



Pretty Sweet Product Development



Grade Level(s): 11 – 12	Lesson Description: Students explore product development, marketing, and food science and innovation through North Carolina business case studies.	Timeframe: Minutes: 360 – 450 Suggested days: 4 – 5
Goals & Objectives Students will... <ul style="list-style-type: none"> ● Consider the impact of food loss on society ● Describe the nutritional contributions of SweetPotatoes ● Understand polymers and their role in the formation of functional jellies ● Compare the addition of fresh fruit to jellies ● Compare food preservation methods ● Understand microwave preservation ● Apply the Lean Canvas Business Model to food product development 		Prepared By: Reno Palombit Family & Consumer Sciences Professional Johnston County Public Schools
North Carolina Family & Consumer Sciences Education Standards:		
Food Science & Technology 9.00 Apply procedures to get a new food product to market. 9.01 Understand the types of preservation methods used in product development. 9.02 Classify food packaging procedures used in product development. 9.03 Implement steps to get a new food product to market.	Food and Nutrition II 2.00 Understand nutrition principles and applications 2.01 Understand nutrients and their role in healthy food preparation. 3.01 Understand food systems and local food. 4.02 Analyze startup processes for ventures in food and nutrition.	
Family & Consumer Sciences National Standards 3.0 9.1 Analyze career paths within food science, food technology, dietetics, and nutrition industries. 9.5 Demonstrate use of science and technology advancements in food product development and marketing. 9.6 Demonstrate food science, dietetics, and nutrition management principles and practices. 9.7 Demonstrate principles of food biology and chemistry. 3.5.6 Evaluate the labeling, packaging, and support materials of consumer goods. 3.5.8 Utilize appropriate marketing and sales techniques to aid consumers in the selection of goods and services that meet consumer needs.		
Materials Needed	<ul style="list-style-type: none"> ● Preprinted large paper copies of the Lean Canvas Business Model and sticky notes ● Audio/visual equipment to show linked video ● SweetPotato products for tasting ● Ingredients for the Fruit Gummy Lab 	



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Day 1

Activity 1: Anticipatory Set

30Minutes

Ask students, “How much food do you think is lost through the supply chain?” Have students call out their answers. Then explain that the Food and Agriculture Organization of the United Nations estimates 30% of food is lost at agricultural production and harvest.

Have students then brainstorm a list of reasons why food is lost throughout the supply chain. Ask volunteers to share their responses and record on the whiteboard.

Then, project the [Food Loss Chart](#) for the students to observe. As a class, facilitate the classification of the student responses into the various food chain steps in the chart: agricultural production and harvest, postharvest, processing and packaging, retail distribution, and consumption.

Talk about the economical and environmental impacts of high food loss on society- food insecurity, inefficiency, lost profit for farmers, higher consumer prices, etc.

Refocus the discussion back to agricultural production by projecting the [Fruit and Veg Price Volatility](#) chart and asking student volunteers to interpret the chart. Explain that food loss as it relates to fresh fruits and vegetables is especially challenging because these foods are highly perishable (compared in this chart to grain products). Use the [Food Loss at the Farm Level](#) article and the [Food Loss: Why Food Stays on the Farm or Off the Market](#) to make sure students have a thorough understanding how food loss occurs through agricultural production.

- [APPENDIX A](#) – Food Loss Chart

- [APPENDIX B](#) – Fruit and Veg Price Volatility

- whiteboard

- marker

Activity 2: Healthier Food, With Less Food Loss Video and Terms
30 Minutes

Use the [Healthier Food, With Less Food Loss](#) video to introduce students to Ripe Revival. As an active listening activity have students write down three words that they are unfamiliar with from the video. You may need to replay the video or pause throughout for students to write down the words. Have students share the words and write a list on the board, placing checkmarks for repeats. Make sure the below terms are included in the list and add them if they aren't.

- Harvest
- Crops
- Entrepreneurs
- Bioactives
- Pomace
- Muscadine
- Nutrients
- Plant proteins (or just Proteins)
- Fusing
- Phytoactive compounds
- Aggregate (particle aggregation)
- Colloidal aggregates
- Polyphenol-protein complex
- Polyphenols
- Capsules

Then assign each student a word to research- you can assign based on rigor and complexity for specific students to challenge them appropriately. Each student will research the term, define it in terms of food science and nutrition, identify examples or interesting facts they learned, and present it to the class using a poster to summarize their findings. Using the [Video Terms](#) handout, have the class record notes on each key term. Double up on key terms that received more checks if needed and add key terms that students shared, but weren't included on this list.

- [APPENDIX C](#) – Video Terms
- Audio/visual equipment to show video
- Large paper for posters
- markers
- colored pencils

Activity 3: SweetPotato Nutrition and Products
30 Minutes

Gather students in the demonstration station. Show the class a SweetPotato, explaining it is one of North Carolina's top agricultural commodities, grown and shipped across the world. Rich in Vitamin A, potassium, fiber, and complex carbohydrates that provide the body with sustained energy. Explain the role of these nutrients using the [Health Benefits of SweetPotatoes](#) page of the NC SweetPotato Commission website.

