

Introduction to Cooking with Gas

Lesson 4: Baking



ADVANCED

Introduction

Welcome to Introduction to Cooking with Gas. Today's topic is understanding how energy is transferred during cooking. Once you learn about energy transference, you will learn how to cook with gas to make your own blueberry muffins.

This lesson can be completed in a classroom or at home. Your teacher will provide instructions for completing the assignment from home.

Opening Assessment

- 1. What is temperature?
 - a. the amount of heat a substance has
 - b. the type of molecules that make up the substance
 - c. the transfer of energy from one substance to another
 - d. the motion of the molecules that make up the substance
- 2. What is heat?
 - a. a form of energy
 - b. a dial setting on an oven
 - c. a measure of how hot an object is
 - d. a change in the temperature of an object
- 3. What appliance is needed for baking?
 - a. a grill
 - b. a range
 - c. an oven
 - d. a microwave
- 4. What is batch cooking?
 - a. cooking one meal at a time
 - b. cooking many meals at a time
 - c. cooking each ingredient separately
 - d. cooking using many appliances at a time
- 5. What is dry cooking?
 - a. cooking that involves fire
 - b. cooking that involves liquid
 - c. cooking that involves hot air
 - d. cooking that involves higher heat



How Is Energy Transferred During Cooking?

When a pot of water is put on a burner, then turned on, the water eventually boils. The burner's **heat** is a form of **energy**. Energy describes how things change or move. For example, energy is required to cook food – heat transfers from the burner to the pot to the water. As energy continues to be applied to the pot of water, the water will increase its temperature and eventually come to a boil. The boiling water then transfers energy to the food in order to cook it, such as making hard pasta and potatoes soft and edible.

Heat and temperature are not the same things. Heat is energy transferred and measured in units, including **joules, calories** and **British thermal units (BTUs)**. Objects or substances cannot have heat as heat is the measure of how energy transfers to or from an object or substance.

Temperature measures the average **kinetic energy** of molecules in Fahrenheit, Celsius or Kelvin. Kinetic energy is motion energy determined by the size and speed of the molecules. As the temperature increases, the kinetic energy of the particles increases because the molecules are moving faster. As the temperature decreases, the kinetic energy of the particles decreases because the molecules are moving slower.

Heat transfers in one of three methods: **conduction**, **convection** and **radiation**. In conduction, heat transfers when objects are in direct contact with or touching each other. For example, pancake batter poured on a hot grill or a steak placed on a hot cast iron pan is cooked by conduction. Convection transfers heat as the warmer gas or liquid rises, and the cooler gas or liquid sinks cyclically. For example, water in a pot is heated at the bottom of the pot. The hot water rises to the top, and the cooler water takes its place, where it is heated and then rises again. Radiation transfers heat indirectly or when the objects are not in direct contact with each other. For example, marshmallows roasted over a campfire or hot dogs on a grill are cooked by radiation.



When a water pot stands on a burner, heat radiates from the flame to the bottom of the pot. The bottom of the pot heats the water through conduction. The warmer water then rises to the top of the pot and releases energy. The water then cools and sinks back to the bottom to be warmed again in convection cycles.

Natural gas ranges and ovens are measured in British thermal units (BTUs), or the amount of heat energy needed to raise one pound of water temperature one degree Fahrenheit. The higher the BTU rating on a range or oven, the more energy can be transferred during the cooking process and the faster the temperature of the food can change.

Cooking with Natural Gas

Natural gas appliances such as commercial natural gas ranges and ovens typically have higher BTU ratings and larger capacities than natural gas appliances found in homes. Many professional chefs and commercial foodservice operators prepare food in a **batch cooking** method to take advantage of the higher amount of energy transfer while reducing the overall energy usage.

Batch cooking involves preparing food or ingredients for many meals and allows several servings of a meal to be prepared and cooked at one time. This enables chefs to consistently and quickly prepare individual meals, maintain the freshness of ingredients and minimize the waste of ingredients. In other scenarios, batch cooking allows several portions of meals to be prepared simultaneously, such as shops offering grab-and-go meals for busy consumers or large crowds in stadiums and universities.

