did a blind taste test of both chocolate chip cookie recipes, we could not tell the difference between them based on taste alone. All of us noticed that the cookies without eggs crumbled faster while we were eating them, which supports my hypothesis. Another noticeable difference between the two recipes is the texture. The egg-free cookies were rougher on the tops and thinner, while the cookies with eggs were softer, smoother, and thicker. I preferred the egg-free cookies best because they were thinner and crispier, which is my favorite type of chocolate chip cookie. Although both recipes were delicious, I like eating cookie dough, and the egg-free recipe ensures I can eat this without getting sick from raw eggs. Overall, this experiment did support my hypothesis, and resulted in a delicious treat to share with my family!

# Brownies

Submitted by: Avery York

## Recipe:

1 cup 8oz/240g unsalted butter, melted and cooled  
2 tablespoons (30ml) vegetable oil  
1 ¼ cups (9oz/260g) white sugar  
1 cup (7oz/200g) packed light brown sugar  
4 (2oz/57g each) large eggs, at room temperature  
1 tablespoon (15ml) pure vanilla extract  
¾ teaspoon salt  
1 cup (3.5oz/130g) all purpose flour  
1 cup (3.5oz/100g) good quality, unsweetened cocoa powder  
7 oz (200g) roughly chopped chocolate or large chocolate chips

1. Preheat oven to 175C/350F
2. Lightly grease an 8x12-inch baking pan with cooking oil spray. Line with parchment paper set aside.
3. Combine melted butter, oil and sugars together in a medium-sized bowl. Whisk well to combine. Add the eggs and vanilla; beat until lighter in color
4. Sift in flour, cocoa powder and salt. Gently fold the dry ingredients into the wet ingredients until just combined.
5. Fold in ¾ of the chocolate pieces.
6. Pour batter into prepared pan, smoothing the top out evenly, and top with remaining chocolate pieces.
7. Bake for 25-30 minutes for just under-done brownies.

## Reflection:

I really enjoy baking and have a big, sweet tooth so I wanted to make brownies for this final project. I remembered how in the past one of my friends' made brownies but realized in the middle of it that they did not have any butter, so they googled if there was anything they could add in as a replacement and discovered that they could use bananas. I found this interesting and wanted to try it. I went online and found this recipe for the brownies without the banana.

<https://cafedelites.com/worlds-best-fudgiest-brownies/>

After making the brownies I found a few differences between the ones made with bananas and the ones made with butter. The first difference was a visual one, I noticed that the brownies made with bananas were a bit more raised than the ones made with butter. This proved my hypothesis wrong as I thought they would not rise as much due to it not being butter as I thought the reaction during leavening would not be as big. The second difference I noticed was in flavor. The brownies made with bananas had not only a chocolate taste but a very present banana taste too them. I found this difference enjoyable, and I actually preferred the ones without the bananas a little bit more, but my roommates enjoyed the ones made with banana more so than the ones without. So, I believe from my knowledge learned from this class that the egg emulsified the oil with the banana to create structure in the absence of the butter. This was due to there being water within the banana, this was an example of chemical change as it was being emulsified. One

physical change observed during this project was the vanilla and oil originally being in liquid states were converted to a solid as the brownies rose and solidified. The sugar in the recipe not only created a more present sweetness to the brownies but also stabilized the brownies as it acted as a bond with the water which allowed the sugar to lock in moisture to help create that texture for the brownies and not cause them to be dry. The type of heat transfer used during this project was convection. I know this because the brownies were being heated in the oven by currents of moving gas.

# Chocolate Chip Cookies

Submitted by: Juliette Fonte

## Recipe:

1 cup unsalted butter  
0.5 cups sugar  
0.5 cups packed brown sugar  
2 eggs  
1 tsp baking soda  
1 tsp salt  
1 tsp vanilla  
2 cups flour  
1.5 cups chocolate chips

## Recipe of change:

1 cup unsalted butter  
0.5 cups sugar  
0.5 cups packed brown sugar  
0.5 cups of milk  
1 tsp baking soda  
1 tsp salt  
1 tsp vanilla  
2 cups flour  
1.5 cups chocolate chips

## Reflection:

There perhaps might not be a specific reason I choose to do chocolate chip cookies. However, if I had to think as to why I might have chosen this as my recipe to make is because chocolate chip cookies are famous all over the world however it still is a recipe some can't tackle to make the best and most wonderful chocolate chip cookies.

The chemistry of chocolate chip cookies is a fascinating interaction of ingredients and reactions that transform basic components into the special sweet treats we all know and love. The basic ingredients are flour, butter, and sugar, and the most famous and special touch on these cookies is chocolate chips. They compact together to create wonderful textures and flavors. Flour is a primary ingredient, that provides a structure through its proteins, gluten, and gladden, forming a web that gives these cookies their texture. The leavening agents are typically baking soda or baking powder these generate carbon dioxide gas during baking time, creating the cookies' distinct purpose. The type and amount of sugar impact sweetness, but they also contribute to the cookies' texture and color. Brown sugar adds its sweetness content and adds moisture and a chewy texture to the cookie. Butter is an essential component, that not only provides flavor but also contributes to the cookies' tenderness. The fat in butter helps to create a soft and moist crumb while aiding in the browning process through Maillard reactions, enhancing the cookies' flavor profile. The show's star is of course chocolate chips, experiencing a lovely transformation as they melt during baking, creating gooey pockets of melted chocolate that sweeten the overall sensory experience. The Maillard reactions between the sugars and proteins in the dough contribute to the cookies' golden-

brown color and complex flavor. Understanding these chemical interactions allows bakers to experiment with ratios and ingredients. The chemistry to achieve the perfect chocolate chip cookie is to have an airy balance of crispiness, chewiness, and flavor to these cookies. I had two recipes and in one of them, I substituted two eggs for 0.5 cups of milk. I had thought that the egg recipe would be my favorite cookie taste of flavor and texture.

