Science of Food Educator Event

June 12, 2024

Everyone - Please sign in via the link in the chat

Illinois Educators - must sign in and sign out at additional link to receive ISBE credit

While we're waiting to begin, **introduce yourself in the chat**!

- **Your name**
- **State of residence**
- **Grade/Subject taught**
- **Share an unusual food pairing that you love**

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Welcome and Agenda

Agenda Item	Time Estimates
Welcome, Sign In, Introductions and Industry Overview (Christina & Katie)	15 minutes (9:00-9:15)
Session 1: Intro to Food Science (Tamieka)	40 minutes (9:15-9:55)
Break – gather ingredients	5 minutes (9:55-10:00)
Session 2: Food Science Experiments (Tamieka)	45 minutes (10:00-10:45)
Session 3: Careers in Food Science & Next Steps for your Students (Linda, Amy & Katie)	45 minutes (10:45-11:30)
Closing Reminders (Christina)	

Objectives and Goals

- **Increase awareness that food science is a part of everything we eat/drink.**
  - Develop an appreciation for using food science examples to help teach scientific concepts in your current curriculum.
- **Understand the pressures and demands on the food industry, to safely feed the billions of people on our planet.**
  - Experience the magnitude of the food industry and all the companies that support it.
- **Attract curious and innovative minds.**
  - Encourage students that are passionate about science & problem solving, to consider a **career** in the food industry. **YOU** are the biggest influence in getting students interested in food science.

Feeding the minds that feed the world

Envision what the very best minds involved in the science of food can achieve when they work together: providing each and every person on the planet with a safe, nutritious, and sustainable food supply.

We award. We educate. We research. We innovate. We share.

Feeding Tomorrow Fund aims to ensure the vital work of food scientists continues and carries over to the next generation.

Chicagoland Food Science Foundation

Develop, promote and support food/beverage industry professionals through awareness and scholarship programs.

Flavor Company

McCormick Flavor Solutions creates flavors for some of the worlds most beloved foods, snacks and beverages! Science & creativity are key to allowing us to please consumer palates across the world.

Pilot Light

Pilot Light is a teacher-centered Food Education nonprofit that develops programming and educator capacity for the food system leaders of the future through engaging and relevant classroom learning.

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through engaging and relevant classroom learning.

Your Team

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Today's Presenters

Tamieka Hardy

Linda Perucca

Eileen Torpy

Katie Sudler

Amy Wang

What is the food industry?

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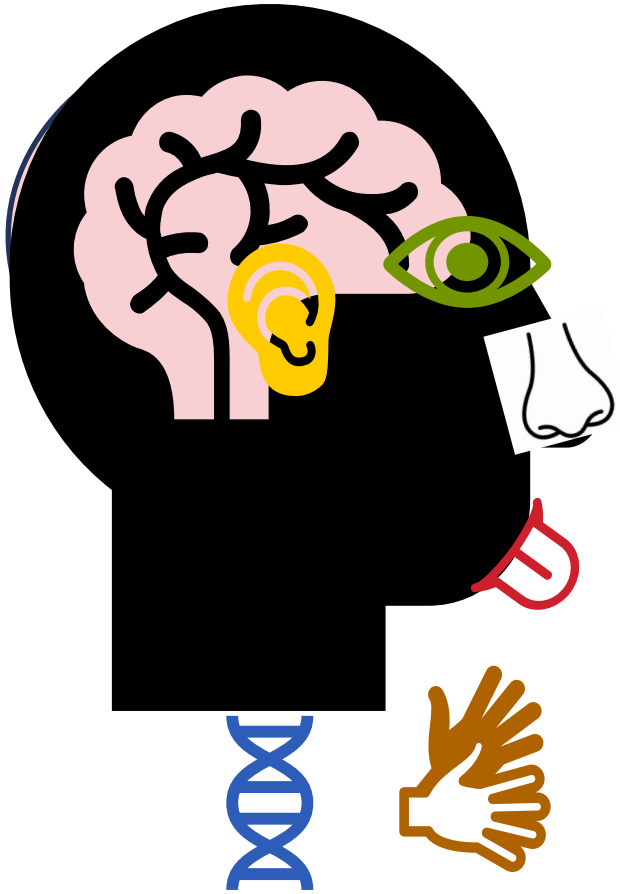
Katie Sudler – Food Ingredients (Flavors)

- 23+ years in the Flavor Industry, supporting Food& Beverage Companies
- **Current Role:** McCormick & Company, Flavor Division - Responsible for partnerships in the communities we manufacture and in food/beverage industry, to build good name and reputation in both.
- **Past Roles:** Food Regulations and Marketing
- **Brands:** Have worked with 100's of companies to ideate and create products across Beverage, Alcohol, Confection, Dairy and Bakery segments.
- **Education:**
  - B.S. in Dietetics - Purdue University
  - Business classes - Northern Illinois University
  - M.S. in Child, Youth & Family Studies – University of Nebraska-Lincoln
  - IL Teaching Certificate - grades 6-12 to teach Health & Family and Consumer Sciences
- **Favorite Subject in High School:** Physics, Environmental Science, Trigonometry

Website: https://www.mccormickfona.com/learn/discover-fona-food-science-for-young-minds
Email: katie_sudler@mccormick.com
Email: https://www.linkedin.com/in/katiesudler/

Meet the food we eat.

