Foam Cakes

Unit: Preparing Foods

Problem Area: Baking and Pastry

Lesson: Foam Cakes

Student Learning Objectives.

Instruction in this lesson should result in students achieving the following objectives:

1. **Summarize basic foam cake ingredients and equipment.**
2. **Prepare foam cakes.**
3. **Analyze physical changes and chemical reactions that occur in foam cake preparation.**

Resources.

The following resources may be useful in teaching this lesson:

E-unit(s) corresponding to this lesson plan. CAERT, Inc. http://www.mycaert.com.

Berenbaum, Rose Levy. *The Cake Bible*. Kindle ed. Houghton Mifflin Harcourt, 2016.

Fletcher, Helen S. "Meringue Shells," *Pastries Like a Pro.* Accessed June 1, 2018. http://pastrieslikeapro.com/2015/04/meringue-shells/#.WXqUC4qQwmI.

Food Science: The Biochemistry of Food and Nutrition. McGraw-Hill Education, 2006.

Gisslen, Wayne. *Professional Baking,* 6th ed. Wiley Publishing, 2012.

Labensky, Sarah R., Priscilla A. Martel, and Eddy Van Damme. *On Baking: A Textbook of Baking and Pastry Fundamentals,* 3rd ed. Pearson, 2016.

Phillips, Sarah. "Angel Food," *CraftyBaking.* Accessed June 1, 2018. https://www.craftybaking.com/learn/baked-goods/cakes/types/angel-food.

Phillips, Sarah. "Biscuit (French)," *CraftyBaking.* Accessed June 1, 2018. https://www.craftybaking.com/learn/baked-goods/cakes/types/biscuit-french.

Phillips, Sarah. "Foam Cakes," *CraftyBaking.* June 1, 2018. https://www.craftybaking.com/learn/baked-goods/cakes/types/foam-cakes.

Phillips, Sarah. "Jelly Rolls or Biscuit Roulades," *CraftyBaking.* Accessed June 1, 2018. https://www.craftybaking.com/learn/baked-goods/cakes/types/jelly-rolls-or-biscuit-roulades.

Equipment, Tools, Supplies, and Facilities

- ✓ Overhead or PowerPoint projector
- ✓ Visual(s) from accompanying master(s)
- ✓ Copies of sample test, lab sheet(s), and/or other items designed for duplication
- ✓ Materials listed on duplicated items
- ✓ Computers with printers and Internet access
- ✓ Classroom resource and reference materials

Key Baking Terms.

The following terms are presented in this lesson (shown in bold italics) and in the corresponding E-unit titled "Form Cakes: Ingredients and Preparation":

- all-purpose flour
- angel
- angel-cake method
- bain-marie
- baker's percentage
- biscuit
- Boston cream pie
- cake flour
- chiffon
- chiffon method
- citrus zest
- clarified butter
- cream of tartar
- dacquoise
- double boiler
- foam cake (unshortened cake)
- fold
- formula
- ganache
- génoise
- gluten
- ladyfingers
- leavened
- meringue
- meringue cake
- meringue shell
- mise en place
- mixing
- nut flour
- pavlova
- petit fours
- recipe
- ribbon stage
- roulade
- saccharide
- salt
- salted sweet cream butter
- scaling
- sponge
- sponge method
- torte
- trifle
- triglyceride
- unsalted sweet cream butter
- vegetable oil

Key Science Terms.

The following terms are presented in this lesson (shown in bold italics) and in the corresponding E-unit titled "Form Cakes: Baking Science":

- absorption
- caramelization
- carbon dioxide (CO_2)
- chemical reaction
- coagulate
- colloidal dispersion
- condensation
- conduction
- convection
- denaturation
- denature
- emulsion
- endothermic reaction
- evaporation
- exothermic reaction
- foam
- gluten
- heat transfer
- homogenous mixtures
- hydrolysis
- hygroscopic
- immiscible
- invert sugar
- Maillard reaction
- pan flow
- pH
- pH scale
- physical change
- radiation
- relative humidity (RH)
- saccharide
- surface area
- surface tension
- viscosity

Interest Approach.

Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

The culinary term "fold" is commonly used in foam cakes recipes and formulas. Introduce the lesson in the following manner:

Discussion: *"Fold" is a culinary term. Describe what it means to fold? Use VM–A as an illustration of the process of folding beaten egg whites into a nut batter. The next picture is the finished product: a chocolate-hazelnut-meringue cake. Ask the students:*

- *"Which ingredients are likely folded?" ANSWER: Typically, beaten egg whites (meringue) and whipped cream are folded.*
- *"Have you seen this in a recipe before?"*
- *"Have you made a recipe that required you to fold? What was the recipe name?"*

Video Clip: *Watch the short (less than one minute) Martha Stewart Living video, "How to Fold," at http://www.marthastewart.com/964920/htb128-how-fold-hi-resmov.*

Video Discussion Questions:

- *What folding steps did you see?*
- *Why were the beaten egg whites added in two steps instead of one?*

CONTENT SUMMARY AND TEACHING STRATEGIES

Objective 1: Summarize basic foam cake ingredients and equipment.

Anticipated Problem: What is a foam cake? What are the basic ingredients in foam cakes? What standard equipment is required to make foam cakes from scratch?

I. A ***foam cake (unshortened cake)*** is a light, airy, spongy cake with little or no fat. They have a high proportion of eggs to flour and are leavened primarily by air beaten into whole eggs or egg whites. Foam cakes include sponge, chiffon, meringue, and génoise. Primarily, foam cakes are ***leavened*** (made to rise) by whipped eggs and steam. The three most important ingredients in a foam cake, in order of importance, are eggs, sugar, and flour. Most foam cakes are drier than butter cakes, because they contain little or no butter or oil. [NOTE: Exceptions include chiffon and most génoise cakes. Also, this lesson addresses baking foam cakes from scratch with recipes. Handling quantity foam cake mixes, in formulas, is a science unto itself. You will learn the terms associated with formulas, but all cakes will be evaluated as recipes. All measurements for cake pans will be in inches unless otherwise stated.] To appreciate the interaction of these ingredients, there are specific terms and characteristics associated with all parts of the cake recipe that should be considered.

A. FORMULA VERSUS RECIPE: Baking is science. Bakers use formulas to ensure consistent products. A formula is a general science and math construct that shows the relationship between given quantities. In baking, a ***formula*** is the written measurement of ingredients by weight (in pounds, ounces, kilograms, or milligrams). Weight measurement is essential when flours and sugars (anything sifted) are added to a baking formula. In contrast, a baking ***recipe*** is the written measurement of ingredients by volume, such as teaspoons, tablespoons, cups, dashes, and pinches—which are perfectly fine for small batches.

1. *Scaling:* ***Scaling*** is a baker's term for weighing out ingredients. Accurately measuring 4.54 cups of cake flour by volume is, at best, a guess, whereas accurately weighing 1 pound of cake flour is precise. In baking and pastry formulas, all ingredients are based on percentages (ratios), and the percentages are what allow the baker to scale the batter up or down (doubling, tripling, etc.) in quantity.
2. *Baker's Percentage:* A ***baker's percentage*** (formula percentage) is the percentage of an ingredient in relationship to the amount of flour in the formula. For example, 1000 grams of flour, 660 grams of water, 20 grams of salt, and 10 grams of yeast are expressed in a baker's percentage as 100 percent flour, 66 percent water, 2 percent salt, and 1 percent yeast. In a baker's formula, all amounts are expressed in percent of the total flour weight; although, it is actually a ratio, as the percentages always add up to more than 100 percent. If a

formula calls for 4 pounds of flour, then 4 pounds equals 100 percent. In the same formula, 2 ounces of baking powder equals 3.1 percent of the total flour weight. [NOTE: Got to the King Arthur Flour webpage, "Ingredient Weight Chart," at http://www.kingarthurflour.com/learn/ingredient-weight-chart.html.] A drawback to a baker's percentage is that gluten-forming flour proteins are not reflected in the formula. This can have an impact on the final product, so it may need to be adjusted. There are, however, many reasons to use a baker's percentage.

a. It enables the baker to work with more precision (with only one unit of measure).
b. It is easy to scale a formula up or down (doubling, tripling, etc.).
c. It is easy to compare which formula is drier, sweeter, or saltier.
d. The baker's percentage helps create uniform ingredient measurements for varying quantities per unit. (For example, 70 grams may be the weight of one to three eggs, depending on their size.)
e. It also serves as a common language among all bakers and baking operations.

B. EGG BASICS: Eggs are the most important ingredients in a foam cake. Eggs (combined with flour) are a structural element in baking. Chicken eggs are the standard. All other types of eggs (duck, ostrich, etc.) are rarely used in baking and pastry formulas. Eggs are a valuable source of vitamins A, B, and D.

1. Grade AA large eggs (about two ounces each, or eight per pound) are the most common size used in baked goods. Eggshell color does not affect how the egg functions in baking and pastry products.
2. Egg weight is more accurate than the number of eggs used.
   a. A large egg white: About $1^{1}/_{3}$ ounces or $2^{2}/_{3}$ tablespoons
   b. A large egg yolk: About $^{2}/_{3}$ of an ounce or $1^{1}/_{3}$ tablespoons
   c. Eight whole large eggs: About 1 pound or 2 cups
3. A fresh egg should have a nicely rounded yolk that is well centered in the white, and the egg, still in its shell, should sink to the bottom of a water-filled container (good way to check freshness).
4. Cracked eggs have a danger of salmonella and should be discarded.

C. EGG FUNCTIONS: Eggs provide many functions in the baking process.

1. *Leavening:* Via air incorporation, egg whites contain lecithin, a protein that lines the outside of the air bubbles created during beating. These bubbles prevent the egg whites from collapsing.
2. *Emulsification:* Eggs act as a binding agent that holds other ingredients together. Eggs are second to flour in providing structure to baked goods.
3. *Moisture:* Eggs keep batters moist without having to add other liquids (which might make the batter too thin or collapse).
4. *Color:* Egg yolks provide color to batter. An egg wash provides a glaze to baked goods that browns the surface (the Maillard reaction).

5. *Flavor and Texture:* Eggs add a distinctive taste to baked goods. The addition of yolks makes baked goods more tender. Eggs act as a thickening agent and provide texture.

D. EGG TEMPERATURE: Eggs are easiest to separate when they are cold. To beat whole eggs or egg whites to their greatest volume, they should be brought to an internal temperature of 65°F to 75°F. Angel food cakes use only egg whites in the batter. Sponge and chiffon cakes beat egg yolks and egg whites separately. The egg white foam (or meringue) is folded into the batter.

E. SUGAR BASICS: Sugar is the second most important ingredient in a foam cake. Sugar is a carbohydrate that is soluble in water, usually crystalline in form, and sweet in taste. Sugars are produced from various types of plants, such as canes (sucrose), beets, sugar maples, and palms. In fact, most fruits and vegetables contain sugar (sucrose, fructose). Solid sugars include cane and beet sugars. Liquids can include honey, molasses, corn syrup, or various manmade liquid sweeteners produced for dietary purposes.

1. ***Saccharide*** is the scientific name for sugar (or an organic compound containing sugar). Sugars and other sweeteners add taste, tenderness, color, and aroma to baked goods. [NOTE: Reducing more than one third of the sugar in a recipe will negatively affect the tenderness, moistness, brownness, and sweetness of the product. It may also change some of the scientific reactions that occur during preparation.]
2. The various grinds of solid sugar (such as granulated, powdered, superfine, or brown) impact finished products. Most baked goods are produced with the solid sugars. Superfine sugar is most often used in foam cakes. When baking, liquid sugars do not react in the same fashion as solid sugars. Consult a reference guide when substituting liquids for solids. [TIP: It is possible to mimic superfine sugar (also called caster or castor sugar) by processing granulated sugar in a food processor. After 30 seconds to a minute, the sugar should become finely ground, and it is then acceptable for use in foam cakes.]
3. Sugar by weight is more accurate than sugar by volume.
   a. A cup of granulated sugar is about 7 ounces.
   b. A cup of confectioners' (powdered) sugar is about 4 ounces.
   c. A cup of packed brown sugar is about 7½ ounces.
   d. A cup of molasses, honey, or corn syrup is about 12 ounces.

F. SUGAR FUNCTIONS: Sugar has many functions within cake batters. [NOTE: Artificial sweeteners do not provide the same browning, tenderizing, and moisture retention as natural sugars.]

1. Flavor
2. Tenderization
3. Color (caramelizes and aids in browning)
4. Feeds yeast organisms (aids in fermentation)

5. Moisture retention (sweetened baked goods stay moist longer than unsweetened types)
6. Spreading of cake batter and cookie dough

G. FLOUR BASICS: Flour is the third most important ingredient in a foam cake. However, flour is not used in meringue cakes or in flourless cakes. All-purpose wheat flour (mixed from hard and soft wheat) is the most commonly used flour for baked goods in the United States. French flour is made from soft wheat. Both hard and soft wheat contain very little germ or husks, and they keep longer than whole meal-type flours. Varying protein content affects the way flours react, so some dessert and pastry recipes may call for 2½ to 2¾ cups. In this case, the process is to measure and add smaller amounts first. Then, following the recipe directions, more flour can be added to create the desired condition (cleans the sides of the bowl, not sticky to the touch, etc.). However, foam cake recipes typically call for a specific amount of flour, such as 2½ cups.