However, I enjoyed the milk ones instead. I enjoyed the enhanced flavor that was coming from this cookie. The flavor was fantastic and the texture was very chewy. Within these two recipes, I expected the milk ones to come out more chewy and not as solid since I had added milk to the recipe which gave more liquid within the recipe, and while mixing all of the ingredients you could tell there was more liquid in one than the other. The supplies I had used for this recipe was a plastic bowl which I used two of so I could separately divide my ingredients. I also used 2 metal spoons and a metal whisk to equally disturb my ingredients. I used a metal pan and parchment paper for the cookies to go into the oven. Overall, this was a great experience to see how flavor and texture can change by changing one ingredient.



# Lemon Blueberry Cupcakes

Submitted by: Holly Burd

## Original recipe:

### Cupcake:

- 1 1/8 cups cake flour
- 1 teaspoons baking powder
- 1/4 teaspoon fine grain sea salt
- 3/4 cups buttermilk, room temperature
- 1/2 teaspoon pure vanilla extract
- 1/2 teaspoon pure lemon extract
- 3/4 cups sugar
- lemon zest from one lemon
- 6 tablespoons unsalted butter, room temperature
- 2 large egg whites, room temperature
- Frosting:
- 2 sticks unsalted butter, softened
- 1 pound confectioners' sugar, sifted
- pinch of fine grain sea salt
- 1 teaspoon vanilla extract
- zest of half lemon (finely grated)
- 1/4 cup fresh blueberries, pureed with 1 tablespoon fresh lemon juice

## Butter substitute (butter) recipe:

### Cupcake:

- 1 1/8 cups cake flour
- 1 teaspoons baking powder
- 1/4 teaspoon fine grain sea salt
- 3/4 cups buttermilk, room temperature
- 1/2 teaspoon pure vanilla extract
- 1/2 teaspoon pure lemon extract
- 3/4 cups sugar
- lemon zest from one lemon
- 3/4 cup of smashed banana
- 2 large egg whites, room temperature
- Frosting:
- 1 cup smashed banana
- 1 pound confectioners' sugar, sifted
- pinch of fine grain sea salt
- 1 teaspoon vanilla extract
- zest of half lemon (finely grated)
- 1/4 cup fresh blueberries, pureed with 1 tablespoon fresh lemon juice

## Reflection:

For the chemistry final project, I chose to bake lemon blueberry cupcakes. I found the recipe on *MyBakingAddition.com*. I chose this recipe because I love to bake, and I love citrus/fruity flavors. Therefore, the lemon blueberry cupcakes were perfect for this project. Upon reading the recipe I found a lot of key ingredients that I felt would make for great substitution. I decided to substitute the unsalted butter with bananas. I predicted the bananas to give the cupcakes a sweeter flavor and a denser texture. After making the two recipes, I can say that my predictions were correct. While making the original recipe there were a lot of different steps involving fluffing the mixtures. I needed to combine the sugar and butter until light and fluffy. I needed to combine the butter milk and flour until light and fluffy. These instructions gave the cupcakes a lighter and fluffier texture. This occurred with the frosting as well. On the other hand, the butter substitute recipe came out denser. In the top left picture above, I included a picture of the baked cupcakes with bananas. I noticed that the cupcakes did not rise as much as the original ones and the batter had air pockets in it. This is where the bananas played a key role in the texture of the cake and frosting. The frosting was very runny due to me not being able to froth the mixture. With that being said, I personally prefer the original version better. I like that the textures were lighter and less dense. As far as the taste goes, I think the bananas drew away the lemon and blueberry flavor. These two flavors are what made me pick the recipe, therefore I did not like that I could not taste them as much with the bananas.

There were a lot of key ingredients in the lemon blueberry cupcakes. First, the butter played a key role. It gives richness and tenderness to the cake and gives a smoother/lighter texture to the frosting. Butter is 80% buttermilk and 15% water. It is a mixture of Triglycerides. This mixture gives the recipe a fat component. The next key ingredient is flour. A starch and protein that is a heterogeneous mixture. The proteins interact with one another and form gluten. It builds structure in the cupcakes. Last but not least, eggs play a key role in the recipe. They contain lipids and proteins. These are emulsifier that bonds with the water and fat molecules within the milk to create structure. All of these three ingredients are key on the texture of the cake and frosting. It is interesting that when I substituted a key ingredient, the texture turned out a lot different and was needing the butter to help with the structure.

Much like anything else in the kitchen, these cupcakes underwent physical and chemical changes. A big physical change that occurred was the rising of the batter throughout the baking process. The heat from the oven caused the baking powder to react with the other ingredients and caused the cake to rise. As for a chemical change, the proteins in the eggs unfolded as they were heated, and the cake became firm. The cupcake mix went from a liquid to a solid. This chemical change effected a physical change. As they go hand in hand with one another.

To bake my cupcakes, I used a convection oven which uses convection heat transfer. For the utensils I used plastic mixing bowls, a stainless-steel whisk, rubber spatulas, stainless steel hand mixer, Teflon – coated aluminum cupcake pan, paper cupcake wrappers, and a plastic icing bag.

# Bapple Bread (Banana Apple Bread)

Submitted by: Victoria Stief

## Recipe:

1 c. sugar  
3 large bananas, mashed  
½ c. applesauce  
1 ½ c. flour  
1 egg

## Reflection:

This recipe was very fun to change and recreate. I chose this recipe of banana bread specifically because it is the one my family uses every time we make banana bread. It is from a church cookbook of many other recipes compiled together from my congregation. It is different from most banana breads. Instead of a cake-like texture, it has a denser texture. There is nothing I know how to compare it to, other than it is not cake-like.

Instead of using butter, for this recipe my proposed change was to use applesauce instead of the butter. The original recipe calls for ½ cup of butter, or 1 stick. I used the same amount of applesauce, which was ½ cup as well. My hypothesis was that the bread would turn out moister than with the original recipe. I also hypothesized that there would be a more distinct apple flavor aside from the obvious banana flavor. The results were exactly as expected. The bread was only a tad less dense, but it had a very strong added apple flavor to the banana. The recipe calls for very ripe bananas and I did not have as ripe ones as I thought. I could taste that in the original as well. Other than this difference, I do prefer the original over the modification. I think because I was raised on the butter being in it, it made it taste a certain way that I love more than the apple. I would however not get rid of the modification for future baking. I think using applesauce instead of butter could be used in many other recipes.