The eating & drinking experience.



Your genetic make-up
- Dictate preferences
- Dislikes
- May alter how you experience something (Cilantro)

Hearing:
- Crunch
- Carbonation
- Popping

Sight:
- Does your food look like it should?

Taste:
- Sweet
- Sour
- Salty
- Bitter
- Umami

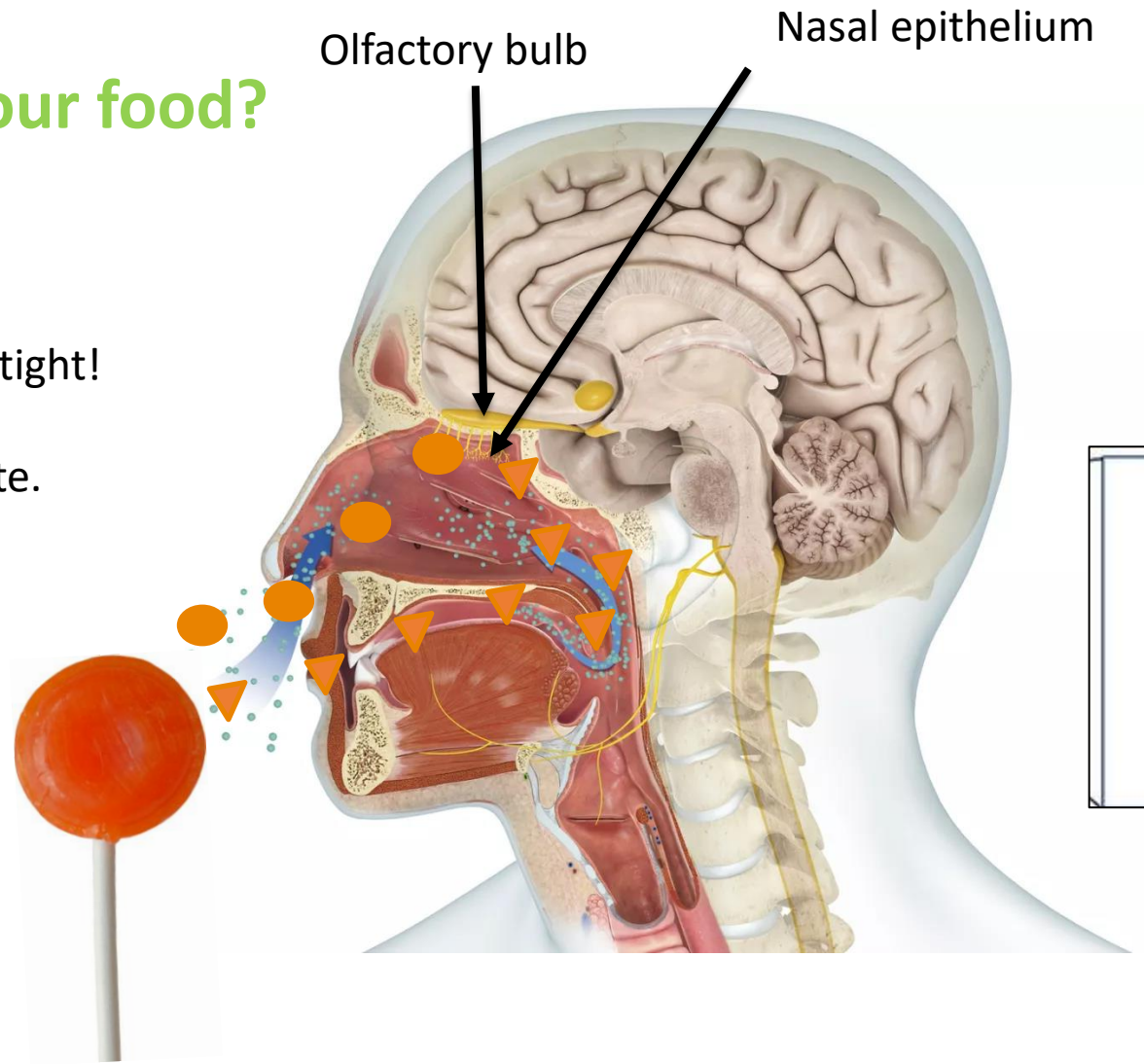
Touch:
- Temperature
- Texture
- Carbonation

Smell:
- Characterizes food/beverages

The science of taste & smell.

