



Introduction to Cooking with Gas

Lesson 7: Grilling

BEGINNER



Introduction

Welcome to Introduction to Cooking with Gas. Today's topic is understanding how efficient natural gas is compared to other fossil fuels. Once you learn about the efficiency of natural gas, you will learn how to cook with gas to make your own grilled vegetable tacos.

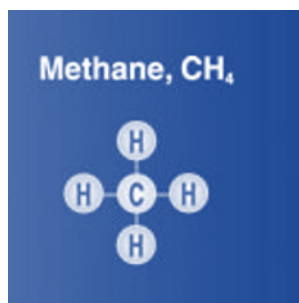
This lesson can be completed in a classroom or at home. Your teacher will provide instructions for completing the assignment from home.

Opening Assessment

1. Which statement BEST describes fossil fuels?
 - a. fuels that come from the absorption of light particles
 - b. fuels that are created by heating uranium atoms
 - c. fuels with high carbon content formed by natural processes
 - d. fuels with high hydrogen content created by capturing wind
2. What does it mean to "grill" food?
 - a. cook food with indirect heat on all sides of the food for long periods of time
 - b. cook food with direct heat above the food for very short periods of time
 - c. cook food on a flat surface at a constant temperature for varied periods of time
 - d. cook food on an open rack with no moisture and direct heat for varied periods of time
3. What is one reason that using natural gas as a fuel source is more efficient than other fossil fuel sources?
 - a. It burns more cleanly.
 - b. It is a renewable source.
 - c. It generates more electricity when burned.
 - d. It is easy to transport over oceans
4. What appliance would you use to grill food in a commercial kitchen?
 - a. plancha
 - b. under fired broiler
 - c. flat griddle
 - d. deck oven
5. What is the best way to prevent your grilled veggies from getting soggy?
 - a. Wrap them in aluminum foil immediately after grilling.
 - b. Brush water or broth directly on the veggies while grilling.
 - c. Chop the veggies into large pieces before grilling.
 - d. Chop the veggies into small and thin pieces before grilling.

How Efficient is Natural Gas?

Electricity comes from different sources such as coal, nuclear and solar power. Some are renewable sources like wind and solar power. Some are not renewable like coal, which is formed from the remains of plants and animals. Similar to other fossil fuels, natural gas was formed millions of years ago deep underground. Decaying animal and plant remains released the gas that was trapped in porous rocks buried deep underground. Because of this, natural gas is a non-renewable fuel source though it is plentiful in the United States.