In my recipe, three key ingredients are the sugar, egg, and flour. The sugar is a carbohydrate, and it adds sweetness and flavor to the bread. It also helps with the structure as well. The egg is protein added to the bread and it also adds to aide in structure of the bread. Typically, the egg allows for the product to be more fluffy or airy. In this case, because of the denseness, it adds a little air to rise but otherwise it aides to make the bread dense. Lastly the flour is the most important ingredient that contributes to structure. It I a carbohydrate as well as a protein. The gluten in the flour allows for the aide in the structure due to the crosslinks of Gliadin and Glutenin.

One physical change that occurs while mixing the ingredients is the state of the banana. It is a solid before it undergoes mashing and then turns into a semi-solid liquid mixture. Another physical change is the egg is cracked open and whisked before adding to the other ingredients. This creates a mixture between the egg yolks, whites, and air. A chemical change is the color of the bread after it has been baked in the oven. The brown color is produced by the Maillard reaction. This reaction includes amino acids (proteins) and sugar. There are so many separate reactions that occur during this reaction that scientists are still researching what could come from it. Lastly, another chemical reaction that occurs in the bread is the formation of gluten in the flour. The process is explained in the above paragraph.

This bread uses convection as the heat transfer. The fans in the oven circulate hot air around the object baking. This leads to evenly baked goods. It uses hot air to cook the food. In this

method liquid can be used to heat the food as well. I also used a glass loaf baking dish because it is a good conductor of heat. Once it gets hot it helps to bake the dish evenly and efficiently. Other than the glass baking dish any other materials do not matter, if there is a mixing bowl and spatula!

# Chocolate Chip Cookies

Submitted by: Sarah Leininger

## Recipe:

2 1/4 cups all-purpose flour  
1 teaspoon baking soda  
1 teaspoon salt  
1 cup (2 sticks) butter, softened  
3/4 cup granulated sugar  
3/4 cup packed brown sugar  
1 teaspoon vanilla extract  
1 banana  
Chocolate chips to taste

## Reflection:

This recipe is the “Nestle Tollhouse” cookie recipe but with banana instead of eggs. This recipe is very special to me because as a young child I always wanted to bake cookies. My mom was never a baker so she didn’t have any recipes she could share. This recipe was the first one my 9-year-old self, came across. For years I have been baking these special cookies and have even come to memorize the recipe. So, for this project I thought it would be perfect to try and switch up the recipe that I loved for years. For the change in this recipe, I used a banana instead of eggs. I thought this would enhance the flavor and could possibly make the recipe better. Adding the banana into the batter instead of the egg made the batter a lot stickier. I can usually roll the batter into a ball in my hand, but this batter would just stick to my fingers. Watching it cook it looked pretty similar to a normal cookie baking. My hypothesis was that the cookies will be sweeter, chunkier, softer, and thicker. After trying a cookie after baking, my hypothesis was not far off. This cookie was sweeter and thicker. What it was not was chunkier. The batter was smooth and so was the cookie. I prefer the banana cookie over the regular cookies. It added such a nice hint of new flavor. A key ingredient of these cookies is flour. Flour is a starch or a complex carbohydrate. The purpose of flour in the recipe is to create a base and have rise to the cookie. The next key ingredient was bananas. Bananas are rich in carbohydrates, mostly from organic sugars. Bananas contain fiber which includes cellulose and pectin. The banana’s purpose in the recipe is to take place of the egg. Egg promotes the fluffiness of the bake and it also hold the batter together. Another purpose of the banana is taste and texture. The last key ingredient in this recipe was butter. Butter is a fatty acid that is composed of triglycerides. The melting point for butter is around body temperature, or 98.6-degree Fahrenheit. There are also proteins within butter that create the browning during cooking. The purpose of butter being in the recipe is to be a leavening agent. It helps the cookies rise and become fluffy. One physical reaction of cookies baking is the Maillard Reaction. This reaction occurs between the sugars and proteins when heat is added. Its responsible for the browning action. It also is responsible for the flavors, smells, and color of the cookie. A chemical reaction happening when cookies bake is a leavening reaction. Baking soda reacts to an acid such as brown sugar, to produce dioxide gas. This is how the cookies become light and airy. The process of baking cookies involves lots of heat transfers. Convection is the transfer of heath through the movement of a liquid. In an oven this liquid is the air. The next heat transfer is conduction. Conduction is the transfer of heat

through direct contact between particles of a substance. While making cookies this happens when the dough encounters the hot pan. The last heat transfer cookies go through while baking is radiation. In an oven radiation is used with infrared waves.

# Chocolate Chip Muffins

Submitted by: Jessica Dauberman

## Recipe:

3 cups all-purpose flour (spoon & leveled)  
3 teaspoons baking powder  
1/2 teaspoon baking soda  
1/2 teaspoon salt  
1 teaspoon ground cinnamon  
1/8 teaspoon ground nutmeg  
1/3 cup (5 Tablespoons) unsalted butter, melted and slightly cooled  
1/3 cup unsweetened apple sauce  
1 cup granulated sugar  
2 large eggs, at room temperature  
1/3 cup sour cream at room temperature  
1 cup milk, at room temperature  
1 teaspoon pure vanilla extract  
1 and 1/2 cups large semi-sweet chocolate chips  
coarse sugar for sprinkling  
mini semi sweet chocolate chips for sprinkling

1. Preheat oven to 425°F (218°C). Generously grease a jumbo 6-count muffin pan with butter or nonstick spray (nonstick spray recommended) or line with muffin liners. Set aside.
2. Whisk the flour, baking powder, baking soda, salt, cinnamon, and nutmeg together in a large bowl. Set aside.
3. Whisk the melted butter, apple sauce, sugar, and eggs together until combined. Then whisk in the sour cream, milk, and vanilla extract. Mixture will be pale yellow. Pour wet ingredients into dry ingredients and fold together with a rubber spatula or wooden spoon until completely combined. Use a whisk to rid any large lumps of flour, if needed. Avoid overmixing. The batter will be thick. Fold in the chocolate chips.
4. Divide batter between each muffin cup, filling all the way to the top. Sprinkle with coarse sugar (for added crunch, recommended!). Bake at 425°F for 5 minutes, then, keeping the muffins in the oven, reduce the oven temperature to 350°F (177°C) and continue to bake for 25-26 minutes until the tops are lightly golden brown and centers are set. Stick a toothpick in the center of a muffin to test for doneness. If it comes out clean, the muffins are done.
5. Allow to cool for 10 minutes in pan before serving.
6. Cover leftover muffins and store at room temperature for 5 days or in the refrigerator for 1 week. Muffins freeze well for up to 3 months. Thaw in the refrigerator or on the counter.

