Chapter 12

Foundations for Successful Food Preparation

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Essential Question

What effect does cooking have on food?

Reading Prep

In preparation for reading the chapter, find a full-service restaurant menu online and print it or save on your computer. As you read the chapter, identify the cooking method used for each menu item.

Lesson 12.1

Cooking Principles

Learning Outcomes

After studying this lesson, you will be able to

- **understand** the reasons food is cooked.
- **explain** the effects of cooking on food.
- **classify** various methods of cooking by the process of heat transfer.
- **explain** basic cooking methods.

Content Terms

baking
boiling
braising
broiling
caramelization
coagulation
convection
cooking
deep-frying
gelatinization
gratiner
grilling
Maillard reaction
panfrying
poaching
poêléing
radiation
roasting
sautéing
simmering
steaming
sweating

Academic Terms

envelop
robust

Understanding the basic science involved in the cooking process will make you a better cook. The knowledge of how heat is applied and how heat affects various food products allows chefs to be more flexible. They are better prepared to adapt to unfamiliar cooking appliances or new foods. Identifying cooking methods correctly is important when communicating in the kitchen or writing recipes and menus. In this lesson, various cooking processes are identified and explained.

Reasons to Cook Food

Cooking is the process of preparing food for eating by applying heat. Soon after prehistoric people harnessed fire, cooking was possible. Food was placed on or near the fire with dramatic results. The act of cooking food was an important step in the development of the human race. The ability to cook food meant a longer, healthier life. Foods are cooked for several reasons (**Figure 12.1**).

Reasons to Cook Food

Safer to Eat	More Digestible	Improved Appeal
• The most important reason for cooking is food safety. • Heat kills microorganisms that cause spoilage and illness.	• The fibrous structure of vegetables and connective tissues in meats are broken down when cooked. • The cooking process makes it easier for the body to extract nutrients from many foods.	• Cooking adds variety and interest to food. • Food products take on different appearances, flavors, aromas, and textures based on how they are cooked.

Figure 12.1 Cooking has a significant effect on foods.

Reading Review

1. Cooking makes foods safer to eat because it kills _____ that cause spoilage and illness.

The Effects of Cooking

What happens to the raw food product when heat is applied? Understanding what heat does to the different elements of food is key to understanding the cooking process and becoming a better chef.

Microorganisms Are Destroyed

Most bacteria, fungi, and molds are killed at temperatures above 135°F (57°C). Most foods are cooked to temperatures higher than this. Once food is cooked to the appropriate temperature, it must be held at or above 135°F to keep it safe. This temperature is key to ensuring that foods are safe when cooked by any of the methods discussed in this lesson.

Connective Tissue Breaks Down

Heat is necessary to make tough pieces of meat and poultry tender and easier to eat. Connective tissues are the tough fibers that hold muscles together. Much of the connective tissue in meat becomes tender when it is properly cooked.

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Figure 12.2 The egg white is transitioning from translucent to opaque as coagulation of proteins occur during cooking. ***Can you identify the egg white that has not coagulated?***

Proteins Coagulate

When proteins are heated, many solidify or become firm. This is called **coagulation**. Coagulation is the reason the texture of many foods change when cooked. Consider the difference in texture between raw and cooked chicken breast or the difference between raw and cooked egg (**Figure 12.2**).

Fibers Break Down

The fibers that make up the cell structure of most plants are broken down with heat. This makes cooked vegetables tender and releases certain nutrients.

A Serving of Science

Texture: Denaturation and Coagulation

When proteins such as eggs, meat, or fish are exposed to certain chemical or physical elements, it causes changes in their structure. This is called *denaturation*. Another name for the process in which food is exposed to chemical or physical elements is *cooking*. For instance, when raw fish is soaked in an acid such as lime juice or eggs are placed in hot water, the bonds that are invisible to the human eye—but essential to the protein's structure—are broken. As a result, newly "freed" parts of the denatured proteins are exposed and ready to make new bonds. When these denatured proteins create new bonds with other denatured proteins in the food, it is called *coagulation*. As coagulation takes place, the new bonds form a net that captures and holds moisture. The food that results is changed not only visibly, but also to touch.

When this process (cooking) is done properly, the result is a texture or density that is pleasing. However, if the process goes on too long, the new bonds become tighter and tighter. Not surprisingly, as the bonds become tighter the moisture they once held in the food is squeezed out. Now you can understand why overcooking food results in a tough, dry product.

Know and Apply

1. During cooking, what happens to the bonds responsible for a protein's structure?
2. How can you apply this knowledge to improve your food preparation skills?

Starches Absorb Liquid

Starches, such as flour and cornstarch, are used to thicken liquids, such as sauces and soups. Many starches must be heated in order for the thickening process to take place. When starches combine with hot liquid, they absorb the liquid like a sponge and swell in a process called **gelatinization**. This process is used in many preparations in the kitchen and bakeshop.

Flavors Blend and Change

The most obvious change when raw food is cooked is the change in flavor. Flavor changes in foods happen in several ways. The most common flavor change is the caramelization of sugars. **Caramelization** is the browning that occurs when sugars are heated, resulting in a richer, more complex aroma and flavor. Sugars are found in some quantity in most ingredients; they are the building blocks for starches.

The flavors of protein foods are also changed by heat. When heat is applied, the amino acids that make up proteins react with other elements, like sugars, in the food to create complex, new flavors. This reaction is called the **Maillard reaction** and is responsible for the great taste of preparations such as sautéed steak or roasted chicken.

Not only does cooking change the flavor of foods, it also helps to blend or marry the flavors of multiple ingredients. Consider the way a combination of meat, vegetables, spices, and seasonings in a long-simmered stew creates a single flavor.

Figure 12.3 Overcooking food has a wide range of undesirable outcomes.

Effects of Overcooking

While the application of heat to food causes many favorable changes, the cooking process must be done to the proper degree. Monitoring timing and temperature is essential to achieve the proper degree of doneness. When foods are cooked to excessive temperatures or for too long, the results are not desirable (**Figure 12.3**).

Reading Review

1. *True or false?* When fats are heated, their flavors change due to caramelization.
2. Gelatinization is a process in which _____ absorb hot liquid like a sponge and swell.
3. List four possible effects on food from overcooking.

Methods of Heat Transfer

The transfer of heat to food products is the essence of cooking. How heat is transferred to the food has a distinct effect on how the finished product turns out. Different appliances and utensils transfer heat in different manners. Consider the difference in taste and appearance between a chicken cooked on a grill and one simmered in liquid. Understanding how heat energy is transferred is the key to distinguishing between different cooking methods. Cooking methods use conduction, convection, or radiation to transfer heat to food.

Industry *Insights*

Energy Efficient Cooking

Cooking is the process of adding heat to food. Producing heat requires energy and energy costs money. For the financially focused chef, reducing energy consumption means increased profit. Traditionally, gas-powered stovetops have been used for cooking in most US restaurants. While gas heat can be adjusted quickly, it is very inefficient. Approximately 30 percent of the heat is actually transferred to the food and the rest is wasted. In addition to wasting energy, this makes the kitchen hot and requires large amounts of ventilation. Induction cooking which works by rapidly changing the magnetic poles in the cookware's metal is a vast improvement. Over 90 percent of the heat generated is actually transferred to the pot, which then cooks the food. Talk about energy savings!

