

# Kitchen Chemistry: Mug Cakes



**Did you know when you are baking a chemical reaction is taking place? When you add heat to something and it changes, it is called an endothermic reaction. Not only is the heat important in your chemical reaction, but also the ingredients you use. So, baking is chemistry!!**



Making mug cakes is a great activity for kids to investigate the chemistry of cake making. It does not take a lot of ingredients and it is also fun to eat. Make some mug cakes for dessert and do a family taste test!

**Time:** 20 minutes total (but only 3 minutes for baking!)

**Explore:** kitchen chemistry, inquiry process (predict, document, test, reflect)

**Materials:**

Microwave	butter
Recipe printout	egg
Kitchen measuring tools	milk
Microwave-safe mug	baking soda
flour	vanilla
sugar	sprinkles

## Recipe:

### Ingredients for 1 Basic Vanilla Mug Cake:

- 2 tablespoons unsalted butter
- 3 tablespoons milk
- 1/2 teaspoon pure vanilla extract
- 3 tablespoons granulated sugar
- 1/4 cup all-purpose flour
- 1/2 teaspoon baking powder
- pinch salt
- 1 tablespoon sprinkles (optional)

### Instructions:

1. Place butter in a large mug and microwave 30 to 40 seconds until melted. Allow to cool 2 to 3 minutes.
2. Quickly whisk in the milk, vanilla extract, and sugar, mixing well (if the butter begins to solidify, microwave it for 30-45 seconds to warm the milk). Whisk in the flour, baking powder, and salt until combined. Stir in the sprinkles.
3. Microwave for 80 to 90 seconds. The top should look set but slightly wet when done. Cool a few minutes before enjoying.

❖ Recipe comes from <https://www.spoonfulofflavor.com/>

## Before you begin ...

### Predict

- ❖ Brainstorm and predict how to make a cake.
  - Ask: What ingredients do you think you need for a cake? Why?
  - Ask: What do you need to do to the ingredients? Why?
  - Ask: How long does a cake usually take to bake in an oven?
- ❖ Explain what you're going to make, and how you'll make it.
  - Explain: We're going to make a chocolate cake today, but we'll use a microwave instead of an oven. It takes a lot less time to cook things in a microwave than in an oven.
- ❖ Introduce the ingredients you'll use. Have kids sort them into two piles: liquid ingredients and dry ingredients.
  - Ask: Which ingredients are dry and which are wet, or liquid?
  - Ask: What do you think each ingredient does to the cake?
  - Ask: What do you predict would happen if you forgot an ingredient or put in too much of one ingredient? (Hint: Use sugar as an example)



## Bake

Make sure kids wash their hands!

Have kids follow along with the recipe on their printout.

- Explain: This is the recipe. A recipe tells us all of the ingredients we need and the instructions to make something. Follow along and check off each ingredient as we add it to the mug to make sure we don't miss anything!

When all ingredients are mixed into the mug, just before putting the mug in the microwave:

- Ask: Let's investigate the mix! Can you see each of the ingredients now?
  - Ask: What happened to the ingredients?
  - Ask: What does the cake look like now? What do you think it will look like when it comes out of the microwave?
  - Ask: What happens to a cake when it is baking?
- Explain: Some ingredients help the cake rise when it's baking. We're going to bake the cake for three minutes in the microwave.
- Ask: Based on our investigating the ingredients, and any baking you've done before, when do you predict the cake will start to rise, or get bigger? Document your prediction.

## Investigate

Have kids observe the mug cake as it cooks in the microwave.

- Ask: What's happening to the ingredients?
- Ask: What does it smell like?
- Ask: What do you think it will taste like? Watch the timer on the microwave when the cake starts to rise. Write down the time on the kid's recipe printout.
- Ask: How much time did it take for the cake to rise?
- Ask: Was your prediction about the cake's rising time right?

## Test

Leave the mug in the microwave for two minutes to let it cool. An adult should take out the mug from the microwave since the mug might still be hot.

Before eating:

- Ask: Can you see each of the ingredients now?
- Ask: What happened to the ingredients?
- Ask: How does the cake look different? Time to eat!
- Ask: What does the cake taste like?
- Ask: Which ingredients can you taste?

## Reflect

- Ask: What made the ingredients change into a cake?
- Ask: What would happen if we baked the cake for less time? More time?
- Ask: What do you think the cake would look or taste like if we took out an ingredient?