## Reflection:

For my final project, I opted to create chocolate chip muffins, because who doesn't like chocolate chip muffins?! But, in actuality, my cousin always substituted the applesauce for the oil, and I figured this was the perfect opportunity to put her substitute to the test. I was unable to get ahold of my cousin's recipe, so I was able to find this muffin recipe with a quick google search, and

used this recipe from Sally's Baking Recipes. Sally's recipe calls for 1/3 cup of oil, and I substituted that for 1/3 cup of unsweetened apple sauce. Personally, I expected the muffins with the adapted recipe and substituted apple sauce to taste like apples and not be able to tell a difference between the regular and adapted recipe. Scientifically I thought the recipe with applesauce instead of oil would work because I know that applesauce contains pectin which replicates oil by coating the flour molecules and limiting the gluten formation. Both muffins came out of the oven relatively similar looking, the only visual difference was that the muffins with the oil had risen more, but that could have very easily been my scooping, or over scooping. My aunt and I both tried both versions of the muffin, and we agreed that the apple sauce muffin was much moister and tender, and no apple sauce taste. I didn't tell her which one had apple sauce in it until after she had decided which one was better, to get an unbiased result.

Some of the key ingredients and their molecular properties and purposes included flour, melted butter, and applesauce. Flour is a composition of complex carbohydrates, more specifically starches and proteins. Flour's purpose in this recipe is to provide both structure and elasticity to the muffins. The melted butter is composed of triglycerides, and its main purpose in the muffin recipe is to add moisture and tenderness to the muffins. The apple sauce in the muffins is made up of pectin, cellulose, fructose, water, and vitamins and minerals. The pectin in apple sauce is what replicates the oil properties in gluten formation within the muffin.

As for physical and chemical changes, some of the physical changes occurring during the muffin baking process include mixing the ingredients together, and the rising of the muffins when baking. The muffins rising is a result of leavening agents releasing carbon dioxide. Some of the chemical changes include, the baking powder and baking soda reacting with the acidic components (sour cream in this case) as well as the browning on top of the muffins from the Maillard reaction occurring.

The main methods of heat transfer include conduction and convection. Conduction occurs when the muffin pan is heated up and transfers the heat directly to the muffins. Convection occurs when the air circulating throughout the oven moves around the muffins transferring the heat to the batter. Some of the materials used in this recipe include a mixing bowl, I used both glass and plastic, a spatula made of silicone, cupcake tins which are made of steel. I used both regular and non-stick coated.



# Cinnamon Rolls

Submitted by: Jarod Updike

## Recipe Instructions

- **Make the dough:** Whisk the flour, sugar, and salt together in a large bowl. Set aside.

Combine the milk and butter together in a heatproof bowl. Microwave or use the stove and heat until the butter has melted and the mixture is warm to the touch (about 110°F/43°C, no higher).

Whisk in the yeast until it has dissolved. Pour mixture into the dry ingredients, add the egg, and stir with a sturdy rubber spatula or wooden spoon OR use a stand mixer with a paddle attachment on medium speed. Mix until a soft dough forms.

Transfer dough to a lightly floured surface. Using floured hands, knead the dough for 3-5 minutes. You should have a smooth ball of dough. If the dough is super soft or sticky, you can add a little more flour. Place in a lightly greased bowl (I use non-stick spray), cover loosely, and let the dough rest for about 10 minutes as you get the filling ingredients ready.

- **Fill the rolls:** After 10 minutes, roll the dough out in a 14×8-inch (36×20-cm) rectangle.

Spread the softened butter on top. Mix together the cinnamon and brown sugar. Sprinkle it all over the dough. Roll up the dough to make a 14-inch log. Cut into 10–12 even rolls and arrange in a lightly greased 9- or 10-inch [round cake pan](#), [pie dish](#), or [square baking pan](#).

- **Rise:** Cover the pan with aluminum foil, plastic wrap, or a clean kitchen towel. Allow the rolls to rise in a relatively warm environment for 60–90 minutes or until double in size. (For a tiny reduction in rise time, see my answer to *Where Should Dough Rise?* in my [Baking with Yeast Guide](#).)

- **Bake the rolls:** After the rolls have doubled in size, preheat the oven to 375°F (190°C). Bake for 24–27 minutes, or until lightly browned. If you notice the tops are getting too brown too quickly, loosely tent the pan with aluminum foil and continue baking. If you want to be precise about their doneness, their internal temperature taken with an [instant read thermometer](#) should be around 195–200°F (91–93°C) when done. Remove pan from the oven and place pan on a wire rack as you make the icing. (You can also make the icing as the rolls bake.)

- **Make the icing:** In a medium bowl using a handheld or stand mixer fitted with a paddle or whisk attachment, beat the cream cheese on high speed until smooth and creamy. Add the butter and beat until smooth and combined, then beat in the confectioners' sugar and vanilla until combined. Using a knife or icing spatula, spread the icing over the warm rolls and serve immediately.

## Reflection:

While preparing the dough I replaced the sugar with an equal amount of maple syrup (¼ cup) I knew this would add a good bit of moisture so I compensated by reducing the milk from ¾ cup to ½ cup. However even so, after mixing it all together I realized while kneading the dough it was still too moisturized and sticky. In turn I added more flour and the dough felt proper. Everything seemed to be great, especially the cream cheese was incredible. However I'm not sure what could have been improved upon as after baking them the outer layer was a little hard and lacked moisture. Overall, the cinnamon rolls were not bad, 6.8/10.