Conduction

Conduction is the transfer of heat energy from one object to another through direct contact. Heat energy travels through solid substances from one molecule to adjacent molecules by means of the vibration of electrons. This is much the same way electricity travels through a wire.

In cooking, heat is conducted from the heating element through pots and pans to the food. The material used to make the pot or pan determines how well the pot or pan conducts heat. Copper is an excellent conductor, while ceramic is a relatively poor conductor. The food product itself can be a conductor. Heat is transferred from the outside of the product to the inside. This is particularly evident when cooking a large roast.

Convection

Convection is the manner in which heat energy travels through liquids and gases. Natural convection occurs when warm air (a gas) rises to the top of an oven or when warmer liquid rises to the top of a pot. The cooler air or liquid descends to the bottom and creates a circular flow (**Figure 12.4**).

By mechanically circulating the gas or liquid, the transfer of heat can be accelerated. This is accomplished when a convection oven circulates air with a fan or a pot of liquid is stirred.

Michelle Lee Photography/Shutterstock.com

Figure 12.4 Convection can be observed when cold cream is added to hot coffee and the currents of cream rise and fall in the coffee.

Radiation

Radiation is the transfer of heat energy through waves. No conductor is necessary to cook with radiation. The glowing flames of a broiler or burning charcoal, for example, transfer heat to the food being cooked by means of radiation.

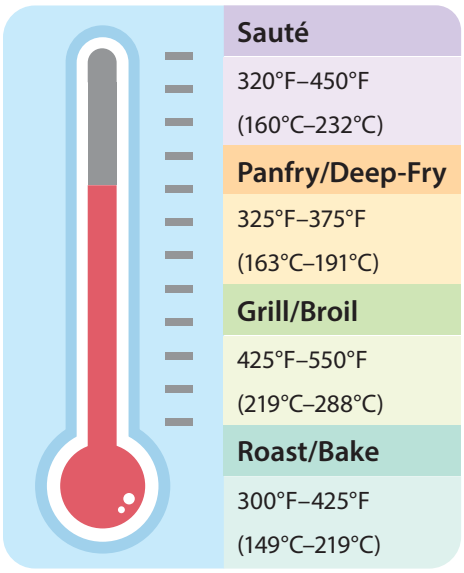
Microwaves also cook food by radiation, but not heat radiation. In microwave cooking, microwaves pass through the food causing the water molecules to vibrate which, in turn, heats the food.

Reading Review

1. *True or false?* The material used to make a pot or pan affects how well it conducts heat.
2. What method of heat transfer does not require any medium for conduction of heat?

Cooking Methods

Methods used to cook in the professional kitchen can be classified as dry-heat methods, moist-heat methods, or combination methods. Combination methods of cooking combine both dry heat and moist heat in the same recipe. These methods can produce some of the most flavorful and complex dishes in the professional kitchen. The various cooking methods transfer heat to food by conduction, convection, or radiation. Some cooking methods transfer heat using two or more of these.



Thermometer: jkcDesign/Shutterstock.com

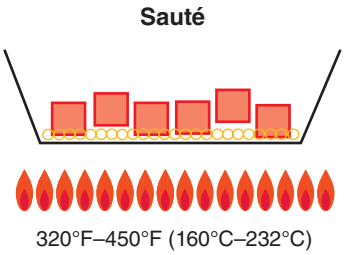
Figure 12.5 Cooking temperatures vary for different dry-heat methods.

Dry-Heat Methods

Dry-heat methods transfer heat to food by conduction, hot air convection, or radiation. Many dry-heat methods begin with a high temperature to create browning and improve flavor (**Figure 12.5**). Although these methods may use higher temperatures, they do not break down fibers or connective tissues as well as moist methods. For this reason, dry-heat cooking methods are most often used with tender products. Dry-heat cooking methods include sautéing, panfrying, deep-frying, grilling, broiling, roasting, and baking.

Sautéing

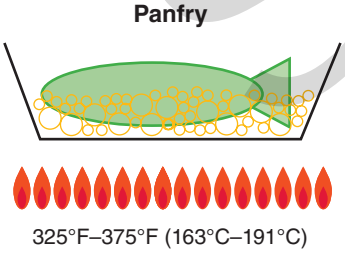
Quickly cooking an item in a small amount of hot fat over high heat is called **sautéing**. This method requires only enough fat to coat the bottom of the pan. In French, the word *sauté* means "to jump." Often, sautéed items are tossed or made to jump in the pan to flip them. Though sautéing is traditionally done in a sauteuse, it can also be done on a griddle or in a wok. Meat, poultry, seafood, vegetables, and starches can all be sautéed. Foods to be sautéed are cut in small, uniform pieces. Larger cuts of meat are generally cut into pieces before sautéing. Sautéing transfers heat by conduction.



The Asian technique of *stir-frying* is similar to sautéing. Small, evenly cut pieces of food are cooked quickly in a small amount of fat. Stir-frying is typically done in a wok rather than a sauteuse. As with sautéing, the pieces of food are regularly stirred or tossed for even cooking.

Home cookbooks often instruct the cook to "sauté items over a low heat." A culinarian refers to this as sweating. **Sweating** is cooking food in a small amount of fat using low heat in order to soften the food without browning. Sweating is typically used with onions, mirepoix, and garlic. The browning brought about by the higher heat of sautéing changes the flavor and appearance of these ingredients, and therefore, affects the finished dish as well.

Panfrying



Panfrying, like sautéing, uses hot fat to cook a food item. However, **panfrying** cooks the food in enough hot fat to cover it halfway. The food is turned during the cooking process in order to cook both sides evenly. Panfrying may also be called *shallow-fat frying*. Large or thick pieces of meat, fish, or poultry may be panfried and then finished in the oven. Heat is transferred to the food primarily by conduction with this method.

Often, panfried items are first coated in flour or are breaded using one of the techniques described in the following section on deep-frying.

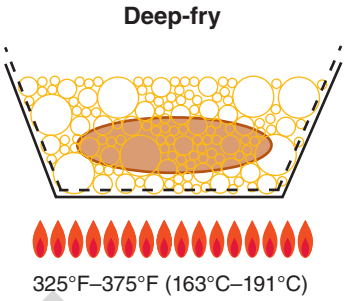
Deep-Frying

Deep-frying is a method that cooks food in enough hot fat to fully cover the item. Enough fat must be used to ensure proper cooking. If too little is used, it is difficult to maintain the fat's high temperature when food is added for cooking. The result from deep-frying in fat that is not consistently hot enough is a finished product that is limp and greasy rather than crisp. The deep-frying method transfers heat by convection.

Deep-frying on the stovetop is dangerous and should be avoided as it can result in serious burns or fires. Deep-frying is best done in a deep-fat fryer, an appliance that precisely regulates the temperature of the fat. Fryers need to be maintained to prevent the oil from breaking down and producing poor tasting food. This includes regular filtering of the oil and periodic deep cleaning.

Most deep-fried foods are coated before being fried. This helps to create a crispy exterior and prevents excess oil absorption. Common methods used to coat foods are dredging, breading, or battering.

- *Dredging* coats the food in flour. The flour may be seasoned or unseasoned. Seasoned flour often includes salt, pepper, and various herbs or spices. The product may be simply dredged in flour or may first be dipped in milk or buttermilk.
- *Standard breading* coats the product in flour, beaten eggs, and bread crumbs. The bread crumbs may be standard bread crumbs or panko bread crumbs.
- *Battered* foods are dipped in a liquid mixture, or *batter*, immediately before deep-frying. The basic ingredients for batter are a starch and a liquid. Examples of batters include beer batter and tempura.



