

Chapter 6

Sugar



Sugar is an energy dense ingredient. Food products high in sugar are considered “empty calories” because little nutrient value is obtained in comparison to the calories consumed. These empty calories count toward your discretionary calories and should be kept to a minimum. Most Americans eat too much sugar which can contribute to an unbalanced diet and dental cavities. As a health professional who can guide individuals in making healthier lifestyle choices, it is important for you to role model positive behavior when you choose to eat sugar-rich foods by eating them in moderation, using proper serving sizes, and choosing foods with fewer empty calories.

Crystallized table sugar comes from two main sources: sugarcane and sugar beets. Sugarcane makes up 70% of the sugar produced worldwide, while sugar beets makes up the other 30%. Many popular food items, such as candy, cakes, cookies, pies, jellies, and ice cream, rely on sugar to provide flavor, improve texture, contribute to structure, and function as a preservative. You should be knowledgeable about what products contain sugar, nutrition facts of sugar-rich foods your clients may eat, how sugar functions in food, and sugar cookery.

LAB ASSIGNMENT:

Candies Galore

The emphasis of this laboratory is to focus on some principals of candy making. You will experiment with making crystalline and non-crystalline candies.

Overview:

All students will calibrate their candy thermometer, complete their assigned candy recipe, taste a small portion of all candy products, and complete the evaluations.

Kitchen 1: Cold Water Test

Old-Timey Fudge (Crystalline)

Kitchen 2: Cold Water Test

Chocolate Truffles (Crystalline)

Kitchen 3: Cold Water Test

Divinity (Crystalline)

Kitchen 4: Cold Water Test

Caramel (Non-Crystalline)

Kitchen 5: Cold Water Test

Peanut Brittle (Non-Crystalline)

Kitchen 6: Cold Water Test

Salt Water Taffy (Non-Crystalline)

Kitchen 7: Cold Water Test

Hard Candy (Non-Crystalline)

Kitchen 8: Cold Water Test

Nougat (Non-Crystalline)

Evaluation Tools:

- Evaluation of Variety of Crystalline Candies
- Evaluation of Variety of Non-Crystalline Candies

Directions:

1. Always begin by washing your hands and thoroughly cleaning/sanitizing work surfaces.
2. Gather the ingredients needed for your assigned recipe.
3. Calibrate your candy thermometer by filling a small pot with water and clipping your candy thermometer to the side. The bulb should not touch the bottom or sides of the pan. Bring the water to a boil and check the temperature. It should read 212° Fahrenheit. If it reads higher or lower, you will need to calculate the difference and adjust your candy recipe accordingly (if higher, add the difference to the recipe's stated temperature or if lower, subtract the difference from the recipe's stated temperature).
4. Complete your assigned recipe.
5. Read "Candy Science" and "Candy Tips for Consumers." Complete the "Candy Questions."
6. When all the candies are finished, taste a small sample of each. Then complete the evaluation tools.
7. Clean your work station and check out before leaving.

STAGE	DESCRIPTION	PRODUCT	SUGAR CONCENTRATION	TEMPERATURE (FAHRENHEIT)
THREAD	Syrup forms a thin thread when dropped in cold water	Syrup (No true candy products)	80%	230-234°
SOFT BALL	Syrup forms a soft ball when dropped in cold water and will flatten when removed from the water	Fondant, Fudge, Penuche	85%	234-248°
FIRM BALL	Syrup forms a firm ball when dropped in cold water and does not flatten when removed but is malleable	Caramels and caramel corn	87%	244-248°
HARD BALL	Syrup forms a hard ball when dropped in cold water and does not flatten when removed. It's shape may be changed with manipulation	Divinity, marshmallow, nougat, popcorn balls	92%	250-266°
SOFT CRACK	Syrup cracks into solid threads when dropped in cold water. When removed, the threads will bend slightly before breaking	Butterscotch, salt water taffy	95%	270-290°
HARD CRACK	Syrup cracks into hard, brittle threads when dropped in cold water. When removed, the threads will break instead of bending	Lollypops, peanut brittle, toffee	99%	300-310°
CLEAR LIQUID	Sugar is liquid and light amber in color	Barley sugar	100%	320°
BROWN LIQUID	The liquid sugar caramelizes. Caramelization turns the sugar brown and produces a rich flavor	Caramelized sugar used as a coating or decoration	100%	338°
BURNT LIQUID	At about 350° Fahrenheit the sugar begins to burn and tastes bitter	No candies	100%	350°

