



Introduction to Cooking with Gas

Lesson 3: Steaming

ADVANCED



Introduction

Welcome to Introduction to Cooking with Gas. Today's topic is understanding steam and how to use steam safely. Once you learn about steam, you will learn how to cook with gas to make your own delicious steamed green vegetable dish.

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 steam?
 - a. boiling liquid water
 - b. heated air
 - c. water vapor
 - d. condensed air
2. Why is steam more dangerous than boiling water?
 - a. Steam is hotter than boiling water.
 - b. Steam is more likely to catch fire than water.
 - c. Steam is poisonous.
 - d. Steam transfers more heat than boiling water.
3. Why is a natural gas leak dangerous?
 - a. It is poisonous.
 - b. It can cause an electrical fire.
 - c. It can aid the growth of bacteria.
 - d. It can cause an explosion.
4. What type of equipment could you use to steam vegetables?
 - a. a shallow pan and spatula
 - b. a baking sheet and parchment paper
 - c. a mixer and mixing bowl
 - d. a deep covered pot and a basket
5. What is the best way to know if your steamed green vegetable is perfectly cooked?
 - a. Its color becomes brighter.
 - b. It breaks apart.
 - c. It is mashed.
 - d. It is wilted.

What Is Steam?

Water is made up of hydrogen and oxygen atoms bonded together into water **molecules**. Molecules are small groups of atoms bonded together; they represent the smallest unit of a compound. Water can exist in each of the three phases of matter: solid, liquid or gas. Adding or removing heat (energy) from the molecules allows the water molecules to undergo a **phase change**. If liquid water is heated to its boiling point of 212° F, the water undergoes a phase change from liquid water to water **vapor** (vapor is another name for gas). **Steam** is also used to refer to water vapor.



In each phase, the water molecules behave differently. The less heat energy the water molecules have, the closer together each molecule is to the others.

Let's examine the spacing of molecules in a **solid**, a **liquid** and a **gas**. In the solid phase, the molecules stay close to one another and vibrate in place. In the liquid phase, the molecules slip past one another but remain close together. Think about molecules in the liquid state like

trying to walk through a crowded space: You can walk around the area, but you are likely to bump into others and move in all directions. In the gas phase, the molecules have gained enough heat energy that they are able to move around freely and rarely bump into one another. Molecules in the gas phase will spread out to fill whatever container they are in. These molecules have enough energy to escape from the surface of the liquid water and become water vapor.

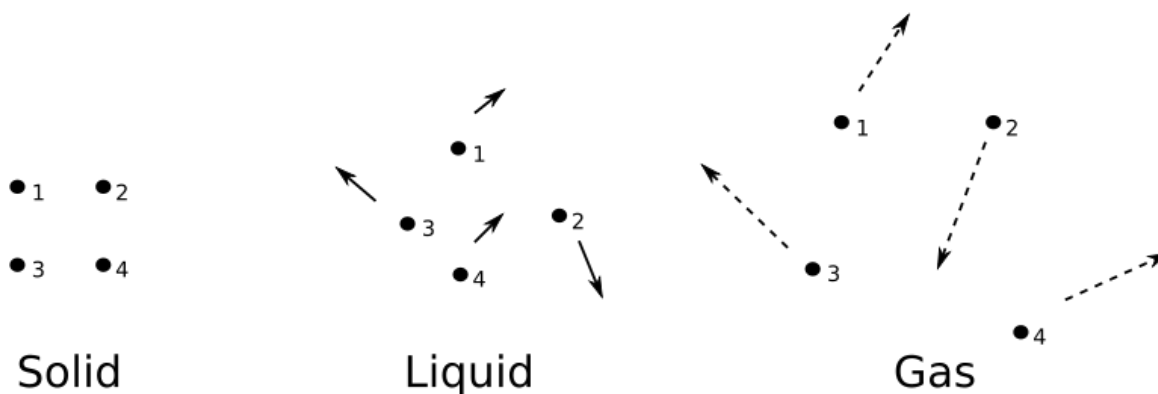


Image credit [Sadi Carnot](#)

Once liquid water is heated to its boiling point, the molecules of water have gained enough energy to escape from the surface of the water and spread out, moving upward and outward.