TECHNIQUE Coating Foods for Deep-Frying

Dredging Method

1. Place food in a dish containing seasoned or unseasoned flour, and coat it with the flour.

2. Gently pat or shake flour-coated food to remove excess flour.

Photos: Draz-Koetke/Goodheart-Willcox Publisher

(Continued)

TECHNIQUE Coating Foods for Deep-Frying

Breading Method

1. Dredge food in flour.

2. Dip food into whipped egg mixture or other liquid, such as buttermilk.

3. Coat the food with egg mixture and shake to remove excess.

4. Place food in container of breading or other crumbs, such as crackers or cereal, and coat food with crumb mixture.

Battering Method

1. Dip food into batter and coat completely.

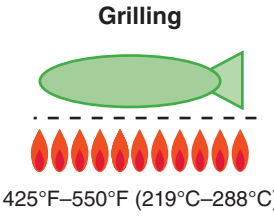
2. Gently shake off excess batter and place food in fryer.

Photos: Draz-Koetke/Goodheart-Willcox Publisher

Foods to be deep-fried are placed into the fryer using one of two methods—basket method or swimming method. In the basket method, the food is placed into fryer baskets that are then lowered into the hot oil. For the swimming method, foods are gently and carefully lowered into the oil without the use of baskets. It may be necessary to gently stir the oil so that the food does not stick to the bottom of the fryer. Typically, battered foods are cooked using the swimming method.

Grilling

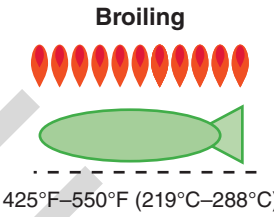
Grilling is a cooking method that uses radiation from a heat source located below the food. A metal grate holds the food over the heat source. Grilled foods can be cooked over a variety of heat sources; gas flames, electric burners, charcoal, or hardwoods are all commonly used in commercial kitchens. During grilling, juices drip from the food onto the heat source, creating smoke. This smoke adds flavor to the food. Grilling is a popular cooking method because of the **robust**, or strong, flavor the cooking process imparts.



Broiling

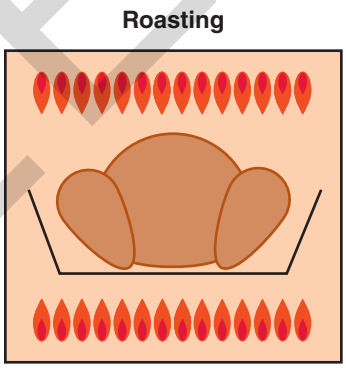
Broiling uses radiation from a heat source located above the food. The food being cooked is placed on a pan or a grate and then placed under the heat source. The heat for broiling is usually intense in order to sear or brown the food.

Often broiling is used as a finishing process to brown cooked foods. **Gratiner** (grah tehn AY) means to brown a food product. Product can also be gratinéed in a hot oven. Browned foods are often described by the French term *au gratin* (OH grah tehn).



Roasting

Originally, roasting was done by turning meat placed on a spit or skewer over the radiant heat of a fire. Today, most roasting takes place in the oven. **Roasting** is a method that cooks a food by surrounding it with hot air. During roasting, the food is uncovered so any moisture released can evaporate. The product to be roasted is often cooked on a rack so air can circulate evenly on all sides and fat can drip away.

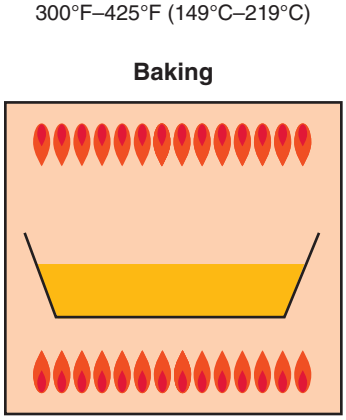


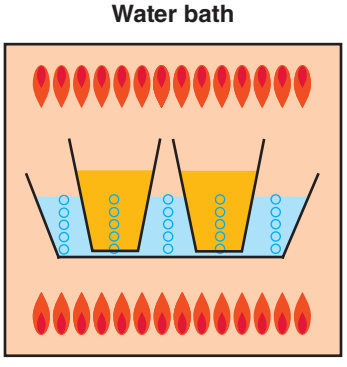
Baking

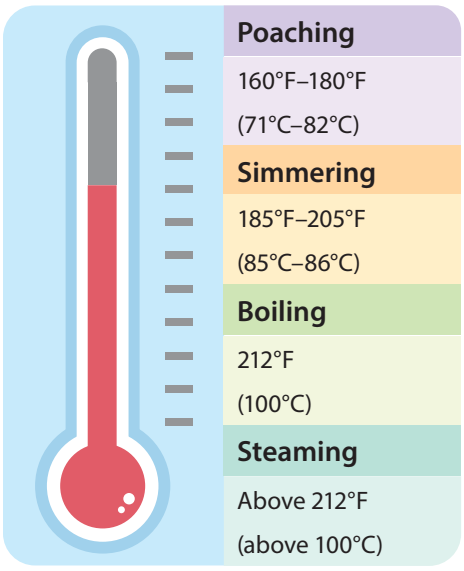
Similar to roasting, baking takes place in the oven; however, **baking** is the method used to cook foods with a certain amount of added moisture. The moisture might be stock, sauce, or custard. Baked products are often cooked covered to keep the moisture in the product.

The subtle difference between baking and roasting is often important when describing foods in menus or recipes. For example, a pork loin (cooked in the oven uncovered) would be described as *roasted*, while lasagna (with the moisture from the sauce) would be described as *baked*. Both baking and roasting use a combination of convection and radiation to transfer heat to foods.

Some products that require a gentle heat are baked in a water bath. To make a water bath, use a container that is larger than the pan holding the food. Partially fill the container with water. Place the pan of food inside the container of water and place in the oven. The water bath regulates the heat so the product cooks very slowly. Baking in a water bath is also called baking *au bain marie* (oh bay mahr EE).







Thermometer: jkcDesign/Shutterstock.com

Figure 12.6 Cooking temperatures vary for different moist-heat cooking methods

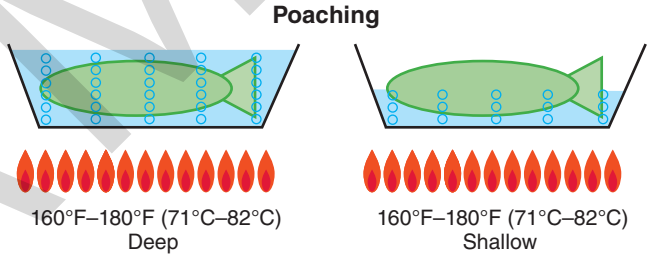
Moist-Heat Methods

Moist-heat methods use liquid or steam in the cooking process. It **envelops**, or surrounds, and penetrates food products during the cooking process. Even at lower temperatures, moisture is more effective at heat transfer than air. For example, you could easily reach your bare hand into an oven heated to 350°F (177°C), but you would never dream of sticking your hand into a pot of liquid simmering at 180°F (82°C). Moist methods are best used for tougher cuts of meats and fibrous vegetables.