# Chocolate Chip Brownies with Browned Butter

Submitted by: Ethan Amis

## Ingredients

1 and a half stick of butter

$\frac{3}{4}$  cup cocoa powder

3 eggs

1  $\frac{3}{4}$  cup of brown sugar

$\frac{3}{4}$  flour

Teaspoon vanilla abstract

Chocolate chips

## Recipe

1 and a half sticks butter browned on the stove at low heat until golden brown, add butter to bowl with  $\frac{3}{4}$  cup cocoa powder. In a separate bowl combine three eggs with 1 and  $\frac{3}{4}$  cup of light brown sugar (whisk until super fluffy and no granules of sugar can be felt when you rub it in between your fingers) Add in chocolate mixture and fold till combined then fold  $\frac{3}{4}$  cup flour and a teaspoon of vanilla Finally add a half cup of chocolate chips and place in the oven at 350 for 25-30 minutes :)

## Reflection

Brownies. You love them, I love them, and if you don't...what? Brownies are something I find as a perfect dessert for one or many to enjoy! So when I stumbled upon this recipe with my girlfriend on Tik Tok (source: <https://www.tiktok.com/t/ZPRvcKDNF/> ), I knew this was going to be the recipe I showed to our class. The recipe was simple and was normal for the most part...except there was an experiment it recommended...browning the butter. I found this intriguing, and made a hypothesis for this experiment:

**“If I brown the butter before mixing all the ingredients together, then the brownies will come out more rich and thick compared to if I didn't brown the butter.”**

I also found this pretty interesting because of the fact I was implementing both physical (the changing of butter from solid to liquid) and chemical (maillard reaction when the milk solids of the butter turn brown) reactions. I wanted to give this a shot so I pulled out all the ingredients I needed (see list above), and went at it. Firstly, I wanted to place my butter in a stainless steel pot, where it would brown in about 5 minutes, which is a conduction heat transfer. Butter has a lipid structure and has the purpose of adding flavor to the dish, and adding reason to the leavening process later on. On the side I had an additional bowl for my three eggs and brown sugar, where I whisked with a rubber spatula until it was super fluffy and you couldn't feel the granules of sugar, which is another physical reaction due to it physically breaking down the sugar crystals and incorporating them into the eggs without creating new chemical compounds. The eggs are a mix of a protein and carb structure and have the purpose of giving moisture to the dish and also having a role in the leavening process. Once the browning of the butter was done, I put that mixture in a separate bowl and placed  $\frac{3}{4}$  of cacao powder within and mixed it with also a rubber spatula until the same idea, which is also a physical reaction. The reason for

the rubber spatula being my choice for my tool is for the fact that it can handle the heat but also mix very well to my standards. Once it was all mixed in, I poured both bowls in one and mixed them until fully mixed together! Then, I put in flour and a tsp of vanilla extract within and folded the mixture until the flour and vanilla extract was integrated. The vanilla extract has a very much sugar like structure (carb) and has the purpose of adding a delightful flavor to a dish. Once everything was mixed nicely, it was time to put it in a baking pan, with a baking sheet under. Weirdly enough, the smell I got from the mix was very caramelized which could be due to the brown butter and its reactions with the other ingredients. Once evenly poured in the pan, I move my uncooked brownie mix until the oven is preheated at 350 degrees and leave it in there for 20-25 minutes (I usually do 30 for brownies due to it sometimes being a bit too raw if I don't), which is a convection heat transfer. There's both physical and chemical changes going on in this process. The physical aspect is within the heat transferring to the batter causing the solidification and texture change. The chemical reaction is with the leavening agents releasing gasses, proteins coagulating, the sugars caramelizing and the maillard reactions leading to the browning and flavoring of the brownies overall. Once the time was up I placed my brownies on a little heat pad and let them sit for a good 25 minutes before cutting. They smelled relatively the same as normal brownies but now it was time to taste...

The brownies overall were a lot more rich and had a better taste to them! It had a more dense taste to them, but wasn't too cake-like. It was as if I made my own volcano brownies from dominos! Overall, I feel my hypothesis was correct! These are some good brownies!! Hope you enjoy the recipe and hopefully you learned something too!

# Chewy Chocolate Chip Cookies

Submitted by: Katherine Thorpe

2 and 1/4 cups (280g) all-purpose flour (spooned & leveled)  
1 teaspoon baking soda  
1 and 1/2 teaspoons cornstarch\*  
1/2 teaspoon salt  
3/4 cup (170g) unsalted butter, melted & cooled 5 minutes\*  
3/4 cup (150g) packed light or dark brown sugar  
1/2 cup (100g) granulated sugar  
1 large egg + 1 egg yolk, at room temperature  
2 teaspoons pure vanilla extract  
1 and 1/4 cups (225g) semi-sweet chocolate chips or chocolate chunks

<https://sallysbakingaddiction.com/chewy-chocolate-chip-cookies>

I picked this recipe after watching a TikTok video exploring various butter types in cookies. It seemed like a fun experiment, so I chose a recipe from Sally's Baking Addiction that used melted butter and aimed to test the impact of using cold butter instead. Following the same recipe directions, I only changed the butter type while keeping the amounts consistent. My hypothesis was simple: if I swap melted butter for cold butter, the cookies will turn out denser due to reduced spreading during baking, resulting in thicker, chewier cookies. The outcome confirmed this; cookies made with cold butter were thicker and fluffier, while those with melted butter spread more, resulting in a greasier texture. Personally, I preferred the original melted butter recipe; it had better flavor and a less dry texture, agreed by my roommates who also participated in the taste test. The recipe included baking soda, a leavening agent that reacts with acidic ingredients like brown sugar in chocolate chip cookies. This reaction releases carbon dioxide gas, causing the dough to rise and creating a softer, more tender texture in the cookies, thanks to its molecular properties. Unsalted butter, acting as a binding agent with fatty acids and glycerol molecules forming triglycerides, played a pivotal role in the cookie structure and texture. The variability in fatty acid chains within butter impacted its physical properties and melting point.