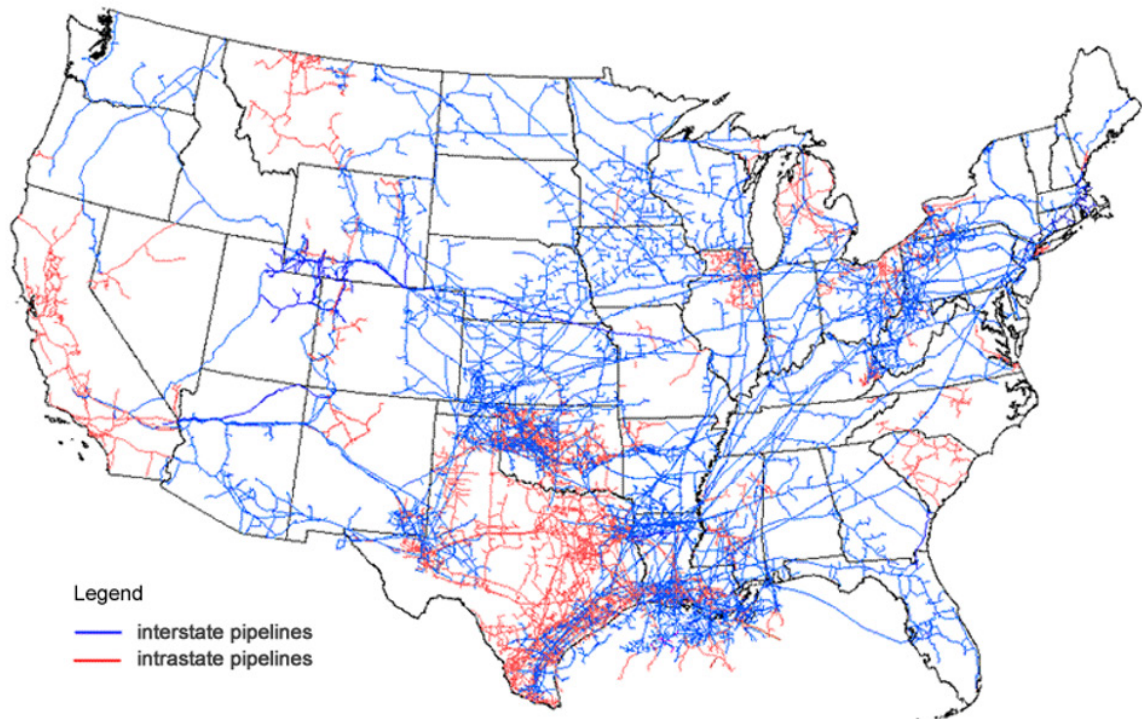
Natural gas is primarily made of methane. Methane contains one carbon atom surrounded by four hydrogen atoms. When it is burned, the gas releases a lot of energy that can be used for many things. Natural gas is used for heating homes and buildings, generating electricity and cooking in the kitchen. When burned, natural gas is the most efficient of the fossil fuels. This means that gas-fired power plants convert the heat energy from burning natural gas into electrical energy at higher rates than with other fuel sources. For example, coal-fired power plants are about 33% efficient while gas-fired power plants are 43% efficient. Newer natural gas combined power plants (which use heat from the natural gas turbine to power a steam turbine) are 60% efficient.

In addition to generating more electricity, natural gas is more efficient than other fuel sources because it can be produced and transported affordably. It is relatively inexpensive and easy to use. It can also be liquified to make it easier to store and ship across the country. The gas is simply cooled to liquify it and warmed back up when it is time to burn it as a gas. By liquifying the gas, it can be transported over water on large tanker ships. This allows it to be transported to places where transporting by pipelines is not possible.

New technologies have been created to make transporting and storing natural gas safer and more efficient. Once processed, natural gas can be stored underground until it is needed. Storing excess natural gas until it is needed helps to ensure plentiful fuel sources are available during times of high demand. The underground storage facilities most commonly used in the United States include depleted natural gas/oil fields, salt caverns and aquifers. Smaller volumes of natural gas can be stored above ground.

The movement of natural gas from storage facilities to where it is used in the market is accomplished with pipeline systems. Larger pipelines are used to transport the gas long distances to where it will be used. Smaller pipelines, often referred to as mains, transport natural gas into the service pipelines that bring gas directly into homes and buildings for use in kitchens and heating.

Map of U.S. interstate and intrastate natural gas pipelines



Source: U.S. Energy Information Administration, *About U.S. Natural Gas Pipelines*

Image Credit: [EIA](#)

Natural gas can also be used to make non-renewable sources more efficient. Wind and solar power plants cannot create a steady amount of electricity because the weather is unpredictable. However, it is possible to use natural gas to power wind turbines as needed to generate electricity that can meet user demands. Additionally, any excess electricity made at a wind or solar plant can now be converted through electrolysis to natural gas and stored for later use. This new technology is called Power-to-Gas and is a way to blend renewable energy sources with an efficient, non-renewable fuel source.

Cooking with Natural Gas

Natural gas is not just an efficient way to produce electricity. Natural gas also provides a very efficient way to perfectly cook food. There are many benefits to cooking with natural gas. Many professional and at home cooks prefer to cook with natural gas appliances instead of with electric appliances. Natural gas appliances, such as an under fired broiler, are easy to use, control and clean, making them a great choice for all commercial kitchens.