Gather a variety of SweetPotato products on the market for students to sample (i.e.- sweetpotato butter, chips, pie, tots, fries, gnocchi, etc. The more varied the better. Begin a conversation about how all of these products were conceived to meet a consumer's demand. Ask thought provoking questions like:

- Who do you think was involved in this product ending up on the shelves at the supermarket?
- What do you think makes this product different from others?
- Why is it important for companies to find something unique to sell?
- What do you think determines the price of these products?
- Why did they pick this type of packaging? Why a box? A bag? A can? A jar? etc.
- Why did they pick that picture to put on the front? Why that font? Why these colors?
- What role do consumers play in the development and success of these products?

Talk about how each product goes through rigorous and stringent product development involving food scientists, chefs, nutritionists, marketing executives, and more. How millions of dollars are invested by a company when it develops new products.

Explain that we will be exploring this process of developing and bringing a product to market over the next couple days by taking a deeper look at the North Carolina-based company Ripe Revival and the science behind their gummies.

[Learn more about SweetPotatoes and their Nutrition](#)

Day 2

Activity 4: Ripe Revival Lean Canvas Business Model Activity 60 minutes

Explain to students that the Lean Canvas is a 1-page business plan template that helps you deconstruct your idea into its key assumptions. Business plans take a long time to write but what is most important is documenting your hypotheses- which in terms of entrepreneurship and food product development is all about the success of a food product. The Lean Canvas Business Model should provide a tool to communicate how your product can be profitable on supermarket shelves and can be created in as few as 20-minutes.

Project the [Lean Canvas Business Model](#) and review with students, explaining that the goal is short lists or blurbs- not paragraphs for each section. It is best if you research and become familiar with this model before class so you can explain it to students. Review [An Introduction to Lean Canvas](#) to learn more. Explain how

With students in small groups, give each group a large format copy of the LCBM (consider laminating for repeated use) and a pad of sticky notes. Next provide them with the links to the following resources and instruct them as a group to imagine that they were the founders of Ripe Revival and they were completing a LCBM to start to build relationships with researchers, vendors, farmers, and investors. The sticky notes allow students to think about ideas/concepts and move them around or replace them easily rather than recording responses directly on the LCBM “placemats.”

Resources for student research:

1. Watch/Read <https://www.cbs17.com/news/nc-state-alumni-researchers-partner-to-create-protein-packed-fruit-gummies/>
2. Read: <https://cals.ncsu.edu/news/coming-up-healthier-foods-with-less-food-loss/>
3. Read: <https://www.confectionerynews.com/Article/2019/11/21/Upcycled-high-protein-gummies-emerge-from-North-Carolina-produce-and-food-science>

While students work and discuss, circulate the room answering questions, challenging misunderstandings, and probing students to think more deeply. Identify an exemplar and to use later when debriefing.

When most of the groups have finished, groups rotate 1-2 times to review other teams and critique by writing comments/feedback/questions and leaving behind for the team to read and reflect. Lastly, use the exemplar you identified while monitoring group work and either use it to debrief or ask the students to present it to the class.

Inform students that they will be developing their own LCBM for a food product they create- they should be thinking about food products that could solve a problem in the marketplace. Advise them to talk with their parents/guardians about their ideas.

- [APPENDIX D](#) – Lean Canvas Business Model Printed to use as placemats

- sticky notes

<p>Activity 5: Lab Planning 30 Minutes</p>	<p>Ask students, “Did you know that fruit gummies are made of polymers?” They’re made with gelatin which consists of nature’s most common polymer, protein. Explain that a polymer is a compound formed of many molecules strung into long chains - hold up a model of a chain (i.e.- metal chain, paper chains, necklaces, etc.). Explain that each individual piece is a monomer and when they are strung together into a chain they become a polymer. Polymers have different physical characteristics depending on the molecules they are made of and how they link together (i.e.- gummy, stretchy, hard, clear, cloudy, etc.). Milk jugs, plastic bags, car bumpers, are all plastics made of polymers. Polymers are critical to the human body and the world around us.</p> <p>In lab groups, provide each group with a Lab Plan sheet and half the groups with the Fresh Fruit Gummies formula and the other half with the Juicy Fruit Gummies. Instruct students complete a detailed lab plan Explain that there should be fair division of tasks and students will be graded on the lab evaluation rubric for safety, sanitation, teamwork, proper use of equipment, techniques and methods, final product, and timeliness. By the end of class, have students return their lab planning sheet and formulas to you for grading.</p>	<ul style="list-style-type: none"> • Chain model • APPENDIX E - Lab Planning Sheet • APPENDIX F - Fresh Fruit Gummies Formula • APPENDIX G - Juicy Fruit Gummies Formula <ul style="list-style-type: none"> • sheet protectors • file folder
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Day 3

Activity 6: Gummy Lab 60 minutes

Remind students of the polymer discussion from the previous class. Explain that students will be using gelatin in the lab. Gelatin's proteins form a triple helix (or spiral) polymer chain which allows the food to gel once the molecules in the juice intersperse within the gelatin's helix. Imagine a slinky being stuffed with tennis balls getting bigger and stiffer. The degree of gelling or expansion of the helix, as well as the physical characteristics of the gummies depends upon what the gelatin is mixed with.