Egg yolk, rich in fats, proteins, and water, contributed to the cookies' texture, structure, and moisture content due to its foam-like structure and emulsifying properties when whipped or beaten. During baking, two physical changes occurred: caramelization, leading to a richer flavor and darker color when sugars were heated, and the Maillard reaction, causing the sugars and proteins in the dough to brown, resulting in a complex flavor profile and the cookies' golden-brown color. A significant chemical change, emulsification, occurred as fat and water-based ingredients combined and stabilized, enhancing the cookies' overall texture and moisture retention. In terms of heat transfer, the oven primarily used convection. The hot air circulating due to temperature differences transferred heat to the cookies, affecting their baking process. While using a whisk to thoroughly mix the ingredients, I noticed challenges with the cold butter as it didn't mix as easily compared to melted butter. The melted butter mixed better with the sugar, resulting in a smoother texture, while the cold butter was a thicker consistency. Interestingly, the cold butter cookies baked drier and spread less, even slightly burning at the bottom, while the melted butter cookies remained soft and didn't burn.

# Chocolate Peppermint Cheesecake

Submitted by: Ty Morral

## Crust

2 1/2 cups dark chocolate Oreos crushed\*  
1/4 cup butter, melted  
2 tablespoons sugar

## Filling

4 packages (8 oz each) cream cheese, softened (same amount of Greek yogurt)\*  
1/4 cup sugar  
1 can (14 oz) sweetened condensed milk (not evaporated)  
1/3 cup whipping cream  
2 tablespoons Gold Medal™ all-purpose flour  
2 teaspoons vanilla  
3 eggs

## Ganache

3/4 cup whipping cream  
1 1/2 cups semisweet chocolate chips  
1 bag (12 oz) soft peppermint sticks, coarsely crushed

## Reflection:

Unfortunately, I was limited to only one springform pan, which means each of the recipes is going to take all of nine hours when you consider that they need to each sit in the refrigerator for six hours each. The first recipe went on without a hitch, it ended perfectly except the aluminum foil caused the sides of the cake to not brown evenly, but other than that, it looked, tasted, and overall turned out great. The second dessert, however, was very pleasing to the eye and could not have looked better. I did not use foil on the edges of the dessert, and this helped even out the browning and keep the sides very clean and straight. They both had flawless crusts that held up well. Overall, the preparation and the making of both desserts went well. The ganache and the peppermint topping both made the dish more aesthetically appealing than they were before.

I did numerous amounts of research to determine if the molecular properties of Greek yogurt would alter the taste, consistency, or healthiness of the dish. Greek yogurt has far less poly and monosaturated fats, less cholesterol, less sodium, and substantially more Vitamin B12. These are all properties that heavily favor Greek yogurt when compared to cream cheese. The tasting table website states that “you can typically sub it out for cream cheese in a 1:1 ratio; Greek yogurt is tangier than cream cheese which may alter the flavor.” I am writing this before I taste it, I am certain that the molecular properties of the Greek yogurt will not alter the taste or consistency of the dish, I firmly believe the Greek yogurt ingredient will overpower the dark chocolate and peppermint taste of the dish.

These are my first reactions after trying a slice of each cheesecake. The classic cheesecake with the cream cheese is much fluffier and has the classic cheesecake taste. It is truly a classic dish, and I should be making this more often. When I tried the other dish, I noticed it was a little heavier and had the distinct yogurt aftertaste, which was not necessarily a bad thing, but it is just a different

taste that would not normally be associated with cheesecake. I would not have any problems taking either of these dishes to a family function or holiday. If I wanted the dessert to still be very tasty but my family needed to have a lower-sugar dessert, I would have no problem making the cheesecake with the Greek yogurt. My girlfriend who is not a big fan of cheesecake tried both, not knowing which was which said that the consistency of the Greek yogurt cake was smoother and lighter. However, the classic cheesecake had a more rich and flavorful taste. She even added both of those recipes into her dessert recipe book.

I am very happy I was assigned this project; I feel like I have a deeper understanding of why people sometimes sacrifice the nutritious option in favor of the tastier maybe not-so-healthy option.

# Oreo Banana Bread

Submitted by: Maura Lane

## Recipe:

3 Bananas  
6 tbsp veg. oil  
½ cup sugar  
1 egg  
1 tsp vanilla extract  
¼ tsp salt  
15 oreos  
1 ½ cups all-purpose flour  
1 tsp baking soda  
1 tsp baking powder

1. Combine bananas, oil, and sugar then add egg, vanilla, and salt
2. Combine flour, baking soda, baking powder in different bowl
3. Combine 1 and 2 to make the batter
4. Crush oreos into small pieces
5. Add ¾ of oreos to batter
6. Pour into greased loaf pan
7. Top with remaining oreos
8. Bake at 350 degrees for 45 min

## Reflection:

I chose this recipe because I made oreo banana bread at some point in middle school. I don't have the recipe I used then, but I remember how tasty it was, so I figured I could make it again. I found a recipe by Tastemade that seemed trustworthy. I decided to change the flour from all-purpose to cake flour. I expected the all-purpose flour to make a denser and more spongy bread than the cake flour. Cake flour has less gluten protein than all-purpose flour, so there would be less structure in the cake flour bread, making it more crumbly.

The recipe was easy to follow and fortunately did not require a hand mixer. I did my best to keep all the other ingredients besides the flour as similar between both batters to ensure only the flour was having an impact on the breads.

Three main ingredients in the recipe are flour, egg, and baking soda. The flour contains gluten proteins that give the bread structure. The egg also gives structure through its proteins. It gives some moisture because it contains water. Some of the water evaporates during the baking, helping with leavening. The baking soda is a soluble base that serves as a leavening agent. The recipe has a physical reaction when it becomes a homogeneous mixture when making the batter. Two chemical reactions that occur are neutralization and the bonding of gliadin and glutenin to form gluten in the flour. The cooking process uses endothermic heat transfer because the batter is absorbing the heat from the oven. The loaf pan I used was made of glass which made it easier to watch the bread rise.