1. ***Gluten*** is an elastic protein found in wheat and cereal flours that gives batter and dough elasticity, strength, and rising ability. (It keeps baked goods from collapsing when removed from the oven.) Gluten stretches (when moistened) and expands to hold the gas produced by the leavening agent. It becomes a structural framework for baked products.
2. The type of wheat (hard or soft) affects the amount of gluten content. Hard wheat (grown in the Midwest) has a high protein content and, as a result, produces more gluten. Soft wheat (grown in the South) has less protein content and produces less gluten. Baked products require different gluten content. Cakes, quick breads, and pastries require much less gluten formation (for a soft, fine texture) than yeast breads.

H. FLOUR FUNCTIONS: Flour adds, provides, and/or creates body (bulk or mass), structure, texture (tender and crumbly or firm and chewy), flavor, and gluten within the baked item.

I. FLOUR TYPES: The following flours are typically associated with cakes.

1. ***All-purpose flour*** is a blend of hard and soft wheat that can be bleached or unbleached. It is the most common flour used in the United States, and it is made up of 8 to 11 percent protein (gluten). It is used for quick breads, pastries, and some cakes. Flour that bleaches naturally (usually via oxygen) is called “unbleached,” and flour that is chemically treated (by chlorine, bromates, or peroxides) is termed “bleached flour.” Bleached flour has less protein than unbleached.
   a. In Europe, these chemicals are not allowed in flour.
   b. Bleached flours are best for pie crusts, cookies, quick breads, pancakes, and waffles.
   c. Unbleached flours are best for yeast breads, Danish pastry, puff pastry, strudel, éclairs, cream puffs, and popovers.
   d. Unbleached flour in the United States may still have been treated with a bromate. Read all ingredients carefully, or go to company websites for milling information.

2. ***Cake flour*** is a finely-ground, soft-wheat flour with a high starch content. It is bleached with chlorine to allow it to absorb more water, which produces a fine, white crumb in cakes. Bleaching makes the flour slightly acidic. This has two effects: It sets the cake batter faster, and it distributes fat more evenly than other flours, which improves the texture. Cake flour is $7^1/_2$ percent protein (gluten). Its low gluten count produces tender cakes. Baked goods with a high sugar ratio benefit from the use of cake flour, because it is able to rise without collapsing (more so than products produced with all-purpose or other wheat flours). Foam cakes need high-starch, low-protein flour, so most call for cake flour. However, some recipes for rolled sponge cakes (roulades) use high-protein flour and add ground nuts or cocoa powder to the batter for added structure and stability. [NOTE: In a pinch, two tablespoons taken from a cup of wheat flour can be a substitute for cake flour.]
3. ***Nut flour*** is made from finely ground nuts, and it can be used to bake breads, cookies, cakes, and, especially, pastry crusts.

J. OTHER FLOUR FACTS: Flour is often used to prepare pans for cake batters and other baked goods to prevent sticking.
   1. Preparing a pan for baking often requires a greased pan to be lightly coated with flour. That pan is then tapped to remove any excess flour. Some baking sprays already contain flour for this purpose.
   2. All flours are different, and they work best when weighed. [NOTE: For information about measuring flour by volume see the "How to Measure Flour" video at http://www.kingarthurflour.com/learn/how-to-measure-flour.html.]

K. SALT BASICS: ***Salt*** is a crystalline compound (NaCl, sodium chloride), primarily used as a condiment, that comes in two types—sea salt distilled from seawater and rock salt found in the earth. Sodium chloride (table salt) was the first salt discovered by humans. Iodized salt (table salt with added iodine) is the salt most often utilized in American cooking.

L. SALT FUNCTIONS: Salt has many functions within cake batters.
   1. Flavor (heightens the flavor of other ingredients, balances sugar)
   2. Slows yeast fermentation, keeping air bubbles small and uniform in size (not good for most foam cakes)
   3. Toughens the texture of soft fat-and-sugar mixtures
   4. Strengthens gluten protein (better texture)

M. LEAVENING BASICS: Leavening is the production of gas in a dough or a batter through an agent, such as steam, air, eggs, baking soda, baking powder, a starter, or yeast. The leavening agent causes expansion in batter by releasing gases within the mixture. Chemical leavening agents (baking soda and baking powder) produce CO_2 gas that helps products rise. Leavening is important in baked goods. Not only does it cause a baked product to rise, but it provides added flavor. [NOTE: Leavening agents are discussed in detail in CA C8–2, "Leavening Agents."]

1. *Steam:* While baking, moisture from batter is converted to steam. Foam cakes use steam as part of their leavening and lift. [TIP: Preheating of the oven encourages the greatest production of steam leavening.]
2. *Air:* Mechanical incorporation of air occurs during batter (dough) mixing, such as whipping, beating, or folding. Air leavening occurs when this vigorous mixing entraps air, creating bubbles that produce foam. Air leavening, from beaten eggs, is the most common leavening agent in a foam cake.
3. *Chemical:* Chemical leavening agents (baking soda, baking powder) produce a gas that helps the product rise. Chemical leavening agents are used sparingly in foam cakes. Some chiffon and génoise cakes use a chemical leavening agent. [NOTE: For a sponge cake recipe that uses a chemical leavening agent (baking powder), the Natasha's Kitchen website has a recipe and short video, "Four-Ingredient Sponge Cake," that can be seen at http://natashaskitchen.com/2016/05/06/easy-sponge-cake-genoise/.]
    a. Baking soda: Baking soda (sodium bicarbonate) is a chemical leavener when combined with an acid. It creates tiny bubbles of carbon dioxide that push against the batter and cause it to expand (leaven, rise). Baking soda reacts with liquids, including sour milk, yogurt, buttermilk, sour cream, and molasses. Because baking soda only reacts once (single-action), it is often added to the dry ingredients first. Then, when wet and dry ingredients come together, the cake must be panned and baked as quickly as possible. [TIP: Mise en place is essential when using baking soda.]
    b. Baking powder: Baking powder is a chemical leaven composed of baking soda, a dry acid (such as cream of tartar), and a starch (such as cornstarch) to prevent lumping. Because of the added acid, baking powder will react on its own when wet. For baking powder leavening to occur, two elements must be available—an acid and an alkaline—that react separately in the presence of moisture. This combination forms gases (tiny bubbles in the batter) that expand for leavening. The most common form of baking powder is a double-acting variety, which has two dry acids. In double-action, the first acid reacts in the cold (room temperature) batter, and the second one reacts in the oven at an approximate temperature of 140°F. This ability to react twice makes baking powder a good choice for most baked products.

N. LIQUID BASICS: Foam cake recipes use very little liquid. The liquids most used in foam cakes are water, juices, and oils. Liquids are needed for chemical changes in structure and texture. When liquid evaporates under the dry heat of an oven, it produces steam. In turn, air bubbles develop and increase the volume of the baked good. Like eggs and flour, liquids are more accurate when weighed. (Two cups of water and two cups of molasses are the same volume but different weights.) The metric system is preferred for measuring liquid, as it does not differentiate between fluids and solids—a gram is a gram and a kilogram is a kilogram.

O. LIQUID FUNCTIONS: Liquids have many functions within baked goods.
    1. Moisture

2. Flavor (milks, creams, fruits, juices, yogurt, or sour cream)
3. Added color (browning from milk and fruit sugars)
4. Leaven with steam
5. Hydrate proteins, starches, gelatins, and leavening agents
6. Activate yeast organisms
7. Mix with flour for proper gluten development
8. Aid in binding (especially in quick breads and muffins)

P. FAT BASICS: Fats are plant- or animal-based, oily ingredients that melt at low temperatures. Fats are compounds of carbon, hydrogen, and oxygen. Lipids are molecules that include fatty acids, triglycerides, cholesterol, and various nutrients. Fats are lipids found in animal and vegetable tissue. (From animals, butter and lard are produced. From vegetables, nuts, legumes, oils and shortenings are made.) Solid fats (butter, margarine, and hydrogenated products) remain solid near room temperature. Oils can solidify when refrigerated or cooled. A byproduct of creating hydrogenated shortenings is the production of trans-fatty acids (trans fat) that may cause a health risk. Shortenings are 100 percent fat. A half-and-half split with butter is a good shortening mixture. Three common fats may be used to make foam cakes.

1. *Vegetable Oil*: ***Vegetable oil*** is fat extracted from plants, fruits, or seeds. Examples of vegetable oils are coconut, corn, cottonseed, olive, palm, rapeseed (canola), safflower, soybean, and sunflower. Oils are liquid at room temperature, but when refrigerated, they may solidify. Vegetable oil is a triglyceride. A ***triglyceride*** is an ester derived from glycerol and three fatty acids, and it is the largest class of fats represented in the human diet. [NOTE: For more information about the properties of fat, see the MYcaert lesson and e-unit for CA B3–5.]
2. *Butter*: ***Salted sweet cream butter*** is a dairy product that is churned (agitating cream to separate fat and water) from fresh, sweet cream, has an 80 percent fat content, and has been flavored with salt. European butters can contain up to 86 percent fat. ***Unsalted sweet cream butter*** (same as the salted variation, minus the salt) is used in many sweet or low-sodium recipes. Water and some milk solids comprise the remainder of butter's contents. Butter is different from shortening in two major ways. It has an enhanced flavor and melts in the mouth.
3. *Clarified Butter*: ***Clarified butter*** is butter fat that has been rendered by separating the milk solids and water from the butterfat. Most commercial butter is 80 to 82 percent fat, 16 to 17 percent water, and 1 to 2 percent milk solids. Clarified butter is prepared by melting butter, and skimming the milk solids off that float to the top or sink to the bottom (as the water evaporates). The remaining butterfat is the clarified butter. The high percentage of water in solid butters creates a lower smoke point. Clarified butter and most oils can be heated at higher temperatures without smoking. As clarified butter is close to 100% butterfat, the lack of water (which encourages spoilage) allows it to be stored for extended periods of time.

Q. FAT FUNCTIONS: Fats provide many functions in a cake.

1. Flavor and richness (especially butter or lard)
2. Moisture
3. Tenderness (shortens gluten strands)
4. Leavening (when creamed)
5. Browning
6. Emulsification
7. Even distribution of added flavors (vanilla, almond, etc.) throughout the batter

R. FLAVORINGS AND ADDED INGREDIENTS: In small quantities, flavorings and aromatics can add something special to a cake.

1. Flavorings may include extracts (concentrated oils or essences diluted with alcohol), natural liquids (such as vanilla, almond, or cherry, also derived from concentrated oils), seeds and beans (vanilla, nutmeg, chocolate, coffee), and spices (like cinnamon, ginger, cloves, or nutmeg). Chiffon cakes are often flavored with ***citrus zest*** (the grated or finely-cut, outer skin of lemons, limes, oranges, and other citrus fruits). Sponge, chiffon, angel, and génoise cakes can also be flavored with cocoa powder and numerous fruit flavors.
2. Other common ingredients can include citrus (and other juices), nuts, chips, coconut, cherries, apples (and other fruits), chocolate, and vegetables. Foam cakes are often filled with a custard or a sweetened, whipped-cream filling layered with a combination of these and other ingredients.
3. ***Cream of tartar*** (potassium bitartrate) is an odorless, white, crystalline powder with a chemical formula of $KC_4H_5O_6$. Cream of tartar is added to egg whites, while whipping, to increase their volume and stabilize their peaks. Cream of tartar is a byproduct of winemaking. Potassium bitartrate crystallizes during grape fermentation, and it is scraped from the inside of wine barrels. It is found in the baking and spice aisle of most grocery stores. To substitute for cream of tartar, combine a ½ teaspoon of lemon juice or white distilled vinegar per egg white.

S. HAND TOOLS AND EQUIPMENT: Basic hand tools and equipment are necessary for creating a well-mixed, balanced, and evenly-baked item.

1. *Mixer:* Stand mixers sit on a tabletop or the floor and have several attachments (flat beater, dough hook, or wire whip). Foam cakes may use the flat beater, but wire whips are used to beat egg whites. Egg yolks are beaten separately for chiffon cakes. Use the flat beater or the wire whip as directed.
2. *Scales:* Platform, digital, or balance scales are used to accurately measure ingredients. Platform scales are often used to measure moist ingredients, and balance scales measure dry ingredients. Digital scales are best to measure small amounts (spices, herbs, leavening agents) or portions (such as two ounces of batter per cupcake).