Each of the following moist-heat methods has a specific temperature range (**Figure 12.6**). The temperatures are noted here to provide a point of comparison. Professionals rarely need to use a thermometer to judge the temperature of a cooking liquid. The motion and appearance of the cooking liquid is an accurate indicator of its temperature. When using moist-cooking methods, observe how rapidly the liquid bubbles.

Poaching

Cooking food in a liquid at a relatively low temperature is called **poaching**. The liquid used is often flavored. Poaching is used for delicate products that might fall apart if cooked at a higher temperature. The temperature range for poaching is 160°F to 180°F (71°C to 82°C). At the proper temperature, the liquid for poaching barely moves and some small bubbles occasionally break the surface. The poaching liquid transfers heat to the food by convection.



A properly poached product maintains its shape and delicate texture. Its taste is enhanced by the flavor of the poaching liquid.

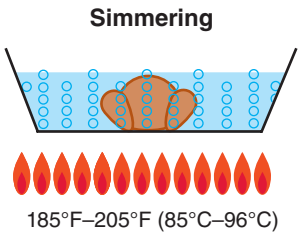
There are two techniques for poaching—shallow poaching and deep poaching. With shallow poaching, a small amount of liquid, usually stock, is used. The liquid is often not enough to cover the product halfway. When the poaching is complete, the liquid in which the food was poached, has a concentrated flavor. That liquid is then used to create a sauce.

When deep poaching, enough liquid is used to fully cover the product being cooked. The liquid used for deep poaching is not used to create a sauce. Deep poaching is often used for items such as eggs, whole fish, and large cuts of poultry.

Simmering

Simmering is performed at a slightly higher temperature than poaching. **Simmering** cooks food in liquid at a temperature just below boiling. At the proper temperature for simmering, 185°F to 205°F (85°C to 96°C), convection causes the liquid to move gently and steadily while bubbles constantly rise to the surface.

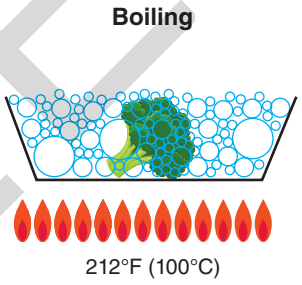
The temperature range for simmering is important because lower temperatures are not hot enough to break down connective tissue in meats. Temperatures above 205°F (96°C) toughen proteins and make the cooking liquid cloudy. Simmering is used to make stocks and broths as well as for cooking tough cuts of meat and poultry.



Boiling

Boiling is cooking in liquid at its highest possible temperature. At sea level, water boils at 212°F (100°C). Boiling liquids move rapidly creating a vigorous rolling motion and large bubbles, transferring heat to the food by convection. If liquids are heated above 212°F, they will change state from liquid to gas, or steam.

Boiling should not be used for protein foods such as meat, poultry, eggs, or fish because the higher temperature makes them tough. Many so-called "boiled" dishes are actually simmered. Boiling is most often used for vegetables, starches, and grains.



A Serving of Science

Atmosphere Affects Moist Cooking

Moist cooking is dependent on atmosphere. The atmospheric pressure surrounding the cooking process has an impact on heat transfer. There are two situations that require adjustment to cooking times due to atmospheric pressures—boiling at altitudes above sea level and cooking with steam under pressure. When boiling at high altitudes, water changes to steam at a lower temperature, therefore, boiled items usually take longer to cook to compensate for the lower temperature.

Altitude	Boiling Temperature
Sea level	212°F (100°C)
1,000 ft. (305 m)	210°F (99°C)
2,000 ft. (610 m)	208°F (98°C)
5,000 ft. (1524 m)	203°F (95°C)
7,500 ft. (2286 m)	198°F (92°C)
10,000 ft. (3048 m)	194°F (90°C)

When steam is put under pressure in a pressure steamer or pressure cooker, the gas becomes denser and holds more heat energy. Items cooked under pressure take much less time to cook. Pressure is measured in *pounds per square inch (psi)*.

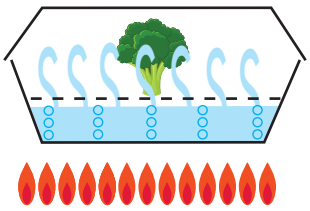
Amount of Pressure	Temperature of Steam
5 psi	220°F (105°C)
10 psi	235°F (115°C)
15 psi	250°F (120°C)

Know and Apply

1. Would it take longer boil a potato in Denver (altitude 5,280 feet) or New Orleans (altitude below sea level)? Why?
2. Would food cook faster in a pressure steamer set at 5 psi or set at 15 psi?

Steaming

Steaming



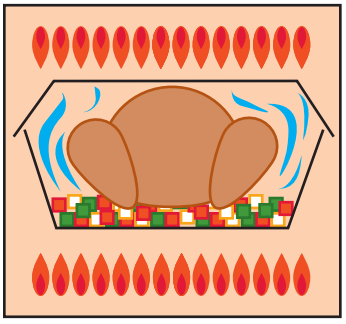
above 212°F (100°C)

Steaming is a moist-heat method that cooks a food product by surrounding it with steam vapor. The temperature of steam is hotter than boiling water. Steaming can be done in a covered pot with food placed on a rack above boiling liquid. Steam vapor rises and surrounds the product being cooked.

Steaming may also be done in a steamer or steam oven. These appliances create steam and then direct the vapor at the food through jets. Some steamers use a fan to create a more rapid convection. Pressure steamers use a tightly sealed compartment with pressurized steam for even greater heat transfer. The heat energy contained in steam vapor increases greatly under pressure.

Poêléing

Poêléing



350°F (176°C)

Poêléing (pweh laying) is a way of cooking a product in a sealed container with no added liquid. This is considered a moist-heat cooking method since the food is cooked by its own steam and hot juices. The process involves placing larger, tender cuts of meat or whole poultry on top of mirepoix (and sometimes bacon) that has been sweated in butter. The cooking dish, which should be sized to the item being cooked, is then covered and placed in a 350˚F (176˚C) oven. The food is basted—often with the butter and its own juices—during the cooking process. These juices then become the base of a sauce after the item is cooked.

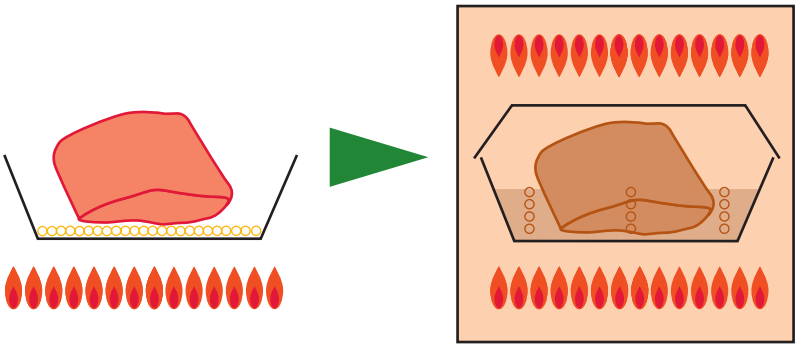
Combination Methods

Once you understand the process and reason for dry and moist techniques, you can more easily understand combination methods. Combination-cooking methods apply both dry-and moist-heat techniques to the same food.