The two breads had subtle differences in their texture, but the cake flour bread took 15 more minutes to bake than the all-purpose flour bread. The cake flour bread also rose to almost

double the height of the other bread. I found this odd as its lower protein content would lead you to believe that it wouldn't retain its structure as well. After trying multiple pieces of each bread, I concluded that I prefer the all-purpose flour bread.



# Chocolate Chip Blondies

Submitted by: Graham Roberts

## Recipe:

<https://bromabakery.com/the-best-chewy-blondies>

## INGREDIENTS

- 1/2 cup unsalted butter, melted and cooled
- 1 cup packed brown sugar
- 1 eggs + 1 egg yolk, room temperature
- 1 tablespoon vanilla extract
- 1/4 teaspoon baking powder
- 1/2 teaspoon salt
- 1 cup all-purpose flour
- 1 cup semisweet chocolate chips (optional)

## INSTRUCTIONS

1. Preheat the oven to 350°F. Line a 8 x 8" baking pan with parchment paper and set aside.
2. In a large mixing bowl whisk together the melted butter and brown sugar. Add the egg and egg yolk, and vanilla extract and mix well.
3. In a separate bowl stir together the baking powder, salt, and flour. Add the wet ingredients into the dry and fold together until just mixed and no clumps of flour remain. Fold in the chocolate chips. Do not over mix.
4. Pour the batter into your prepared pan, spreading into an even layer.
5. Bake for 25 to 30 minutes or until the blondies are golden brown, set on the edges and have puffed up. The middle will still be undercooked, but they will continue to cook as they cool!
6. Once the blondies are cool, cut into 9 squares for big blondies, or 16 squares for smaller portions and enjoy!

## Reflection:

I chose this recipe because I wanted to pick a dessert that most people like (a combination of chocolate chip cookies and brownies) and because I have a few people in my life who are either gluten-free or eat low-sugar diets. In the altered version of the recipe, I swapped out the all-purpose flour for blanched almond flour and the brown sugar for a baking sugar alternative. I didn't expect it to be too different to the original, but I thought it would not rise as well and be less chewy. I also thought it would be less dense, come out with a grainier texture, and need to cook longer. During the preparation phase for the altered recipe, it was immediately noticeable that in the wet mixture the butter was not combining well with the sugar substitute. When it was in the oven it took longer to get that structure like the original recipe, and it was all bubbly. But, right towards the end of the cooking time, all of the sudden it turned cake-like and browned within not even one minute of it looking the way it did before. The batter for the original recipe looked much more appetizing than the altered recipe, it looked like I was making a gross concoction of baby foods all mashed and mixed together. The original recipe was definitely my preferred between the two. The texture was more like a cookie rather than cake and it looked more appealing to me personally. As for taste, they honestly were not that different tasting and if I were blind-folded and did a taste test,

the biggest difference would be the texture, but other than that it would be difficult to tell. There were three important ingredients in this recipe: the eggs, flour, and baking powder. Egg yolk is 50% water, 16% protein, 32% lipids, and the phospholipases help to make the egg yolk more emulsifying. Flour, specifically all-purpose flour, is the backbone in the baking process, having a 10-12% protein make-up, containing a mix of hard and soft wheat flours. Baking powder is made up of sodium bicarbonate, cream of tartar, and usually cornstarch or some other moisture-absorbing agent. With some of these ingredients in mind, there are some key physical and chemical changes occurring in the recipe. There are two noticeable physical changes: at the start of the recipe when the butter is melted halfway and at the end when the mix is in the oven, with the convection and radiation heating, and begins to brown. The noticeable chemical change is when you mix together the wet mixes and they emulsify. There were quite a few utensils and pans used in this recipe. I had to use two mixing bowls, a small and a large, cup sized measuring glass, fork and whisk for mixing, some spatulas to get every bit of cookie mix, and an 8x8 baking pan. This recipe was a lot of fun and I would recommend it for anyone who wants to make something pretty simple, so delicious, and easy to share with people!

# Chocolate Chip Cookies

Submitted by: Katie Gilbert

## Recipe:

### Ingredients:

1 1/8 cups all-purpose flour  
1 1/8 cups almond flour  
1 teaspoon baking soda  
1 teaspoon salt  
1 cup (2 sticks) unsalted butter, softened  
3/4 cup granulated sugar  
3/4 cup packed brown sugar  
1 teaspoon vanilla extract  
2 large eggs  
2 cups Nestle Toll House semi-sweet chocolate morsels  
1 cup chopped nuts (optional)

### Instructions:

- Preheat your oven to 375°F (190°C).
- In a bowl, combine the all-purpose flour, almond flour, baking soda, and salt. Set aside.
- In a large mixing bowl, beat the softened butter, granulated sugar, brown sugar, and vanilla extract until creamy.
- Add the eggs one at a time, beating well after each addition.
- Gradually add the dry ingredients (a mixture of all-purpose flour and almond flour) to the wet ingredients, mixing well after each addition.
- Stir in the Nestle Toll House semi-sweet chocolate morsels and nuts (if using).
- Drop rounded tablespoons of cookie dough onto ungreased baking sheets, leaving enough space between each cookie.
- Bake in the preheated oven for 9 to 11 minutes or until golden brown. Keep an eye on them, as baking times may vary.
- Remove the cookies from the oven and let them cool on the baking sheets for a few minutes before transferring them to wire racks to cool completely.

## Reflection:

I chose this recipe because my grandmother always makes chocolate chip cookies using the Nestle Tollhouse recipe, except she adds the entire bag of chocolate chips. However, I replaced half of the all-purpose flour with almond flour. Almond flour, made from finely ground almonds, is gluten-free and imparts a distinctive nutty taste. My hypothesis was a subtle change in the texture and flavor of the cookie. When baking the modified recipe, the cookies appeared slightly denser and chewier. The almond flour added a hint of nuttiness that I felt complemented the sweetness of the chocolate. The flavor profile was definitely richer and more complex. While I really did enjoy the modified recipe, I enjoyed the original recipe more due to the nostalgia attached to it.