Of course, liquid water cannot change into water vapor unless the liquid water is heated to its boiling point. The movement of heat is called **heat transfer**. Heat transfer is always from a warmer object to a cooler object.

There are three kinds of heat transfer:

- **Conduction** occurs when objects are in contact and heat flows from the warmer object to the cooler object.
- **Convection** occurs when currents of warm gases or liquids flow into a cooler region, carrying the energy with them.
- **Radiation** occurs when electromagnetic waves transfer energy from a warmer object to a cooler object across a distance.

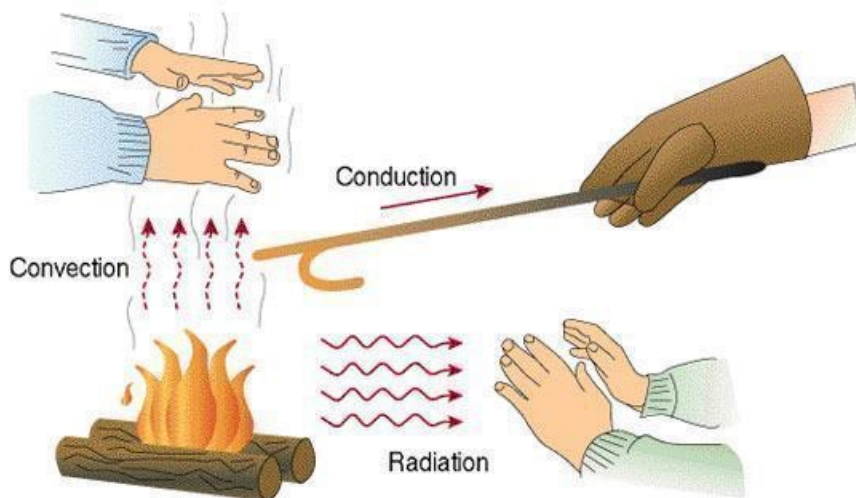


Image credit [Kmecfiunitl](https://www.kmefiunitl.com)

Let's identify the kinds of heat transfer that occur when liquid water is boiled in a pot to produce steam (water vapor). A natural gas burner can be used for the source of heat. This is the heat transfer that occurs:

- The natural gas burner is in contact with the pot, so heat moves from the burner to the pot by conduction.
- The pot is in contact with some of the liquid water, so heat moves from the pot to some of the liquid water by conduction.
- The liquid water that is heated moves upward in a current and heats the rest of the liquid water in the pot. This is heat transfer by convection.

- When the water is hot enough to boil, steam is produced. The steam moves upward in a current and heats the surrounding air by convection.
- In addition, electromagnetic waves spread out from the burner, the pot, the hot liquid water and the steam and heat the surroundings. This is heat transfer by radiation.

The more energy that is transferred in the form of heat, the hotter an object becomes. However, temperature is not the only factor that determines how much heat is transferred.

For example, the water vapor that makes up steam is at the same temperature as the boiling liquid water: 212°F. Each molecule in water vapor has more energy than each molecule in the boiling liquid water. This additional energy is the energy the molecules in the vapor gained when they overcame the attractive force between molecules in the liquid phase.

The additional energy gained by the molecules in water vapor is called the **heat of vaporization**. Because of the heat of vaporization, a set mass of steam will transfer more energy than the same mass of boiling liquid water.

The greater amount of heat transferred by steam (water vapor) means it can cook food more quickly than boiling water. But it also means that steam is more dangerous than boiling water. Steam can cause severe burns. Take care to avoid exposing your skin to steam.

Cooking with Natural Gas



Natural gas is an inexpensive and efficient source of heat when it is lit on fire. Natural gas is stored in containers and transported along connecting tubes when needed for heat.

What happens if there is a leak in the containers or tubes that contain natural gas? A buildup of natural gas can cause an explosion.

But even a small amount of natural gas is dangerous. Like water vapor, natural gas can spread out through the air because it is in the gas phase. Natural gas will replace some of the oxygen in the air that people need. Reduced oxygen can cause headaches, dizziness, tiredness, eye and throat irritation, nausea and difficulty breathing.

Because of the dangers of natural gas, it is important to be on the alert for gas leaks. Natural gas has an additive, called mercaptan, that smells like rotten eggs. This smell can tell you that there is a gas leak. Other signs that there is a gas leak are a hissing sound, damage to a natural gas container or connecting tube, or house plants that die without an apparent cause.

