



# Introduction to Cooking with Gas

Lesson 1: Boiling

**ADVANCED**



## Introduction

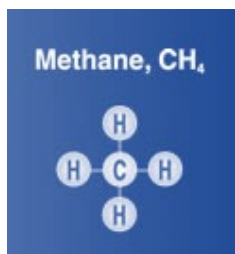
Welcome to Introduction to Cooking with Gas. Today's topic is understanding what natural gas is and where it comes from. Once you learn about natural gas, you will learn how to cook with gas to make your own delicious potato dish.

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 natural gas?
  - a. a fossil fuel
  - b. an atmospheric gas
  - c. an elemental fuel
  - d. residue from burning coal
2. What does "boiling" mean?
  - a. the bubbling of a liquid
  - b. the temperature of a liquid
  - c. the phase change between liquid and gas
  - d. the amount of heat transferred to a liquid
3. What is an advantage of using natural gas over other energy sources?
  - a. Natural gas is a renewable energy source.
  - b. Natural gas is versatile and has many uses.
  - c. Natural gas is easier to obtain than other energy sources.
  - d. Natural gas can produce more energy than all other sources.
4. What type of equipment do you use to boil water to cook food?
  - a. a shallow pan
  - b. a baking sheet
  - c. a mixing bowl
  - d. a deep pot
5. What is the best way to know if your potatoes are perfectly cooked?
  - a. by sticking a fork in them
  - b. by seeing if they just start to break apart
  - c. by checking the temperature of the water
  - d. by using a timer

# What is Natural Gas?

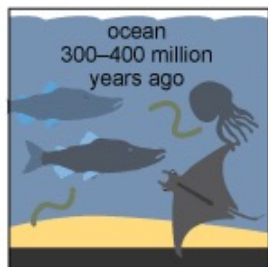


**Natural gas** is formed deep underground. Natural gas is used for cooking, heating and cooling, among other things. Many power plants also use natural gas to generate electricity. It is a gas that is primarily made of methane. Methane is made of one carbon atom and four hydrogen atoms and is written as CH<sub>4</sub>. **Methane** is a type of **hydrocarbon fuel**, which is a fuel made up of hydrogen and carbon atoms. Other fossil fuels such as coal and petroleum are also hydrocarbon fuels. Each hydrocarbon fuel has a different number of carbon and hydrogen atoms.

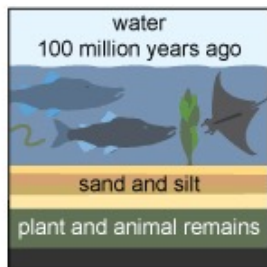
Natural gas is a colorless and odorless **fossil fuel** in its natural state. Fossil fuels formed over hundreds of millions of years ago from the remains of plants and animals deep within Earth's surface. The remains were buried under thick layers of sand, silt and rock. As the remains underwent increasing amounts of heat and pressure, the organic material (carbon, hydrogen, nitrogen and oxygen) turned into coal, oil and natural gas. Due to the very long time and specific conditions needed for fossil fuels to form, they are considered **nonrenewable resources**. Fossil fuels are removed from the deep layers of rock and refined to be used for various purposes, including producing energy.

## Petroleum and natural gas formation

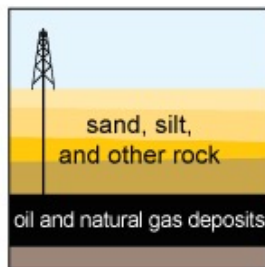
Tiny marine plants and animals died and were buried on the ocean floor. Over time, the marine plants and animals were covered by layers of silt and sand.



Over millions of years, the remains were buried deeper and deeper. The enormous heat and pressure turned the remains into oil and natural gas.



Today, we drill down through layers of sand, silt, and rock to reach the rock formations that contain oil and natural gas deposits.



Source: Adapted from National Energy Education Development Project (public domain)

Image from the [EIA](#)

In its natural state, natural gas is colorless and odorless, which makes it difficult to detect if there is a gas leak. Natural gas leaks are unsafe because it is harmful to breathe in natural gas and the fumes can also cause fires and explosions if ignited. Therefore, all natural gas used for energy is mixed with a gas called **mercaptan** (CH<sub>4</sub>S), which adds a foul odor similar to rotten eggs. This helps people detect if there is a natural gas leak in their home. Natural gas is not safe to breathe and the added odors allow people to detect and trace the source of the leak so that it is quickly repaired.