Braising

Braising is a combination-cooking method that combines browning and simmering. First, the food is browned on all sides, usually in a small amount of fat. Next, liquid is added, and then it is simmered. Braising has the advantage of being able to tenderize tough cuts of meat or poultry like simmering. It also has the richer flavor and color of sautéed items.

Braising



Nutrition *Tidbit*

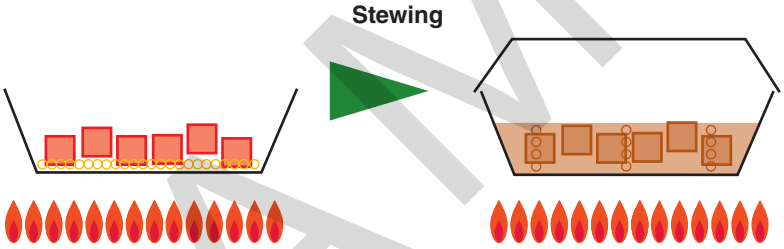
Healthy Cooking Techniques

Cooking techniques can affect the nutrient content of food. For instance, deep-frying at high temperatures can destroy heat-sensitive vitamins. Frying also adds calories and fat. Choose roasting, baking, grilling, broiling, poaching, sautéing, braising, steaming, and stir-frying instead. These healthier cooking alternatives help retain important nutrients and avoid unwanted fat and calories.

The first part of the braising process is often performed on the stovetop over high heat in a small amount of fat. After the product is browned, liquid is added and brought to a simmer. The item is covered and may then be cooked either on the stovetop or in the oven. The cooking liquid from a braised dish is typically rich in flavor and is often used to make a sauce to accompany the braised item.

Stewing

Strictly speaking, stewing is not a unique cooking method. Either the braising or simmering technique can be used to make a stew. Stews are different from braised or simmered dishes because the ingredients are cut in smaller pieces. The ingredients for a stew cook in enough liquid for them to float freely during the cooking process. The slow simmering of a stew is excellent for combining the flavors of many different ingredients in one dish.



Reading Review

1. Identify the following as dry-, moist-, or combination-cooking methods: (A) grilling, (B) poaching, (C) braising, (D) stewing, (E) poêléing, (F) deep-frying.
2. *True or false?* Liquid that is simmering barely moves and has some small bubbles occasionally breaking the surface.
3. Braising is a combination of which two cooking methods?

Lesson 12.2

Developing Taste

Learning Outcomes

After studying this lesson, you will be able to

- **contrast** eating with tasting.
- **explain** how the senses of sight, smell, taste, and touch contribute to how a person interprets food.
- **recall** factors that affect taste perception.
- **summarize** how chefs use and analyze taste combinations.
- **implement** a technique for tasting food critically.

Content Terms

gustation
olfaction
piquant
retronasal pathway
umami

Academic Terms

gauge
propel
tactile

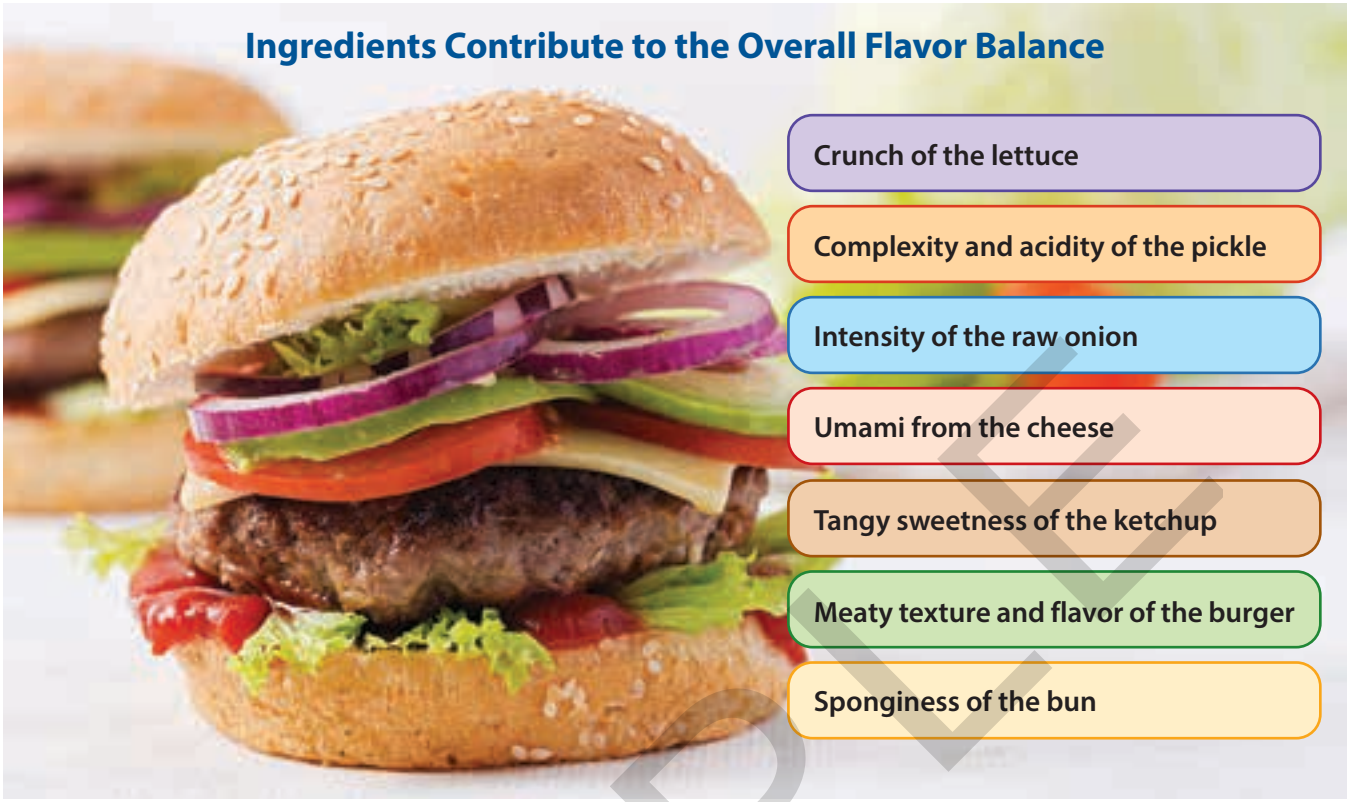
Much time is spent learning how to present food attractively; however, appearance is only the first step in appreciating a dish. The ultimate success or failure of a dish depends on flavor. Taste is the artistic arena in which chefs function. Therefore, it is important that all chefs understand how taste is perceived.

Eating Versus Tasting

There is a difference between eating and tasting. Eating refers to the general process of ingesting food. Eating does not require thought. Tasting is different and requires concentration. Tasting is the process of thoughtfully analyzing foods and beverages using your senses.

Taste is the chef's most powerful tool for quality control. Chefs who walk around the kitchen constantly tasting do so to verify the quality of the food being prepared. Without tasting, there is no way to accurately judge the quality of a particular dish, especially in a fast-paced kitchen.

Painters develop an artistic eye capable of evaluating different colors and shapes. Singers and musicians develop their sense of hearing to distinguish differences in tone, rhythm, and harmony. Likewise, foodservice professionals must develop their sense of smell and taste. Developing these senses requires work and practice. For instance, the last time you ate a hamburger, did you think about how each of the ingredients contributed to the overall flavor balance of the burger (**Figure 12.7**)?