Be sure you know how to turn off the gas supply in the kitchen. If you suspect that there is a gas leak, turn off the gas supply, ensure that all people leave the building and call the gas company or the authorities.

Another danger is fire, which can be caused by heat, either from a range or an electrical appliance. Flames or heat from a burner can ignite a **flammable** material that was placed too close. A flammable material is a material that can easily catch fire when placed in a flame. Heated oils or grease can catch on fire or can also ignite a flammable material that was placed too close. Another kind of fire that can occur in any location in the home is a fire in electrical wiring, either in a cord or inside an appliance.

Prevent kitchen fires using these precautions:

- Wear clothing and sleeves that are close fitting when cooking, and tie back long hair.
- Keep flammable objects such as potholders, thermal mitts, papers, towels and clothing away from heat sources.
- Keep the rangetop and adjacent counters clear.
- Always remain in the kitchen when food is cooking, and if you leave the kitchen, turn off all burners.
- Use a timer or thermometer as needed so that food does not overheat, especially oils and grease.
- Never place hot oils and grease in the garbage.
- Replace worn out appliance cords or plugs.
- If you have frayed or worn appliance cords or plugs, have them replaced.
- Unplug small appliances when not in use.
- Do not use extension cords with appliances.
- Secure burner controls if children are in a kitchen.

If a SMALL fire occurs in a flammable material or in an appliance, and ONLY if it is safe to do so, turn off the heat source or close any door to the appliance. Use ONLY an upside-down pan, baking soda, salt or a dry chemical fire extinguisher to smother the flame. Do not use water because if there is hot oil or grease the fire could splatter and spread. Do not use any other foods to smother the flame, as they are also flammable. Never carry or move anything that is burning.

If you cannot approach the fire safely, evacuate immediately and call 911.

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 moist cooking method.

Moist Cooking: Steaming

Moist cooking methods include poaching, simmering, boiling, steaming and blanching. Each method utilizes liquid or steam in order to cook the food. This lesson will utilize a **range** or **rangetop** and the steaming cooking method. A natural gas range or rangetop in commercial kitchens is either found in combination with an oven or as a separate appliance built into a countertop. The burners are connected to a gas line with a valve controlled by a knob. To turn on the burner, the knob is turned to the ignition setting to start the flow of gas and produce a spark to ignite the gas. The size of the flame is controlled by the knob, which adjusts the temperature of what you are cooking.

The steaming can be carried out on the range or rangetop using a **steamer**. A steamer is a deep pot with a clear tight-fitting lid and a basket that can hold the food above the bottom of the pot. A small amount of water is added to the bottom pot, and the water is heated until it is boiling. The steam then rises and cooks the food in the basket. The basket can be made of metal or bamboo. Sometimes multiple baskets are placed above the boiling water.



Image credit [Kowloonese](#)

Foods like root vegetables and green vegetables cook well by steaming. Because steamed vegetables are not immersed in water, they retain more nutrients and flavor than other methods of cooking. Steam also cooks food rapidly. You will learn how to utilize steam, as well as other forms of moist heat, to cook various proteins, vegetables and starches throughout your lessons on moist cooking. Using natural gas enables the cook to quickly control the amount of heat transferred to the pan by increasing or decreasing the flames. The water can be kept boiling at a steady rate.

Instructor Demonstration

Watch the instructor demonstration on proper natural gas range safety and how to boil water to produce steam and cook root vegetables. Answer the following questions as you watch the demonstration.

- What safety tips did the instructor give during the demonstration?
- How much water did the instructor put into the pot?
- How high did the instructor have the flame underneath the pot?
- How did the instructor determine how long to cook the green vegetables?
- 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 own delicious steamed green vegetable dish using kale or asparagus. Once steamed, the green vegetables can be mixed with a little butter or olive oil. You can optionally add other fresh vegetables, proteins or flavorings.