When cooking, there is greater control over the temperature used to prepare the food. Cooks have more control over the heat they need. Natural gas ovens and ranges distribute the heat more evenly. This means that the food gets cooked evenly as well. Natural gas saves more energy than electric units because natural gas appliances only use the gas while the appliance is in use. This is important especially in large commercial kitchens where many units are being used at once. In certain situations, a natural gas rangetop can also be used in the event of a power outage simply by lighting the gas with a match. Heavy caution is advised when doing this, and it is never recommended that a gas oven be lit with a match at any time.

The key to an effective and efficient kitchen is to maintain both the cleanliness of the equipment and the upkeep of the equipment by regularly checking for damaged parts. Natural gas appliances are preferred by many chefs because they have hotter burn temperatures and cook food faster and more thoroughly. This saves time, energy and money and helps reduce wasted food.

On average, equipment that runs on natural gas will save money in operating costs. It is dependable, durable and overall requires very little maintenance. To make sure that the equipment is running optimally, you should check the gas line for leaks. This can be easily done using a commercially made gas leak checking product. This product is like a "goo" that you rub on the gas line and watch for bubbles to appear. If there are bubbles, you will know that the gas is leaking out. It is also important to keep the equipment clean. Grates that are covered in grease not only pose a fire hazard but also cause the appliance to work harder and use more energy. Another important energy saver for gas appliances is to avoid using the lowest setting where the flame is barely visible. This can lead to the flame going out and the gas remaining on. Always make sure that the knob is turned completely to the off position when the unit is not in use. Avoid bumping the knobs or the unit. This can also cause the gas to leak if the gas connections come loose.

In general, natural gas powered appliances are easy to use and to clean. Because the heat comes from a flame instead of a heating coil, it is easy to wipe up spills without having them stick and burn to the unit. To clean a natural gas appliance, first turn off the heat and allow the appliance to cool. Once cool, use a damp cloth to wipe up all the surfaces. Make sure to clean the ceramic grates but do not submerge them in water. Make sure that all venting areas are clean of dust and grease. This will help to keep the appliance running well and working efficiently.

The recipe in this lesson refers to the use of an under fired broiler to grill vegetables. Just like with cleaning other appliances, when cleaning an under fired broiler, you must first turn off the gas and allow it to cool. Once cool, scrape off all the built up food on the unit and completely wipe the drip shields. Don't forget to wipe and clean the burners and empty and clean the grease pan. The ceramic briquettes in an under fired broiler must be regularly checked and periodically turned to maintain their efficiency. They can be washed as needed and should be replaced every six to eight months. This will help your under fired broiler work well for a long time.

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: Grilling

Dry cooking methods include broiling, grilling, griddling, roasting, baking, sautéing and deep frying. Each method utilizes the circulation of hot air, or in the case of sautéing and deep frying, the use of fat to transfer heat in order to cook the food. Dry cooking results in the browning of food. This happens when the amino acids and sugars found in food turn brown when they are heated. This lesson will utilize an under fired broiler or a cast iron grill pan on a range top and the *grilling* cooking method. A natural gas **under fired broiler** or **charbroiler** in a commercial kitchen radiates heat upward from ceramic or volcanic briquettes, much like charcoal briquettes that would be used with an outdoor grill. These units might also have stainless steel radiants that are elevated and heated by the burners below.



Another way to grill in the kitchen is to use a cast iron grill pan, also called a riffle pan, to grill vegetables and meats on the range top. In this instance, the grill pan is placed over the gas burner and the burner is ignited to the highest temperature to get the grill pan very hot. There are ridges on the grill pan spaced evenly across the bottom of the pan to create the lined markings made when grilling on an outdoor grill.

When food is grilled, dry heat is applied to the surface of the food either above, below or to the side of the food. The food often sits on an open wire grid so that the heat can be directly applied to the food. Grilled food has lined markings where the wire grids touched it and browning has occurred. Because the food is directly applied to the heat, grilling times are often not very long for cooking food.

Foods like hamburgers, steaks, pork chops, ribs, chicken, salmon and halibut cook well on the grill. Most fruits and vegetables can easily be grilled and will add flavor and color to make a well-balanced meal. You will learn how to grill, as well as how to conduct other forms of dry heat, to cook various proteins, vegetables and starches throughout your lessons on dry heat cooking.