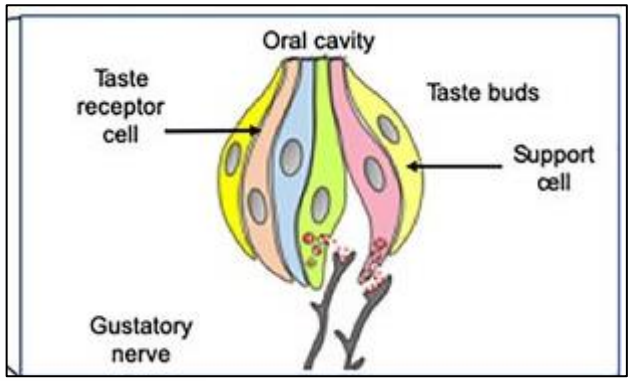
How do you 'taste' your food?

1. Grab a piece of candy.
2. Unwrap it.
3. Plug your nose.
4. Put candy in mouth. Plug it tight!
5. What do you taste?
6. Let's talk about how we taste.



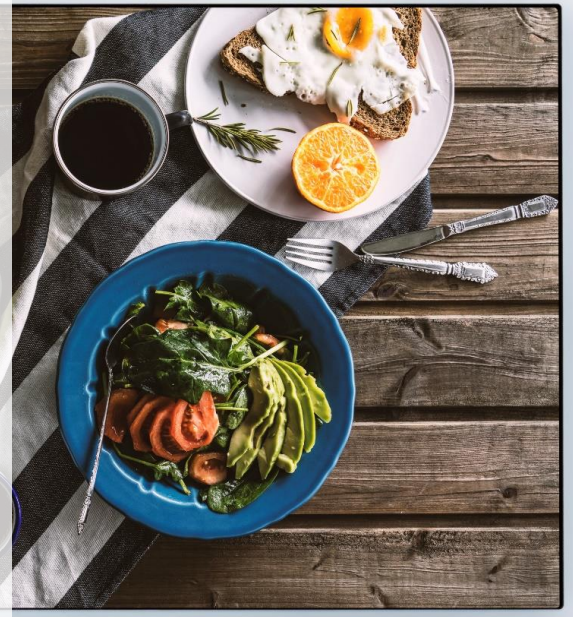
Index:
- Orthonasal
- Retronasal

Taste buds



Food Science & your students

- Your students need to understand how science, technology & society are interrelated.
- Challenge our students to build on what they already know– connecting what is learned in a science class & their lives in the world.
- Take the concerns, interests & experiences of students and connect them to the classroom, using scientific knowledge & critical thinking.