3. *Spatulas:* Numerous spatulas are available, with most used for stirring, scraping, or icing.
    a. Wooden spatulas are very practical for stirring. The flat surfaces easily scrape off the edge of a pan. Also, egg mixtures (such as custard fillings) can be prepared with a wooden spatula.
    b. Rubber scrapers are used to remove all traces of dough and batter from a bowl or vessel. They are also used to gently fold beaten egg whites or meringue into a batter or dough.
    c. Metal icing spatulas (straight and offset) are used to ice many types of cakes.
4. *Cutting Boards:* Marble, polyurethane, and wooden cutting boards are used to protect table surfaces and reduce contamination.
5. *Knives:* Paring knives are used for trimming. Chef knives are used to chop, section, or split. Slicers are used to section cakes and to trim edges from bar cookies.
6. *Hand Whips:* A metal-handled, multi-wire whisk is used to incorporate air into various products, such as eggs or heavy cream.
7. *Wooden Spoons:* Large wooden spoons are used in creaming, cake-batter mixing, and folding operations. Chefs and cooks often prepare chocolate mixtures, sauces, and glazes with a wooden spoon.
8. *Sheet Pans:* Straight-sided pans (full, half, and three-quarter sizes) are used to bake sheet cakes, pan cookies, or sponge cakes.
9. *Jellyroll Pans:* These straight-sided pans (15½ × 10½ × 1) are used to bake sponge cakes, especially jellyrolls.
10. *Rectangular and Square Pans:* Rectangular (9 × 13 × 1.5) and square (8 × 8 × 1.5) are common household pan sizes. These are primarily for small sheet cakes that are served directly from the pan.
11. *Layer-Cake Pans:* Layering pans are typically round, but could be square, rectangular, or other shapes. (They can vary up to 18 inches, but 9 × 9 × 2 or 3 is common.) Professional layer pans are used to make all types of two- and three-layer cakes. Some have loose bottoms for easy cake removal. Special filled foam cakes are baked in round layer cake pans.
12. *Loaf Pans:* Loaf pans (9 × 5 × 3 or 10 × 4 × 3) are used for baking pound cakes, fruitcakes, and breads. Some angel food cakes are baked in loaf pans and sold commercially.
13. *Tube Pans:* These pans (9 × 3 is common) are used to make angel food cakes, Bundt® cakes, and chiffon cakes. Sometimes, these pans are fluted. Bundt® cakes are normally made with a butter cake batter; however, many chiffon cakes are baked in Bundt® pans due to the added fat or oil.
14. *Springform Pans:* Springform pans (9 and 10 are common) have hinged sides and a removable bottom. They are typically used to bake cheesecakes, layered cakes, or frozen desserts.
15. *Scoops:* Scoops (or dippers—resemble ice cream scoops) come in many sizes. Scoop numbers generally correspond to measures. Portions are based on a

number of leveled scoops. [A scoop number of 100 means that 100 portions are found in a quart of batter. A scoop numbered 12 (each scoop contains a scant ½ cup) is typically used to portion cupcakes.]

16. *Liners:* Disposable parchment paper and reusable silicone pan liners are used in conventional, convection, and microwave ovens. Pan liners make cake layers easy to remove from pans. Silicone liners are reusable.
17. *Double Boiler and Bain-marie:* A ***double boiler*** is a saucepan that is made up of two pans that nestle together—the bottom pan is filled half full (or less) with simmering water, and the top pan holds the ingredients. Typically, the top pan does not touch the simmering water. A ***bain-marie*** is a hot water bath ("bain" is the French term for bath) used to slow cook foods or keep them warm. In many foam cake preparations a bain-marie is used to hold or melt an ingredient over simmering water. [NOTE: The Spruce Eats website has an example of a bain-marie that can be seen at https://www.thespruce.com/definition-of-bain-marie-480588.]

Teaching Strategy: *Use VM–A to introduce folding (see the "Interest Approach" section above). Use VM–B to illustrate the three main ingredients used in foam cakes: eggs, sugar, and flour. Use VM–C to illustrate leavening, preheating, and other foam cake ingredients. Use VM–D to review the function of each ingredient, with a special emphasis on foam cakes. Consider creating a "Foam Cake Equipment and Tools Scavenger Hunt" game. Make a list of ingredients and tools shown throughout "Objective 1." Add other tools available in your laboratory setting. You may select different lab groups to discuss and/or demonstrate the use of designated pieces of equipment for foam cake preparation.*

Objective 2: Prepare foam cakes.

Anticipated Problem: What is mise en place? What are the foam cake categories? What are basic foam cake preparation methods? How are foam cake pans prepared? How are foam cakes tested for doneness and cooled?

II. Many tasks, steps, ingredient preparations, tools, equipment pieces, and types should be discussed when preparing a foam cake.

A. MISE EN PLACE: Before mixing, the baker must follow the rules of mise en place. ***Mise en place*** is a French cooking term that means "to set up" or "to arrange." The baker should:

1. Read the entire recipe.
2. Collect all of the ingredients and allow them to come to room temperature (with the exception of heavy cream, which should usually remain refrigerated until use).
3. Measure all ingredients accurately, preferably by weighing.
4. Follow processes requested by the recipe. This might include chilling a stainless steel bowl in the freezer (to whip heavy cream), ensuring ingredients are

at room temperature, or pre-cooking/pre-cutting added ingredients (such as fruit compotes, toasted spices, or nuts).

5. Prepare the workstation by cleaning the area, gathering tools (cutting board, knives, etc.), and arranging equipment (such as a stand mixer) as required.
6. Preheat the oven.
7. Prep baking pans. (For example, the recipe may call for the baker to grease the pan, add parchment paper, or grease a liner).
8. Make a cooling station (a clear area with cooling racks, etc.).

B. CAKE PAN PREP: Different cake pans, recipes, and batter ingredients require different pre-baking preparations.

1. *Ungreased:* Angel, chiffon, and most sponge cakes are baked in ungreased pans. During baking, the batter expands up the sides of the ungreased pan for support.
2. *Greased:* Lard or solid vegetable shortening, such as Crisco® or lard (not butter, margarine, or sprays), is applied to the inside of layer, Bundt®, tube, loaf, square, and rectangular cake pans. The shortening can be spread with fingers, a pastry brush, or a paper towel. Shortening tends to release cakes easier than other fats.
3. *Greased and Floured:* First, the pan is greased. Then, about one teaspoon of flour is sprinkled into the pan while it is tapped and turned (until the flour adheres to the greased bottom and sides). The pan is turned over, and the excess flour is tapped out. Recipes that use fluted tube pans usually direct the baker to grease and flour the pan. [NOTE: Cakes served from a pan would not require flouring.]
4. *Grease, Parchment Paper, and Grease:* The grease, parchment paper, and grease method is especially desirable when baking tender layer cakes. The process for a baker is as follows:
    a. Lightly grease the layer pan.
    b. Add a parchment or silicone liner.
    c. Grease the parchment or silicone liner.
    d. To remove layers from the pan, loosen any cake that clings to the sides of the pan. Turn over the pan onto a rack, a plate, or your hand. The greased parchment or silicone layer ensures that the cake layer comes out cleanly.
5. *Greased and Sugared*: The baker follows the grease and flour method, but substitutes sugar for flour. Some recipes for angel cakes use this technique. The heated sugar allows the cake to more easily release, and gives the cake a crisp, sugary crust.
6. *Non-Stick Pans:* Non-stick or coated pans may have specific directions for greasing.

C. ROOM TEMPERATURE: Prior to mixing, bringing all ingredients to room temperature (68°F to 70°F) is an essential step in preparing a well-mixed cake.

1. *Butter:* Butter should be brought to between 60°F and 70°F, or as stated in the recipe, but it shouldn't be too soft (or melted). Butter that is too cold won't

beat evenly. It won't incorporate air or increase in volume. Butter that is too soft is unable to adequately trap air, and it may cause the cake batter to collapse in the oven.

2. *Eggs:* Cold eggs do not whip as well as room temperature or warm eggs. Cold eggs decrease cake volume and may cause a chocolate batter to seize (not blend smoothly). When eggs and liquids are cold, the batter can curdle (separate into liquid and fat), and the texture may become too dense.
3. *Fat:* If any of the ingredients are too warm, the fat will melt and not whip effectively enough to incorporate air.

D. SIFTING: Thoroughly sifting all dry ingredients together helps produce an evenly-baked cake.

1. *Lumps:* Cake flour and cocoa powder are finely ground products. They tend to form small lumps that don't break apart during blending or beating, especially when they are not sifted with the other dry ingredients.
2. *Tunnels:* The result of unevenly sifted dry ingredients can be the creation of large holes and tunnels in the middle of the baked cake.
3. *Raw Flour Pockets:* Using a sifter or a wire whisk helps ensure that all raw flour is evenly distributed throughout the batter (and that no pockets of batter are surrounded dry flour).

E. MIXING: ***Mixing*** is a general instructional term that describes stirring, beating, blending, binding, creaming, whipping, and folding—any action that combines two or more ingredients evenly to become one product. Each mixing method adds a different texture and character to a baked good. Even the paddle, hand-whisk, or wire-whisk attachment can make a difference in the final outcome. (The type of spoon can also affect the finished product.)

1. *Stirring:* All ingredients are mixed together with a utensil, usually a spoon, in a circular motion.
2. *Beating:* Ingredients are moved vigorously in a back-and-forth, up-and-down, and around-and-around motion until the components are smooth.
3. *Blending:* Everything is thoroughly mixed until the ingredients become one product.
4. *Creaming:* Fat and sugar are beat together until they are light, airy, and pale-colored.
5. *Whipping:* Air is incorporated into the ingredients (often whole eggs, egg whites, or heavy cream) by mechanical means, such as a stand mixer, a hand mixer, or a wire whisk.
6. *Folding:* One ingredient is gently folded into another, by hand, with a large spoon or spatula. This keeps the batter light and aerated. (Whipped creams and eggs are often folded into other ingredients to maintain their airy quality.)

F. SPONGE: A ***sponge*** is a light and airy foam cake that contains three basic ingredients: eggs, sugar, and flour. A ***biscuit*** is the French term for sponge cakes. These cakes are leavened by air beaten into the eggs. They contain fat from egg yolks (and sometimes, oil). A sponge cake is prepared by beating room temperature egg yolks and sugar until they are thick and lemon colored. [TIP:

"Thick and lemon colored" is usually signaled by the ability of the mixture to ribbon off of the beater and back into the bowl. The flour is added, and then folded, into the stiffly-beaten, egg-white mixture (sometimes with cream of tartar already incorporated into the whites).] The following is a list of tips when making sponge cakes.

1. *The Ribbon Stage:* All sponge-cake recipes test the doneness of egg-and-sugar whipping using the ribbon stage. The ***ribbon stage*** is a test to see if the batter forms a thick stream that folds back on itself as it's lifted from the bowl. [NOTE: An 18-minute recipe and video, "American Sponge Cake," can be seen on the Joyofbaking.com website at http://www.joyofbaking.com/AmericanSpongeCake.html. This shows the ribbons of an egg-white mixture, and the method of folding flour into the egg whites.]
2. *Baking Techniques:* Most sponge cakes are baked in sheet pans and rolled up (jellyroll fashion), or they are baked in round deep-sided layer pans. Fillings or toppings include fresh fruits, fruit purées (and jam), nuts, ice cream, sweetened whipped cream, buttercream icing, a chocolate glaze or ganache, or other cream fillings in rich flavors. Sponge cake can also be baked in a sheet pan and cut into small sponge cake shells.
3. *Flavorings:* Common flavorings include extracts, citrus zest, cocoa powder, or liqueurs.

G. SPONGE CAKE TYPES: Sponge cakes have many qualities essential for a variety of cakes.

1. *Ladyfingers:* ***Ladyfingers*** are a low-density, dry, egg-based sponge shaped much like a person's finger. They are leavened with a chemical leavening agent (along with the separately beaten egg yolks and egg whites). The batter is piped into long fingers before baking. [NOTE: "How to make ladyfingers" can be seen on the Eddy Van Damme website at http://www.chefeddy.com/2009/11/how-to-make-ladyfingers/.]
2. *Flourless:* Flourless chocolate sponge cake is made with chocolate, cocoa, and separately-beaten egg yolks and egg whites. [NOTE: A 20-minute video of a Chocolate Sponge Cake recipe can be watched on the Joy of Baking website at http://joyofbaking.com/ChocolateSpongeCake.html.]
3. *Torte:* A ***torte*** is a rich cake made from layers of cake and cream. There are several sponge variations and recipes for tortes.
4. *Roulade:* A ***roulade*** is any foam cake baked in a jellyroll pan, removed from the pan, and rolled in a towel while still warm. This allows the cake to "shape or mold" around the filling without breaking. Roulade cakes may be filled with whipped cream, ganache, lemon curd, buttercream icing, jelly, or jam. (Pronounced "guh-NAWSH," ***ganache*** is a whipped mixture of chocolate and heavy cream.)

5. *Petit Fours*: ***Petit fours*** are small, decorative, and layered bite-size sponge cakes, often covered with fondant or marzipan icing. The protein structure from the large proportion of eggs in the batter holds the cake together. This allows for the following:
    a. Flavorings, liqueurs, or soaking syrups can be brushed on the layers without crumbling the cake. Angel food and most foam cakes have a delicate flavor and aroma that compliment a variety of flavored syrups, fillings, and toppings.
    b. Round sponge-cake layers can be cut crosswise, covered with a filling, stacked, topped, or iced.
    c. Other cakes can be decorated with the petit fours. Decorations can be created when cutting the layers, and then molded onto the outside of other cakes.
    d. Mousse and ganache mixtures can be held by petit fours without becoming soggy.
6. *Boston Cream Pie*: A ***Boston cream pie*** is a two-layered (minimum) sponge cake filled with a vanilla pastry cream and topped with a chocolate glaze (or, sometimes, a dusting of powdered sugar). It is said these cakes were originally baked in a pie tin, hence their name. [NOTE: There are numerous variations of the original Boston cream pie. Some fold in beaten egg whites, have multiple layers, or add ganache. Go to the Yankee magazine article at https://newengland.com/yankee-magazine/food/desserts/pies-pastries/boston-cream-pie-2/.]