Instructor Demonstration

Watch the instructor demonstration on proper natural gas range safety and how to grill vegetables on a range top using a grill pan. Answer the following questions as you watch the demonstration.

- What safety tips did the instructor give during the demonstration?
- How did the instructor prepare the grill pan on the range top?
- What vegetables did the instructor use and how did the instructor prepare the vegetables for grilling?
- What tips did the instructor give for grilling vegetables that were smaller or hard to place on the grill?
- How did the instructor determine how long to cook the 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 grilled vegetable tacos using grilled vegetables of your choice. Once cooked, the lightly seasoned grilled vegetables will be put into tortillas of your choice. You can optionally top the grilled vegetables with some cheese, olives, cilantro, salsa and/or sour cream.

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 a variety of vegetables from the vegetable list and at least one item from the oil category. You will want to choose a variety of seasonings from the third list as well. 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 variety of vegetables to be grilled:

zucchini
yellow squash
onion (red, yellow or sweet)
mushrooms
red, green, yellow
or orange bell peppers
poblano peppers

Select an oil (1 Tbsp):

avocado oil
canola oil
olive oil
safflower oil
vegetable oil
melted butter

Select optional toppings and seasonings (season according to taste):

fresh salsa
cheeses such as sharp cheddar, colby jack or feta
fresh tomatoes
avocado
cilantro
black beans
olives
salt
pepper
prepared taco seasoning
chili powder
cumin
no-salt-added Mexican seasoning blend
garlic powder
onion powder
paprika

Safety first:

- Always keep a Class ABC fire extinguisher nearby.
- Practice knife safety when cutting the vegetables and use knives that are properly sharpened.
- Have an oven mitt on hand to protect your hands from getting burned.
- Use metal tongs to flip the vegetables on the grill. Do not use your fingers to turn or remove the vegetables from the grill.
- Be aware of any plastic, paper or other flammable objects near the open flame. Move these items away from the range.
- Be sure that the grill sits firmly and in place over the open flames.
- Do not lean over the grill pan.
- Never use wet or moist potholders, oven mitts or towels as they will conduct heat, burning your hands.

Equipment:

- Cutting board
- Sharp knife
- Grill pan, or riffle pan
- Metal tongs
- Mixing spoon
- Oven mitts
- Small bowls for mixing seasoning (optional)
- Skewers (optional for grilling smaller vegetables like mushrooms)
- Under fired broiler, or gas range or cooktop
- Plate
- Utensils
- Napkins

Ingredients:

- Choice of vegetables, cut in large pieces for grilling
- Choice of oil and seasonings
- Tortillas (corn or flour, taco size)
- Choice of toppings such as cheese, tomatoes, avocado and fresh herbs

Procedure:

1. Begin by washing or rinsing the vegetables. If using mushrooms, brush them gently with a paper towel to remove the dirt, or rinse them under cold water.
2. Prepare vegetables for the grill. Cut the vegetables in large pieces. You will have to cut them into smaller pieces after they have cooled, but to make them easier to flip on the grill, keep them in larger pieces.
 - » Slice zucchini and yellow squash in large quarter-inch slices or half-moon shapes.
 - » Cut the onion into quarter pieces, leaving the root side in place. This will help the onion stay together and not separate on the grill.
 - » Cut the bell peppers or poblano peppers into quarter pieces. Leave the stem to make it easier to move them on the grill.
3. Once the vegetables are cut, put them into a bowl and pour a tablespoon of oil over the vegetables to lightly coat them. If you are using multiple seasonings, it is helpful to mix them in a small bowl first and then sprinkle them over the vegetables using a mixing spoon to distribute the seasoning. Let the seasoned vegetables sit for 10-20 minutes before grilling.
4. While the vegetables are sitting, prepare the grill pan. Carefully place the grill pan on the range top burners. Turn the knob and ignite the flames. Use high heat to get the grill hot, then turn the heat down to medium-high.
5. Using the metal tongs, arrange the vegetables on the grill. Different vegetables will take different amounts of time to cook. Make sure you have turned the heat down. A too-hot grill will burn the outside of the vegetable while leaving the inside raw. You will know when the veggies are done when they are pliable or wiggly and have dark marks on the outside. Use the following guidelines for grilling vegetables:
 - » Peppers and onions: 8-10 minutes, flipping halfway through cooking time
 - » Squash and mushrooms: 7-8 minutes, flipping halfway through cooking time
 - » Softer fruits and vegetables: 4-6 minutes, flipping halfway through cooking time
6. When the vegetables are done, carefully remove them from the grill and put them on a cutting board to cool. After the vegetables have cooled, cut them into smaller, bite-sized pieces that can fit into a taco-size tortilla.
7. Serve immediately.
8. Add any additional spices and/or chili peppers to the pan, being careful not to overcrowd.