## Extension

Try making the recipe several times again, but remove one of the ingredients each time. Have kids predict and observe what happens to the cake without that ingredient. How long does it take to rise? Does it taste different?



## What's happening...

- 1) Normally, a cake would take an hour or more to make in an oven, but with a microwave oven, you can make one in minutes! Microwave ovens use waves of energy called – you guessed it – microwaves to cook food quickly. The microwaves go into the food and make water molecules inside move around really fast. The movement creates heat which cooks the food.
- 2) The cake dough isn't really a cake, but when it's heated in the oven, a chemical reaction occurs and new bonds are formed. How does heat change things? It creates chemical reactions. When it comes to heat and baking, there are two types of chemical reactions to consider; one is “exothermic,” a reaction that produces heat, and the other is “endothermic,” a reaction that takes heat in. As you bake a cake, you are producing an endothermic chemical reaction that changes ooey-goey batter into a fluffy, delicious treat!
- 3) Removing the baking powder produces a flat cake which isn't very spongy. That's because baking powder contains chemicals which react to produce carbon dioxide gas which gets trapped in little pockets in the cake when it cooks.
- 4) Removing the egg produces a cake that doesn't have much structure. That's because eggs contain long chain-like molecules (called proteins) which unravel and form new hard, strong structures inside the cake when cooked, as you'll know if you've fried or boiled an egg.
- 5) Removing the oil from the recipe produces a very dry cake because without the oil to coat the other ingredients, the cake mixture dries out when heated.

**Have fun experimenting with different recipes and ingredients – depending on what you have on hand at home. Let the kids experiment with combining different flavors together. On the next pages, you will find some recipes for inspiration.**

## FROSTED LEMON POPPY SEED MUG CAKE

### Ingredients:

#### Cake

1/3 cup oat flour  
1/2 tsp baking powder  
1/2–1 tsp lemon juice  
1 tsp lemon zest  
1 tbsp applesauce  
2 tbsps maple syrup  
Dash of turmeric (optional)  
1/4 tsp poppy seeds

#### Frosting

1 cup chopped pineapple  
1 tsp lemon juice  
1/2 tsp lemon zest  
1/2 tsp tapioca starch or  
cornstarch



### Instructions:

For the mug cake: Mix together all the ingredients in a microwave safe ramekin or mug. Make sure the batter only fills it about halfway, otherwise it will overflow.

Microwave for 1-1.5 minutes.

For the frosting: Blend all the ingredients till smooth.

Pour into a microwave safe bowl and microwave for 2 minutes, stir, then an additional 1 minute on high. It should be thick a thick glaze-like consistency.

Top your mug cake with the frosting and enjoy!

❖ Recipe comes from <https://www.feastingonfruit.com/>

## EGG FREE VANILLA MUG CAKE

### Ingredients:

4 tablespoons all-purpose flour  
2 tablespoons sugar  
1/2 teaspoon baking powder  
4 tablespoons milk (or dairy free milk)  
1/4 teaspoon vanilla extract  
1 1/2 tablespoons flavorless oil (sunflower, vegetable or coconut oil)  
1 tablespoon Funfetti sprinkles



### Instructions:

In a microwavable mug whisk together the flour, sugar and baking powder.

Add in the milk, vanilla and oil and mix until just combined. Stir in the sprinkles.

Microwave for roughly 1 minute to 1 minute 10 seconds, or until firm to the touch (timing is based on my Panasonic Inverter Microwave which is 1200 Watts so your timing may vary).

❖ Recipe comes from <https://www.biggerbolderbaking.com/>

## SNICKERDOODLE MUG CAKE

### INGREDIENTS:

1/4 cup + 2 tablespoons all-purpose flour  
2 tablespoons sugar  
1/4 teaspoon baking powder  
1/4 teaspoon cinnamon  
1/4 cup milk, at room temperature  
2 tablespoons salted butter, melted and cooled  
1/2 teaspoon pure vanilla extract

For layering/topping:

1 tablespoon sugar  
1/4 teaspoon cinnamon



### INSTRUCTIONS:

In a small bowl, whisk together flour, sugar, baking powder, and cinnamon until thoroughly, completely combined, with no streaks of any ingredients remaining. Blend in milk, butter, and vanilla until batter is smooth. Into a 14-ounce (or larger) microwave-safe mug with straight sides, scoop a big spoonful of batter, then sprinkle with a spoonful of cinnamon sugar. Alternate layers, ending with cinnamon sugar.