Timolina/Shutterstock.com

Figure 12.7 The vibrant colors of the ingredients contribute to the visual appeal of this hamburger. ***Does a food's appearance factor affect its taste?***

Tasting is work and requires effort. As you take the time to concentrate on the foods you eat, you will begin to form a taste memory. A taste memory is a library of taste sensations and combinations that are cataloged in your brain. Professional chefs have large taste memories. They draw on their taste memory when creating and evaluating dishes.

Reading Review

1. What is the difference between eating and tasting?
2. *True or false?* Taste is a powerful tool for judging the quality of a dish.

Taste Physiology

Many people think that taste is only a matter of what happens in your mouth when eating food. This is just part of the story. Taste physiology refers to the mechanisms of how the body perceives taste. Taste physiology is about more than just what happens when food is in your mouth. Interpreting food involves the eyes and nose as well as the mouth.

Sense of Sight

In almost all instances, food is first interpreted visually. In other words, you most often see the food before the other senses register its presence.

When you see food, strong messages are sent to your brain including whether the food is edible or if you want to eat it. Chefs work hard to make food visually appealing so the customer wants to eat it on sight. In fact, attractive food sets up a certain expectation level that the food will smell and taste delicious.

Sense of Smell

The sense of smell is referred to as **olfaction** (ohl FAHK shun). Olfaction interprets airborne molecules that enter the nasal cavity and make contact with the olfactory bulb. The olfactory bulb is a small area (about the size of a postage stamp) in the sinus region of the nasal cavity. The information gathered by the olfactory bulb is then transmitted to the brain via the olfactory nerve.

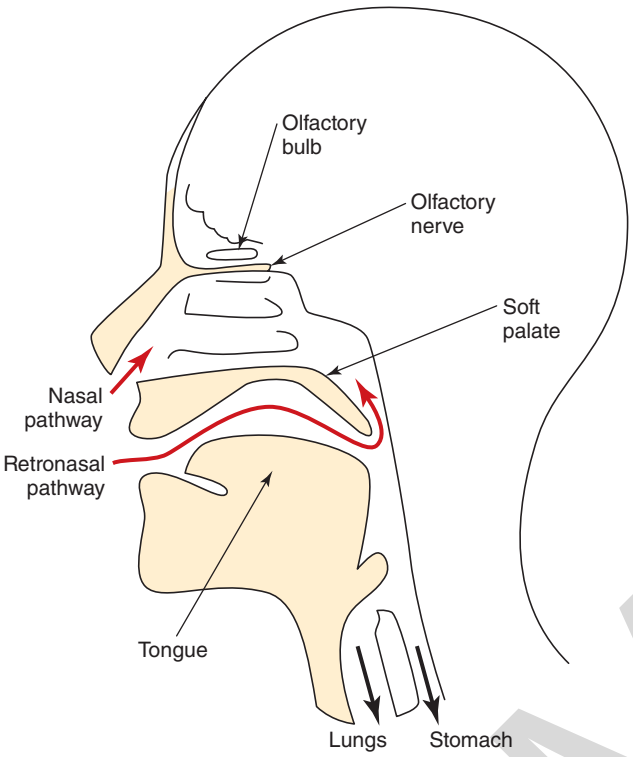


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Figure 12.8 Aromas reach the olfactory bulb by two different routes.

Aroma's Route

There are two routes by which aromas reach the olfactory bulb. The first is simply through the nose, or nasal pathway. The second route is the **retronasal pathway**. The retronasal pathway is the route aromas travel up the back of the nasal cavity from the back of the throat cavity (**Figure 12.8**). Aromas are **propelled**, or pushed, into the nasal cavity retronasally during swallowing or by breathing out through your nose while food or beverages are in your mouth.

Temperature Affects Olfaction

Heat also has an effect on olfaction. Hot foods produce more aromas, or molecules, that travel to the olfactory bulb. Therefore, a soup served hot tastes stronger and more flavorful than if it were served lukewarm. Conversely, ice cream must be strongly flavored because it is served cold and therefore produces fewer aromas.

Olfaction's Role in Taste

Olfaction is an integral part of tasting food. The sense of smell recognizes well over 10,000 different smells at various levels of intensity. It is the sense of smell that accounts for food tasting complex. For example, the flavor of herbs, spices, ripe fruit, and smoky bacon are all "tasted" in the nose. If aromas cannot reach the olfactory bulb, food tastes boring. Remember the last time you had a stuffy nose and could not taste food? The swelling inside the nasal cavity and excess amount of mucus simply kept aromas from reaching your olfactory bulb. For instance, if you ate a chocolate bar while enduring a head cold, you might only perceive a sweet and slightly bitter substance that melts in your mouth and has a fatty sensation. You would not be able to perceive the flavor of chocolate. In a similar way, bacon would only taste crunchy, salty, and slightly sweet if you were unable to smell it.

If you watch professional chefs or wine tasters, they often smell a product by inhaling quickly and intensely. There is a reason behind this technique. They inhale deeply to propel as many molecules as possible to the olfactory bulb. They do not inhale many times in a row because the sense of smell fatigues easily. This means that as you repeatedly smell the same aroma, you perceive it less and less. At some point, your sense of smell may no longer even recognize the aroma. For instance, perhaps you have stepped into an elevator with someone wearing too much perfume. At first, the aroma is strong and obnoxious; however, the more time you spend in the elevator, the less you perceive the perfume. The reason is simple—your nose has become fatigued with smelling the same aroma and no longer perceives it. In essence, your nose only smells *changes* in aromas.

Sense of Hearing

Typically, hearing is not considered part of tasting. In fact, hearing plays a role in the interpretation of food. Your sense of hearing interprets certain food- or beverage-centric sounds like sautéing food, sizzling fajita platters, or a carbonated beverage being poured into a glass (**Figure 12.9**). Your sense of hearing can also hear food in your mouth. It contributes to our interpretation of foods that are crunchy or carbonated.

Viktor_LA/Shutterstock.com

Figure 12.9 The sound of this carbonated drink is heard both as it is being poured into the glass and again in your mouth as you drink it. ***What are other food or beverage sounds that you hear and interpret as tasty?***

Sense of Taste

Gustation (guh STAY shun) refers to the sense of taste. The mouth cavity perceives only five basic tastes—sweet, salty, sour, bitter, and umami (u MAH mee). These five basic tastes are critical to appreciating and evaluating food.

Taste Buds

Taste buds are concentrated mostly on the tongue. A smaller number of taste buds are found throughout the mouth and throat. People are born with about 10,000 taste buds that are clustered on small bumps on the tongue called *papillae* (pah PIHL ee). Different taste receptors on taste buds interpret particular tastes. In other words, there are sweet-, salty-, sour-, bitter-, and umami-specific taste receptors. Taste buds are replaced on average every 10 days. This explains why taste is not permanently lost after you burn your tongue.

How Tastes Are Perceived

The tongue interprets sweet from various sugar compounds and alcohol. Salty impressions result from the tongue making contact with chemical salts. Table salt, or sodium chloride, is the most common salt consumed. Sour sensations arise from acidic substances.

In the kitchen, the most common acids are lactic acid from dairy products, citric and malic acid from fruits, and acetic acid from vinegar. Bitter compounds are common in many foods such as chocolate, artichokes, tonic water, cruciferous vegetables, coffee, tea, and olives. The bitter taste is a taste humans learn to like with repeated exposure. In general, intensely bitter foods are not appreciated in the same way sweet or umami sensations are appreciated from birth. Mildly bitter foods can successfully add to the complexity of a dish. Some people are repulsed by bitter sensations.