H. SPONGE METHOD: The ***sponge method*** (foam method or egg-foaming method) is a foam-cake, egg-beating technique for creating leavening from whole eggs. In most cases, the beaten eggs are the only leavening in the cake. The trapped air from the whipped eggs gets hot, expands, and forms steam (leavening) while the cake bakes. Foam cakes contain a high proportion of eggs (or egg whites) in relation to other ingredients. This makes its cell structure larger and coarser than creamed and blended cakes. The sponge method requires ingredients to be at room temperature. Whole eggs and sugar are often warmed (100°F to 105°F) in a hot water bath (bain-marie) and whisked continuously. This provides a larger volume of air that is added to the mixture, thus producing the spongy texture. Pans for sponge cakes are often ungreased. This allows the delicate cakes to cling to the pans' sides while baking. Often, sponge cakes do not shrink from the sides of the pan. There are several steps a baker will follow in the sponge method.

1. *Step One*: Mise en place should be done. Bring ingredients to room temperature (68°F to 70°F) prior to mixing. Weigh all ingredients separately. Cold eggs do not whip as well, or provide as much volume, as room-temperature or warmed eggs. Eggs are often separated when cold and then covered until room temperature. If the recipe uses whole eggs (specifically, some génoise cakes), place the egg (still in the shell) in warm water for five minutes before whipping. Preheat the oven. Angel, chiffon, and most sponge cakes are baked in ungreased pans. The cakes crawl up the sides of ungreased pans for support during baking. [NOTE: This is the typical cake pan preparation for foam

cakes.] An ungreased parchment liner is a quick cake-pan preparation used for some génoise cakes. [NOTE: A few foam cakes use other cake-pan preparations. Those methods will be covered later.]

2. *Step Two:* Whisk together the dry ingredients. (This includes half of the sugar. The sugar combines with the flour to prevent flour-starch particles from clumping together.)
3. *Step Three:* The warmed eggs and/or egg yolks, half of the sugar, cream of tartar (if called for), and the flavoring are beaten on medium speed to twice their original volume. Test to ensure that the batter mixture forms the ribbon stage before moving onto the next step.
4. *Step Four:* Set the mixer speed to "low" and slowly add any other liquids and flavorings (only if called for in the recipe).
5. *Step Five:* Switch to the paddle attachment (or a spatula) and gently fold in the dry ingredients. This will be done until the batter is smooth without dry pockets (carefully, as to not deflate the batter). For best results, dry ingredients are slowly sifted into the batter, folding between additions. To ***fold*** is to combine two mixtures, one light and one heavy, without deflating the lighter mixture. Folding can be completed with a wooden spoon, rubber spatula, or a paddle attachment.
    a. The folding action is a downward motion and a careful turning over of the mixture (this prevents the air from escaping). This action is completed while turning the bowl and scraping the mixture from the bottom with the spoon or spatuala.
    b. Folding should be completed quickly and completely (no streaks of batter, whipped eggs, or egg whites should remain).
6. *Step Six:* Fold in any melted butter, clarified butter, or oil to the batter (only if designated by the recipe).
7. *Step Seven:* Portion the batter into prepared pans and bake. Foam cakes are baked in a preheated oven immediately after mixing (to prevent the loss of air bubbles). The rush of the hot air allows the cake to fully rise (from the development of steam and the coagulation of the egg-foam bubbles). In contrast, an unheated oven prevents egg-foam coagulation at peak volume, and it can deflate.

I. CHIFFON: ***Chiffon*** is a foam cake that is moist, tender, light, airy, springy, and made with fat. Chiffon cake fats may include egg yolks, butter, or oil. Because they contain fat, they exhibit some characteristics of butter cakes, especially their moist, tender quality. They are leavened with beaten egg whites, egg yolks, and baking powder. Chiffon cakes are often citrus flavored, but they may also be chocolate or contain chopped fruits or nuts.

1. *Pans:* These cakes are often baked in tube pans or angel food cake pans. Two-piece tube pans make removing the cake from the pan easier.
2. *Cooling:* After baking, chiffons should be immediately turned upside down to prevent the foam structure of the cake from shrinking and to ensure that air circulates around the entire pan to cool. After they have completely cooled in

the pan, they can be removed. A knife or thin spatula helps loosen the cake from the tube pan. [NOTE: Bakepedia has an orange chiffon cake recipe by Dede Wilson at https://www.bakepedia.com/orange-chiffon-cake/.]

J. THE CHIFFON METHOD: The ***chiffon method*** is a foam-cake preparation for folding beaten egg whites into a batter of egg yolks, flour, and fat. This method incorporates all whipped ingredients (egg whites, meringue, heavy cream) into the batter in thirds using the folding motion. A key to this mixing method is the ensuring that each third is thoroughly incorporated before adding the next third. Bakers are also careful not to deflate the mixture during folding. The steps for a baker to use the chiffon method are:

1. *Step One:* Prepare mise en place, following all steps. Be sure to bring all ingredients to room temperature (68°F to 70°F) prior to mixing. Weigh all ingredients separately. Preheat the oven. Cake pans are prepared by the grease and flour method, the grease-parchment-grease method, or the grease and sugar method. [NOTE: Follow directions on the recipe for cake pan preparation.]
2. *Step Two:* Sift dry ingredients together in a bowl—set aside.
3. *Step Three:* Combine liquid ingredients, fat (including egg yolks), and flavoring into a bowl and set aside.
4. *Step Four:* In a mixer, whip room-temperature egg whites (with cream of tartar, if called for in recipe) until they have medium peaks.
5. *Step Five:* Alternate folding thirds of the dry and liquid ingredients into the egg whites (ending with dry ingredients). Take care not to overmix. [NOTE: Some cakes will have whipped cream to be added during this portion. It will be folded in between the liquid and dry ingredients above.]
6. *Step Six:* Portion the batter into prepared pans and bake.

K. GÉNOISE: A ***génoise*** is a foam cake characterized by a light, airy, sponge-like texture that is made with melted (or clarified) butter, whole eggs beaten to the ribbon stage, and no added leaveners. Eggs and butter make this cake moist with a tender mouthfeel. It is also less sweet than a typical sponge cake. Génoise cakes are also known as European cakes, as they are named for the cake's place of origin, Genoa, Italy. Génoise-cake recipes vary.

1. *Sugar and Egg Mixture:* Some bakers heat the sugar and whole egg mixture until warm over a pot of simmering water. Because the pan or bowl cannot touch the simmering water (the protein in the egg would coagulate), the easiest method is the use of a double boiler. A larger bowl could also be placed atop a smaller pan of simmering water (like a bain-marie). Then, the warmed sugar and egg mixture is whipped until the mixture forms a ribbon. [NOTE: If the egg mixture starts getting lumpy, the eggs are cooked, and the baker has to start over.]
2. *Butter:* Different bakers swear by either regular melted or clarified butter. [NOTE: Danilo Alfaro has a step-by-step process in an article, "How to Make Clarified Butter," on The Spruce Eats website at https://www.thespruce.com/how-to-make-clarified-butter-995451.]

3. *Demos:* Since eggs are the only leavening in this cake, a baker should watch a demonstration video before attempting the recipe. Videos demonstrating how whole eggs are beaten until lemon in color and tripled in size (the ribbon stage), how to measure sifted flour, the folding technique (to prevent the loss of the egg volume), and génoise cake techniques are also available on multiple sites. [NOTE: The CraftyBaking website has an egg-beating and génoise demo at https://www.craftybaking.com/howto/eggs-beating-techniques-whole-eggs-and-yolks.]

L. ANGEL: An ***angel*** (angel food cake) is a foam cake characterized by a feather-light, delicate, airy texture that is made with egg whites, flour, sugar, and no fat. Angel cakes contain no egg yolks, no chemical leavening agents, and no butter or oil. They contain more sugar than any other foam cake, but they are cholesterol free (because they contain no fat and no egg yolks). It is basically a meringue with flour added. Angel food cakes were invented in the United States and dubbed "the food of the angels."

1. *Egg Whites:* These cakes are made with 10 to 12 whipped egg whites, cream of tartar (for egg white stabilization), sugar, flour, salt, and extracts. [TIP: Extra care must be taken to ensure that no egg yolk or any speck of fat comes in contact with the egg whites, the bowl, or the whisk. Even one speck of fat prevents the egg whites from reaching peak volume.]
2. *Pans:* They are baked in ungreased tube pans (angel food pans). The lack of grease helps the egg white batter cling and climb up the sides of the tube pan. The pan should be cooled completely, upside down, to prevent the cake structure from collapsing.

M. ANGEL CAKE DESSERTS: Angel cakes are a base for numerous desserts.

1. Stuffed Angel Food Cake: To stuff an angel cake, the baker cuts off the top third, makes a tunnel, and adds a gelatin, curd, chocolate ganache, fresh fruits, whipped cream, pudding, or other fillings.
2. Layered Angel Food Cake: The cake is cut into two to three layers. It is then filled or frosted with any of the toppings listed for stuffed angel cakes. [NOTE: The New York Times author, Melissa Clark, posted an amazing lemon-curd, layered, angel-food recipe from High Street restaurant at https://cooking.nytimes.com/recipes/1018018-lemon-angel-food-cake-with-preserved-lemon-curd.]
3. Trifle: A ***trifle*** is a British dessert that is layered in a straight-sided dish, and it can include any combination of foam cake (usually angel food or sponge), cream, custard, fruit, jam, and sweetened whipped cream.
4. Roulade: Angel cakes create light roulades. Baked in a sheet or jellyroll pan and rolled in a towel while warm, an angel cake can then be filled, iced, sugared, and sliced crosswise to reveal a spiral shape.

N. The ***angel method*** is a foam-cake preparation technique that focuses on the beating of air into egg whites for maximum leavening. In most cases, the beaten egg whites are the only leavening in the cake. The angel cake method directs ingredients to be at room temperature prior to mixing. This provides a larger

volume of air that is added to the mixture, thus producing the spongy open texture. Pans for angel cakes are ungreased. An ungreased pan ensures that this delicate cake batter will cling to, and climb up, the sides of the pan while baking. Angel cakes do not shrink from the sides of the pan like butter cakes. The steps for a baker to produce a perfect angel cake are listed below.

1. *Step One:* Prepare mise en place for ingredients, oven, pans, and cooling station. Ingredients should be room temperature, but some recipes will call for the egg whites to be warmed in a bain-marie.
2. *Step Two:* Combine, sift (four times), and then set aside the cake flour and one-fourth of the superfine sugar.
3. *Step Three:* Use the wire whisk attachment and beat the egg whites, salt, and cream of tartar, gradually add the remaining superfine sugar. Bring the egg white mixture to stiff peaks. (Basically, a French meringue is made.) [NOTE: If using a copper bowl, follow the directions on the recipe]
4. *Step Four:* In thirds, gently fold the dry ingredients into the egg whites.
5. *Step Five:* Portion the batter into prepared pans and bake.
6. *Step Six:* Invert the pan to cool completely.

O. MERINGUE: ***Meringue*** is a flourless foam cake prepared from a mixture of stiffly-beaten, room-temperature egg whites and sugar (or sugar syrup). Meringue mixtures are often stabilized with cream of tartar and contain no fat. There are three basic types of meringue: French, Swiss, and Italian.

P. MERINGUE TYPES: These common meringues have a few differences.

1. *French:* French meringue is the most commonly prepared and the least stable type of meringue (until baked). All preparations are completed without heat, until the egg-white mixture reaches stiff peaks.
2. *Swiss:* With Swiss meringue, the egg whites are gently beaten with sugar over a double boiler. When the mixture reaches 120°F to 130°F, the sugar is dissolved. Then, the mixture is removed from the heat and beaten to stiff peaks. It's smoother and silkier in appearance than French meringue.
3. *Italian:* Italian meringue is prepared by slowly drizzling 240°F sugar syrup into room temperature whites that have been whipped to a firm peak. This is then re-whipped until the mixture is satiny, stiff, and cooled. Italian meringue is a base for many buttercream frostings.
4. *Meringue Shells:* A ***meringue shell*** is a light, airy, nest formed from any meringue product, dried in the oven to a chewy and soft texture, and filled with sweetened creams, curds, custards, ice creams, fruits, or ganaches. To make meringue shells:
    a. The mixture is beaten to stiff peaks with more sugar than for a common meringue.
    b. The meringue is spread on parchment paper with a spoon, or it can be piped with a pastry bag into circles, heart shapes, or other designs. Shells can be thin for stacking, as for a meringue cake, or shaped with a depression (nest) in the middle to hold a filling.

c. These meringue shells should be baked in the oven, slowly. (Usually, 225°F to 300°F is recommended. One recipe variation calls for the baker to preheat an oven, turn it off, place the shells, and leave the oven light on for overnight drying). [TIP: To prevent gummy, sticky, and hard meringue shells, bakers usually select a day with low humidity to make the shells.]

5. *Meringue Cake:* A ***meringue cake*** is a series of hard meringue disks layered with fillings. [NOTE: The MyRecipes.com website posted a Southern Living recipe, "Fresh Strawberry Meringue Cake," at http://www.myrecipes.com/recipe/fresh-strawberry-meringue-cake. Recipes for meringue cakes vary greatly. They can include layers of butter cake, meringue disks, sweetened cream, custard, or berries.]
6. *Dacquoise:* A ***dacquoise*** (pronounced "dah-kwahz") is a French dessert cake that is assembled with layers of almond and hazelnut meringue discs and then topped with whipped-cream or buttercream icing. [NOTE: The Craftsy article and recipe, "Dessert 101: What is Dacquoise & How is it Used?," can be seen at https://www.craftsy.com/blog/2015/07/what-is-dacquoise/.]
7. *Pavlova:* A ***pavlova*** is a filled, meringue-shell dessert with a crisp crust and a soft and light interior (typically filled with sweetened cream and fresh fruits). It is said to have been created for the Russian ballerina Anna Pavlova when she was touring Australia and New Zealand. [NOTE: The Truffles and Trends website has a mixed-berry pavlova that can be seen at https://www.trufflesandtrends.com/home/2016/4/27/mixed-berry-pavlova-layer-cake.]