Microwave on high for 1 to 1 1/2 minutes, or until cake is done to your liking. Allow to cool for a couple of minutes before serving.

❖ Recipe comes from <https://www.fiveearthhome.com/>

## 2 INGREDIENT MUG CAKE

### INGREDIENTS

6tbsp boxed cake mix  
2½ tbsp sparkling water



### INSTRUCTIONS

Add ingredients into a microwave-safe mug that can hold at least 8 oz of liquid. Whisk vigorously with a small whisk until batter is smooth and no cake mix lumps remain.

Cook in the microwave at full power for about 1 minute and 10 seconds or until cake is cooked. Let cake cool a few minutes before decorating and eating.

❖ Recipe comes from <https://kirbiecravings.com/>



## THE MOISTEST CHOCOLATE MUG CAKE

### INGREDIENTS:

1/4 cup all-purpose flour  
2 tablespoon unsweetened cocoa powder  
1/4 teaspoon baking powder  
2 tablespoon granulated sugar (you can add 1 tbsp. more if you like it a bit sweeter)  
1/8 teaspoon salt  
1/4 cup + 1 tbsp. milk  
2 tablespoon vegetable oil  
1 tablespoon hazelnut chocolate spread or mini chocolate chips



### INSTRUCTIONS:

In a medium bowl, whisk together dry ingredients.

Whisk in the milk and vegetable oil until all ingredients are combined and batter has no clumps.

Pour batter into a microwave-safe mug. Mine was a 14-ounce mug. You want enough head space for the cake to rise without pouring over.

Add hazelnut chocolate spread in the middle of the batter or mini chocolate chips. Just drop it in the middle, no need to push it down and sink it in the batter. It does that on its own when it cooks! :)

Place a paper towel into the microwave and set the mug on top (this is to catch any batter if your mug cake overflows).

Microwave mug cake for 70 seconds on high

**Note:** Please note that ALL microwaves are different therefore can yield different results and can overcook this mug cake if you aren't careful. My microwave is 950 watts and I cooked mine on 100% power for 70 seconds\*. Knowing this information, it may help you better judge how long to cook yours for and at what power.

❖ Recipe comes from <https://www.tablefortwoblog.com/>

## BANANA BREAD MUFFIN IN A MUG

### INGREDIENTS

- 1/2 very ripe banana
- 1/4 teaspoon vanilla extract
- 2 tablespoons all-purpose flour, or gluten-free flour mix
- 1 teaspoon sugar, optional but not needed
- 1/4 teaspoon baking powder
- Pinch of salt
- 1 tsp oil of your choice, optional but not needed

### Optional add ins:

mini chocolate chips, sprinkles, chopped walnuts, chopped pecans, hemp seeds, etc.

### INSTRUCTIONS

Mash the banana in a small bowl and mix in oil and vanilla extract.

Put the flour, sugar (if using), baking powder and salt in a small espresso mug. Blend thoroughly with a fork.

Add the mashed bananas, mix in any additional mix-ins like chocolate chips, nuts, etc.

Microwave 90 seconds then let it cool about 1 minute before eating. If making a double batch in a large mug, cook 2 minutes.

❖ Recipe from <https://www.skinnytaste.com/>



## CHOCOLATE PEANUT BUTTER MUG CAKE

### Ingredients

- 6 tablespoons 2% milk
- 2 tablespoons canola oil
- 6 tablespoons all-purpose flour
- 3 tablespoons sugar
- 3 tablespoons quick-cooking oats
- 1/2 teaspoon baking powder
- 1/4 teaspoon salt
- 2 tablespoons semisweet chocolate chips
- 1 tablespoon creamy peanut butter

### Directions

Spray a 12-ounce coffee mug with cooking spray. Combine milk and oil in mug. Add flour, sugar, oats, baking powder and salt; stir to combine. Add chocolate chips; dollop center with peanut butter.

Microwave on high until toothpick inserted in center comes out clean, 2-1/2 minutes. Serve immediately.

❖ Recipe comes from <https://www.tasteofhome.com/>