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 3	Proficient 2	Emerging 1
Procedure	clearly followed given instructions and the example provided in the demonstration	somewhat followed given instructions and/or the example provided in the demonstration	did not follow given instructions and/or the example provided in the 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

Create Your Recipe

For this recipe you will need to choose one item from the green vegetable and one item from the fat categories. You can choose to add additional flavorings and ingredients based on your dietary preferences, restrictions or 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 green vegetable:

1/2 lb. kale
1/2 lb. asparagus

Select a fat (1 tbsp):

olive oil
butter

Select extra flavorings (optional):

1/4 tsp black pepper
1/4 tsp chili flakes
1/2 tsp chives
1/4 tsp dill
1/4 tsp rosemary
1/4 tsp tarragon
1/2 tsp salt
1 tbsp bacon crumbles
1 tbsp lemon juice
1 tsp roasted garlic
1 tsp scallions
1 tsp vinegar

Safety first:

- Always keep a Class ABC fire extinguisher nearby.
- Only add 1 inch of water to the pot.
- Make sure there are no pot holders, towels or other flammable materials next to the burner.
- Make sure there are no plastic or meltable objects next to the burner.
- Always use dry thermal mitts to protect your hands from being exposed to steam.
- Always use dry pot holders to protect your hands from being burned on the hot pot.
- Never use wet or moist potholders, oven mitts or towels, as this will conduct heat, burning your hands.
- Never lean over a pot that contains boiling water.
- If you need to open a pot that contains steam, open the lid away from you and let the built-up steam escape before adding or removing food.
- Always pour hot liquids away from you.
- Practice knife safety when cutting foods, and use knives that are properly sharpened.

Equipment:

- deep pot with a clear tight-fitting lid
- thermal mitts
- pot holders
- steamer basket with retractable handle that will fit inside the pot and can hold the food right above the level of the boiling water
- large fork or tongs
- gas range or cooktop
- large knife
- cutting board

Ingredients:

- choice of green vegetable
- choice of fat and other toppings
- water

Procedure:

1. Rinse the green vegetables.
2. Cut the green vegetables into bite-size pieces using the knife and cutting board. Discard any woody stems or ends.
3. Arrange the green vegetables in the steamer basket, with the larger pieces on the bottom.
4. Add water to the pot until it is about 1 inch deep.
5. Place the pot on the burner and then turn the burner on and move the knob to high.
6. When the water comes to a boil, place a thermal mitt on your hand and place the steamer basket in the pot using the retractable handle.
7. Place the lid on the pot and reduce heat to medium-low.
8. Set the timer between three and five minutes. Use a shorter time for crisper vegetables and a longer time for softer vegetables.
9. Watch the pot to make sure that steam is produced and that the water does not dry out.
10. When the timer goes off, examine the vegetables. If they are done, the color should be brighter.

11. Remove the lid, place a thermal mitt on your hand and remove the steamer basket from the pot using the retractable handle.
12. Replace the lid on the pot.
13. Completely drain the water from the vegetables.
14. Toss the desired amount of oil or butter with the vegetables. Taste and add seasonings if needed based on your preference.
15. Serve immediately.

Tips:

- If you prefer, add herbs to the boiling water for a more subtle taste.
- Put a lid on your pot while the water is heating to bring it to a boil faster.
- If the vegetables are not done enough for your taste, reboil the water and place the basket back in the pot for additional steaming.
- If a steamer basket is not available, a metal colander can be used in a deep covered pot. If a metal colander is not available, three foil balls can be made and placed as legs in the pot with a heat-proof plate on top. The rotating plate in a microwave is a heat-proof plate. If you are using these alternate equipment setups, allow the hot water in the pot and the vegetables to cool before removing the vegetables, for safety.

Activity

After you complete cooking your green vegetable dish, respond to one of the two questions that follow, as assigned by your teacher.

1. Now that you know how steamed foods are prepared and how they appear, what other foods have you eaten in the past that were prepared by steaming? Describe the steamed food and explain why you think it was steamed.
2. Steaming is better than boiling because steamed vegetables have more flavor and nutrients. What happens to nutrients when a green vegetable is placed in boiling water and when it is placed in steam? Include text and drawings in your answer.