Q. TESTING DONENESS: Bakers all have their own systems for knowing when a cake is done. Most home cooks and professional chefs test cakes for doneness by using one of a few time-honored methods. With practice, a baker develops a sense of the additional time the cake will need.

1. *Time, Temperature, and Aroma Test:* The baker surmises doneness after the cake has been in the oven for the requisite amount of time, has baked at the suggested temperature, and "smells like cake."
2. *Toothpick Test:* A toothpick, a thin skewer, or a cake tester is carefully inserted into the center of the cake. If it comes out clean, the cake is done. If not, it needs more time. The cake tester should be washed and dried, or a new toothpick should be used, each time the cake is tested for doneness. [NOTE: Most sponge cakes do not use the toothpick method of testing for doneness. Typically, the insertion of a toothpick is not necessary as the other test methods are more accurate for foam cakes.]
3. *Color Test:* The cake is lightly browned (golden).
4. *Touch Test:* If the cake's center is touched lightly with fingers, it springs back. If it has an indentation, it needs more time.

R. COOLING: Most cakes should be cooled before icing or serving. With foam cakes, most are ungreased and have limited leavening. Certain steps need taken to assure the consistency stays in tact after removing them from the oven.

1. *Inverted:* Angel, and many sponge cakes, are baked in tube pans and cooled upside down—on their pan legs or on a bowl (for air circulation). Foam cakes

are cooled inversely to avoid collapse as they cool (especially when no chemical leavening is used). Most foam cakes are not removed from the pan until completely cooled—just prior to being iced (although some exceptions do exist). To remove a foam cake from a pan, a knife or thin metal icing spatula is ran around the outside edges (to loosen them). A two-piece tube pan makes it easier to remove the cake from the pan. A knife around the tube center (and then around the bottom of the tube pan after it is disconnected) separates it from the cake.

2. *Rolled:* Roulades (jellyrolls, Swiss rolls, etc.) should briefly cool on the cooling rack, be removed from the pan, and then immediately rolled in a clean, powdered-sugar-dusted kitchen towel. They are then returned to the cooling rack.
3. *Removed before Cooling:* Some sponge and génoise cakes (especially those baked in layer pans) briefly sit on a cooling rack before being removed from the pan, placed on parchment, and then put back on a cooling rack. Once cooled to the desired temperature, the parchment liner can be removed. Some recipes call for the immediate removal of the parchment paper from the sponge cake, while others cool with the parchment paper in place. After completely cooled, the baker can cut, fill, and ice as directed.

Teaching Strategy: *Use VM–E to review functions of foam cake ingredients. Use VM–F to review mise en place rules. An activity is provided on the VM to identify mise en place rules used in a selected foam cake recipe. Partners or small lab teams should each have a different foam-cake recipe and evaluate it for the mise en place rules they would use prior to mixing. The teams would report their findings to the class.*

Use VM–G to illustrate several sponge cakes. Then, go to The Spruce Eats website at https://www.thespruce.com/definition-of-bain-marie-480588 to project a picture of the bain-marie. Explain how it is used for sponge category cakes.

Use VM–H to illustrate the ribbon stage. Use VM–I to illustrate chiffon cakes. Use VM–J to illustrate génoise cakes. Use VM–K to illustrate angel cakes. Consider showing the Everyday Food video, "Whipping Egg Whites to Perfect Peaks," on YouTube at https://www.youtube.com/watch?v=zhuRyq7NrcA. This video also addresses how to fix overbeaten egg whites. Use VM–L to illustrate meringue, meringue cakes, meringue shells, and a dacquoise. See if the students can identify the pictures after reviewing meringue.

Use VM–M to review the sponge method. This VM has an assignment for students to review a sponge-method cake recipe and complete an evaluation table. Use VM–N to illustrate foam cake pan preparation. Use VM–O to discuss foam cake doneness and cooling based on two examples.

Assign LS–A to prepare and evaluate a four-ingredient génoise cake. Students also describe the characteristics of génoise cakes used on the data table evaluation. They will practice cutting a cake layer into two thinner layers. The lab group can also

engineer a génoise masterpiece, sketching their unique design. Use VM–P to illustrate the steps to building a Victoria Sponge Cake.

Objective 3: Analyze physical changes and chemical reactions that occur in foam cake preparation.

Anticipated Problem: What physical changes occur during foam cake preparation? What chemical reactions occur during foam cake preparation? What is foam? How does surface area affect the baking time of cakes? How does the pan size affect the baking time of cakes? How do relative humidity and altitude affect the baking of cakes?

III. Baking is a science. Many scientific actions occur when making and baking foam cakes. Numerous physical changes and chemical reactions are necessary to prepare the perfect foam cake. The difference between a chemical reaction and a physical change is compositional. This section will discuss the definitions and various situations related to chemical reactions and physical changes when baking. Cake mixtures are complex: they are simultaneously foam, emulsion, and complex colloidal dispersion. The three main components of a foam cake are eggs, sugar, and flour. The process to transform these ingredients into a foam cake (something solid) is part of a scientific process through physical changes and chemical reactions. Understanding the science behind these processes will help you bake amazing, light, delicious cakes. [NOTE: The teaching strategy below should be read before the start of this section.]

A. CHEMICAL REACTIONS: A ***chemical reaction*** is a process that produces a permanent change in the chemical composition and molecular structure of a substance. For example, fresh eggs that are fried cannot become fresh eggs again. The protein in the egg has been permanently changed, and the structural makeup is very different. When dough and batter are heated in an oven, a chemical reaction occurs and new bonds are formed. Heat creates exothermic and endothermic chemical reactions. For example, baking a cake produces an endothermic reaction that changes sticky batter into a solid cake. An ***exothermic reaction*** produces heat. An ***endothermic reaction*** absorbs heat.

1. Heat helps leavening agents produce tiny gas bubbles that make the cake light (by rising).
2. Heat causes egg proteins to firm, helping to give the cake structure.
3. Heat dries cake batter (fats are still able to keep the cake moist).

B. PHYSICAL CHANGES: A ***physical change*** is the transformation of a substance that does not alter its chemical properties—a phase change. The change can involve a difference in the way the substance displays appearance (color or shape), texture, temperature, or smell, but it usually results in a change of state, such as liquid to solid. Melting, boiling, and freezing are examples how to create a physical phase change. An ice cube that melts is still water, and its chemical properties remain intact. [NOTE: In the physical change described here, the ice

cube and warm temperature are the reactants—the ingredients of physical change. The liquid water is the product, or result, of a physical change.]

C. ABSORPTION: ***Absorption*** is the act of one substance (liquid or solid) taking up (soaking up) particles from another substance (gas or liquid) by physical or chemical means.

   1. *Hygroscopic:* ***Hygroscopic*** is a term relating to the ability of a substance to absorb water from its surroundings. Liquid is absorbed into flour. The more water absorbed into flour, the more the batter stretches. This creates more ***pan flow*** (ease of the batter filling the pan's shape). Sugars are hygroscopic, including table sugar, honey, brown sugar, and molasses. Foam cakes often use caster or superfine sugar that dissolves easily in the egg foam. Sugar attracts water, keeping baked goods moist and soft. [NOTE: The prefix "hygro" relates to humidity. A hygrometer measures humidity, while a hygroscope indicates when humidity is present.]
   2. *Gluten:* ***Gluten*** is an elastic protein found in wheat and cereal flours that gives batter and dough elasticity, strength, and the rising ability. Gluten comes from a plant's endosperm (the starchy portion of a grain), and it forms when water is added to the two flour proteins of glutenin and gliadin (found in wheat, barley, or oats). Gluten continues to develop as the foam cake batter is mixed. Most foam cakes use cake flour that contains less protein, so foam cakes generally have less gluten development. Gluten provides chew.

D. CONDENSATION: ***Condensation*** is the conversion (a physical change) of a vapor (gas) into a liquid—the reverse of evaporation. When cold batter and dough are placed into a warm oven, moisture (condensation) is produced on the surfaces. This action cools down the crust, and it allows the baked good to rise before the crust hardens. A porous surface on a baked good can be due to too much condensation.

E. EVAPORATION: ***Evaporation*** is the conversion (a physical change) of a liquid into a vapor (gas). The rate of evaporation increases with the rise in temperature. Evaporation is used in many culinary processes to concentrate a solution; such as cooking down pan sauces to thicken and intensify the flavor, simmering tomatoes to release moisture, or thickening a roux.

F. EMULSION: An ***emulsion*** is a semi-liquid, stable mixture in which one or more liquids are suspended within another. An emulsion can have two or more ***immiscible*** (unmixable) ingredients. While emulsions are immiscible, ***homogeneous mixtures*** are a mix of ingredients that have a uniform composition (the same properties throughout).

   1. Typical emulsions include a liquid suspended in a fat or an oil. (Think of vinegar and oil dressing.) The goal in baking is to form a water-in-fat emulsion. An unstable cake-batter emulsion can curdle or weep. [NOTE: The addition a tablespoon or more of flour to a curdled cake batter may reverse the appearance of curdling. Foam batters are whisked for air leavening, and must have a stable emulsion for proper rise.]

2. Chiffon cakes often use oil or butter. Some génoise cakes use solid butter, melted butter, or clarified butter in their recipe. Solid butter should be used at 60°F to 70°F. Whole eggs, egg whites, and egg yolks must be at room temperature to whip to their maximum volume. [NOTE: For more general information about emulsions, see MYcaert CA B3–8 lesson and e-unit.]

G. HEAT TRANSFER: A ***heat transfer*** is the exchange of thermal energy between two objects, or the physical process of a food absorbing heat from a source. While heating food, molecules absorb energy, vibrate quickly, and bounce off each other. Each collision produces heat, which is transferred to the food. This is the basis of cooking. There are three methods of heat transfer. [NOTE: For more detailed information, the Biscuit People article, "Heat Transfer for Biscuit Baking," can be read at http://biscuitpeople.com/heat-transfer-for-biscuit-baking/. Their process described for biscuits is the same for foam cakes.]

1. *Radiation:* ***Radiation*** is the transmission of heat through waves of energy. Microwave and infrared waves are two types of radiation in cooking. Radiant heat is evident with the opening of a preheated oven, a hand stretched over coals, or the feeling of skin near a boiling pot. Warmed air is transferred to food and cooks it (radiation cooks through indirect contact).
2. *Conduction:* ***Conduction*** is the passing of heat between solid objects through direct contact. For example, heat is conducted from stovetop burners to pots and pans. Heat is then conducted from the pots and pans to the food. Cake pans transfer heat, by conduction, to the batter.
3. *Convection:* ***Convection*** is the transfer of heat by the circulation of warm air or water. In a convection oven, a fan blows hot air over and around the food. (In savory cooking, sous-vide is a method of cooking sealed bags of food in a warmed water bath. In foam cakes, the double boiler and bain-marie are two convection heat sources used.)

H. CARMELIZATION: ***Caramelization*** is the oxidization (browning) of sugar, or the natural sugars in fruits and vegetables, in order to get a sweet, nutty, brown sauce or coating. Caramelization is the last chemical reaction to occur during baking. It only occurs when sugars are heated. The flavors of caramelization occur after 356°F is reached. Cakes baked at 350°F have no caramelized flavor, but might have ingredients that caramelize. Each sugar type caramelizes at a different temperature.

1. Fructose caramelizes at 230°F (110°C).
2. Sucrose caramelizes at 320°F (160°C).
3. Baked goods made with honey or fructose develop a darker color, because they begin browning at a lower temperature (honey contains fructose).

I. HYDROLYSIS: ***Hydrolysis*** is the chemical separation of a compound through the addition of water. For example, adding water to sucrose leaves glucose and fructose. The result of this hydrolysis is an invert sugar. An ***invert sugar*** is equal parts glucose and fructose (derived from water and sucrose). In a foam cake, the heating of eggs and sugar (prior to whipping) allows time for the conversion of sucrose (table sugar) to begin (with moisture from the fat—including egg yolks).

[NOTE: The inversion processes can involve the hydrolysis of sucrose with an acid and some heat (used in candy making).]

J. FOAM: ***Foam*** is a mass of bubbles that is created in or on the surface by whipping or agitation. In foam cakes, the act of whipping egg whites causes a protein film that holds the foam. A child blowing bubbles with a wand dipped in a soapy solution creates a type of foam. All foams are a type of ***colloidal dispersion*** (a suspended substance) in which air is dispersed without dissolving. Not all ingredients foam. To foam, a liquid must have a low surface tension. ***Surface tension*** is a property of a liquid that allows it to resist external forces. The surface of a liquid, where the liquid is in contact with gas, acts like a thin elastic sheet. (Remember the soap bubble? It's a pressurized bubble of air contained within a thin, elastic surface of liquid. This is surface tension.) Warm temperatures lower the surface tension of liquid eggs, making it easier for bubbles to form. Egg foams develop the volume and lightness of sponge, génoise, and chiffon cakes due to their ability to foam, and the innate surface tension of liquid eggs.