Understanding Umami

The fifth basic taste, **umami**, results from an amino acid called a *glutamate*. Amino acids are the building blocks of protein. While the concept of umami has been understood by chefs for centuries, it was not identified until 1908. Its scientific discovery happened in Japan, which accounts for its Japanese name. The taste receptor for umami was finally characterized in 2002, which scientifically confirmed it as our fifth taste. Umami is critical to producing delicious food and is perceived as a satisfying richness or meatiness. It is especially evident in fermented soy products, certain ripe vegetables, sea vegetables such as seaweed, aged cheeses, aged meats, long-cooked stocks and braised meats, and monosodium glutamate (MSG) (**Figure 12.10**).

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Figure 12.10 These are some foods that convey the taste of umami.
How is the taste perception of umami described?

Umami is perceived when the amino acid, glutamate, is not attached to the rest of a protein molecule. This is called *free glutamic acid*. Monosodium glutamate is a combination of sodium and glutamic acid. It is sold in grocery stores and is a white crystal that looks like salt. In your mouth and in the presence of liquid, the sodium and glutamic acid separate producing a free glutamic acid that is able to interact with the umami taste receptor. In this way, monosodium glutamate is a way to quickly introduce umami into recipes much like salt is added to recipes to make them saltier. Monosodium glutamate has been repeatedly verified by regulatory bodies across the world as a completely safe substance to use in cooking.

Sense of Touch

In addition to the sense of taste, the mouth registers the sense of touch. The mouth perceives **tactile**, or physical, sensations and temperature changes just as the skin on the rest of your body does.

The sense of touch allows your mouth to perceive differences in texture. As you chew, the inside of your mouth registers how crunchy, hard, soft, slimy, fatty, or smooth a food is. The ability to interpret texture allows you to **gauge**, or judge, the tenderness and juiciness of a steak, or whether a vegetable is cooked to the correct stage of doneness.

Piquant (pee KAHNT) refers to the spicy hot sensation. Like texture, piquant is a tactile sensation. Piquant is the result of a chemical irritation of the lining of the mouth. A small amount of piquant adds interest to a dish. Large amounts of piquant can make food difficult to eat—although this can become an acquired taste. Some of the most common piquant ingredients are chiles, peppercorns, onions, garlic, and mustard (**Figure 12.11**).

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Figure 12.11 The spiciness in piquant foods is perceived by the sense of touch. ***What causes piquant foods to be perceived as spicy in the mouth?***

Reading Review

1. How does the sense of sight affect taste?
2. What are the two ways that aromas can reach the olfactory bulb?
3. How is the flavor or perception of umami best described?
4. List three different piquant foods.

Factors Affecting Taste

While humans share the same physical mechanisms for perceiving food, they do not perceive or interpret food identically. For instance, a plate of steaming brussels sprouts may make one person's mouth water, while another person might be repulsed. Similarly, one person may believe a well-seasoned dish to be flavorful while another person may think it overly salty.

Chef's *Notes*

Comfort Foods

Comfort foods are those foods that are associated with childhood. Most often, comfort foods are simple foods that were prepared frequently at home. These foods cause a strong positive emotional response. Chefs often consider comfort foods when planning a menu since they are typically well-liked by the customer. It should be noted that comfort foods are strongly linked to culture. Macaroni and cheese may be one person's comfort food, while raw fish dipped in soy sauce and wasabi may be another's comfort food.

Subjective Factors

Taste is a highly individualized and complex topic that reflects the diversity of human beings. It is shaped by our genetic makeup, life experiences, and culture. People may dislike certain foods because those foods are not part of their culture. In some cultures, plates of barbecued chicken feet would be warmly received. In other cultures, such a dish would be reviled. Food preference is often linked with memory. For instance, a particular food that was eaten during a vacation may elicit positive feelings. On the other hand, a food consumed while one had the flu may create negative feelings.

Physical Factors

Aside from subjective interpretation of food, there are physical explanations as to how or why people perceive taste differently. The ability to taste food may be diminished for many reasons. Colds and illnesses can make food taste boring. Head trauma and certain medicines and medical treatments such as radiation and chemotherapy can impair the ability to taste. Some medicines can make food taste radically different.

Age also affects taste perception. Children have a heightened sense of taste. As people age, the number of taste buds decrease, and the olfactory bulb can become less sensitive to certain aromas.

Some people are born with a heightened ability to taste. These people are called *supertasters*. They are genetically wired to taste foods more sensitively than the rest of the population. As a result, what may be slightly bitter to most people may be too bitter to eat for a supertaster.

Reading Review

1. *True or false?* A fondness for sourdough pancakes with huckleberry syrup first eaten while on your favorite vacation in the mountains is an example of an objective factor affecting taste.
2. List four physical factors that could affect a person's ability to perceive taste.

Taste Combinations

Chefs spend their careers focusing on taste. They use their senses to evaluate the quality of the products they purchase. They use their senses to combine and balance the flavors of diverse foods. They use their senses to understand how the cooking process affects the flavor of the food. Understanding taste is at the heart of the professional chef's art.

When chefs want to create a new dish or analyze a menu item, they often break down a dish into its most basic taste components. This allows them to better analyze a certain preparation. Once a chef has considered the different aromas, tastes, and textures, they will be able to evaluate the overall success of the flavor combination. For instance, a chef would break down barbecue sauce into the components described in **Figure 12.12**.

Once the chef has isolated each element, they evaluate the relative intensity of each ingredient. The goal is to achieve a balanced barbecue sauce.

Evaluating Flavor Combinations

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Figure 12.12 Barbecue sauces can contain a wide variety of aromas that lead to the complexity of barbecue sauce.

Another key to understanding taste combinations is to consider basic taste pairings that complement each other. Chefs often employ these pairings when designing a new dish. Some of the most basic combinations are

- sweet and sour
- fat and sour
- sweet and bitter
- salt and sour
- sweet and salt
- umami and salt

To better understand how these pairings work, consider the fat and sour pairing. Imagine a small bowl of oil. If tasted at this point, the oil would simply coat the mouth with a fatty sensation. Slowly, vinegar is added to the oil. Tasting periodically, the fat coats the mouth less and less as more vinegar is added. Eventually, a balance is struck between the fat that pleasantly coats the mouth, and the acid that perks up the taste buds and cuts through the fat. If more vinegar is added, the impression of the fat diminishes and is replaced by an overpowering acidity.

Reading Review

1. *True or false?* A chef analyzes a dish by breaking it down into its basic taste components.

Tasting like a Chef

Chefs must be able to taste accurately and make quick decisions in a fast-paced kitchen. The ability to taste critically is the most important skill for controlling the quality of food being served. When tasting food, a chef must ask the question "Is this dish really as good as it can be?" Each taste of food is compared to the many different taste experiences a chef has had previously. A technique that can be used to taste critically is called *TAAT (Taste, Analyze, Adjust, Taste)*. TAAT includes the steps shown in **Figure 12.13**.

When first learning the *TAAT* technique, it seems slow and methodical. As you master the process, it moves faster. Over time, this process helps you build a taste library in your brain of many different taste experiences. Eventually, you will taste critically and quickly like a professional chef.