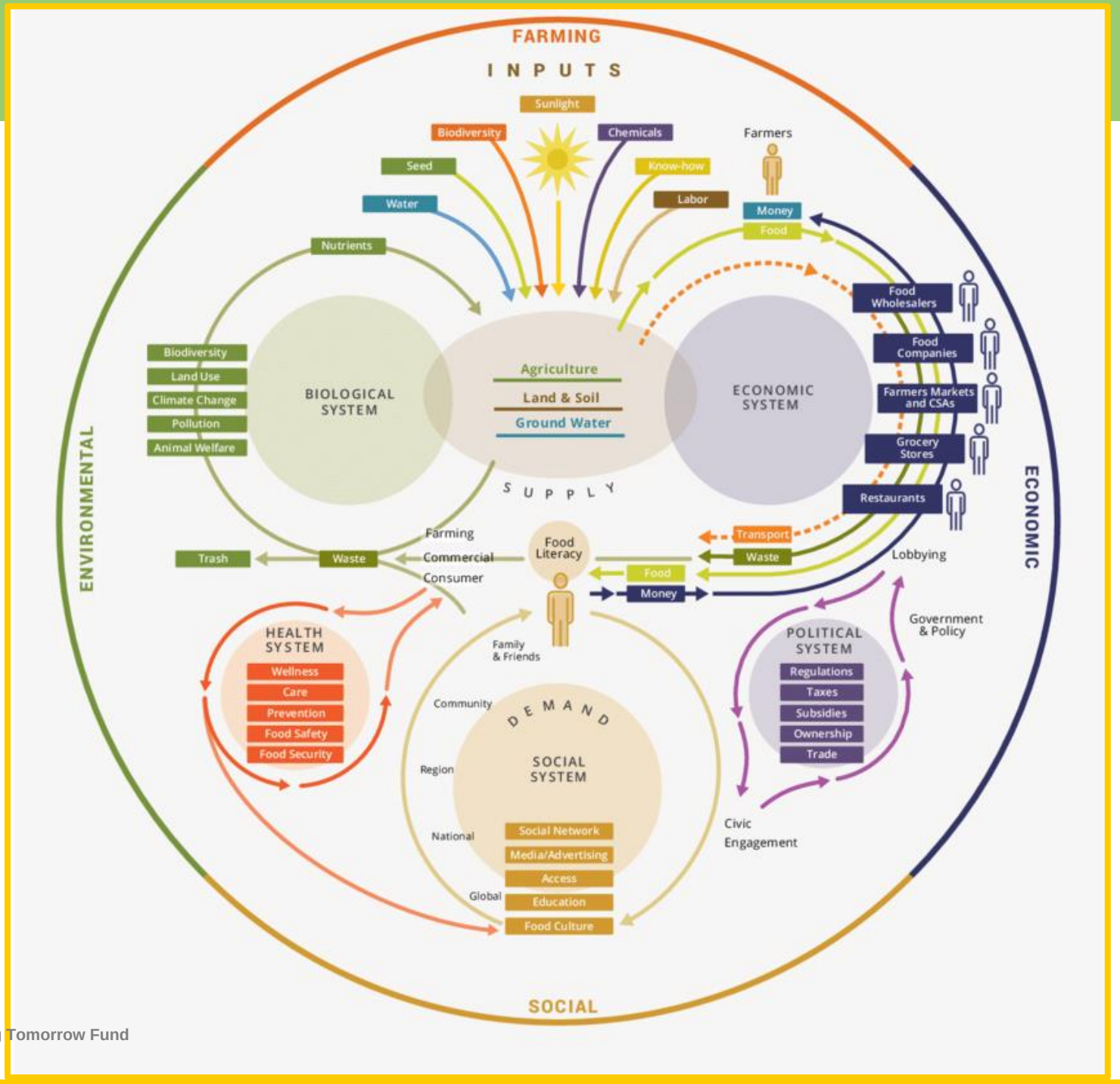
Food System


PRODUCTION
TRANSPORT
TRANSPORT
PROCESSING
TRANSPORT
TRANSPORT
RETAIL
CONSUMER
Our Food System
Deforestation
Employment
Renewable energy
Trade
Economic growth
Health & nutrition
Food security
Food culture
Animal welfare
Water pollution
GHG emissions
Waste

Food System

- “We live in a world where everything is connected. We can not longer think in terms of us and them when it comes to the consequences of the way we live. Today it's all about WE.”

- Gregg Bradden, Author, The Turning Point



Food Industry Facts

- Dollar Size of food and beverage industry is difficult to navigate.
- Global food industry experiences appx. 3% growth
- Major Metro Areas are strong in food manufacturing.
- Thousands of companies make up the industry, all various sizes.

Nation's capital of food & beverage industry is Chicagoland

- Approximately 4,500 firms make up the cluster
- 130,000 employees
- $32 billion in sales.

***Encompasses any consumable/ingestible product that is either produced or uses products from companies to manufactured finished, marketed and sellable product.*

Top Food/Beverage Companies - USA

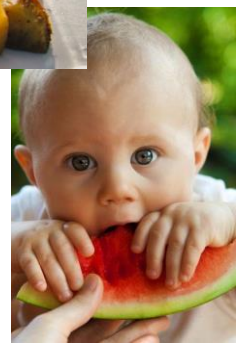
1. Nestle
2. PepsiCo, Inc
3. Anheuser – Busch InBev
4. JBS
5. Tyson Foods
6. Archer Daniels Midland Company (ADM)
7. Mars
8. Cargill
9. The Coca-Cola Company
10. Kraft Heinz Company

Brands you may not know they own:

1. Gerber, Purina Pet, Häagen-Dazs, Essentia Water, Vital Proteins
2. Quaker, Pepsi, Aquafina, Frito Lay, Doritos
3. Goose Island, Corona, Kona, Modelo, Stella
4. Largest animal protein processor in the world
5. Sara Lee, Bosco's, Jimmy Dean
6. Food ingredients (ancient grains, colors, flours, sweeteners, nuts, proteins, more)
7. Wrigley, Seeds of Change, Skittles, Kind, Banfield Pet, Royal Canin
8. Food ingredients (cocoa, oils, flour, hydrocolloids, starches, more)
9. Honest, Vitamin Water, Powerade, Topo Chico, Gold Peak tea, Aha
10. Oscar Meyer, Capri Sun, Philadelphia, Planters, Ore-Ida, Maxwell House

What is the food industry?

Food brings people together.
Food science brings the food system together.



Session 1: What is Food Science?

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Tamieka Hardy

Tamieka Hardy, MAS, PCQI, is the Fellowship Alumni Network (FAN) Manager at Pilot Light. She holds degrees in Culinary Arts, Culinology®, Food Science and Nutrition, and Food Safety and Technology.

With a background as a food scientist and research chef, Tamieka holds considerable expertise in food safety and technology. She is the CEO of Croissant Sol, LLC, a consultancy that offers product development services and food safety education.

Tamieka is also a food industry writer, with articles published in Prepared Foods Magazine and the Journal of Renal Nutrition. In her role at Pilot Light, she manages the Fellowship Alumni Network, supporting food educators and professionals.

Tamieka's diverse experience in culinary arts, food science, and safety enables her to contribute effectively to various initiatives, promoting better food education and industry practices. Her work continues to make a positive impact in the food industry ecosystem.

Introductions

Eileen Torpy

Eileen Torpy oversees Pilot Light's external partnerships related to teacher professional development including AgEd (Agriculture Education) & Advocacy, Classroom to Cafeteria, and SnackTime Explorers. She is passionate about supporting educators as they teach through food and expanding access to Food Education to more classrooms nationwide!

About Pilot Light

Pilot Light is a teacher-centered Food Education nonprofit that develops programming and educator capacity for the food system leaders of the future through engaging and relevant classroom learning.