1. Natural proteins, at the molecular level, are shaped like coils or springs. When exposed to heat, salt, or acid, they ***denature*** ("de-nature," lose natural characteristics or break apart) and the coils unwind. Foams form when the protein in the eggs denatures. When proteins denature, they ***coagulate*** (bond together and form solid clumps). As a foam cake bakes, protein in the egg whites (ovalbumin) coagulates and gives the foam structure.
2. ***Denaturation*** is a chemical reaction from heat or acidity that breaks down a substance's molecular structure. With food, a protein's molecule loosens its hydrogen bonds that originally formed coils and springs, and then, it turns it into a long, shapeless chain. Denaturation occurs in egg whites due to the physical heat from whipping—which causes the proteins to unfold. Egg whites' ***viscosity*** (a measure of thickness, or resistance to flow), due to their large protein molecules, makes them easily denatured by whipping. In contrast, regular milk does not retain the foam that forms when it is whipped, because milk contains less protein and is less viscous. On the other hand, heavy whipping cream has the viscosity to stand up to whipping and retain its foam.
3. Both egg yolks and whites can foam. Egg-white foam provides the most leavening and structure to a foam cake. A single egg white can expand six to eight times in volume when whipped. Older egg whites thin out over time and are easier to whip (An older egg white will whip to stiffer peaks than a fresh egg).
4. Adding salt to egg whites while whipping deflates the foam. It was a long held belief that salt "stabilized" rather than deflated the egg whites. [TIP: If salt is added to a foam cake batter, it should be added with the flour.]

K. PH SCALE: When working with foods, ***pH*** is the level of acidity or alkalinity (a.k.a. basicity) of a given substance. The ***pH scale*** is a system of numbers used to measure the pH levels of a water-based liquid, with seven being neutral. The scale is a linear measure from 0 to 14. Neutral (neither acid nor alkaline) is a pH of 7 (water). Acid is a pH of less than 7 (lower numbers on the pH scale). Alkaline is a pH greater than 7 (high numbers on the pH scale). Alkaline substances release

higher levels of hydrogen when mixed with water. Acids neutralize alkali and vice versa.

1. Fresh egg whites foam best at a pH of 4.6 to 4.8. In other words, fresh eggs are best for all foam cakes (versus bulk liquid, dried, or frozen egg whites). [NOTE: For more information about pH and pH scale, see the MYcaert lesson CA B3–9: pH in Cooking.]
2. Cream of tartar (an acid) lowers the pH of egg whites. This is why cream of tartar is added to eggs for whipping in a foam cake or a meringue. Cream of tartar allows the egg whites to produce more foam and stabilizes the egg whites. White vinegar or lemon juice can be substituted for cream of tartar. These acids would also lower the pH of the egg whites. Cream of tartar also whitens the cake and provides a fine-grained texture.

L. MAILLARD REACTION: The ***Maillard reaction*** is a chemical effect that occurs when proteins and sugars react and break down under heat. Amino acids and simple sugars rearrange into rings that reflect light and produce a browned appearance (and tantalizing aromas). It is a series of three complex reactions. These reactions occur between amino acids (proteins) and sugars (monosaccharide and some disaccharide sugars that can donate electrons to another chemical) being reduced at higher temperatures. The Maillard reaction (named for the scientist, Louis Camille Maillard) produces different aromas in bread than in standing rib roast or baked fish, because the amino acids and simple sugars differ in those foods. This process is responsible for the browning of a cake, as well as its toasted flavor. As the oven, grill, or pan temperatures increase, so does the Maillard reaction. [NOTE: The Food-Info.net website has for more information on complex reactions and Louis Maillard at http://www.food-info.net/uk/colour/maillard.htm.]

M. CARBON DIOXIDE: ***Carbon dioxide (CO_2)*** is a colorless, odorless gas (except in high concentrations), and it is a natural by-product of cellular respiration. Baking soda, baking powder, and yeast are all leavening agents that produce CO_2. (Baking soda and baking powder are two common chemical leavening agents, while yeast is a living organism.) CO_2 is evident in the leavening of cakes and other baked goods.

1. Baking soda ($NaHCO_3$), or sodium bicarbonate, is a chemical leavening agent that, when heated, produces and releases carbon dioxide using the formula $2NaHCO_3 \rightarrow CO_2 + Na_2CO_3 + H_2O$. (Sodium bicarbonate releases carbon dioxide, sodium carbonate, and water vapor.)
   a. In a recipe, Sodium bicarbonate needs paired with an acid. If baking soda is used in a recipe without an acid, it will produce a bitter taste and a yellowish color.
   b. Baking soda is a single-action (reacts only once), chemical leavening agent that reacts when mixed with an acid, such as cream of tartar, buttermilk, molasses, sour cream, yogurt, lemon juice, vinegar, brown sugar, or cocoa. [TIP: When a foam cake that uses baking soda is baked, everything must be ready before the liquid is added to the leavening agent (the section on leavening components can be referred to).]

2. Baking powder is a chemical leavening agent that contains baking soda, dry acids, and starch (as filler). It produces more carbon dioxide gas than baking soda. When heated, it produces carbon dioxide using the formula $NaHCO_3$ + H^+(from the acid) → Na^+ + H_2O + CO_2. (Sodium, water, and CO_2 are all released.)
3. Some cake recipes and formulas use both baking soda and baking powder.

N. SURFACE AREA: In baking, the ***surface area*** is the part of a baked product that is directly exposed to the heat—the total uncovered exterior. The surface area of a foam cake determines its baking time. A larger pan has more surface area and, as a result, the cake will bake quicker. On the other hand, if a baker fills a smaller, deeper cake pan with the same volume of mix meant for the large pan, the batter will have a smaller surface area, take longer to bake, and, if left at same temperature, would have an undercooked center. As a general rule:

1. Two 8 × 2 round pans bake for 30 to 40 minutes.
2. One 8 × 8 × 2 square pan bakes for 25 to 30 minutes.
3. Cupcakes, with a high ratio of surface area to volume, tend to dry out quickly in the oven. They bake for 14 to 19 minutes.

O. BATTER DEPTH: Batter depth affects the baking time of all baked goods. As a general rule, Bundt® cakes have more depth than most cakes, and they bake for 40 to 45 minutes.

P. OVEN TEMPERATURE: Foam cake oven settings vary by type, pan, humidity, and altitude. [NOTE: More information is available on the Recipe.com website at http://www.recipetips.com/kitchen-tips/t--585/types-of-bakeware.asp.]

Q. HIGH ALTITUDES AND HUMIDITY: Baking in high altitudes (3,500 to 6,500 feet above sea level) requires an increase in oven temperature by 10°F to 20°F. Baking cakes on a rainy day may have the same effect as a high altitude. ***Relative humidity (RH)*** is a measure of the moisture in the air. It is the percentage of actual saturation compared to the density of vapor saturation. In other words, the higher the RH percent, the more moisture is available in the surrounding air. Both a high altitude and a high RH result in a lower barometric pressure. Rainy weather is caused by a low-pressure storm system. High elevations have dry, low-pressure air. This lower barometric pressure (thin air) tends to cause cakes to over rise, and then, to deflate. Recipes can be adjusted by decreasing the amount of leavening agent and sugar. Then, liquid and protein (milk, eggs, flour) are increased to strengthen the batter.

1. To experiment with altitude and RH issues, students of baking should follow the directions below.
   a. Depending on elevation, decrease baking soda and baking powder by ⅛ to ¼ teaspoon. (At 3,000 to 5,000 feet, decrease one teaspoon of soda to ⅞ of a teaspoon. Above 5,000 feet, it would be ¾ of a teaspoon.)
   b. Increased evaporation also increases the concentration of sugar, which can weaken the structure, so decrease sugar by one to three tablespoons per cup.

c. Increase oven temperature by 15°F to 25°F. Use the lower increase when baking delicate or chocolate cakes. Leavening and evaporation move more quickly at higher altitudes, so use a higher temperature. This will set the cake structure before it dries out.
d. Decrease baking time by five to eight minutes per every 30 minutes (due to increase in oven temperature).
e. Increase liquid by one to two tablespoons at 3,000 feet, and then increase by 1½ teaspoons for each additional 1,000 feet (keeps products from drying out).
f. Increase protein in the batter (to trap gas) by adding two to three tablespoons of flour or by adding one egg white. [NOTE: Betty Crocker recommends adding a ¼ cup of all-purpose flour and increasing the water to 1½ cups (from 1¼ cups) in high altitudes. For more information about how rain affects baking, Fred Decker's article, "Does Rain Affect Baking Cakes?," can be read on eHow at http://www.ehow.com/info_12318209_rain-affect-baking-cakes.html.]

2. RH should be monitored throughout the baking process: storage, proofing (breads), baking, and cooling.

Teaching Strategy: ***TAKE NOTE:*** *Two common baking examples may help students differentiate between a physical change and a chemical reaction:*

- *Adding vinegar to baking soda causes the mixture to fizz (a gas is given off).*
- *Boiling water produces steam.*

One of these examples is a chemical reaction and the other is a physical change. To be termed a chemical reaction a new substance must be formed. When water boils, liquid water changes into steam, but it's still water (in a gas form)—a physical change. It's possible for the steam to return to a liquid state; however, when vinegar is added to baking soda, the gas produced is a new substance, CO_2. It is not possible to turn this new solution back into vinegar and baking soda; therefore, it is a chemical reaction. [See VM–Q and VM–R.]

Use VM–Q to illustrate physical changes that occur during baking. Use VM–R to illustrate the chemical reaction that occurs when baking soda is added to vinegar. Then, demonstrate the reaction for the class. Use VM–S to illustrate cake batter emulsion. Use VM–T to illustrate the chemical reaction of foam colloidal dispersion. Use VM–U to illustrate the chemical reaction of foam protein coagulation and denaturation. A foam cake lab is a great way to reinforce basic science concepts of foam, emulsion, colloidal suspension, etc. This is a good way to discuss physical changes and chemical reactions in a hands-on way, versus a lecture. Consider using the extra cake layer from LS–A to make a new cake, while going through the chemical reactions and physical changes that have happened in the cake.

NGSS AND FCS CLASSROOMS: *Students benefit from learning the biological and chemical basics of food and nutrition. Culinary Arts allows real-life applications to scientific principles. Introducing the science behind the skills gives students a head start in understanding scientific terms and reactions. Science in FCS (Family and Consumer Science, Home Ec) classrooms encourage students to develop scientific reasoning skills with a fun twist. Get students prepared for Next Generation Science Standards (NGSS). Be part of the conceptual shifts in science education. NGSS states, "K–12 science education should reflect the interconnected nature of science as it is practiced and experienced in the real world." (https://www.nextgenscience.org/) FCS classes already include problem solving, teamwork, and applying real-life concepts (including physical changes and chemical reactions). Adding science concepts in FCS classes is a continuation of what is already being taught. When teaching a skill, try to explain the science behind the skill. This will develop and prepare your students, giving them both a scientific and an artistic viewpoint.*

RESEARCH LINKS: *There are multiple benefits of teaching science in FCS classrooms. For details about teaching science in FCS, try using some of the following quick links.*

- *"Cooking Class Benefits Kids in Many Ways" on the US News & World Health Report site at http://health.usnews.com/health-news/diet-fitness/diet/articles/2011/11/10/cooking-class-benefits-kids-in-many-ways*
- *"Six Reasons You Should Study Food Science" on the Institue of Food Technologists website at http://sciencemeetsfood.org/6-reasons-why-you-should-study-food-science/;*
- *"The Top 5 Reasons to Teach Nutrition Education in Your Classroom" on the Dairy Counsel of California website at http://www.healthyeating.org/Schools/Tips-Trends/Article-Viewer/Article/521/Top-5-Reasons-to-Teach-Nutrition-Education-in-Your-Classroom.aspx.*

DEMONSTRATION OF SURFACE TENSION #1: *Foam occurs in liquids with a low surface tension. Water has a high surface tension. Demonstrate surface tension with a glass container of tap water (glass bowl, custard cup or glass cup). First, add one drop of oil to the water in the glass. The surface tension keeps the oil drop in place. Next, add one drop of detergent and the oil quickly spreads to the outside edges of the container. Detergent is a surfactant (an agent that reduces surface tension).*

DEMONSTRATION OF SURFACE TENSION #2: *First, add tap water to a glass bowl. Then, whisk the water until bubbles form. Point out how temporary the bubbles you created last. Next, add one drop of soap or detergent and whisk again. These bubbles form across the water and last much longer. The soap lowers the surface tension of the water. Egg whites have a low surface tension that allows foam to last longer when whipped.*

Review/Summary.

Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. If a textbook is being used, questions at the ends of chapters may also be included in the Review/Summary. Use the E-Units as textbooks for this lesson.

Application.

Use the included visual master(s) and lab sheet(s) to apply the information presented in the lesson.

Evaluation.

Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activities. A sample written test is provided.

Answers to Sample Test:

Part One: Matching—Foam Cake Terms

1. i
2. e
3. f
4. l
5. j
6. g
7. d
8. k
9. a
10. h
11. b
12. c

Part Two: Matching—Science Terms

1. g
2. c
3. h
4. k
5. e
6. j
7. a
8. i
9. b
10. d
11. l
12. f

Part Three: True/False

1. F
2. T
3. T
4. F
5. T
6. T
7. F
8. T
9. T
10. T
11. F
12. T
13. T
14. F

Part Four: Short Answer

1. Answers will vary, but they should have four out of six of the following: Ladyfingers, flourless sponge, torte, roulade, petit fours, Boston cream pie
2. Answers will vary, but they should contain the following information: A ganache is a whipped mixture of chocolate and heavy cream.