4	3	2	1
<p>The student response ...</p> <ul style="list-style-type: none">• fully responds to each part of the writing prompt with relevant, strong details• has logical organization• uses effective language and word choice for purpose and audience• contains no errors in usage or grammar	<p>The student response ...</p> <ul style="list-style-type: none">• addresses each part of the writing prompt with sufficient details• has sufficient organization• uses mostly effective language and word choice for purpose and audience• contains minor errors in usage or grammar that do not affect meaning	<p>The student response ...</p> <ul style="list-style-type: none">• addresses some of the writing prompt with weak details• attempts organization• uses some language and word choice for purpose and audience• contains minor errors in usage or grammar that slightly affect meaning	<p>The student response ...</p> <ul style="list-style-type: none">• does not address a large portion of the writing prompt• lacks organization• rarely uses appropriate language and word choice for purpose and audience• contains major errors in usage or grammar that greatly affect meaning

Final Assessment

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 - b. heated air
 - c. water vapor
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3. Why is a natural gas leak dangerous?
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 - c. It can aid the growth of bacteria.
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4. What type of equipment could you use to steam vegetables?
 - a. a shallow pan and spatula
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 - c. a mixer and mixing bowl
 - d. a deep covered pot and a basket
5. What is the best way to know if your steamed green vegetable is perfectly cooked?
 - a. Its color becomes brighter.
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Introduction to Cooking with Gas—Advanced

Lesson 3: Steaming

Teacher Guide

(1-2 class sessions depending on setting)

Introduction

This lesson covers a basic understanding of phase change and heat transfer. Then, students will learn how natural gas is used on a rangetop to boil water and steam green vegetables. Keep in mind that students may have dietary preferences, restrictions or allergies that may need to be accommodated in order for them to complete the recipe. Note that students may have different types of appliances or equipment at home, such as an electric or induction range or a colander or foil, 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 and that the student uses the alternate equipment safely.

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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What Is Steam? (10 minutes)

Students will read about phase change and heat transfer. The following questions could be used for a class discussion or given to students to complete individually.

- What are the three phases of matter?
- In what ways are phases of matter alike? In what ways are they different?
- What phase of matter is steam?
- In what direction does heat flow?
- Why is steam dangerous?

Cooking with Natural Gas (8 minutes)

Students will read about the dangers in the kitchen that relate to a natural gas leak and to heat. The following questions could be used for a class discussion or given to students to complete individually.

- What are the dangerous outcomes of a natural gas leak?
- What is one way that you would know that there is a natural gas leak?
- What are flammable materials? What is an example of a flammable material?
- Should you use water to put out a kitchen fire? Why or why not?

Cooking Methods (2 minutes)

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

Moist Cooking: Steaming (4 minutes)

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

- How are boiling and steaming different?
- What is an advantage of cooking with steam?
- How does using a natural gas burner help control the amount of heat transferred to the water?

Instructor Demonstration (6 minutes)

The demonstration can either be performed in class or recorded for remote use. If the demonstration is done in person, cut most of the vegetables ahead of time so that they are ready for steaming, and start boiling the water for your demonstration while the students complete their readings. Keep some of the green vegetables whole to illustrate how to chop in your demonstration.

The demonstration should include:

- how a gas range/range works
- safety tips when using a gas range/range
- how to prepare the vegetables in equal sizes so that they cook at the same rate
- how to use a steamer
- benefits of using steaming as a cooking technique
- how to determine if the green vegetables are done
- adding butter or oil and flavorings to the steamed green vegetables
- how to use a knife to cut ingredients safely

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

- What safety tips did the instructor give during the demonstration?
- How much water did the instructor put into the pot?
- How high did the instructor have the flame underneath the pot?
- How did the instructor determine how long to cook the green vegetables?
- What cooking tips did the instructor give during the demonstration?

Selecting and Preparing a Recipe (9 minutes)

If the students will be cooking in the classroom, ensure that the ingredients are available to the students ahead of time. 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 will be cooking at home, be sure to provide the list of ingredients or the “mise en place” ahead of time to give the students time to assemble the ingredients. Take into consideration 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 cook their own steamed green vegetable dishes. Students will select a green vegetable, a fat and optional flavorings from a list in order to complete their recipe. Cut up vegetables ahead of time for students.

Students cooking at home can submit a description of the ingredients and procedure they used along with pictures of their completed recipe 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.

Scoring Rubric:

Criteria	Excellent 3	Proficient 2	Emerging 1
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Activity (5 minutes or as homework)

The questions in this activity are provided to be used either in the classroom during any down-time or as homework. Allow students to choose which prompt they want to research.

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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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