Old-Timey Fudge

Ingredients:

2 cups sugar	3/4 cup milk
2 ounces unsweetened chocolate (cut up)	1 teaspoon light corn syrup
2 tablespoons butter	1 teaspoon vanilla
1/2 cup chopped nuts (optional)	

Method:

1. Prepare a 9x5x3-inch loaf pan by lining it with foil, extending the ends over the edges of the pan. Butter the bottom and edges of the foil. Set aside.
2. Butter the sides of a heavy 2-quart saucepan. Add sugar, milk, unsweetened chocolate, and light corn syrup to the saucepan. Cook over medium-high heat, stirring frequently until the mixture boils. Clip a candy thermometer to the side of the pan. Reduce the heat to medium-low. Continue boiling at a moderate, steady rate, stirring frequently, until the mixture reaches 234° Fahrenheit, soft-ball stage (20-25 minutes).
3. Remove the saucepan from the heat. Add the butter and vanilla, but do not stir. Cool to 110° Fahrenheit (about 55 minutes), without stirring or agitating.
4. Remove the thermometer from the saucepan. Beat the mixture vigorously with a wooden spoon until the fudge begins to thicken. If desired, add nuts. Continue beating until the fudge becomes very thick and begins to lose its glossiness (about 10 minutes).
5. Immediately spread the fudge in the prepared pan. While still warm, score into squares. When the fudge is firm, grip the foil edges and lift out of the pan. Cut the fudge into squares. Store tightly covered.

Chocolate Truffles

Ingredients:

11 1/2 ounces (1 package) milk chocolate pieces	1/3 cup whipping cream
1/4 teaspoon almond extract	1/2 cup toasted almonds, ground
8 ounces vanilla-flavored candy coating	1/2 cup semisweet chocolate pieces
1 teaspoon shortening	

Method:

1. Prepare two baking sheets by lining them with waxed paper. Set aside.
2. In a heavy saucepan, combine milk chocolate pieces and whipping cream. Cook over low heat stirring frequently until the chocolate melts, about 4-5 minutes. Remove the saucepan from the heat and let it cool slightly. Stir in the almond extract. Beat the mixture with an electric mixer on low speed until smooth. Cover and refrigerate about 1 hour or until firm.
3. Shape the chocolate truffle mixture into 1-inch balls; roll the balls in the ground almonds. Place the balls on a prepared baking sheet. Freeze for 30 minutes.
4. Meanwhile, melt the candy coating in a small heavy saucepan over low heat. Quickly dip the truffles, one at a time, into the coating. Let the excess coating drip off the truffles. Then, place the truffles on the second prepared cookie sheet; let stand 30 minutes or until the coating is set.
5. In a small saucepan, heat the semisweet chocolate pieces and shortening until melted. Decoratively drizzle the melted chocolate over the tops of the truffles. Store tightly covered at room temperature.

Divinity

Ingredients:

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|--------------------------------------------------|------------------------------------|
| 2 1/2 cups sugar | 1/2 cup light corn syrup |
| 1/2 cup water | 2 egg whites |
| 1 teaspoon vanilla | 1-2 drops food coloring (optional) |
| 1/2 cup chopped candied fruit or nuts (optional) | |

Method:

1. In a heavy, 2-quart saucepan combine sugar, light corn syrup, and water. Cook over medium-high heat, while stirring, until mixture boils.
2. Clip a candy thermometer to the side of the pan. Reduce the heat to medium; continue cooking, without stirring, until the mixture reaches 260° Fahrenheit, hard-ball stage (10-15 minutes). Remove the pan from the heat and remove the thermometer.
3. In a large mixing bowl, beat the egg whites with an electric mixer on medium speed until stiff peaks form (tips stand straight).
4. Gradually pour a thin, steady stream of the hot sugar mixture over the whites while beating continuously on high speed. Beat about 3 minutes, scraping the sides of the bowl occasionally. Add vanilla and if desired, the food coloring. Continue beating on high until the candy starts to lose its gloss (5-6 minutes) and holds its shape. When the beaters are lifted, the mixture should fall in a ribbon that mounds on itself.