Learn more and get involved at www.pilotlightchefs.org, and follow @pilotlightchefs on Instagram, Facebook, and LinkedIn.

Session 1

Food Education & Food Science 101

Objective

At the conclusion of this session, you will have a foundational understanding of :

- What food science is
- The different disciplines that make up the food science industry
- Pilot Light's Food Education Standards 1 - 3
- How food science impacts the principles of Food Education Standards 1 - 3

What is Food Science?

The Institute of Food Technologists defines food science as “The science of food encompasses food science, food technologies, and their applications across the food industry. Learn more about this exciting field and the positive impact in keeping our food safe, nutritious, delicious, and sustainable.”

What is Food Science? (cont'd)

Multidisciplinary industry

- Biology/Microbiology
- Chemistry
- Nutrition
- Physics
- Engineering
- Psychology

Applications of Food Science

Biology

Food preservation

Microbiology

Cheesemaking

Chemistry

Flavor & aroma creation

Nutrition

Development of nutraceutical foods

What are the Food Education Standards?

1. Food connects us to each other.
2. Foods have sources and origins.
3. Food and the environment are interconnected.
4. Food behaviors are influenced by external and internal factors.
5. Food impacts health.
6. We can make positive and informed food choices.
7. We can advocate for food choices and changes that impact ourselves, our communities, and our world.

Food Education Standards 1 - 3

1. Food connects us to each other.

2. Foods have sources and origins.

3. Food and the environment are interconnected.

Foods Connects us to Each other

By sharing food with others, we connect as humans and learn more about one another’s experiences and identities.

Foods Have Sources and Origins

By honoring and acknowledging the land and people who grow and cultivate food, we can better understand the context and stories of cultures and trace their movements over time.

Foods and the Environment are Interconnected

By recognizing food (in all its forms) as a part of an ecosystem, we can analyze the interdependence of all living organisms on one another for energy and better address the effects humans have on the environment.

The Intersection of Food Science and Food Education Standards in the Classroom

FES 1: Foods Connects us to Each Other

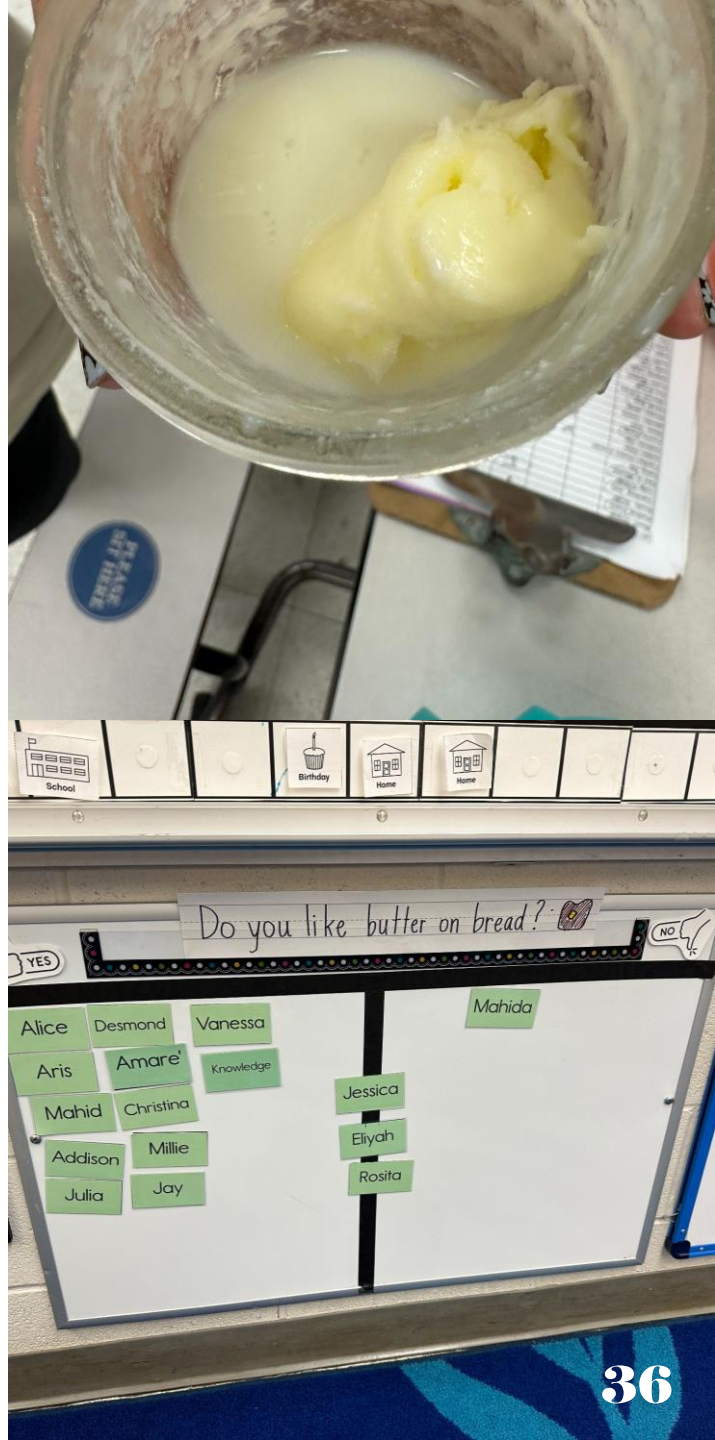
Community Outreach: Elementary School Students worked together to assemble 322 "just add water" meals for seniors