Several steps in the process of batch cooking are the same, no matter the scenario:

- Determine the menu: Decide ahead of grocery shopping what meals will be cooked, the ingredients and how many portions.
- Food storage containers: If the portions will be served in a grab-and-go style or stored in the freezer, the correct container types are needed to preserve the meals and ingredient freshness.
- Buying ingredients at wholesale and in bulk: When possible, certain ingredients are more economical when bought in large quantities, especially those with long shelf lives, such as dried beans, rice and pasta.
- Prepping ingredients: If multiple recipes call for the same ingredient, prepare that ingredient all at once and then portion it into separate containers.
- Cook time and temperatures: Several different recipes can be put into the oven at the same time and temperature. To save on energy and time, utilize all the oven racks to maximize the amount of food cooked at once.



For example, today's recipe is pizza. If you were a chef preparing pizza for a large group, the menu would include how many portions of pizza will be made and the amount of dough, sauce, cheese and toppings needed. Large batches of pizza dough can be made at once and then split into smaller pieces. Similarly, large pots of sauce can be made at once, large amounts of cheese can be grated at once and large amounts of toppings can be sliced at once. Convection ovens with multiple racks can be utilized to bake several pizzas at one time. Unused portions of the ingredients can be stored in the freezer or refrigerator for later use.

Cooking Methods

There are three types of cooking methods that utilize natural gas:

- 1. Moist cooking involves cooking with moisture in either liquid or steam form.
- 2. Dry cooking involves cooking without any moisture.
- 3. Combination cooking combines moist and dry heat cooking.

Today, you will be learning about and preparing food using a dry cooking method.



Dry Cooking: Baking

Dry cooking methods include broiling, grilling, griddling, roasting, baking, sautéin, and deep-frying. Each technique utilizes dry, hot air or hot fat to cook the food. This lesson will utilize a convection oven and the dry cooking method.

A conventional oven has two burners that heat the air inside the oven to cook food. The burner at the bottom of the oven is used for most cooking and baking, while the burner at the top is mostly used for broiling. The dish closest to the active burner cooks the fastest.

Radiation carries the heat from the burners to the food. When cooking and baking, heat rises from the bottom burner, creating temperature gradients as well as hot and cool spots inside the oven. These differences in temperature cause food on other racks or even on different areas of the same rack to cook unevenly. Typically, in conventional ovens, food cooks faster at the top of the oven than at the bottom of the oven. A convection oven has a fan on the backside of the oven and an exhaust system that circulates hot air around the oven's cavity, reducing hot and cool spots, resulting in food that cooks more evenly on each rack. Heat is carried from the burners to the food by both radiation and convection cycles. Not only does the food cook more evenly on each rack, the food often cooks faster. This allows both time and energy to be saved when cooking with convection ovens. Some convection ovens have a third burner on the back of the oven to further increase efficiency. The amount of moisture in convection ovens is also typically lower than in conventional ovens, allowing food to be brown and crisp on the outside better in convection ovens while staying moist on the inside.



The gas convection oven baking chamber maximizes airflow with the built-in fan by directing heat and evenly channeling it through the entire oven cavity, resulting in even cooking/baking/ roasting throughout the entire cavity.

Baking and **roasting** are nearly identical methods of cooking that use dry, indirect heat for cooking foods. When baking or roasting in a convection oven, a fan's hot air is circulated to provide even cooking. Roasting applies to meats and vegetables, and baking applies to bread, pastries, cakes and cookies. Typically, baking uses lower temperatures than roasting.

Foods like bread, pies, cookies, pastries, cakes, pizza and whole fruits and vegetables cook well in baking. You will learn how to bake and use other dry heat forms to cook various proteins, vegetables and starches throughout your lessons on dry cooking.



Instructor Demonstration

Watch the instructor's demonstration on proper natural gas range safety and how to bake blueberry muffins. Answer the following questions as you watch the demonstration.

- What safety tips did the instructor give during the demonstration?
- At what temperature did the instructor set the oven?
- What tips did the instructor give about setting the temperature or time using a conventional versus convection oven?
- What tips did the instructor give with preparing the muffins?
- What tips did the instructor give about the types and quantities of muffin add-ins?
- How did the instructor determine how long to cook the muffins?
- How did the instructor determine when the muffins finished cooking?
- What tips did the instructor give about cooling the muffins before eating?
- What cooking tips did the instructor give during the demonstration?