- Drop a spoonful of the candy mixture onto waxed paper. If it stays mounded, it is ready. If the mixture flattens, continue beating for 30 to 60 seconds, and check again. If the mixture is too stiff to spoon, beat in a few drops of hot water to soften the mixture. Once ready, quickly stir in the fruit or nuts, if desired, and drop by spoonfuls onto waxed paper. Let cool. Store tightly covered.

Caramel

Ingredients:

2 1/4 cups packed brown sugar	1 cup butter
1 cup light corn syrup	2 cups light cream
1 cup chopped walnuts (optional)	1 teaspoon vanilla

Method:

- Prepare an 8x8x2 or 9x9x2-inch baking dish by lining it with foil, extending the ends over the edges of the dish. Butter the bottom and edges of the foil. If desired, sprinkle walnuts onto the bottom of the dish. Set aside.
- In a heavy 3-quart saucepan, melt 1 cup of butter over low heat. Add brown sugar, cream, and corn syrup; mix well. Cook and stir over medium-high heat until the mixture boils. Clip a candy thermometer to the side of the saucepan. Reduce heat to medium; continue boiling at a moderate, steady rate, stirring frequently, until the mixture reaches 248° Fahrenheit, firm-ball stage (45-60 minutes).
- Remove the saucepan from the heat and remove the thermometer. Stir in the vanilla. Quickly pour the mixture into the prepared pan. When the caramel mixture is firm, grip the foil edges and lift the caramel out of the pan. Use a buttered knife to cut the caramel into 1-inch squares. Wrap each piece in wax paper or plastic wrap.

Peanut Brittle

Ingredients:

4 tablespoons butter	2 teaspoons baking soda
2 cups sugar	1 cup light corn syrup
1/2 cup water	2 cups raw peanuts

Method:

1. Prepare two baking sheets by lining them with foil, extending the ends over the edges of the pans. Butter the bottom and edges of the foil. Set aside. Measure the butter and baking soda and set aside.
2. Butter the sides of a heavy, 3-quart saucepan. In the saucepan, combine the sugar, light corn syrup, and water. Cook and stir over medium-high heat until the mixture boils.
3. Add the peanuts. Clip a candy thermometer to the side of the saucepan. Reduce the heat to medium-low. Continue boiling at a moderate, steady rate, stirring occasionally, until the color changes to light brown and the mixture reaches 300° Fahrenheit, hard-crack stage (15 to 20 minutes more).
4. Remove the saucepan from the heat and remove the thermometer. Quickly stir in the butter and baking soda, stirring constantly. Immediately pour half of the mixture into one prepared baking sheet and half into the second sheet. Spread the candy across each sheet by using 2 forks to lift and pull the candy.
5. Cool completely, then break or snap into pieces. Store in an airtight container.

Salt Water Taffy

Ingredients:

- | | |
|------------------------------------|-----------------------------------------------------|
| 2 cups sugar | 1 cup light corn syrup |
| 1 cup water | 1 1/2 teaspoons salt |
| 2 tablespoons butter | 1/4 teaspoon flavoring (peppermint, cinnamon, etc.) |
| 1-2 drops food coloring (optional) | |

Method:

1. Butter a 15x10x1-inch baking dish. Set aside.
2. Butter the sides of a heavy, 2-quart saucepan. In the saucepan, combine the sugar, light corn syrup, water, and salt. Cook and stir over medium-high heat until the mixture boils. Clip a candy thermometer to the side of the saucepan. Reduce the heat to medium and continue boiling at a moderate, steady rate, without stirring, until the mixture reaches 265° Fahrenheit, hard ball stage (about 40 minutes).
3. Remove the pan from the heat and remove the thermometer. Stir in the butter. Stir in the flavoring and food coloring, if desired. Pour into the prepared dish. Cool for 15-20 minutes or until taffy mixture is easy to handle.
4. Butter your hands. Then, twist and pull the candy until it turns a creamy color and is stiff and quite difficult to pull (10-15 minutes). Your candy is ready if it cracks when you tap it on the counter. Divide the candy into 4 pieces; twist and pull each piece into a long strand about 1/2-inch thick. With buttered kitchen scissors, snip bite-size pieces of taffy off each strand. Wrap each piece in plastic wrap or wax paper.