- Used left over food from a food donation event (food *waste reduction* and *sustainability*)
- Ingredients were freeze dried to preserve them and make them shelf stable (*food processing, food chemistry*, *food microbiology*)
- Ingredients were measured into individual packets so they were all the same (*quality assurance*), and attached to a recipe card (*formulation*)

FES 1: Foods Connects us to Each Other

Buddy classroom model: Pre-K and 7th grade classes paired together to make butter

- Develop community through mentorship
- Taught perseverance and patience
- 7th graders continued with a separate lesson learning about viscosity and textures of foods (*food physics* and *food chemistry*)
- Pre-K continued with separate lesson on food preferences (*sensory science* and understanding of texture and functions of foods)



FES 2: Foods Have Sources and Origins

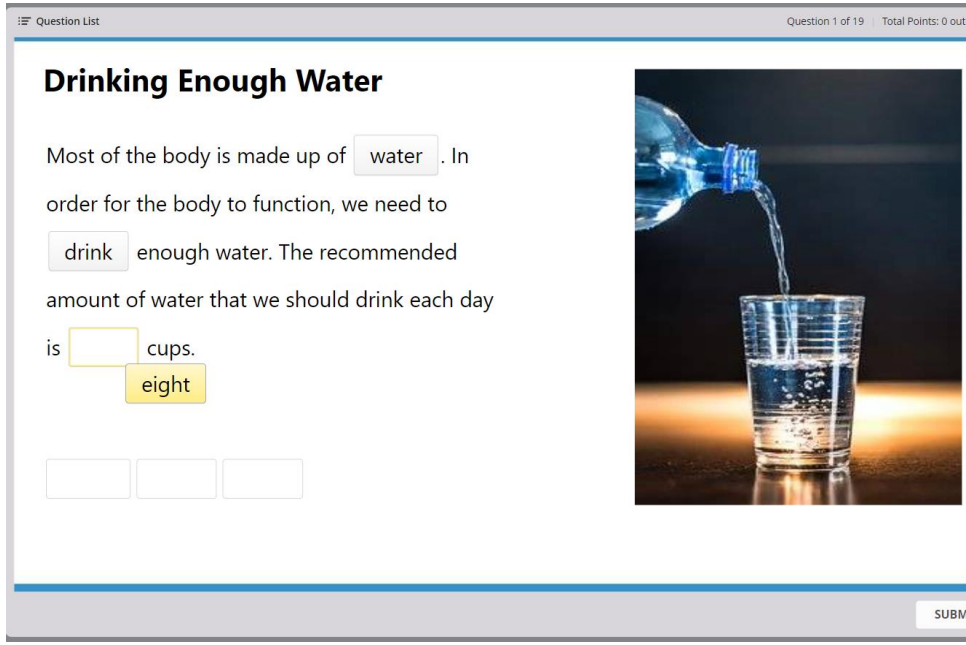
Subject Matter Expert/Professional Demonstrations

- Classroom visit by lavender farmer sharing about the uses of culinary lavender
- Students were allowed to experience the difference between culinary lavender and decorative lavender and discussed why they were similar and different *(aroma and flavor science*)
- Students tasted lavender in different applications: buttercream, t ea, lemonade
- The students developed and sampled a lavender lemonade recipe (*formulation*)

FES 3:
Foods and the Environment are Interconnected

Reflective exercises

- Discussed the idea of water being a limited resource,
- Reflected on trying not to be wasteful
- Brainstormed solution to be more conservative with water usage
- Students programmed an online software using logic codes and created quizzes about the importance of water in the diet and for the body as a whole (*nutrition, computer coding*)



In conclusion…

- The food science is a wide umbrella which is largely interdisciplinary and impacts the food system from its origins to its consumption.
- The Seven Food Education Standards (FES) look at the social and scientific factors of food, its accessibility, and its impacts on culture and wellbeing.
- Utilizing the FES to introduce concepts around food science is a synergistic approach to understanding the food ecosystem for learners

5-minute break – gather materials

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Reminder to Change to Speaker View

Change your view to “Speaker” in the top right-hand corner where it says “View”

Session 2: Food Science Experiments

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Session 2

Practical Application Lab
Astronomy: Out of this World Food

Curriculum Objectives

Students will better understand the many implications of meal planning in space by collaborating small groups to learn about the categories of food that can be consumed during space travel, by creating a meal plan for an astronaut, and by creating recipes of foods that can be eaten in space.

