

Sweeten Up Food Science!

Background

The following lesson plans and activities were developed as part of the 2022-2023 North Carolina State University Food Science Fellowship. I completed a job shadow at Morinaga America Inc. in Mebane, North Carolina where Hi-Chew™ candy is produced for North America. I implemented what I learned in developing the following activities for the four units in FN43 Foods II - Food Technology. The activities can be used in other courses such as Foods and Nutrition II or Culinary Arts I, II, III, or IV. Get students engaged in food science with these interactive activities using some of their favorite sweet treats!

Activities

Unit 1 - Basic Food Technology Principles: Sweet Sensory Evaluation	
<p>In this activity students use their senses to analyze how aroma and temperature affect flavor. Students will practice using sensory evaluation as they examine the science behind taste!</p>	<p>FN43 Foods II - Food Technology Objectives:</p> <ul style="list-style-type: none"> ● 1.01 Understand objective methods in a food analysis laboratory. ● 1.02 Understand subjective methods in a food analysis laboratory. ● 2.01 Understand changes to physical properties of food. ● 2.02 Understand the changes to the chemical properties of food.
Unit 2 - Food Constituents: Candy Making Choice Lab	
<p>Students will work in groups to complete a lab-based project preparing a candy of their choice. Students will present their candy to the class, demonstrating their understanding of crystalline and non-crystalline candies and other simple carbohydrate principles.</p>	<p>FN43 Foods II - Food Technology Objectives:</p> <ul style="list-style-type: none"> ● 3.02 Understand the functions of nutrients in food.
Unit 3 - Food Microbiology and Safety: Controlling Common Food Hazards Matching in Willy Wonka's Chocolate Factory	
<p>Students will work together to match key terms and other important concepts about controlling common food hazards using Willy Wonka's magical chocolate factory as the setting.</p>	<p>FN43 Foods II - Food Technology Objectives:</p> <ul style="list-style-type: none"> ● 5.01 Understand microorganisms associated with food quality and safety. ● 6.01 Understand non-microbial food hazards and allergen labeling. ● 6.02 Understand ways to control common food hazards.
Unit 4 - Food Production, Biotechnology, and Food Processing: How HI-CHEW™ Candy Is Made	
<p>Students will watch the video: "How HI-CHEW™ Candy Is Made" and complete an activity guide to connect food production and processing with Morinaga America Inc., a North Carolina food manufacturing facility.</p>	<p>FN43 Foods II - Food Technology Objectives:</p> <ul style="list-style-type: none"> ● 7.01 Understand "farm to table" as related to food production. ● 9.02 Classify food packaging procedures used in product development.

Unit 1 - Basic Food Technology Principles: Sweet Sensory Evaluation Teacher Guide

Materials:

Per Student:

1. Water
2. Flavored candies, such as Hi-Chew™ or jelly beans
3. Blind-folds
4. Ice Cream at room temperature and frozen
5. Bowls and spoons

Lesson Plan:

- Begin by asking students to define flavor. Have students share with a partner or write down their definition individually. Lead a class discussion where students share their answers. Most students will identify taste as the main part of flavor, and will describe the five tastes. Review the five basic tastes: sweet, salty, umami, bitter, and sour. You may discuss how taste buds work, describing how food particles activate our taste buds, which then trigger a signal to our brain about a perceived flavor. Tell students that in this activity they will examine how aroma and temperature affect flavor.
- Hand out copies of the Sweet Sensory Evaluation to students and have them begin Part 1: Exploring Aroma and Taste. Students will obtain different flavored candies from you and try to guess the flavor while isolating their senses, through using blind folds and holding shut their noses.
- Discuss with students how the experience of flavor does not end in the mouth. Smell or aroma is an essential part of flavor. Ask students if they have ever experienced a cold where their stuffed up nose has diminished their sense of taste. Discuss how foods release scent particles. As these particles float into our nasal passages, they activate our smell receptors. The smell receptors signal to our brain to perceive a unique smell. Our brains combine taste bud and smell receptor signals to fully experience the flavor of our foods. Examples of foods that have strong aromas that influence flavor include coffee (400 aromatic chemicals) or fresh orange juice (250 aromatic chemicals). Also discuss how aroma can protect us from spoiled or unsafe foods. Examples include the aroma of sour milk or rotten meat.
- As students continue to Part 2: Temperatures and Taste, provide them with samples of room temperature and frozen ice cream. After students complete this part, discuss how the room temperature ice cream sample was sweeter than the frozen. Taste buds often work more efficiently at warmer temperatures than cold. Cold or chilled foods will need additional sugars or sweeteners to get the “right” taste.
- Allow students time to complete the discussion questions with a partner or group at the end of the activity and share out answers.