Hard Candy

Ingredients:

2 cups sugar	1 cup light corn syrup
1/2 cup water	1/4 teaspoon food coloring, color as desired
Few drops cinnamon oil or peppermint oil	

Method:

1. Prepare an 8x8x2-inch baking dish by lining it with foil, extending the ends over the edges of the dish. Butter the bottom and edges of the foil. Set aside.
2. Butter the sides of a heavy, 2-quart saucepan. In the saucepan, combine the sugar, light corn syrup, and water. Cook over medium-high heat until the mixture boils (about 5 minutes), stirring occasionally to dissolve the sugar. Clip a candy thermometer to the side of the saucepan. Reduce the heat to medium and continue boiling at a moderate, steady rate, stirring occasionally, until the mixture reaches 290° Fahrenheit, soft-crack stage (20-25 minutes).
3. Remove the pan from the heat and remove the thermometer. Quickly stir in the desired food coloring and flavored oil. Immediately pour the mixture into the prepared dish. Let it stand for 5-10 minutes or until a film forms over the surface of the candy.
4. Using a broad spatula or pancake turner, begin marking candy pieces by pressing a line on the surface, 1/2 inch from the top edge of the pan. Do not break the surface film. (If lines do not remain in candy, it is not cool enough to mark. Try marking again in a few minutes.) Repeat along the other three sides of pan, intersecting lines at corners to form squares.
5. Continue marking lines along all sides, 1/2 inch apart, until you reach the center. Retrace the previous lines, pressing the spatula deeper but still not breaking the surface film. Repeat until the spatula can be pressed to the bottom of the pan along all lines. Cool completely. Grip the foil edges to lift the candy out of the pan; break the candy into squares. Store tightly covered.

Nougat

Ingredients:

2 cups sugar	1 1/2 cups light corn syrup
1/4 teaspoon salt	1/4 cup water
2 egg whites	1/2 teaspoon almond extract
Few drops food coloring, green	4 tablespoons butter, softened
1 cup toasted pistachio nuts	

Method:

1. Prepare an 8x8x2-inch baking dish by lining it with foil, extending the ends over the edges of the pan. Spray the bottom and edges of the foil with nonstick cooking spray. Set aside.
2. In a large saucepan, combine the sugar, light corn syrup, salt, and water. Heat over medium-high heat, stirring occasionally until the sugar dissolves. Clip a candy thermometer to the side of the saucepan. Continue to cook until the mixture reaches 250° Fahrenheit, hard-ball stage.
3. While the mixture is cooking, place the egg whites in a large bowl and beat until stiff peaks form (tips stand straight).
4. Once the sugar mixture reaches 250° Fahrenheit, remove it from the heat. Then, slowly pour one fourth of the mixture into the stiff egg whites, while beating constantly. Continue to beat the egg whites until the mixture holds its shape.
5. Return the saucepan with the remaining sugar mixture to the stove and continue to cook over medium-high heat until the mixture reaches 300° Fahrenheit, hard-crack stage.
6. With the mixer running, slowly pour the remaining sugar mixture into the egg white mixture and continue beating until the mixture is thick and stiff.
7. Add the almond extract and a few drops of green food coloring to create a light green tint. Add the softened butter and beat until the candy is very thick and satiny. Finally, add the pistachio nuts and stir until combined.
8. Spoon the nougat into the prepared pan and press it smoothly and evenly. Allow it to sit at room temperature.
9. Grip the foil edges to lift the candy out of the pan. Place on a cutting board and cut into small squares to serve. Store in the refrigerator with squares wrapped individually in waxed paper or plastic wrap. Store tightly covered.

EVALUATION OF VARIETY OF CRYSTALLINE CANDIES

1. Taste each variation and place the numerical score for each characteristic in the upper left hand corner of each box. (Score System: 1=very poor; 2=poor; 3=fair; 4=medium; 5=good; 6=very good; 7=excellent)
2. Provide comments/descriptions to justify the numerical score.

VARIETY	OLD-TIMEY FUDGE	CHOCOLATE TRUFFLES	DIVINITY
APPEARANCE			
CONSISTENCY/ TEXTURE			
TENDERNESS/ OILINESS			
FLAVOR			
OVERALL QUALITY			

EVALUATION OF VARIETY OF NON-CRYSTALLINE CANDIES

1. Taste each variation and place the numerical score for each characteristic in the upper left hand corner of each box. (Score System: 1=very poor; 2=poor; 3=fair; 4=medium; 5=good; 6=very good; 7=excellent)
2. Provide comments/descriptions to justify the numerical score.