Astronomy: Out of This World Food

Lesson Topics

- Anatormy
- Dehydration
- Hydration
- Outer space
- Nutrition

Integrated Subject(s)

- Science
- Mathematics
- English language arts

Materials – Equipment for Station 1

- Sink
- Cutting board
- Knife
- Convection oven or dehydrator (this lesson could be adapted with more time in advance if using a dehydrator!)
- Containers to store kale (raw and cooked) and fruit (raw and cooked)
- Sheet pan and parchment paper or foil
- Tasting plates, portion cups, and spoons for sampling
- Napkins and paper towels

Materials – Equipment for Station 2

- Sink
- Mixing bowl, tongs, and scale
- Measuring cups and spoons - 2 sets
- Plastic bags with closure for each student
- Tasting plates, portion cups, and spoons for sampling
- Napkins and paper towels

Materials - Ingredients

Station 1

- 4c dried fruit
- 3c fresh fruit

Station 2

- 2-4 instant pudding boxes (4 servings/box)
- 3 c dried milk
- Water

Station 1 Activity: Dehydrating

@ Oven/Dehydrator- observe/discuss slow dehydration process & taste

1. Taste dried fruit (students will try and compare with raw and/or kale)
2. Purchase pre-dried bananas, strawberries, or pineapple (you choose!)
3. Heat oven at the lowest setting with a raw version of selected fruit (bananas, strawberries, or pineapple)

Note: This will take 60ish mins, so be sure to start this process beforehand, if using dehydrator start the day before.

Station 2 Activity: Rehydrating

@ Table station - make instant pudding in plastic bags

observe/discuss rehydration process & taste

- Follow directions listed in recipe* -- can have groups of students working in groups to weigh and read labels
- Taste dry powder mix (before adding liquid ingredients)
- Assemble instant puddings (each student can make their own mini portion, or you could work in groups -- whatever is easier)!
- Taste rehydrated pudding (after kneading)

Take Home Activity – DIY Trail Mix

Students will be given a selection of dried fruits made during the class activities.

Each student will mix fruits of their choice to make 1 cup of dried fruit trail mix.

Each student will create packaging for the individual trail mix.

Take home and share trail mix with family

Possible Cross Curricular Activities & Connections

Discussion and research: Why do we need to leave Earth?

Build background: What is the International Space Station?

Watch video clips: One Strange Rock, Episode “Escape”; WALL-E (bone loss, lack of exercise, food in liquid form)

Planning exercise: create a 5-day meal plan

Growing exercise: how lettuce grows in space

Culminating Activity: Astronaut Meal

Thank you!
Questions?

Tamieka Hardy

Tamieka@pilotlightchefs.org

www.pilotlightchefs.org

Session 3: Food Science Careers and Next Steps

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Linda Perucca

- 30+ years in the Food & Beverage Industry
- Director SciTech Patent Art; Mondelez, Kraft Foods, Schwan's, Board Member Chicagoland Food Science Foundation
- Global Intellectual Property Management, Product Development, Corporate Learning & Capability Development
- **Brands:** Kraft Mac and Cheese, Kraft Cheese, DiGiorno Pizza, Tombstone Pizza, Oscar Mayer Hot Dogs
- **Education:** B.S. Food Science Degree - Purdue University
- **Favorite Subject in High School:** Geometry and Science

Linda Perucca/ LinkedIn

Food Industry Careers

- The food industry is very diverse.
- Truly from Farm to Fork – many steps in between
- Employs from GED to PhD
- Link to Research from Purdue – to fill Ag related positions
  - Shortage of graduates to fill jobs

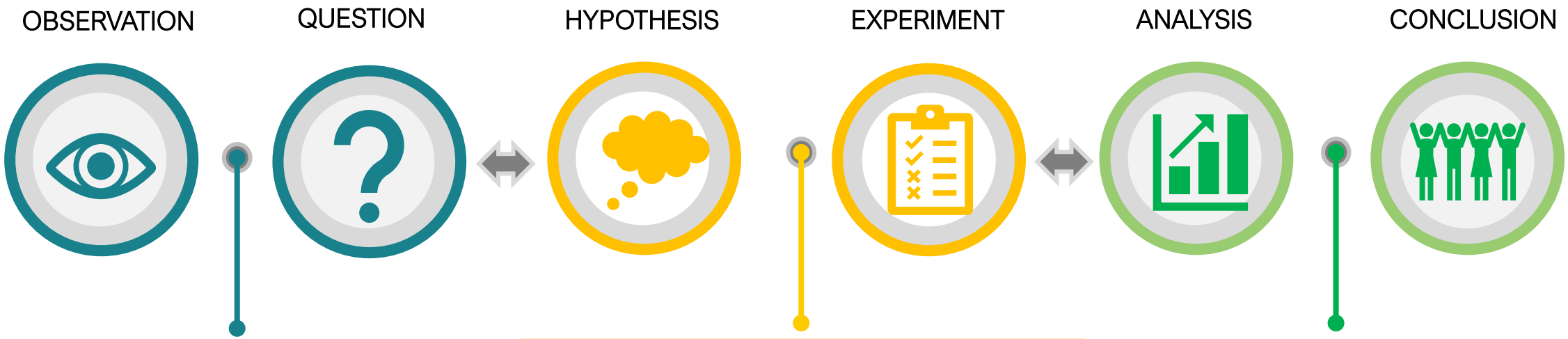
Food Technology is….