Name:

Sweet Sensory Evaluation

Instructions: In this activity, you will use your senses to analyze how aroma and temperature affect flavor. You will practice using sensory evaluation as you examine the science behind taste!

Part 1: Exploring Aroma and Taste

1. Obtain candies from your teacher. Do not look at them.

2. Close your eyes or put on a blindfold, then have a group member give you a candy. Hold your nose, eat the candy and try to determine its flavor. What flavor do you think it is? _____

Describe, using all of your senses, the candy you tasted.

3. Repeat with a second candy, taste it with your eyes open and not holding your nose (but still don't look). Try to determine its flavor. What flavor do you think it is? _____

Describe, using all of your senses, the candy you tasted.

4. What changed between the first tasting and second tasting? Could you taste the flavor of the candy better with your eyes open and nose open?

Part 2: Exploring Temperature and Taste

5. Compare the smell of the frozen ice cream with that of the room-temperature ice cream. Which ice cream produces the strongest smell? Is there a difference?

6. Place a spoonful of frozen ice cream in your mouth. Close your mouth and try to concentrate on the flavor. What is the flavor like? Is it not sweet, sweet, or too sweet?

7. Let the ice cream melt in your mouth. Does the flavor change as the ice cream melts? When do you experience the strongest flavor?

8. Rinse your mouth with water.

9. Taste the room-temperature ice cream. How is the flavor different from that of the completely frozen ice cream? Does it taste just as good? Why or why not?

10. Ask your group members if they experience similar changes in perceived flavor that you did? Why do you think this happens?

Reflection Questions:

1. Many people will experience a temporary or even permanent loss of smell at some point in their lives. Can these people taste the same things as you? Can these people perceive the same flavors as you? Why or why not?

2. If we chilled or froze the Hi-Chew™ candy to complete a second round of this activity, how do you think changing the temperature of the product would affect the flavor?

3. The second part tested the effects of temperature on sweet food. Do you think we would reach the same conclusions for bitter or sour beverages/foods? Why or why not?

Unit 2 - Food Constituents: Candy Making Choice Lab Teacher Guide

Teacher Background:

After teaching about simple carbohydrates, have students complete this candy making choice lab in groups. Students will prepare a candy product of their choice and will present it to the class to demonstrate their knowledge about crystalline versus noncrystalline candy, interfering agents, agitation, ripening, and crystal formation.

Suggested Materials:

Candy making recipe supplies, such as:

- Lollipop sticks
- Flavor Extracts or Emulsions
- Food Dye
- Citric Acid
- Molds
- Pipettes or squeeze bottles
- Foil candy wrappers and cello bags
- Candy thermometers

Tips for success:

- Help students select recipes for their candy that are either crystalline or non-crystalline. Shortcut recipes will not demonstrate the crystallization of sucrose. Assist students in scaling their recipe appropriately and adjusting it to fit into their provided class time.
- Review safety procedures as students will be handling hot sugar solutions.
- Students may need more than one lab day to complete their candies or work through different variations of their candy to be successful. I would suggest completing a fudge lab or another candy making lab prior to this choice lab to give students hands-on experience.
- Candy recipe suggestions include:
 - Fudge
 - Peanut brittle
 - Divinity
 - Soft caramels
 - Gummy bears
 - Candy corn
 - Lollipops
 - Glass candy

Group Member Names:

Candy Making Choice Lab

Instructions: In this lab you will put into practice what you have learned about candy making from our sugars unit. Brainstorm what candies your group would like to make (no "shortcut" recipes, must be from scratch!) and complete these lab forms with your group members.