VARIETY	CARAMEL	PEANUT BRITTLE	SALT WATER TAFFY	HARD CANDY	NOUGAT
APPEARANCE					
CONSISTENCY/ TEXTURE					
TENDERNESS/ OILINESS					
FLAVOR					
OVERALL QUALITY					

LEARN MORE:

Sugar Science

- ◆ Sugars are simple carbohydrates that are chemically classified into two main types:
 - **Monosaccharides:** The simplest form of sugar consisting of only one single unit. The three monosaccharides include **glucose, fructose, and galactose**. Glucose is the most abundant simple sugar found in foods. It is the building block of all simple and complex carbohydrates.
 - **Disaccharides:** Simple sugars consisting of two linked monosaccharides. The three disaccharides include:
 - » **Sucrose:** glucose + fructose (table sugar)
 - » **Lactose:** glucose + galactose (milk sugar)
 - » **Maltose:** glucose + glucose
- ◆ Sucrose, or table sugar, is derived from two main sources: sugarcane and sugar beet. Sugarcane accounts for approximately 70% of sugar production worldwide, while beet sugar accounts for the remaining 30%. Sugarcane is derived from tropical grasses requiring subtropical climates to grow. The cane portion of the sugarcane is where its sucrose is stored. It looks similar to a bamboo stick. Sugar beets grow in temperate climates. The sugar beet stores its sucrose in a tuberous root.
- ◆ For sugar, sweetness is not its only function in food. Even sweetening ability can vary from sugar to sugar. For example, fructose is the sweetest of the sugars, followed by sucrose, glucose, galactose, maltose, and lactose being the least sweet. Each chemical arrangement is unique, allowing their capabilities to differ. These chemical properties also impact how each sugar dissolves, crystallizes, browns, melts, absorbs water, contributes to texture, ferments, and preserves food.
- ◆ The phase change when a substance changes from a liquid to a solid is called **crystallization**. Crystallization is a vital step in the candy making process because the development or inhibition of crystal formation determines the type of candy being prepared and its quality. Candies are classified into two main groups (crystalline and non-crystalline) based on crystal formation. Crystalline candies, such as divinity, fondant, and fudge are creamy and contain small, repeating crystal structures. While non-crystalline or amorphous candies, such as caramels, peanut brittle, and taffy do not have a clear crystal pattern. Non-crystalline candies can further be divided into three types: chewy (caramel), hard (peanut brittle), and aerated (marshmallow).

- ◆ When a sugar solution is boiled to the point of saturation (enough water has evaporated that no additional sugar can be dissolved at that temperature) and is then allowed to cool, producing a super-saturated solution (more sugar is present than can be dissolved at that temperature), crystals form. Each crystal has a nucleus surrounded by tightly packed molecules. In candy making, you typically want nuclei to form quickly so the resulting product has many small crystals that feel smooth on your tongue. If nuclei form too early, they form slowly and you end up with larger crystals that feel grainy. The rate of nuclei formation/crystallization is dependent on the crystallizing substance, concentration, temperature, interfering agents, and agitation.
- ◆ Sucrose tends to form large crystals; while, glucose and fructose form smaller crystals. Corn syrup and honey have higher concentrations of glucose and fructose, and can be added to sucrose solutions (made from granulated sugar) to prevent the formation of large crystals. A second way to prevent large crystal formation is to add an acid, such as lemon juice. This speeds up the break down (or inversion) of sucrose into glucose and fructose, forming an invert sugar which resists crystallization and helps to retain more moisture.
- ◆ **Caramelization** is a nonenzymatic browning process that occurs when sugars have been heated beyond their natural melting point. It is a result of sugar decomposition. After sucrose has been heated in a dry pan to 320° Fahrenheit it begins to melt into a clear, viscous mass. If the sucrose is heated to 338° Fahrenheit it will caramelize, becoming smooth and glossy. Each sugar's melting point is different.
- ◆ Caramelized sugars are less sweet but more flavorful than the original sugar and may even be slightly bitter. The darker the caramel, the less sweet it is. Candies made using caramelization include caramels and peanut brittle. Other items that also use its flavoring are sauces, puddings, ice creams, and frosting.
- ◆ The moisture and texture of foods made with sugar is influenced by the sugar's **hygroscopic** ability (attraction and retention of moisture). The moisture-absorbing property of sugar makes it imperative that baking mixes be stored in airtight containers to prevent clumping. Otherwise, moisture drawn to the mixture will lower the quality of the baked product.
- ◆ Sugar, especially sucrose, affects the texture of some foods. For example, because sugar attracts water, baked products maintain a soft, moist texture and prevent drying. Confectioner's sugar can be dusted onto moist cakes to further attract moisture creating a sticky, sweet coating. Sugar is used to prevent overdevelopment of protein and starch structures in baked goods, which causes the dough to become tough. It also keeps meringues (a mixture of egg whites and sugar beaten until stiff) light and fluffy by forming a supportive coating around the air bubbles in the batter.