## Cooking with Natural Gas

Natural gas is the preferred fuel source for cooking by both commercial foodservice operators and professional chefs. It is adjustable, abundant, reliable and is more cost-effective and energy efficient.

There are several fuels to power cooking appliances in commercial kitchens: natural gas, electricity and induction. Each of these types of appliances has their advantages and disadvantages, but natural gas is seen as the preferred standard for cooking appliances, particularly ranges, ovens and fryers.

Natural gas also offers flexibility when controlling the temperature – the heat can instantly be turned on or off and the temperature can be precisely controlled. Electric stoves, for example, take time to heat up and cool down, and any changes in temperature take additional time. The ability to quickly turn a natural gas stove on or to adjust the temperature by changing the size of the flame allows cooking times to decrease, which also leads to higher efficiencies. The ability to precisely control the temperature is also important for the heat to be evenly distributed while cooking or baking.

Most natural gas stoves can also be used during power outages, even though most stoves use electric burner ignitors. A match can be used carefully to light the gas and allow you to cook on a stovetop. Note, however, that natural gas ovens use additional electric components to function and will not be usable during a power outage. It is never advised to stick a match in a gas oven.

Investing in energy efficient natural gas cooking appliances whenever possible can not only lower your energy bills each month but allows for less time for the appliances to be used while cooking. It is also important that gas appliances be properly maintained to avoid gas leaks.



# 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: Boiling

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 stovetop and the boiling cooking method. A natural gas **range** or **stovetop** 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 controls the temperature of what you are cooking.



The amount of heat energy a gas stove has is measured in British thermal units (BTUs). **BTUs** are defined as the amount of heat needed to raise the temperature of one pound of water one degree Fahrenheit. Each gas range can have a different amount of BTUs, and each burner on a gas range can also have different amounts of BTUs. This is important to keep in mind as varying amounts of BTUs can lead to different cook times: the higher the BTU, the higher the temperature the stove can get and the faster the water will boil or the food will cook.

Water boils when it reaches a temperature of 212°F. **Boiling** is the result of a **phase change** when the water changes from liquid to gas. The water in the pot will continue absorbing heat from the flame but its temperature will not rise above 212°F. Instead, the water will change into steam.

Water is typically boiled in a pot for use in cooking. When water boils you will see many large, rapidly forming bubbles in the pot – this is when the water is ready for use in your recipe!

Foods like root vegetables, pasta and eggs cook well in boiling water. You will learn how to utilize boiling water, as well as other forms of moist heat, to cook various proteins, vegetables and starches throughout your lessons on moist cooking.

## **Instructor Demonstration**

Watch the instructor demonstration on proper natural gas stove safety and how to boil water to cook potatoes. 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 potatoes?
- 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 potato dish using a type of potato. Once cooked, the potatoes will be tossed with a little butter or olive oil. You can optionally toss the potatoes with some additional 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 of your completed dish.

| Criteria   | Excellent<br>3  | Proficient<br>2   | Emerging<br>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<br>(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 potato list and one item from the fat categories. You can choose to add any additional toppings or flavors based on your dietary preferences, allergies and available ingredients. Before starting to cook, it is important to have all of your ingredients, tools and equipment prepared – what chefs call “mise en place” or “everything in its place.”

### Select a potato:

Small baby potatoes, all approximately the same size, approximately 1-2 inches in length

Large sweet potatoes, cut into even, 1-inch pieces

Large potatoes, cut into even, 1-inch pieces

### Select a fat:

olive oil

butter

### Select extra flavors and toppings (optional):

black pepper or chili flakes  
fresh chives or rosemary, finely chopped  
grated cheddar cheese  
your favorite dried spice blend  
steamed broccoli  
cooked and chopped bacon  
canned black beans, drained and rinsed  
fresh chopped garlic or garlic powder  
caramelized onions  
salsa

### **Safety first:**

- Always keep a Class ABC fire extinguisher nearby.
- 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, flame-retardant potholders to protect your hands from burning on the hot pot.
- Always pour hot liquids away from you.
- Never use wet or moist potholders, oven mitts or towels as this will conduct heat, burning your hands.