Candy Name	
Yield (you may need to decrease from original recipe)	
Recipe Source (insert link or write the name of the cookbook)	
Specialized Equipment Needed	

Ingredients	
Item	Amount

Procedure
<i>Adapt and adjust the recipe steps to fit into your class time.</i>

Procedure Continued...

Name:

Group Members:

Candy:

Candy Making Choice Lab Presentation

Instructions: Create a presentation about your candy to present to your classmates as they taste your candy. Include the following items in your presentation.

Slide	Required Components
Slide 1: Title	Include a title, your group members, and your candy.
Slide 2: Candy Sensory Evaluation	Insert a photo of your candy from the lab. Using sensory evaluation terms, describe the sensory characteristics of your candy. Include aroma, taste, texture, and appearance.
Slide 3: Type of Candy	Identify if your candy is crystalline or non-crystalline, and why.
Slide 4: Functions of Ingredients	List the function of each ingredient in your candy recipe. Identify types of sugars (include mono or di-sacharides) and label interfering agents.
Slide 5: Candy Making Process	Summarize the steps of your candy making process. Include the temperature and stage of crystallization of sucrose your candy requires. Explain if agitation, cooling, or ripening were needed. Describe the final texture of your candy and how you ensured a quality product. Include photos of the process.
Slide 6: Evaluation	Reflect and evaluate on this lab experience. What worked well? What would you improve if you made this candy in the future? What did you learn about candy making and the crystallization of sucrose throughout this project? How did your group improve throughout the crystallization of sucrose labs in this unit?

Unit 3 - Food Microbiology and Safety: Controlling Common Food Hazards Matching in Willy Wonka's Chocolate Factory Teacher Guide

Lesson Plan: Review controlling common food hazards with the following scenarios from Willy Wonka's magical chocolate factory. Students will match key terms and other important concepts from Unit 3 with examples, definitions, and scenarios. Cut out the cards before giving to students to match.

Key:

Food & Drug Administration	This federal agency is responsible for enforcing federal regulations at Willy Wonka's Chocolate Factory.
The United States Federal Food, Drug, and Cosmetic Act	This set of laws passed by Congress in 1938 gives authority to the U.S. Food and Drug Administration (FDA) to oversee the safety of food, drugs, medical devices, and cosmetics - including Willy Wonka's Chocolate Factory.
Good Manufacturing Practices	These are the procedures the Oompa Loompas follow for processing and packing chocolate under sanitary conditions.
Standard Sanitary Operating Procedures	As the Oompa Lompas make chocolates, they ensure a clean and sanitary environment.
HACCP	Willy Wonka's systematic approach to identify, assess and control the risks of identified hazards.
Prerequisite Programs	Willy Wonka has created programs that include a Oompa Loompa illness policy, cleaning and sanitizing procedure, garbage removal, pest control, equipment selection, and employee hygiene
Biological Hazard	An Oompa Loompa has salmonella and comes to work. He contaminates the chocolate with the bacteria.
Physical Hazard	A piece of a golden ticket is in the chocolate bar.
Physical Hazard	A piece of the glass elevator breaks off and contaminates the chocolate.
Physical Hazard	Violet Beauregarde spits her gum into the chocolate river.
Chemical Hazard	An Oompa Loompa spills sanitizer on the production line. It contaminates the chocolate.
Chemical Hazard	An Oompa Loompa forgets to clean equipment that was used to prepare a peanut butter candy. The equipment is later used to make chocolate bars. The chocolate bars are now contaminated with peanuts.
Food Allergy Labeling Requirements	The Food and Drug Administration requires Willy Wonka to list common allergens on labels in simple terms for the nine major food allergens.