- ◆ Other functions of sugar in foods include fermentation, preservation, and leavening. Beers, wines, cheeses, yogurts, and certain breads are made through fermentation of carbohydrates. Some foods are preserved by using high concentrations of sugar to inhibit the growth of microorganisms. When sugar is added to a bread batter, its particles break up the dough, creating pockets of air. During baking, these air pockets expand, causing the batter to rise.

Sugar Tips for Consumers

- ◆ Sugar is a part of your discretionary kilocalories. Someone, consuming a 2,000 kilocalorie diet has about 200 discretionary kilocalories. Discretionary calories may come from candy, cakes or other sweets, added fats like butter, or fat found in higher fat versions of milk and meat products. Dietitians and other health professionals recommend limiting your intake of empty calorie foods high in sugar. So, if you choose to eat sugar-rich foods as part of your discretionary calories, be sure to do so in moderation. People trying to lose weight should try cutting out their discretionary calories.
- ◆ Sweet foods you buy from the store may be labeled “sugar free” or “reduced sugar.” Foods labeled sugar free must contain less than 0.5 grams of sugar per serving, but watch out, these foods may still be high in calories. Foods labeled reduced sugar contain 25% less sugar than the usual product. In addition, choose more food and beverage products that say “Unsweetened” or “No Added Sugar.”
- ◆ A large proportion of foods on the market contain high fructose corn syrup as their main sweetening ingredient. High fructose corn syrup is similar to sucrose (table sugar) in that they both contain 4 calories per gram, both are metabolized the same way within the body, and both contain glucose and fructose. However, they are different in the amount of glucose and fructose each one contains. High fructose corn syrup contains more fructose, the sweetest simple sugar, than glucose to produce a much sweeter tasting product than regular table sugar could and with less expense. Like products that are sweetened with regular table sugar, products sweetened with high fructose corn syrup should be consumed in moderation.
- ◆ To increase the fiber and nutrient content of sweet foods such as candy, ice cream, and cookies, add nuts or dried and fresh fruit to your recipes.
- ◆ To decrease the amount of calories coming from sugar, many people have turned to substituting part of their sugar with a sugar substitute. However, like sugar, sugar substitutes are also to be used in moderation.
- ◆ Sugar cookery requires precision in the kitchen. In preparing sugar concentrated products like candies, frostings, and fondants, best results occur when you follow the recipe closely using the exact ingredients and quantities called for in the recipe. Be sure to adhere to specified temperatures or cold water test stages.

- ◆ To test the temperature of your syrup, you will need a candy thermometer. Always test your candy thermometer before heating your candy mixture by inserting the thermometer into boiling water. Be sure the bulb does not touch the bottom or sides of the pan. Read the temperature at eye level. It should read 212° Fahrenheit at sea level. If it reads higher or lower, you will need to calculate the difference and adjust accordingly (adding or subtracting the difference to/from the temperature stated in your recipe).
- ◆ When you prepare candy at higher altitudes, the recipes will need to be adjusted because the boiling point of water is lower than 212° Fahrenheit at higher altitudes. A rough estimate is to subtract 1° Fahrenheit for every 500 feet above sea level. If you bring your candy syrup up to the sea level recipe temperature, too much water will evaporate and the mixture will become too concentrated.
- ◆ Humidity can also affect your candy making. As your candy cools, it may begin to absorb moisture from the air, making it difficult for the candy to set up. Dry, cool days are the best candy making days. If you decide to make candy when it is humid, be sure to cook the syrup to the upper end of the temperature range.
- ◆ For some candies, it is important to quickly add any additional ingredients (e.g. chocolate) once the candy reaches its ultimate temperature. To aid in this process, measure out all of your ingredients ahead of time.