Tips:

- Avoid wrapping foil around hot vegetables. This will make them soggy.
- Cooking times will vary depending on the size of the vegetables. Use the time guides, but add cooking time if the vegetables are still undercooked.
- Additional seasonings can be added after the veggies are cooked.
- Poblano peppers can be spicy to some people. Avoid using them if you are sensitive to spicy foods.

Activity

After you complete cooking your vegetable tacos, use the word bank to complete the fill-in-the-blank activity. There will be words left over.

Word Bank

bite-sized	dry	indirectly applied	non-renewable
browning	efficient	large	renewable
burning	electrolysis	liquified	under fired broilers
directly applied	fruits	moist	vegetables

Fill in the Blank

1. Natural gas is a/an _____ fuel source because there is a limited amount.
2. One way to make grilling vegetables easy is to cut them into _____ pieces. This will prevent them from falling through the grate.
3. Grilling is a form of _____ cooking. No moisture is needed.
4. _____ occurs in dry cooking when sugars and amino acids in the food darken after they are heated.
5. Natural gas is a/an _____ fuel because less of it is leaked or wasted during transportation.
6. Natural gas can be _____ by cooling it to make storage and transportation easier.
7. Excess electricity produced by solar and wind power can be converted to natural gas through _____.
8. _____ radiate heat upward from briquettes located under the grate.
9. Dry heat is _____ to the surface of food held on a wire grate.
10. Most _____ and _____ cook well on the grill and add color and flavor to a balanced meal.

Final Assessment

1. Which statement BEST describes fossil fuels?
 - a. fuels that come from the absorption of light particles
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3. What is one reason that using natural gas as a fuel source is more efficient than other fossil fuel sources?
 - a. It burns more cleanly.
 - b. It is a renewable source.
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 - d. It is easy to transport over oceans
4. What appliance would you use to grill food in a commercial kitchen?
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5. What is the best way to prevent your grilled veggies from getting soggy?
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Introduction to Cooking with Gas—Beginner

Lesson 7: Grilling

Teacher Guide

(1 class session)

Introduction

This lesson covers a basic understanding of natural gas and why it is more efficient than other fossil fuels in general and in the kitchen. Then, students will learn how natural gas is used either on an under fired grill or a range top with a grill pan to grill and cook 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 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 Efficient is Natural Gas? (5 minutes)

Students will read about the efficiency of natural gas compared to other fossil fuels and how it is used in the kitchen. Generate discussion with the students using the following for guidance.

- Natural gas burns more cleanly than other fossil fuels. This means there are less harmful gases released and no ash or particulates are released as a byproduct.
- Natural gas is a fossil fuel, which means it is not renewable. However, there is new technology that can convert excess electricity created by solar cells and wind turbines to natural gas to be stored and used later.
- Natural gas has fewer leaks and has less waste during storage and transportation. This means that more product can be delivered to the customer.
- Because natural gas is easy to get and is fairly abundant in the United States, it costs less to use than other fuels like coal for energy.