Recall	Willy Wonka voluntarily communicates to his customers that his chocolate caramel truffles have undeclared milk and soy. People who have an allergy or severe sensitivity to milk or soy run the risk of serious or life-threatening allergic reaction if they consume these products.
Separating Raw Materials from Ready-to-Eat Foods	The Oompa Loompas are careful to follow procedures to keep sugar, cocoa powder, soy lecithin, and other ingredients away from finished chocolate candies.
41° F	The temperature that TCS foods in the factory must be stored at or below.
Step 1: Conduct a hazard analysis	The Oompa Loompas identify hazards associated with their chocolate production. They list physical, biological, and chemical hazards associated with each step of production and discuss what could happen if they are not controlled.
Step 2: Determine CCPs	A point, step, or procedure where an identified hazard can be prevented, eliminated, or reduced to acceptable levels.
Step 3: Establish Critical Limits	The Oompa Loompas have criteria that must be met to prevent, eliminate, or reduce hazards of CCPs so that their chocolate is safe to eat. They have limits for time, temperature, water activity, and other physical dimensions.
Step 4: Establish Monitoring Procedures	During chocolate production, Oompa Loompas visually observe, monitor temperatures and times, and measure pH and water activity of the various chocolates.
Step 5: Establish Corrective Actions	An Oompa Loompa realizes a batch of chocolate has been contaminated. She discards the entire batch and makes a record of the incident.
Step 6: Verification procedures	Oompa loompas determine that all critical limits for CCPs are sound, ensure that the HACCP plan is being properly followed, have regulatory personnel review the plan, and check the accuracy of monitoring equipment.
Step 7: Establish record keeping	Oompa Loompas keep records of the HACCP plan, including critical limits, monitoring procedures, plan verification, and corrective action plans.

Controlling Common Food Hazards Matching in Willy Wonka's Chocolate Factory

<p>Separating Raw Materials from Ready-to-Eat Foods</p>	<p>Food & Drug Administration</p>	<p>Step 5: Establish Corrective Actions</p>
<p>HACCP</p>	<p>The Oompa Loompas identify hazards associated with their chocolate production. They list physical, biological, and chemical hazards associated with each step of production and discuss what could happen if they are not controlled.</p>	<p>Oompa Loompas keep records of the HACCP plan, including critical limits, monitoring procedures, plan verification, and corrective action plans.</p>
<p>These are the procedures the Oompa Loompas follow for processing and packing chocolate under sanitary conditions.</p>	<p>Good Manufacturing Practices</p>	<p>Step 7: Establish record keeping</p>
<p>The Oompa Loompas are careful to follow procedures to keep sugar, cocoa powder, soy lecithin, and other ingredients away from finished chocolate candies.</p>	<p>Standard Sanitary Operating Procedures</p>	<p>As the Oompa Lompas make chocolates, they ensure a clean and sanitary environment.</p>

<p>Willy Wonka's systematic approach to identify, assess and control the risks of identified hazards.</p>	<p>41° F</p>	<p>This set of laws passed by Congress in 1938 gives authority to the U.S. Food and Drug Administration (FDA) to oversee the safety of food, drugs, medical devices, and cosmetics - including Willy Wonka's Chocolate Factory.</p>
<p>An Oompa Loompa forgets to clean equipment that was used to prepare a peanut butter candy. The equipment is later used to make chocolate bars. The chocolate bars are now contaminated with peanuts.</p>	<p>Prerequisite Programs</p>	<p>Chemical Hazard</p>
<p>The Food and Drug Administration requires Willy Wonka to list common allergens on labels in simple terms for the nine major food allergens.</p>	<p>Biological Hazard</p>	<p>Food Allergy Labeling Requirements</p>
<p>A piece of a golden ticket is in the chocolate bar.</p>	<p>Physical Hazard</p>	<p>An Oompa Loompa has salmonella and comes to work. He contaminates the chocolate with the bacteria.</p>

<p>A piece of the glass elevator breaks off and contaminates the chocolate.</p>	<p>Physical Hazard</p>	<p>Willy Wonka voluntarily communicates to his customers that his chocolate caramel truffles have undeclared milk and soy. People who have an allergy or severe sensitivity to milk or soy run the risk of serious or life-threatening allergic reaction if they consume these products.</p>
<p>Violet Beauregarde spits her gum into the chocolate river.</p>	<p>The Oompa Loompas have criteria that must be met to prevent, eliminate, or reduce hazards of CCPs so that their chocolate is safe to eat. They have limits for time, temperature, water activity, and other physical dimensions.</p>	<p>Recall</p>
<p>An Oompa Loompa spills sanitizer on the production line. It contaminates the chocolate.</p>	<p>Chemical Hazard</p>	<p>Willy Wonka has created programs that include a Oompa Loompa illness policy, cleaning and sanitizing procedure, garbage removal, pest control, equipment selection, and employee hygiene</p>
<p>The United States Federal Food, Drug, and Cosmetic Act</p>	<p>The temperature that TCS foods in the factory must be stored at or below.</p>	<p>This federal agency is responsible for enforcing federal regulations at Willy Wonka's Chocolate Factory.</p>