Inform students they will get to the refrigeration phase and clean up. They will taste the gummies tomorrow.

As students prepare their formulas, monitor for and correct safety, sanitation, techniques, and procedures. Take notes on a clipboard to assist you when scoring the rubric after class. Consistently remind students of their time remaining.

- formula ingredients
- tools
- equipment
- completed lab plans
- formula directions

Activity 7: Problems in the Food Market Brainstorm 30 Minutes

Spend time at the end of class brainstorming problems in the food market. Imagine walking down a grocery aisle or someone trying to decide what to buy for food. Frame the brainstorm as a judgement-free, free-flowing exercise used to innovate new and creative ideas. Judgement and criticism interfere with creativity and innovation. The crazier the list the better. Explain that these problems can provide a springboard for the product innovation activity they will do tomorrow. You may need to provide a few examples to get the ball rolling.

Their homework is to think about either one of the problems shared in class or another one not shared, that strikes a cord with them and come up with one or two ideas for a product/service that they will use in class to develop their own Lean Canvas Business Model.

Day 4

Activity 8: Fruit Gummy Lab Tasting and Debrief 20 minutes

Redistribute their lab plan sheets and formulas. Instruct the groups to unmold their gummies and swap some of their gummies with groups who had the different version of the recipe. As a group they should answer the lab debrief/reflection question on the Lab Plan handout.

Debrief with students going over each reflection question as a class.

Activity 9: Food Scientist Career Spotlight 20 Minutes

Use the popcorn group reading strategy to read the [Career Spotlight of Trisha Bhatia](#), a Food Scientist with Ripe Revival. Debrief with students using the following key points:

- Why is she working to produce a consistent quality? What is the benefit of consistency in a food product? What could happen if food products are inconsistent?
- Review the FDA's Good Manufacturing Processes (GMPs) and how they play a role in food safety during production. Why does the federal government have an interest in food safety?
- Review phytochemicals and why having a plateful of colors is nutritionally beneficial as Trisha's mother said. What health benefits do phytochemicals provide?

Continue the popcorn group reading strategy by reading the article on microwave processing linked in the Trisha's interview and debriefing with these points:

- What is [Microwave assisted extraction \(MAE\)](#)? What other methods exist for food preservation? What are the benefits of MAE over other forms of food preservation? [consider con
- What are the benefits of science, technology, research, and development on food production? Highlight a few benefits from the article on the impact of this technology on society.

<p>Activity 10: Food Product Innovation Using the LCBM 40 Minutes</p>	<p>Provide students with the laminated Lean Canvas Business Model and sticky notes. Instruct students to complete their own LCBM based on a problem they found important to them and a product or service they thought of. Remind students this is not a thorough, detailed business plan. It is a framework intended to help think through the business model and communicate the idea. The sticky notes help them to easily refine the sections or move things around if needed- just like any innovation it will take several attempts and drafts. Remind students that all innovation, including food innovation, requires determination, resiliency, and grit.</p> <p>Students will time and may need help to complete and think through the different sections. To help students who may get stuck provide them with An Introduction to Lean Canvas as a reference guide. Circulate the room and help students work through the process. Some students may need help getting out of the weeds because they are too caught in the details. It is also likely some students will need you to ask some guiding questions to formulate a particular section.</p> <p>Have students take pictures of their LCBM once they get it to a complete place. They should send their picture to you and you can compile all the LCBMs into one Slideshow to project. You may have some student volunteers or if time permits have all students present their idea for a new food product.</p>	<ul style="list-style-type: none">• APPENDIX D – Lean Canvas Business Model• sticky notes
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Summary
10 Minutes

As you summarize this unit, remind students how they have learned about food innovation and product development by digging into the case study of Ripe Revivals. A company that developed relationships with food scientists and technologists to apply new processes to a local agricultural commodity- SweetPotatoes- and used it to address a problem- food loss and food insecurity- in a way that provides the market with a product that consumers not only want to buy because it tastes good, but also because of the story. These stories behind food products will become more and more important as consumers increasingly want to support products and businesses that promote ideals of ethics, environmental sustainability, nutrition and health, racial/ethnic equality, economic mobility, and other societal concerns.

The Lean Canvas Business Model is used to capture those stories and provide a working, evolving document that grows and shifts with the business. It gives entrepreneurs a tool to communicate their business to potential partners- like customers, vendors, and investors.

They learned how protein provides a polymer chain to give structure to gummies, just like DNA in our bodies. How microwave preservation is applied to SweetPotatoes and other foods to make purees for a number of byproducts, increasing efficiency in the food system and limiting waste.

On an exit ticket or scratch piece of paper have students respond to one or more of the following reflection prompts:

In this unit on product development:

- I was surprised to learn...
- I now know the following terms...
- I did not like...
- I want to research more about...
- I wish we could have...

Sources

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