Maintaining the Efficiency of Natural Gas Appliances (5 minutes)

Students will read about the benefits of using natural gas in the kitchen and learn how to clean and maintain natural gas appliances. The following questions could be used for a class discussion or given to students to complete individually.

- Why is it important to clean and maintain all natural gas appliances in the kitchen?
- Why might a person designing a kitchen opt to have appliances that use natural gas?
- What is a good way to check for gas leaks on the various units?
- Why might it be easier to cook with an appliance that uses natural gas than an electric appliance?
- What is one way to clean an under fired broiler?
- How can a natural gas appliance be useful in a power outage?

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: Grilling (5 minutes)

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

- What are the benefits to cooking with dry heat?
- What happens to food cooked with dry heat when the sugars and amino acids in the food are exposed to the heat?
- Why is grilling a good way to cook food when you don't have a lot of time?
- What foods are good for grilling?
- Which foods might be hard to grill?

Instructor Demonstration (10 minutes)

The demonstration can either be performed in class or recorded for remote use. If the demonstration is done in person, consider having some prepared vegetables that have been chopped and seasoned ready to go on the grill. Have unchopped vegetables and seasonings ready to show the students how to put the vegetables together. But use the pre-prepared vegetables on the grill during your demonstration.

You may also consider having various toppings chopped and ready ahead of time so that you can put the food together after the vegetables have been grilled. You might consider having the students start their recipes the night before by chopping and seasoning their vegetables and leaving them in the fridge so that they are ready to begin grilling directly following the demonstration rather than waiting for the vegetables to sit after students chop them.

The demonstration should include:

- how an under fired broiler and how a gas range top with grill pan work
- safety tips when using an under fired broiler or grill pan
- knife techniques and safety when cutting vegetables
- how to grill, including tips for how to adjust the temperature for perfectly grilled vegetables
- benefits of using grilling as a cooking technique, especially when there is limited time for cooking
- how to cook vegetable tacos, noting how to check for doneness
- finishing the vegetable tacos with flour or corn tortillas and incorporating other optional ingredients for toppings

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 many vegetables did the instructor put on the under fired broiler or grill pan?
- How high did the instructor have the flame?
- How did the instructor determine how long to cook the various vegetables?
- 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, or have some vegetables pre-prepared for them to grill. 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. You can also have the students prepare their vegetables during the instruction time. This will allow extra time for cutting multiple vegetables. You might also have the students heat their grill pans while they are cutting their vegetables so that they can put the vegetables right on the grill.

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. If the students are preparing this meal at home, suggest to them that they can cut and season the vegetables the night before or in the morning and they will be ready to grill right out of the refrigerator.

Students will use the instructor demonstration as a guide to cook their own vegetable tacos. Students will select an assortment of vegetables, 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 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.

Scoring Rubric:

Criteria	Excellent 3	Proficient 2	Emerging 1
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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)

This activity is provided to be used either in the classroom during any down-time, or as homework. Students will use the words in the word bank to complete the sentences. There will be words left over in the word bank.

Word Bank

bite-sized	dry	indirectly applied	non-renewable
browning	efficient	large	renewable
burning	electrolysis	liquified	under fired broilers
directly applied	fruits	moist	vegetables

Fill in the Blank

1. Natural gas is a/a **non-renewable** fuel source because there is a limited amount.
2. One way to make grilling vegetables easy is to cut them into **large** pieces. This will prevent them from falling through the grate.
3. Grilling is a form of **dry** cooking. No moisture is needed.
4. **Browning** occurs in dry cooking when sugars and amino acids in the food darken after they are heated.
5. Natural gas is a/an **efficient** fuel because less of it is leaked or wasted during transportation.
6. Natural gas can be **liquified** by cooling it to make storage and transportation easier.
7. Excess electricity produced by solar and wind power can be converted to natural gas through **electrolysis**.
8. **Under fired broilers** radiate heat upward from briquettes located under the grate.
9. Dry heat is **directly applied** to the surface of food held on a wire grate.
10. Most **fruits** and **vegetables** cook well on the grill and add color and flavor to a balanced meal.

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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