Selecting and Preparing a Recipe

The following section can be completed at home if the preparing and cooking can be performed safely. Residential and commercial cooking equipment vary; while the information focuses on natural gas equipment, electric ranges and stoves may also be used to complete the cooking assignment.

Now you are going to make your blueberry muffins. You will select various ingredients, including flour, liquid, egg, and any optional add-ins.

Your teacher will review your recipe and dish based on the criteria listed below. If you are learning remotely, your teacher will provide you with instructions on how to submit your recipe and images or video(s) of your completed dish.

Criteria	Excellent	Proficient	Emerging
	3	2	1
Procedure	clearly followed	somewhat followed	did not follow given
	given instructions	given instructions	instructions and/
	and the example	and/or the example	or the example
	provided in the	provided in the	provided in the
	demonstration	demonstration	demonstration
Content	content and	included content	included little to no
(submitted photos,	explanations were	and explanation but	additional content or
procedure, videos,	thorough and well	included few specific	explanations and/or
etc.)	detailed	details	no specific details
Organization	organized when preparing and making their recipe	somewhat organized when preparing and/or making their recipe	not organized when preparing and/or making their recipe



Create Your Recipe

You will need to choose one item from the flour, milk, fat and egg categories for this recipe. You can choose to add any additional toppings or flavors based on your preference, dietary restrictions, allergies and available ingredients. Before starting to cook, it is important to have all of your ingredients, tools and equipment prepared ahead of time, what chefs call "mise en place" or "everything in its place."

Select a flour:	Select a milk:	Select an egg:	Select optional add-ins or flavors:	
All-purpose flour	Milk	Large eggs	Fruit such as blueberries,	
Whole wheat flour	Buttermilk	Flax eggs	cherries	
A blend of whole wheat and all-	Plain or vanilla unsweetened	Aquafaba	Chocoate or carob chips	
purpose flour	non-dairy	(see tips)	Dried fruit such as raisins, currants, berries, cherries, apples, pineapple or mango	
1-to-1 gluten- free flour	milk such as almond or soy			
			Spices such as cinnamon, nutmeg or pumpkin pie spice	
			Chopped nuts such as walnuts or almonds	
			Additional flavorings such	

Additional flavorings such as chopped crystalized ginger, lemon zest or almond extract

Safety first:

- Always keep a Class ABC fire extinguisher nearby.
- Always use dry, flame-retardant potholders to protect your hands from burning.
- Never use wet or moist potholders, oven mitts or towels as they will conduct heat, burning your hands.
- Practice knife safety when cutting any ingredient and use properly sharpened knives.



Equipment:

- regular-sized muffin tin or mini muffin tin
- regular-sized muffin tin liners or mini muffin tin liners
- two medium-sized mixing bowls
- spatula or large spoon or hand mixer
- whisk or hand mixer
- dry measuring spoons and cups
- liquid measuring cups

Ingredients:

- 1 ³/₄ cup flour of choice
- ½ teaspoon baking soda
- 1 teaspoon baking powder
- 1⁄2 teaspoon kosher salt
- ³⁄₄ cup sugar
- ½ cup butter or oil
- ¾ cup milk of choice
- 2 eggs of choice
- 1 teaspoon vanilla extract
- 1 ½ cups add-ins such as blueberries
- if using dry spices such as cinnamon, add about ½ teaspoon

Procedure:

- 1. Preheat the oven to the temperature indicated by the instructor or to 400°F.
- 2. Line the muffin tin with liners.
- 3. Combine the flour, baking soda, baking powder and salt in one mixing bowl. Whisk gently together or use the hand mixer on low speed to evenly incorporate the ingredients and remove any lumps.
- 4. Combine the sugar, oil, milk, eggs and vanilla extract in the other mixing bowl. Whisk, use the spatula, or use the hand mixer to beat the ingredients together at medium to high speed.
- 5. Pour the wet ingredients into the dry and mix using the spatula, large spoon or mixer on low speed until the mixture comes together.
- 6. Spoon the batter evenly into the prepared muffin tin.
- 7. Bake regular-sized muffins for 20-25 minutes or mini muffins for about 10-12 minutes, until the tops are dry and golden brown.