### **Equipment:**

- a large pot (a general rule is 4-5 quarts of water in a 6-8 quart pot for one pound of dried pasta)
- pot holders
- colander
- a large spoon or tongs
- a fork
- a gas range or cooktop

### **Ingredients:**

- choice of potato
- choice of fat and other toppings
- water
- salt (approximately 1 tablespoon per 4 quarts of water depending on the type of salt –use a little more if using kosher salt or slightly less if using table salt or sea salt)

### **Procedure:**

1. Put the whole baby potatoes or pieces of larger potatoes in a large pot. Fill with cold water until the potatoes are covered by at least 1 inch, then stir in the salt.
2. Place the pot on the burner, then turn the burner on and move the knob to high.
3. When the water comes to a boil, reduce the heat until the water comes to a gentle, less rapid boil.



4. Cook for approximately 10-15 minutes after the water comes to a boil, depending on the size of the potatoes or pieces of potato. Note that smaller potatoes may cook faster. Begin testing the potatoes just before 10 minutes. Gently stick a fork into one of the potatoes. If the fork goes in easily, the potatoes are ready. If not, test again in another minute or two.
5. When the potatoes are cooked, drain them in a colander over the sink. Add the potatoes back to the pot.
6. Toss about 1-2 tablespoons of olive oil or butter per pound of potatoes. Add more olive oil or butter as needed to ensure the potatoes are fully coated. Stir in any of your chosen additional toppings now. Taste and add more salt or other seasonings if needed based on your preference.
7. Serve while hot or at room temperature.

### **Tips:**

- If you prefer, salt the water before you cook the potatoes to add flavor. Potatoes are like a sponge and soak up flavor. You can also try chicken or vegetable broth to cook the potatoes in.
- Put a lid on your pot while the water is heating to bring it to a boil faster, but do not cover the pot with the lid while the potatoes are cooking or it will change the cook time.
- Note that larger potatoes will take longer to cook and smaller potatoes or small pieces of a larger, cut up potato will take less time to cook.
- All of your potatoes or potato pieces should be approximately the same size for even cooking. If the potatoes or pieces are uneven, you will end up with some that are overcooked and some that are undercooked.