Sample Test

Name _____

Foam Cakes

Part One: Matching—Foam Cake Terms

Instructions: **Match the term with the correct definition.**

a. angel
b. angel method
c. chiffon
d. chiffon method
e. foam cake
f. fold
g. génoise
h. meringue
i. mise en place
j. ribbon stage
k. sponge
l. sponge method

_____1. A French cooking term that means “to set up” or “to arrange”

_____2. A light, airy, spongy cake with little or no fat

_____3. To combine two mixtures, one light and one heavy, without deflating the lighter mixture

_____4. A foam-cake, egg-beating technique for creating leavening from whole eggs

_____5. A test to see if the batter forms a thick stream that folds back on itself as it’s lifted from the bowl

_____6. A foam cake characterized by a light, airy, sponge-like texture that is made with melted (or clarified) butter, whole eggs beaten to the ribbon stage, and no added leaveners

_____7. A foam-cake preparation for folding beaten egg whites into a batter of egg yolks, flour, and fat

_____8. A light and airy foam cake that contains three basic ingredients: eggs, sugar, and flour

_____9. A foam cake characterized by a feather-light, delicate, airy texture that is made with egg whites, flour, sugar, and no fat

____10. A flourless foam cake prepared from a mixture of stiffly-beaten, room-temperature egg whites and sugar (or sugar syrup)

____11. A foam-cake preparation technique that focuses on the beating of air into egg whites for maximum leavening

____12. A foam cake that is moist, tender, light, airy, springy, and made with fat

Part Two: Matching—Science Terms

Instructions: **Match the term with the correct definition.**

a. chemical reaction
b. coagulate
c. denature
d. emulsion
e. foam
f. heat transfer
g. hydrolysis
h. immiscible
i. Maillard reaction
j. pH
k. physical change
l. surface tension

_____1. The chemical separation of a compound through the addition of water

_____2. Lose natural characteristics or break apart

_____3. Unmixable

_____4. The transformation of a substance that does not alter its chemical properties—a phase change

_____5. A mass of bubbles that is created in or on the surface by whipping or agitation

_____6. The level of acidity or alkalinity (a.k.a. basicity) of a given substance

_____7. A process that produces a permanent change in the chemical composition and molecular structure of a substance

_____8. A chemical effect that occurs when proteins and sugars react and break down under heat

_____9. Bond together and form solid clumps

____10. A semi-liquid, stable mixture in which one or more liquids are suspended within another

____11. A property of a liquid that allows it to resist external forces

____12. The exchange of thermal energy between two objects, or the physical process of a food absorbing heat from a source

Part Three: True/False

Instructions: **Write *T* for true or *F* for false.**

_____1. Using a wooden spoon to whip egg whites is essential to create maximum volume.

_____2. The goal in baking is to form a water-in-fat emulsion.

_____3. Just a few minutes after baking, sponge and génoise cakes should be removed from layer pans to cool.

_____4. One-piece tube pans make it easier to remove the baked cake from the pan.

_____5. The toothpick test for doneness is rarely used for sponge cakes.

_____6. An angel cake crawls up the sides of an ungreased pan for support during baking.

_____7. An unheated oven helps coagulate foams and provides peak volume.

_____8. Folding is a downward motion and a careful turning over of the mixture while turning the bowl, and having the bowl of the spoon or spatula scraping the bottom of the bowl.

_____9. Foam cakes contain a high proportion of eggs or egg whites in relation to other ingredients.

____10. Many foam cakes are cooled inverted (upside down).

____11. The three main ingredients of foam cakes are eggs, sugar, and fat.

____12. Cream of tartar is added while whipping egg whites to increase foam and stabilize the peaks.

____13. A single egg white can expand to six to eight times in volume when whipped.

____14. Cake flour is higher in protein and more finely ground than all-purpose flour.

Part Four: Short Answer

Instructions: **Answer the following.**

1. Name four of the six types of sponge cakes learned in this lesson.

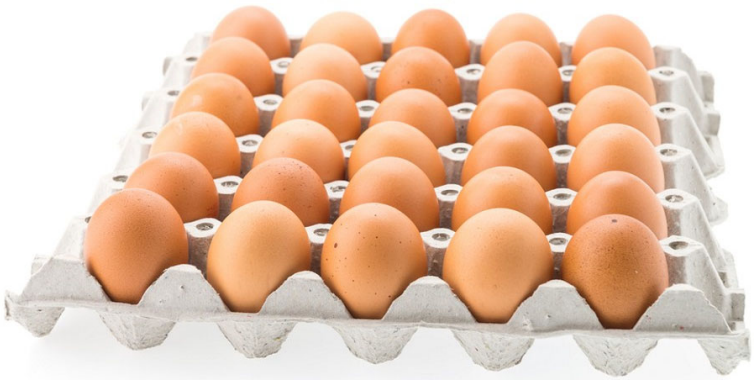
2. What is a ganache?

FOLDING: FOAM CAKES

To **fold** is to combine two mixtures, one light and one heavy, without deflating the lighter mixture. Folding can be completed with a wooden spoon, rubber spatula, or a paddle attachment. Whipped egg whites are folded into a nut mixture for a chocolate hazelnut meringue cake. The finished chocolate hazelnut meringue cake with chocolate cream topping is pictured.

FOAM CAKES: WHAT ARE THEY? WHAT ARE THEY MADE FROM?

Foam cake (unshortened cake) is a light, airy, spongy cake with little or no fat. They have a high proportion of eggs to flour and are leavened primarily by air beaten into whole eggs or egg whites. Foam cakes include sponge, chiffon, meringue and génoise. Primarily, foam cakes are ***leavened*** (made to rise) by whipped eggs and steam. The three most important ingredients in a foam cake, in order of importance, are eggs, sugar, and flour.



FOAM CAKE: ADDED INGREDIENTS AND LEAVENING

In addition to the three main ingredients in foam cakes, the other ingredients can include salt, a chemical leavener, liquids (limited use), fat (usually oil), flavorings, and an acid. Key elements of a perfect foam cake are the incorporation of air (whipped egg whites) and the steam produced via a preheated oven. Describe the whipped egg whites pictured here. Are they foamy with soft peaks, or stiff and shiny? The oven is preheating to 202°C. What temperature is that on the Fahrenheit scale? What ingredients can be added to egg whites to increase their volume and to stabilize the peaks?

BASIC BAKING INGREDIENT FUNCTIONS

Due to the limited number of ingredients in foam cakes, the best results are achieved using high-quality eggs, superfine sugar, and cake flour. Measure accurately, and closely follow recipe instructions. The following chart is a review of cake ingredient functions. Foam cakes' main ingredients are highlighted in the beginning of the list.

Ingredient	Functions
Flour	Body (bulk or mass), structure, texture (tender and crumbly or firm and chewy), flavor, and gluten
Eggs	Leavening via egg beating, emulsification, binding agent that holds other ingredients together, structure, moisture, color, browning (egg wash), flavor, texture, thickening
Sugar	Flavor, tenderization, color (caramelizes and aids in browning), feeds yeast organisms (aids in fermentation), moisture retention (sweetened baked goods stay moist longer than unsweetened types), batter and dough spreadability
Fat	Flavor and richness (especially butter or lard), moisture, tenderness (shortens gluten strands), leavening (when creamed), browning, emulsification, and even distribution of added flavors (vanilla, almond, etc.)
Salt	Flavor (heightens the flavor of other ingredients, balances sugar), slows yeast fermentation (keeping air bubbles small and uniform in size), toughens the texture of soft fat-and-sugar mixtures, and strengthens gluten protein (better texture)
Leavening	Rising ability and added flavor
Liquid	Moisture, flavor, color (browning), steam leavening, hydration (protein, starch, leavening agent), activates yeast organisms, mixes with flour for proper gluten development, binding agent (especially in quick breads and muffins)
Flavoring	Enhances or fundamentally changes the taste of baked goods

FOAM CAKE PREPARATION EQUIPMENT & TOOLS

Identify each tool and piece of equipment used to make foam cakes.

MISE EN PLACE

Mise en place is a French cooking term that means "to set up" or "to arrange." You should:

1. Read the entire recipe.
2. Collect all of the ingredients and allow them to come to room temperature (with the exception of heavy cream, which should usually remain refrigerated until use).
3. Measure all ingredients accurately, preferably by weighing.

4. Follow processes requested by the recipe. This might include chilling a stainless steel bowl in the freezer (to whip heavy cream), ensuring ingredients are at room temperature, or pre-cooking/pre-cutting added ingredients (such as fruit compotes, toasted spices, or nuts).

5. Prepare the workstation by cleaning the area, gathering tools (cutting board, knives, etc.), and arranging equipment (such as a stand mixer) as required.

6. Preheat the oven.

7. Prep baking pans. (For example, the recipe may call for the baker to grease the pan, add parchment paper, or grease a liner).

8. Make a cooling station (a clear area with cooling racks, etc.).

ASSIGNMENT: In pairs or small teams, select a recipe. List your mise en place steps. Remember to discuss required ingredients, equipment, prep tasks, and any additional processes required by the recipe.

FOAM CAKES WITH FAT: SPONGE

A **sponge** is a light and airy foam cake that contains three basic ingredients: eggs, sugar, and flour. A **biscuit** is the French term for sponge cakes. These cakes are leavened by air beaten into the eggs. They contain fat from egg yolks (and sometimes, oil). The sponge cakes illustrated here are a plain sponge cake with strawberries and vanilla cream, ladyfingers, a chocolate roulade cake, and a Boston cream pie. Identify each picture.

RIBBON STAGE

All sponge-cake recipes test the doneness of egg-and-sugar whipping using the ribbon stage. The **ribbon stage** is a test to see if the batter forms a thick stream that folds back on itself as it's lifted from the bowl.

FOAM CAKES WITH FAT: CHIFFON

Chiffon is a foam cake that is moist, tender, light, airy, springy, and made with fat. Chiffon cake fats may include egg yolks, butter, or oil. Because they contain fat, they exhibit some characteristics of butter cakes, especially their moist, tender quality. They are leavened with beaten egg whites, egg yolks, and baking powder. Chiffon cakes are often citrus flavored, but they may also be chocolate or contain chopped fruits or nuts. The chiffons pictured here are orange, green tea, strawberry, and chiffon cupcakes.

FOAM CAKES WITH FAT: GÉNOISE

A **génoise** is a foam cake characterized by a light, airy, sponge-like texture that is made with melted (or clarified) butter, whole eggs beaten to the ribbon stage, and no added leaveners. Eggs and butter make this cake moist with a tender mouthfeel. It is also less sweet than a typical sponge cake. The plain génoise cake (illustrated here) is the basis for the berry and whipped cream version.

VIDEOS:

- "How to Make a Génoise Cake," Gourmet Test Kitchen. (Note the ribbon stage.)
  - https://www.youtube.com/watch?v=nKa1e_CpvoY
- "How to Make a Génoise, a Cake for All Occasions," Everyday Living.
  - https://www.youtube.com/watch?v=oqXx0asEeUg

ARTICLE & VIDEO:

- "Black Forest Cake," Joy of Baking.com. (Note the mise en place.)
  - http://www.joyofbaking.com/printpages/BlackForestCakeprint.html
  - https://www.youtube.com/watch?v=ot5YdDTLTBY

FOAM CAKES WITH NO FAT: ANGEL

An **angel** (angel food cake) is a foam cake characterized by a feather-light, delicate, airy texture that is made with egg whites, flour, sugar, and no fat. Angel cakes contain no egg yolks, no chemical leavening agents, and no butter or oil. They contain more sugar than any other foam cake, but they are cholesterol free (because they contain no fat and no egg yolks). It is basically a meringue with flour added. The images here are a close-up of angel-cake batter, a plain angel food cake in a tube pan, a loaf of angel food cake, and angel food cupcakes.

(Photo: Courtesy of Michael Coté. Licensing Agreement: https://creativecommons.org/licenses/by/2.0/deed.en.)

FOAM CAKES WITH NO FAT: MERINGUE

Meringue is a flourless foam cake prepared from a mixture of stiffly-beaten, room-temperature egg whites and sugar (or sugar syrup). Meringue mixtures are often stabilized with cream of tartar and contain no fat. There are three basic types of meringue: French, Swiss, and Italian. The meringue desserts pictured here include a dacquoise, meringue shells, a pavlova, and meringue cake layers. Based on your knowledge of meringue cakes, identify each.

SPONGE METHOD

The **sponge method** (foam method or egg-foaming method) is a foam-cake, egg-beating technique for creating leavening from whole eggs. This image is of a Victoria sponge cake with a layer of custard cream and jam. Look online and find a specific sponge cake recipe. Read the sponge method steps for your cake. Then, review your class notes and the E-Unit to compare steps. Identify the basic steps the recipe follows and list them in the blank "Sponge Method Evaluation Table." See the sample data table included here.

Sponge Method Evaluation Table Sample: Step-by-Step

Recipe Title: _____

Student Name: _____

Describe each step in your own words.	Step listed in recipe: Why is it important?	Step not listed in recipe: Why was it not listed?	Important step not listed: Explain why it's important.
1. Measure ingredients	1. Measuring is important	1. Ingredients at room temp: Perhaps, all bakers are supposed to know this step. What about first-time bakers?	1. Cold eggs are easier to separate but they do not make adequate foam volume—eggs should be room temperature or warmed before beating.