Tips:

- If using fresh fruit such as blueberries, dust the berries with a bit of flour so they don't sink to the bottom of the muffins.
- Mix the ingredients until they are only just incorporated. Over-mixing the batter can lead to dense and rubbery muffins.
- To make one flax egg, mix 1 tablespoon of flaxseed meal (ground flaxseed) and 3 tablespoons of water in a small bowl. Set aside for 10-15 minutes until the mixture has somewhat congealed before using. For two flax eggs, double the amount of flaxseed meal and water.
- Aquafaba is the liquid found in cans of chickpeas and has properties that make it suitable for egg replacement in certain recipes. Three tablespoons of aquafaba replace one egg. For two aquafaba eggs, use 6 tablespoons of aquafaba.
- Buttermilk substitute can be made by combining milk or non-dairy milk with lemon juice or white vinegar in the ratio of 1 cup of milk to 1 tablespoon of lemon juice or vinegar. For ¾ cup of liquid, use ¾ cup milk or nondairy milk and ¾ tablespoon of lemon juice or vinegar.
- While sugar is a dry ingredient, it is often considered a wet ingredient when baking.



Activity

After you finish baking your muffins, you may wonder what different ingredients play in baking the muffins. Predict what may happen if the following ingredients were omitted from the recipe.

Ingredient Baking soda	Prediction
Flour	
Sugar	
Baking powder	
Eggs	
Milk	
Salt	



Final Assessment

- 1. What is temperature?
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 - c. cooking each ingredient separately
 - d. cooking using many appliances at a time
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Introduction to Cooking with Gas—Advanced Lesson 4: Baking Teacher Guide

(1-2 class sessions depending on setting)

Introduction

This lesson covers a basic understanding of how energy is transferred during cooking. Students will learn how natural gas is used in a convection oven to bake muffins. Keep in mind that students may have dietary preferences, restrictions or allergies that may need to be accommodated to complete the recipe. Note that students may have different appliances at home, such as an electric or induction range, which will not prevent them from completing the assignment. If the student is preparing food at home, ensure that appropriate adult supervision will be available.

This lesson could be completed in a classroom or at home. Suggestions and instructions will be given for both scenarios.



Opening Assessment Answer Key (3 minutes)

Use these questions to obtain a baseline for what your students know before beginning the lesson. The correct answers are highlighted.

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How Is Energy Transferred During Cooking?

(5 minutes)

Students will read about the different ways energy is transferred during the cooking process, including conduction, convection, and radiation. The following questions could be used for a class discussion or given to students to complete individually.

- What is the difference between temperature and heat?
- What are the different ways heat can be transferred?
- What is the difference between heat being transferred through direct contact versus indirect contact?
- How do conduction, convection, and radiation differ?
- What are examples of conduction, convection, and radiation?

Cooking with Natural Gas (4 minutes)

Students will read about the benefits of batch cooking and how professional chefs and foodservice operators utilize it. The following questions could be used for a class discussion or given to students to complete individually.

- What is batch cooking?
- What are the benefits of batch cooking in a restaurant?
- What are the benefits of batch cooking for large crowds?
- What are the steps of batch cooking?

Cooking Methods (2 minutes)

Students will understand that there are three cooking methods that utilize natural gas: moist cooking, dry cooking and combination cooking.

Dry Cooking: Baking (4 minutes)

Students will read about cooking with dry heat and the baking technique. The following questions could be used for a class discussion or given to students to complete individually.

- What are the benefits of cooking with dry heat?
- What is the difference between baking and roasting?
- How does heat transfer during baking?
- How do convection ovens differ from conventional ovens?



Instructor Demonstration (7 minutes)

The demonstration can either be performed in class or recorded for remote use. If the demonstration is done in person, consider preheating the ovens while the students complete their readings so that the ovens will be at the proper temperature in time for your demonstration.

You may also consider preheating the ovens during this time so that the students will be able to cook along with the demonstration. Or have the students preheat their ovens during the demonstration to begin cooking after the demonstration, instead of waiting for the ovens to come to the proper temperature.