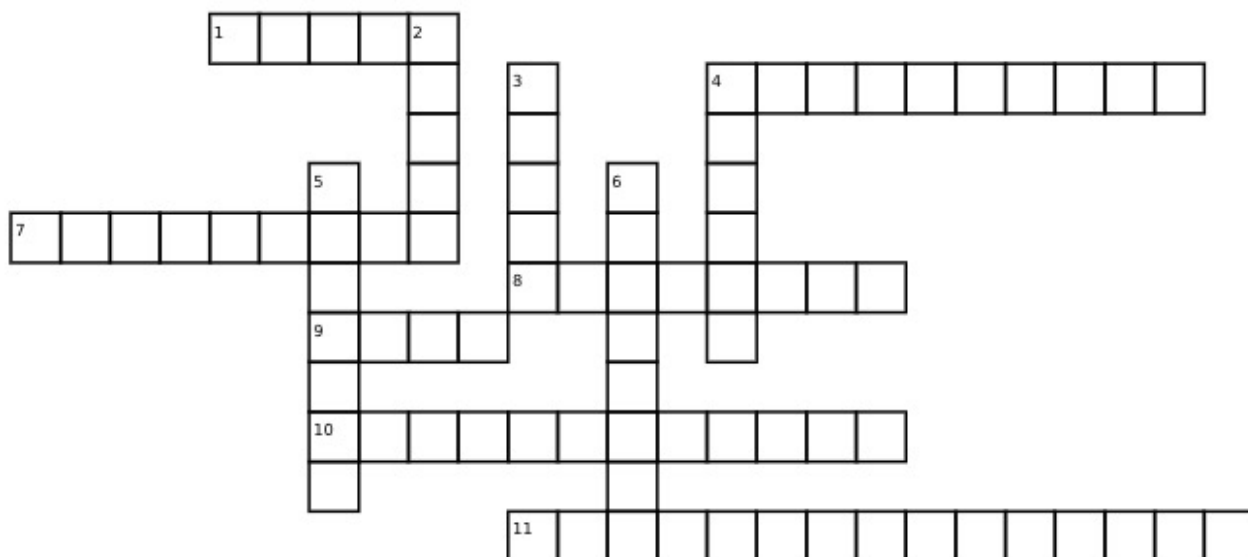
## **Activity**

After you finish cooking your potato dish, select one prompt to write about:

1. The restaurant you work at wants to serve the potatoes you just made as a side dish. Explain what the ideal main dish would be and include descriptions of flavors, textures and aromas that compliment your potato dish. Also include details of any other sides that would make the plate a complete meal.
2. If your potato recipe did not turn out as you expected, write about the differences between your expectations (better or worse) and the results. Include specific details about how your procedure/ingredients made the recipe better than you expected or how you could change your procedure and/or ingredients in order to make your results closer to your expectations the next time you cook it.

## Additional Activity

Use the clues to fill in the crossword puzzle.



### Across

1. When water reaches 212°F, it changes into \_\_\_\_\_.
4. Natural gas is an example of a \_\_\_\_\_. (2 words)
7. Natural gas stoves are more energy \_\_\_\_\_ than electric stoves.
8. A \_\_\_\_\_ is often found on top of an oven in many homes.
9. A BTU is the amount of \_\_\_\_\_ needed to raise the temperature of one pound of water 1°F.
10. Because natural gas needs a long period of time and extreme conditions to form, it is known as a \_\_\_\_\_ source.
11. Natural gas burners respond \_\_\_\_\_ when the knob is turned.

### Down

2. \_\_\_\_\_ cooking utilizes water or steam.
3. When water \_\_\_\_\_, it changes from a liquid to a gas.
4. Natural gas burners heat up \_\_\_\_\_ than electric burners.
5. The primary component of natural gas is \_\_\_\_\_.
6. In its natural state, natural gas is colorless and \_\_\_\_\_.

## Final Assessment

1. What is natural gas?
  - a. a fossil fuel
  - b. an atmospheric gas
  - c. an elemental fuel
  - d. residue from burning coal
2. What does “boiling” mean?
  - a. the bubbling of a liquid
  - b. the temperature of a liquid
  - c. the phase change between liquid and gas
  - d. the amount of heat transferred to a liquid
3. What is an advantage of using natural gas over other energy sources?
  - a. Natural gas is a renewable energy source.
  - b. Natural gas is versatile and has many uses.
  - c. Natural gas is easier to obtain than other energy sources.
  - d. Natural gas can produce more energy than all other sources.
4. What type of equipment do you use to boil water to cook food?
  - a. a shallow pan
  - b. a baking sheet
  - c. a mixing bowl
  - d. a deep pot
5. What is the best way to know if your potatoes are perfectly cooked?
  - a. by sticking a fork in them
  - b. by seeing if they just start to break apart
  - c. by checking the temperature of the water
  - d. by using a timer

# **Introduction to Cooking with Gas—Advanced**

## **Lesson 1: Boiling**

### **Teacher-facing Materials**

(1-2 class sessions depending on setting)

## **Introduction**

This lesson covers a basic understanding of natural gas, including where it is found. Then students will learn how natural gas is used on a stovetop to boil water and cook potatoes. 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 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.

1. What is natural gas?
  - a. a fossil fuel
  - b. an atmospheric gas
  - c. an elemental fuel
  - d. residue from burning coal
2. What does "boiling" mean?
  - a. the bubbling of a liquid
  - b. the temperature of a liquid
  - c. the phase change between liquid and gas
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3. What is an advantage of using natural gas over other energy sources?
  - a. Natural gas is a renewable energy source.
  - b. Natural gas is versatile and has many uses.
  - c. Natural gas is easier to obtain than other energy sources.
  - d. Natural gas can produce more energy than all other sources.
4. What type of equipment do you use to boil water to cook food?
  - a. a shallow pan
  - b. a baking sheet
  - c. a mixing bowl
  - d. a deep pot
5. What is the best way to know if your potatoes are perfectly cooked?
  - a. by sticking a fork in them
  - b. by seeing if they just start to break apart
  - c. by checking the temperature of the water
  - d. by using a timer



## **What is Natural Gas?** (5 minutes)

Students will read about natural gas, including what it is and how it is formed. The following questions could be used for a class discussion or given to students to complete individually.