Reading Review

1. What are the steps in the TAAT technique?

Figure 12.13 TAAT Tasting Technique

Step	Explanation
Step 1 **Taste the Food**	The first step is to see the food, smell it, and place it in your mouth. Many times cooks do not taste the food before serving it to the customer. This is comparable to a painter painting a canvas with his or her eyes closed. This seems foolish, but occurs frequently in many kitchens.
Step 2 **Analyze the Food**	This step requires work and concentration. During this step, thought is focused on how the food looks, smells, tastes, and feels. Consideration is also given to the balance of the dish. Are all the components of the dish in proper balance? Is something missing or too strong? Is it too dry or too moist? Is it sweet, bitter, or salty when it should not be? Are the umami levels sufficiently high? Is it too crunchy or not crunchy enough? There are many questions that must be asked at this point. When first learning to taste critically, it is very helpful to record your impressions or discuss them with classmates.
Step 3 **Adjust the Food**	Based on your impressions in step two, it may be necessary to adjust the dish. This may take many forms. Perhaps more salt, liquid, umami, sugar, or lemon juice is added. Maybe it is inedible and must be discarded. Whatever the specifics, step three requires action. You do something to make the dish more perfect.
Step 4 **Taste the Food Again**	Adjustments made in step three, have changed the way the food tastes, so the process starts over. You must taste, analyze, and adjust again. It may take many times through this process to get the dish to be as perfect as possible. Eventually, the process finishes with step two when you analyze the dish and determine that it is correct. At this point, the food can be served.

Chapter 12 Review and Assessment

Summary Points

Lesson 12.1 Cooking Principles

- Food is cooked to make it safer to eat, easier to digest, and more appetizing.
- Understanding how heat affects the different elements of food will make you a better chef.
- Heat can be transferred by conduction, convection, or radiation.
- Cooking methods can be classified as dry, moist, or combination methods. Within each classification, the heat may be transferred to the food in different ways.

Lesson 12.2 Developing Taste

- Tasting is the process of thoughtfully analyzing foods and beverages using your senses. Analyzing food over time creates a taste memory that is crucial for all chefs to develop.
- The body perceives taste with the eyes, nose, and mouth.
- Taste is highly individual and is the result of genetics, life experiences, and culture. Illnesses, medicines, medical treatment, and age can reduce the ability to taste.
- Chefs use their developed sense of taste to combine flavors in a balanced and creative way. Chefs often break a dish down into its basic taste sensations to better analyze it.
- The ability to taste critically is an important skill for controlling the quality of food served.

Test Prep

1. Which of the following is a reason to cook food?
   A. To avoid interaction with medications.
   B. To make the food less digestible.
   C. To remove monosodium glutamate from the food.
   D. To make food safer to consume.
2. During poaching, heat is transferred to food by which process of heat transfer?
   A. Convection.
   B. Poêléing.
   C. Conduction.
   D. Radiation.
3. Adding more salt to strike a balance with a dish's sweetness is an example of which step in the TAAT technique?
   A. Step 1: Taste.
   B. Step 2: Analyze.
   C. Step 2: Adjust.
   D. Step 4: Taste.
4. Which of the following is a basic taste combination?
   A. Fat and glutamate.
   B. Piquant and spicy.
   C. Sweet and bitter.
   D. Sour and umami.
5. Coating an ingredient in flour is called _____.
   A. dusting
   B. dredging
   C. battering
   D. brining

Core Skills

6. **Math.** Pressure cooking methods can reduce cooking time to as little as one-third the time as nonpressurized methods. If a food product usually requires 1¼ hours to cook, how long would it take to cook using a pressure cooking method? (Round your answer to the nearest whole minute.)
7. **Speaking.** The microwave is one of the most used kitchen appliances in the home. Prepare a presentation about how a microwave works and its proper use. How is the radiation generated? How does the radiation heat food? Why is there a turntable in many microwave ovens? What types of foods can be cooked in a microwave? Be sure to address any safety considerations. Share your presentation with the class.
8. **Math.** A chef must be able to produce all the dishes for a particular table at the same time. Suppose the guests at a table order the following entrées: sautéed chicken dish (10 minutes to prepare); poached salmon dish (12 minutes to prepare); braised beef dish (20 minutes to reheat); vegetable stir-fry (five minutes to prepare).

Using the preparation times given in parentheses, when should the chef instruct each cook to start making their dish? Assume the chef wants the food ready to serve to the table at 6:10 p.m.

9. **Math.** When tasting your dish, the chef noted that the flavor from the thyme was overwhelming. You explain that the recipe called for two tablespoons of fresh thyme but you substituted two tablespoons of dried thyme instead. The chef tells you to remake the dish and adjust the amount of herbs because dried herbs have more concentrated flavor. The chef informs you that when substituting dried herbs for fresh, you should use one-third the amount of dried herbs as called for fresh. How much dried thyme should you use when you remake this recipe?
10. **Writing.** Create a simple chart with four headings—sense of smell, sense of hearing, sense of taste, and sense of touch. Bring this chart to your next meal and as you eat be aware of the sensations you are experiencing. Make notes in the appropriate columns about your perceptions. Then write a summary of your experience to share with the class. What did you learn about developing taste?
11. **CTE Career Readiness Practice.** Presume you are a chef at a local retirement community. The residents have the choice to either participate in group meals in the dining room or prepare their own meals. Many choose the latter. Because eating should be enjoyable as well as sustain life, a number of residents have requested a class on making foods more appealing and flavorful. The facility manager knows your expertise and has asked you to make a presentation to the residents. Develop a presentation/demonstration that will teach residents how to
    A. create visually appealing food, and
    B. enhance the aromas and flavors of foods to make them more appealing to eat.

Critical Thinking

12. **Evaluate.** Select three boneless, skinless chicken breasts of similar size and shape. Each chicken breast must be cooked to an internal temperature of 165°F (74°C) using a different dry-heat cooking method such as sautéing, grilling, and baking. Evaluate each finished product and record your observations on appearance, flavor, tenderness, and moisture.
13. **Assess.** Should printed menus describe the cooking method used for different dishes? Why?
14. **Relate.** Some chefs determine the doneness of a steak by touch. Steaks that are softer to the touch are more rare and those that are firmer to the touch are more well done. What happens during the cooking process that would explain why this method works?
15. **Conclude.** In previous centuries, eating meat was considered a privilege and was quite expensive. Often times, older work animals were consumed at the end of their lives. Why was it that simmering, braising, and stewing were commonly used for these animals?

Culinary Skills Lab

Learning how to taste critically is an important skill for a chef. In teams, select a soup recipe to prepare or obtain a recipe from your instructor (alter the yield of the recipe to suit the number of members of your team). Prepare the soup. Then use the steps in the *TAAT* (Taste, Analyze, Adjust, and Taste) technique to critically analyze your soup. As a team complete Steps 1 and 2 and discuss what adjustments should be made to make your soup more flavorful and appealing. Then complete Steps 3 and 4. Discuss the results of Steps 3 and 4. At what point does your team think its soup would be ready to serve the customers? Why?

Chef's E-portfolio

Analyzing Taste Sensations

Upload your chart and summary from the writing activity #10. Ask your instructor where to save your file. This could be on the school's network or flash drive of your own. Name your portfolio document *FirstnameLastname_Portfolio Ch#.docx* (i.e., JohnSmith_PortfolioCh12.docx).