The demonstration should include:

- how a gas convection oven works
- safety tips when using a gas convection oven
- how to bake, including tips for how different temperatures affect how items bake
- benefits of using baking as a cooking technique
- how to bake muffins, noting how to check the muffins for doneness
- how to line the muffin tins with liners or how to grease the muffin tin cups
- tips for types and amount of add-ins and flavorings to include in the recipe
- why muffins should be put into the oven quickly after mixing the wet and dry ingredients
- knife techniques and safety when cutting ingredients

Students will use the following questions as a guide to either a class discussion after the demonstration or note taking during the demonstration:

- What safety tips did the instructor give during the demonstration?
- At what temperature did the instructor set the oven?
- What tips did the instructor give about setting the temperature or time using a conventional versus convection oven?
- What tips did the instructor give with preparing the muffins?
- What tips did the instructor give about the types and quantities of muffin add-ins?
- How did the instructor determine how long to cook the muffins?
- How did the instructor determine when the muffins finished cooking?
- What tips did the instructor give about cooling the muffins before eating?
- What cooking tips did the instructor give during the demonstration?



Selecting and Preparing a Recipe (30 minutes)

If the students are cooking in the classroom, ensure that the ingredients are available ahead of time. If timing is a concern, consider having students make mini muffins to take less time to bake. Make sure that student allergies, dietary restrictions and preferences are taken into account. Also, be sure to plan a few minutes at the end of class for cleanup.

If the students are cooking at home, be sure to provide the ingredients or the "mise en place" ahead of time to give the students time to assemble the ingredients. Consider the time the recipe typically takes to cook and the ability for students to purchase their ingredients from the grocery store.

Students will use the instructor demonstration as a guide to cooking their muffins. Students will select their ingredients, including flour, fat, milk, egg and optional flavorings, and add-ins from a list to complete their recipe.

Students cooking at home can submit a description of the ingredients and procedure they used along with pictures of their completed dishes or a video of themselves cooking the recipe. Be sure to share instructions with your students on what to submit and how to share it with you.

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	3	2	1
Procedure	clearly followed given	somewhat followed given	did not follow given
	instructions and the	instructions and/or the	instructions and/or the
	example provided in the	example provided in the	example provided in the
	demonstration	demonstration	demonstration
Content (submitted photos, procedure, videos, etc.)	content and explanations were thorough and well detailed	included content and explanation but included few specific details	included little to no additional content or explanations and/or no specific details
Organization	organized when preparing and making their recipe	somewhat organized when preparing and/or making their recipe	not organized when preparing and/or making their recipe

Scoring Rubric:



Activity (10 minutes or as homework)

Students will write down their predictions if certain ingredients were omitted from the muffin recipe.

Ingredient	Prediction	
Baking soda	Baking soda is a leavener, and it reacts with acids that affect the flavor and browning of baked goods. Without baking soda, the muffins won't rise properly, and the taste and browning of the muffins will not be right.	
Flour	Flour provides structure in baked goods. Without flour, the muffins will most likely fall apart.	
Sugar	Sugar not only provides sweetness and flavor to a recipe, but it also affects the texture, rising and color of baked goods. Without sugar, there could be several issues with the muffins.	
Baking powder	Baking powder is a leavener with a built-in acid to react when heat and/or liquids are added. Without baking powder, the muffins won't rise properly, and the taste can be affected.	
Eggs	Eggs bind ingredients together and provide leavening in baked goods. Without eggs, the muffins may not rise properly and may crumble and not hold together very well.	
Milk	Milk adds flavor, color and texture to baked goods. Without milk, the muffins may be dry, lacking in flavor or lacking in texture.	
Salt	Salt is used as a flavor enhancer for other ingredients, and it also reacts with other ingredients to ensure the baked goods have the right texture and strength. Without salt, the muffins may taste bland, or the texture may not be quite right.	



Final Assessment: Answer Key (3 minutes or as homework)

Use these questions in conjunction with the discussion questions in each section to formatively assess student growth over the course of the lesson. Address any student misconceptions that remain at the end of the lesson. Consider having students compare their opening assessment with their final assessment to see how their understanding of cooking with gas improved over the course of the lesson.

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