- Why does natural gas only form deep underground?
- Why is natural gas considered a nonrenewable resource?
- Why is it important to note that natural gas is colorless and odorless in its natural state?

## **Cooking with Natural Gas** (5 minutes)

Students will read about the benefits of cooking with natural gas appliances. The following questions could be used for a class discussion or given to students to complete individually.

- Why is natural gas more efficient than electricity for cooking appliances?
- Why are natural gas cooking appliances more precise than electrical cooking appliances?
- Why is it important to properly maintain natural gas cooking appliances?

## **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: Boiling** (5 minutes)

Students will read about cooking with moist heat and the boiling 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 moist heat?
- What occurs when water reaches its boiling point?
- Do you think water will boil more slowly or more quickly using a natural gas burner versus an electric burner? Why?

## Instructor Demonstration (10 minutes)

The demonstration can be performed in person in the class or remotely, or recorded for remote use. If the demonstration is done in person, consider starting to boil a pot of potatoes when the students enter the room to save time and to demonstrate how to determine that the potatoes are cooked and how to prepare the final dish. While demonstrating the prep-work (cutting potatoes, pouring water, etc.) consider having students follow along with their own ingredients to save time.

The demonstration should include:

- how a gas stove/range works
- safety tips when using a gas stove/range
- benefits of using boiling as a cooking technique
- how to cook potatoes, noting that the potatoes should all be approximately the same size for even cooking
- why potatoes should begin in cold water for more even cooking
- finishing the potatoes with butter or olive oil and incorporating other optional 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?
- 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 potatoes?
- What cooking tips did the instructor give during the demonstration?

## Selecting and Preparing a Recipe (20 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 potato dishes. Students will select a type of potato, a fat and optional flavorings and toppings from a list in order 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 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<br>3  | Proficient<br>2   | Emerging<br>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<br>(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                             |

## Activity (10 minutes or as homework)

Students will select one of the prompts and write about their experiences in cooking their potato recipe. Share out the short answer scoring rubric with students before they complete their writing activity.

1. The restaurant you work at wants to serve the potatoes you just made as a side dish. Explain what the ideal main dish would be and include descriptions of flavors, textures and aromas that compliment your potato dish. Also include details of any other sides that would make the plate a complete meal.
2. If your potato recipe did not turn out as you expected, write about the differences between your expectations (better or worse) and the results. Include specific details about how your procedure/ingredients made the recipe better than you expected or how you could change your procedure and/or ingredients in order to make your results closer to your expectations the next time you cook it.

### Scoring Rubric:

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

## Additional Activity: Answer Key (10 minutes or as homework)

This additional activity is provided to be used either in the classroom during any down-time or as homework. In this activity, students will use the clues to fill in the crossword puzzle.



### Across

1. When water reaches 212°F, it changes into steam.
4. Natural gas is an example of a fossil fuel. (2 words)
7. Natural gas stoves are more energy efficient than electric stoves.
8. A stovetop is often found on top of an oven in many homes.
9. A BTU is the amount of heat needed to raise the temperature of one pound of water 1°F.
10. Because natural gas needs a long period of time and extreme conditions to form, it is known as a nonrenewable source.
11. Natural gas burners respond instantaneously when the knob is turned.

### Down

2. moist cooking utilizes water or steam.
3. When water boils, it changes from a liquid to a gas.
4. Natural gas burners heat up faster than electric burners.
5. The primary component of natural gas is methane.
6. In its natural state, natural gas is colorless and odorless.



## 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.

1. What is natural gas?
  - a. a fossil fuel
  - b. an atmospheric gas
  - c. an elemental fuel
  - d. residue from burning coal
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