Candy Questions

1. Compare and contrast crystalline and non-crystalline candy including structural and physical properties. Provide examples of each.
2. You are ready to make Old-Timey Fudge, but first you test your candy thermometer by inserting it in boiling water. It reads 215° Fahrenheit. What adjustments will you need to make to the thermometer readings? (Reference the Old-Timey Fudge recipe to give specifics in your answer)
3. Step 3 of the Old-Timey Fudge recipe reads “Cool to 110° Fahrenheit (about 55 minutes), without stirring or agitating.” Why is it important to avoid stirring or agitating the mixture?

4. Name and describe the browning reactions responsible for giving caramels and peanut brittle their characteristic colors.

Caramels:

Peanut brittle:

5. Why is baking soda added to peanut brittle?

Sugar Teacher Tips

Overview

This lab experience will take a full class period of 2¼ hours to complete.

- ◆ Students will experiment preparing a crystalline and non-crystalline candy.
- ◆ Students will experiment with different proportions of fat, sugar (and kinds of sugar), and flour in products to understand their functions.
- ◆ The students may be introduced to equipment they have not used previously such as a candy thermometer.

Lab Management

Demonstrations

- ◆ The instructor may demonstrate the consistency of sugar water boiled to different end point temperatures.
- ◆ Consider comparing baking in a conventional oven, convection oven, and microwave oven.
- ◆ Discuss differences in types of baking containers.
- ◆ Discuss the appearance of a finished product when it is removed from the oven and then after cooling.

Time Management

- ◆ Allow sufficient time for candy making.
- ◆ Remind students to measure out all needed ingredients before starting recipes.

Sensory Evaluation

- ◆ Instruct the students on how to display and when to evaluate the products. As time allows, a student from each kitchen should comment about the preparation of the dish and the final product.
- ◆ Evaluate at the same time, side by side: fudge and peanut brittle.

- ◆ Add a tasting of sugar, fructose, aspartame, splenda, stevia, honey, molasses, corn syrup, agave nectar, and/or other sweeteners available in your local stores. Compare price, taste and after taste, calories, and consistency.

Nutrition Points for Discussion:

- ◆ The Dietary Guidelines for Americans recommend that all Americans eat and drink fewer foods and beverages with added sugars.
- ◆ Even so, there is a role for foods and beverages sweetened with sugar (sucrose) and other caloric sweeteners. In an attempt to reduce the amount of sugar, some recipes use alternative sweeteners. It is important to understand the function of sugar in the product before substituting with a non-caloric sweetener.
- ◆ Discuss the function of fat in each of the recipes where it is used.
 - What is the function of butter or margarine in the old timey fudge? Can it be replaced or eliminated?
 - What is the role of fat in peanut brittle? Could it be reduced or eliminated?
- ◆ Discuss the function of sugar in each recipe.
 - What functions does sugar play in old timey fudge?
 - What functions does sugar play in a cake?
 - What is the role of light corn syrup in peanut brittle?
- ◆ Salt has either been eliminated from the traditional recipe or is listed as optional. Discuss with the students the function of salt in these recipes.

SHOPPING LIST: (8 SECTIONS)

Item	Utilized Unit/Lab Section	Purchased Unit
Chopped Nuts (optional)	1 cup	1 package
Almonds	½ cup	1 package
Chopped Walnuts	1 cup	1 package
Raw peanuts	2 cups	1 cont.
Pistachio Nuts	1 cup	1 package
Sugar	12 ½ cups	(2) 5 lb bag
Brown Sugar	2 ¼ cups	1 bag
Unsweetened Chocolate	2 oz	1 block
Milk Chocolate pieces	11 ½ oz	1 bag
Semisweet chocolate pieces	½ cup	1 bag
Light corn syrup	6 cups + 1 tsp	3 bottles
Vanilla	1 TBSP	1 bottle
Almond extract	¾ tsp.	1 bottle
Vanilla flavored candy coating	8 oz	1 package
Flavoring (peppermint, etc)	½ tsp.	1 bottle
Food coloring (any color)	4-6 drops	1 box
Food coloring (green)	2-3 drops	1 bottle
Baking soda	2 tsp.	1 box
Salt	1 ¾ tsp.	1 cont.
Milk	¾ cup	1 pint
Whipped cream	1/3 cup	1 pint
Light cream	2 cups	1 pint
Butter	1 ¾ cups	1 block
Shortening	1 tsp.	1 cont.
Eggs	4	1 dozen