Three key ingredients in this recipe include almond flour, chocolate chips, and butter. Almond flour is composed of finely ground almonds, contributing a higher fat content than all-purpose flour. The fat content enhances moisture retention in the cookies. Almond flour also influences the texture, making the cookies denser and chewier. Chocolate morsels contain cocoa, sugar, and fats. Cocoa contributes to the chocolate flavor, while fats influence the texture. The chocolate morsels provide sweetness and richness complementing the nutty undertones of the almond flour. Finally, butter consists of water, milk, and fat. The fat content contributes to tenderness and flavor, while water content aids in moisture retention. Butter provides moisture and enhances the overall flavor of the cookies.

One of the physical changes in this recipe included mixing the ingredients, the incorporation of dry and wet ingredients involves physical changes, such as the dispersion of flour particles in the wet mixture. One of the chemical changes was the Maillard Reaction. Occurring during baking, the Maillard reaction leads to the browning of the cookie surface, enhancing flavor and creating an appealing golden color. Additionally, there is a carbon dioxide release. The reaction between baking soda and acidic components in the recipe produces carbon dioxide. The primary method of heat transfer during the cooking process is convection. As the cookies bake in the oven, heat is transferred through the air, promoting even cooking and the development of desired textures and flavors.

The modified Nestle Toll House chocolate chip cookies offer a unique twist on the classic recipe, incorporating the subtle nuttiness of almond flour. This culinary experiment not only resulted in a delicious treat but also provided understanding the molecular properties and functions of key ingredients, as well as recognizing the physical and chemical changes occurring during preparation, we gain a deeper appreciation for the science behind the art of baking.

# Lemon Blueberry Bread

Submitted by: Ariel Berger

## Recipe:

1 1/2 cups of all-purpose flour  
1 teaspoon baking powder  
1 teaspoon salt  
1/3 cup of melted unsalted butter  
1 cup granulated sugar  
1/2 cup yogurt  
1/2 teaspoons of vanilla extract  
2 teaspoons fresh grated lemon zest  
2 tablespoons fresh lemon juice  
1/2 cup milk  
1 cup fresh blueberries

Preheat oven to 350 degrees

Mix, flour, salt, and baking powder into a small mixing bowl and place to the side

Mix, eggs, sugar, vanilla, lemon juice and lemon zest into a big mixing bowl

Slowly start to pour flour mixture and milk into the big mixing bowl

Toss blueberries in a small amount of flour so that they don't sink to the bottom of the bread

Gently fold blueberries into large mixing bowl

Place in a 9 by 3 pan and bake for 65 minutes

## Reflection:

The recipe I chose for this project was lemon blueberry bread. I wanted to bake something I knew I could enjoy, and this is my favorite. I love the tartness of the lemon and the sweetness of the blueberries. My grandmother had made this dish a couple of years ago and when I got the recipe, I started to make it all the time.

I decided for my change to substitute the egg for something else to see how it would affect the batter. While looking I came across yogurt and I never knew that yogurt could be substituted so I decided to try it. I learned for every egg; it would be 1/4 of a cup of yogurt. My hypothesis was that the yogurt would create a more dense and moist bread. I also said that the bread would not rise as much because the yogurt is denser and heavier. The result was just as I expected. The first thing that was different about the bread was the batter with egg was darker than the batter with yogurt, because I used vanilla yogurt. The next thing I noticed was after baking the yogurt substitute had made the bread rise significantly less than the one with egg. The loaf rose about half as much as the batter with egg. The last main differences between them were the density and texture of the bread. The batter with egg in it created a lighter, fluffier bread while the batter with yogurt created a denser cake like bread. My parents tried the yogurt bread without me telling them there was yogurt instead of egg and they said it was good, but heavy and thick. My preference is the batter that has eggs in the batter, just because of the texture and density of the bread, as they both tasted the same.

Some of the most important ingredients in this dish are egg, lemon juice, and salt. The egg is important to create stability and structure for the batter. Eggs are high in protein (12%), lipids

(12%), and full of water with some carbs and minerals. Lemon juice adds flavor and moisture to the bread. Lemon juice is made up of citric acid and other vitamins. Salt is used in the dish to slow down the sugar's consumption of yeast. Salt is made up of sodium and chloride.

A physical change that happens during the baking process is the bread rises and creates a golden-brown crust on the top. Another physical change could be the mixing of the dry and wet ingredients to create the batter. A chemical change that is occurring during baking is the Millard reaction. The Millard reaction can affect the aroma, texture and flavor by sugars and amino acids reacting to each other and creating a variety of new compounds.

The Method of heat transfer that was used is conduction and radiation. Conduction is when the bread is placed directly onto the hot rack of the oven. Having that direct contact to heat up the pan and to cook the loaf. Radiation was also used because the heat flow inside the oven flowed between the walls and the bread. My oven is an electric oven that was set to 350 degrees, and that combined with the metal pans I used (this is different from the proposal, I only had one glass pan) was able to cook my bread in about 65 minutes.

# Zucchini Bread

Submitted by: Lilly McDonnell

## Recipe:

1. preheat oven to 350 degrees F. Butter an 8x4 inch loaf pan
2. In a mixing bowl, mash the ripe zucchini with a fork until completely smooth. Stir the melted butter into the mashed zucchini
3. mix in the baking soda and salt, stir in the sugar, beaten egg, and vanilla extract. Mix in the flour
4. pour the batter into your prepared loaf pan and bake the bread for 55 to 65 minutes at 350 degrees F or until a toothpick or wooden skewer inserted into the center comes out clean.
5. remove from oven and let cool in the pan for a few minutes. Then remove the zucchini bread from the pan and let cool completely before serving. Slice and serve.

## Reflection:

For this project, I chose to take a simple banana bread recipe and alter it. At first, the alteration I wanted to make was substituting the baking soda for baking powder, but I felt that doing that would not change much. Instead, I chose to substitute bananas for zucchini. My mom has made zucchini bread in the past, but I have never tried it myself. Throughout the recipe, I used zucchini instead of bananas. I cut and mashed up the zucchini before adding the rest of the ingredients. It took the bread the same amount of time to cook, and it smelled so delicious while cooking. I was not sure if I would like the bread while I was making it, but I really liked the taste of it. I liked this project because I did something I normally would not do while baking.