Step 1: Conduct a hazard analysis	Step 6: Verification procedures	A point, step, or procedure where an identified hazard can be prevented, eliminated, or reduced to acceptable levels.
Physical Hazard	Step 2: Determine CCPs	An Oompa Loompa realizes a batch of chocolate has been contaminated. She discards the entire batch and makes a record of the incident.
Oompa loompas determine that all critical limits for CCPs are sound, ensure that the HACCP plan is being properly followed, have regulatory personnel review the plan, and check the accuracy of monitoring equipment.	Step 3: Establish Critical Limits	During chocolate production, Oompa Loompas visually observe, monitor temperatures and times, and measure pH and water activity of the various chocolates.
Step 4: Establish Monitoring Procedures		

Unit 4 - Food Production, Biotechnology, and Food Processing: How HI-CHEW™ Candy Is Made Teacher Guide

Materials:

Video Link: <https://youtu.be/Vm1Zeu-DpmU>

Teacher Background:

Hi-Chew™ has long been a popular chewy candy in Japan. In 2015, Morinaga, the manufacturers of Hi-Chew™ opened its first candy making facility in Mebane, North Carolina.

Lesson Plan:

- Distribute the How HI-CHEW™ Candy Is Made activity guides to students.
- Ask them to brainstorm foods that are manufactured in North Carolina. Examples include Krispy Kreme, Texas Pete, Hi-Chew, Mt. Olive Pickles, House-Autry Mills, Pepsi Bottling, Lance's Crackers, Campbells, Lance Crackers, and Dole. Tell students that North Carolina is also home to Moringa America Inc., the manufacturers of Hi-Chew™ candy.
- Ask students if they have ever enjoyed the Japanese candy that is uniquely soft with a long-lasting, chewy texture and comes in different fruit flavors.
- Play the "How Hi-Chew™ Candy is Made" Inside Edition video on YouTube. As students watch, they should complete the questions on the accompanying worksheet. Discuss questions afterwards as a group.
- Have students complete the second part as they take on the job of product developers to create a product that solves a problem with an existing food product, similar to how Hi-Chew™ was a product that was created to solve the Japanese cultural taboo of taking gum out of your mouth. You may need to review packaging with students, including packaging materials and functions, depending on how long ago you covered the content. Students may choose to use this product as part of their product development project in objective 9.03 Implement steps to get a new food product to market.

Name:

How HI-CHEW Candy Is Made

Instructions: As you watch the “How HI-CHEW Candy Is Made” Inside Edition video, answer the questions provided. Video Link: <https://youtu.be/Vm1Zeu-DpmU>

Part 1: Video Questions

1. How did Hi-Chew™ candy get its start in Japan?
2. Using the steps of making Hi-Chew™ candy listed below, number the steps in order from 1 to 5.

Step Number	Process
	The cooled mass gets formed into a snake.
	The cooked base and fruit concentrate cools.
	The snake gets cut into small chewlets.
	The chewlets get packaged into colorful packaging.
	A cooked base and fruit concentrate form a candy mass.

3. Why would Hi-Chew™ keep their product formula secret?
4. Why did Hi-Chew™ candy gain popularity in America?
5. Identify and research one career that would involve working at Hi-Chew™ manufacturing their candy. Explain the roles of the job, typical salary, and education needed for the position.

Part 2: Product Creation

Hi-Chew™ is a product that was created to solve the Japanese cultural taboo of taking gum out of your mouth. Find a partner and brainstorm a problem that you or the food industry may have with an existing food product. Then, create a food product that solves that problem. Create a mock advertisement that explains and markets your product. Include a drawing of your product on your advertisement that includes the packaging. Remember, the type of packaging material used with a specific food product depends on: the function the package must perform, the protection needed, conditions of shipping and storage, and chemical composition of the food. Make sure your packaging is tamper-evident.