Sponge Method Evaluation Table: Step-by-Step

Recipe/Formula Title: _____

Team members: _____

Describe each step in your own words.	Step listed in recipe: Why is it important?	Step not listed in recipe: Why was it not listed?	Important step not listed: Explain why it's important.
1.			
2.			
3.			

Describe each step in your own words.	Step listed in recipe: Why is it important?	Step not listed in recipe: Why was it not listed?	Important step not listed: Explain why it's important.
4.			
5.			
6.			
7.			
8.			

VM–N

FOAM CAKE PAN PREPARATION

Which of the cake pan preparation techniques is illustrated in this picture? For which foam cake is the prep technique suitable? Explain your responses. Be prepared to discuss the most suitable foam cake for each of the cake-pan prep techniques.

FOAM CAKE DONENESS AND COOLING

Pictured are a chocolate sponge layer cake and an angel food cake. Notice the parchment circles that have been removed from the bottom of the chocolate sponge cake. Describe the following for each cake:

1. How would you test each cake for doneness? What would explain your response?
2. How are sponge cakes cooled?
3. How are angel food cakes cooled?
4. What's special about the roulade cooling technique?

(Photo: Courtesy of Logan Ingalls. Licensing agreement: https://creativecommons.org/licenses/by/2.0/deed.en)

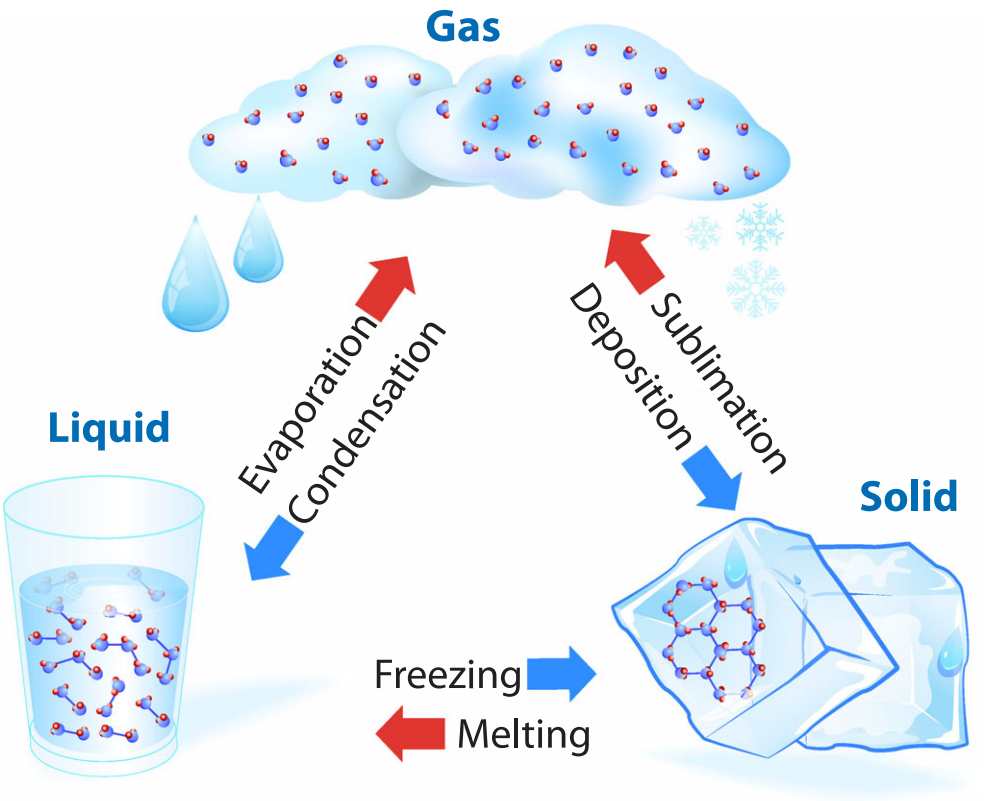
ENGINEERING A VICTORIA SPONGE CAKE

The step-by-step process to construct a Victoria sponge cake is illustrated here. When working on a cake that needs a little engineering, think about your fillings and decorations. This sponge uses raspberry jam filling and a whipped cream filling. It is decorated with herbs and fruit.

PHYSICAL CHANGES

A **physical change** is the transformation of a substance that does not alter its chemical properties—a phase change. The change can involve a difference in the way the substance displays appearance (color or shape), texture, temperature, or smell, but it usually results in a change of state, such as liquid to solid. Melting, boiling, and freezing are examples how to create a physical phase change. An ice cube that melts is still water, and its chemical properties remain intact.

STATE OF MATTER



CHEMICAL REACTIONS

A **chemical reaction** is a process that produces a permanent change in the chemical composition and molecular structure of a substance. For example, fresh eggs that are fried cannot become fresh eggs again. The protein in the egg has been permanently changed, and the structural makeup is very different. When water boils, liquid water changes into steam, but it's still water (in a gas form)—a physical change. It's possible for the steam gas to return to a liquid state; however, when vinegar is added to baking soda, the gas produced is a new substance, CO_2. It is not possible to turn this new solution back into vinegar and baking soda; therefore, it is a chemical reaction.

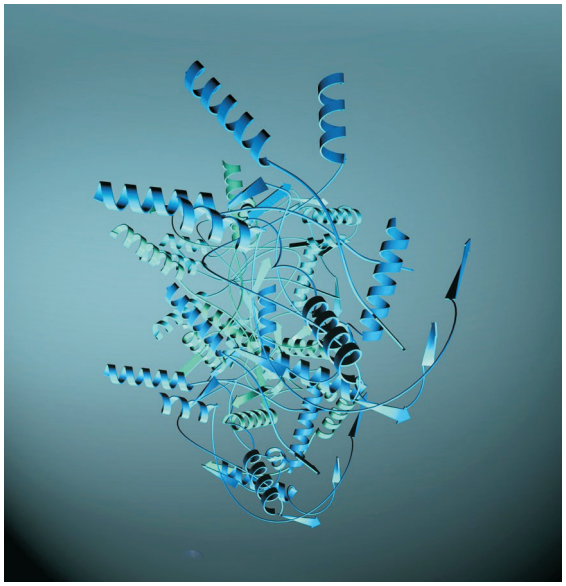
PHYSICAL CHANGE: CAKE BATTER EMULSIONS

Cake mixtures are complex. They are simultaneously foam, emulsion, and a complex colloidal dispersion. An **emulsion** is a semi-liquid, stable mixture in which one or more liquids are suspended within another. An emulsion can have two or more immiscible (unmixable) ingredients. The goal in baking is to form a water-in-fat emulsion. The lemon chiffon cake (pictured here) uses oil and citrus juice in the recipe—two immiscible ingredients. The physical action of whipping the batter suspends the oil in the liquid and creates a smooth cake-batter emulsion.

CHEMICAL REACTION: FOAM COLLOIDAL DISPERSION

Foam is a mass of bubbles that is created in or on the surface by whipping or agitation. In foam cakes, the act of whipping egg whites causes a protein film that holds the foam. All foams are a type of **colloidal dispersion** (a suspended substance) in which air is dispersed without dissolving. The stiffly beaten egg whites in this image are a type of egg foam—a colloidal dispersion.

CHEMICAL REACTION: PROTEIN COAGULATION AND DENATURATION



Natural proteins, at the molecular level, are shaped like coils or springs. When exposed to heat, salt, or acid, they **denature** ("de-nature," lose natural characteristics or break apart) and the coils unwind. Foams form when the protein in the eggs denatures. When proteins denature, they **coagulate** (bond together and form solid clumps). As a foam cake bakes, protein in the egg whites (ovalbumin) coagulates and gives the foam structure. Pictured here is a cheesemaker checking the temperature of the heated milk. Notice the steam and the clots (coagulated milk proteins) forming in the tank.

Name _____

Prepare a Four-Ingredient Génoise Cake

Purpose

The purpose of this activity is to prepare and evaluate a génoise cake.

Objective

Research, plan, prepare, and evaluate a four-ingredient génoise.

Materials

- lab sheet with data table
- VM–P Engineering a Victorian Sponge Cake
- device with Internet and print capabilities
- food supplies and equipment (as needed to prepare the cake)
- parchment paper (circles or rolls)
- pencil and scissor to cut circles from parchment rolls
- sketch paper and colored pencils

Procedure

1. TASK #1: Access the Natasha's Kitchen video recipe, "Four-Ingredient Sponge Cake," at http://natashaskitchen.com/2016/05/06/easy-sponge-cake-genoise/.
   a. Read the tips for success.
   b. Watch the video demonstration and listen to the instructions.
   c. Review the variations that can be produced from this cake recipe. [NOTE: This recipe can be printed from this website link.]

2. TASK #2: Using classroom standard practices, plan for the preparation of the génoise cake. Have your instructor approve the lab plans.
3. TASK #3: Conduct mise en place. As directed, prepare and bake the génoise cake. Follow standard safety and sanitation rules. Use proper techniques to prevent deflating the egg foam in the sponge. REMEMBER: The pan preparation for a génoise is parchment paper fitted to the bottom (no grease).
4. TASK #4: Define each term used in the data table evaluation (found below). (This task can be completed while the sponge cake is baking. As a class, discuss your definitions with the instructor.)
5. TASK #5: Remove cakes from the oven. Follow recipe directions for cooling.
6. TASK #6: Watch Chef Jaime Oliver illustrate the technique to cut a sponge cake in half on YouTube at https://www.youtube.com/watch?v=h1DK9fot4uE. (This is an appropriate method to use to cut sponge, but the video showed a few problems.) Respond to these questions:

    a. What did you notice about the appearance of the cake's crumb?

    b. Chef Oliver did not cut two even layers from this sponge. Did he intend to do that or did he do something wrong? Explain your response.

    c. List the steps to cut a sponge cake into thin layers with a serrated knife.

7. TASK #7: When completely cooled, separate one cake layer into two thin layers, using a long serrated knife, as directed in the video. (Refrigerate or set your second cake aside. You will use it in step 11.)
8. TASK #8: Evaluate the split cake using the "Génoise Evaluation Data Table." Rate your Génoise sponge cake in each category.

Génoise Evaluation Data Table

Date: _____

Cake Baker: _____

CATEGORIES	Génoise Characteristics	Lab Group Rating 5 (high) to 1 (low)
Appearance	Thin, golden-brown crust	
	Uniform crumb color	
	Rough, slightly-cracked top crust	
	Symmetrical	
	Optimum volume	
Texture	Light in weight in proportion to size	
	Well aerated	
	Fine, even, oval-shaped cells with thin cell walls	
	Sugary, slightly sticky crust	
Tenderness	Moist	
	Soft crumb and crust	
	Delicate crumb that is easily broken apart	
Flavor	Pleasant, well blended	
	Not eggy (doesn't taste like scrambled eggs)	

Write a brief summary of your data table ratings. Add them together and divide by 14. This is your average for all categories! How did you do?

9. TASK #9: Look at the steps for the Victoria sponge cake on VM–P. Break into a group of two or three bakers.

    a. Engineer your own plan for a filled-and-iced génoise cake. Think about tasty fillings, glazes, or icings that would make a génoise masterpiece. Share all the ideas as a lab group.
    b. As a group, determine the sketch or a combination of several sketches for your génoise masterpiece. [NOTE: Your instructor will provide details of the preparation, filling, topping, and decorating of the second génoise layer.]

10. Turn in your completed lab sheet (and cakes!) to your instructor.

Prepare a Four-Ingredient Génoise Cake

1. The "Génoise Evaluation Data Table" is adapted from "Characteristics of Some Standard Foam Cakes" on the CraftyBaking website at https://www.craftybaking.com/learn/baked-goods/cakes/types/foam-cakes.)
2. OPTION #1: If time and budget allows, have each student group select one engineered plan to prepare in a separate lab using the extra sponge cakes prepared in this lab. Each group would sketch a plan to engineer a unique, layered sponge cake with fillings, toppings, and decorations. The finished product can be evaluated with the same data table provided in this lab activity.
3. OPTION #2: If time and budget do not allow adding a lab to prepare the culinary sketch, have students sample one cake layer and evaluate it with the data table. (Students will have a better reaction to a sponge cake with a filling and topping.) Consider having the student groups prepare a Victoria sponge cake with jam (raspberry is typical) between the layers, and a powdered sugar or caster sugar topping. [NOTE: Caster sugar can be prepared by blending granulated sugar. Another simple filling could be fresh whipped cream between the layers.]
4. OPTION #3: The remaining sponge-cake layers could be frozen for use later in making petit fours during the "Frosting, Icing, and Glaze" lesson, CA C8–6. If the remaining sponge cake will be frozen for later lab use, do not cut this cake horizontally. If the cake will be used for petit fours, the baking pan for the second sponge could be a square 8 × 8 pan.
5. OPTION #4: More advanced lessons could include making other sponge cakes that require heating the eggs and sugar. A chocolate génoise is found on the JoyofBaking.com website at http://www.joyofbaking.com/ChocolateGenoise.html and on the Martha Stewart Living website at http://www.marthastewart.com/338834/chocolate-genoise. Students may find the metric recipe for génoise cake with the step-by-step pictures interesting on the Meilleur du Chef website at https://www.meilleurduchef.com/cgi/mdc/l/en/recipe/genoise-sponge-cake.html. This could be a chance for them to learn how to translate metric measurements into American ones.