Food Technology is the ***application*** of food science principles and knowledge to the

- Selection
- Preservation
- Processing
- Packaging
- Distribution
- and Use of safe, nutritious & wholesome food.

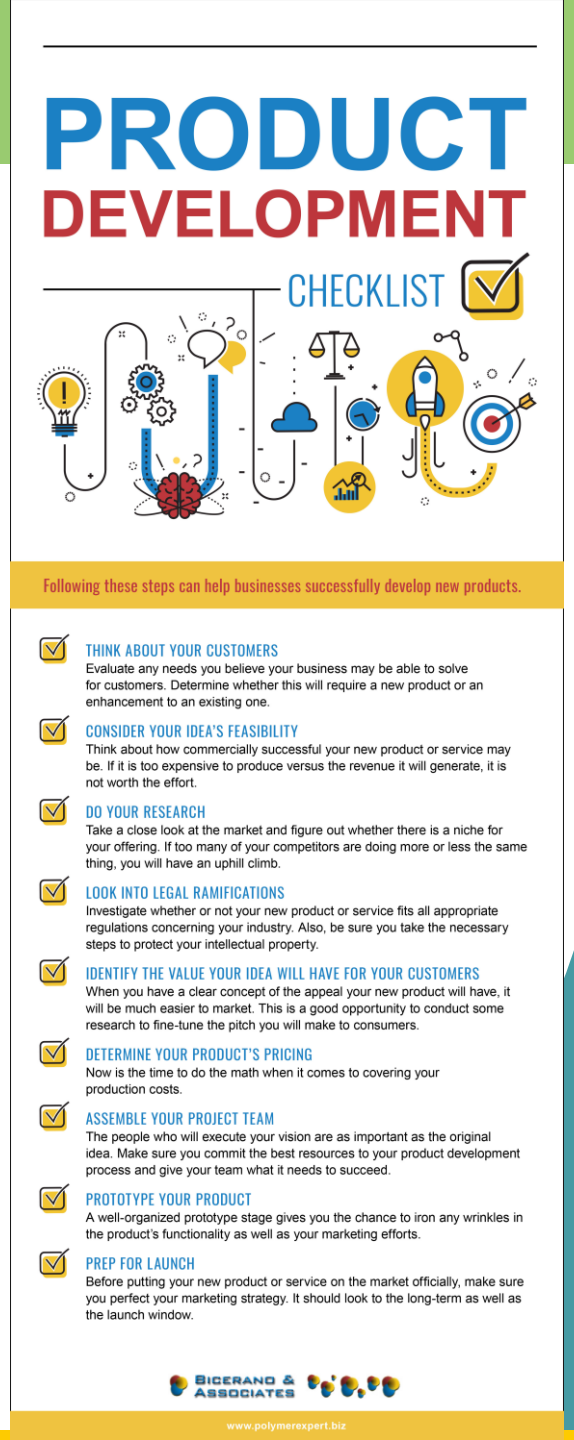
From Concept to the Consumer. How ideas come to life.

The food industry applies the scientific method to the "Idea to Shelf" Innovation Stages. Different careers within these stages bring new products to the market.



Idea to Product Development

- Creating **new** products for the grocery store shelves is one of the most exciting projects in the industry.
- New product development requires strong communication skills, team-work, and project management skills!
- Everyone at the company is involved:
  - from understanding consumers wants and likes
  - *to* creating to new concepts with marketing & legal
  - *to* developing and testing the concepts with product development and sensory scientists
  - *to* purchasing equipment, ingredients, packaging
  - *to* making the product with engineering, manufacturing



If you were creating a new chip, what would you create?

- What health or regulatory claims would you like to make?
  - Claims around salt, fat, protein, fiber, etc.
  - Claims including organic, ingredients, sourced from, and many more.
- What would the base of the chip be?
  - Corn, potato, vegetable powder, insects, get creative!
- Chip shape, packaging, colors, look and feel.
- Plain or with flavor varieties?

Key roles necessary for innovation and new product development

Consumer Insights (CI)

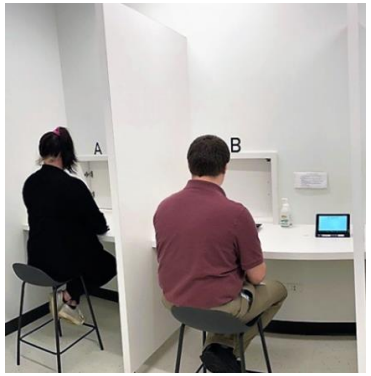
Understand the current market landscape, looking at data, trends, consumption info & consumer wishes. The goal is to help identify areas where a brand can play or improve current portfolio.

Marketing

Create new product concepts-with R&D *and* CI. Ideation, creation of new concepts, logos, brands to help drive new product development.

Research & Development (R&D)

Gold Standards development. Use scientific knowledge to help make a new product. R&D understands commercialization restraints, consumer data and marketing to make best product for company.



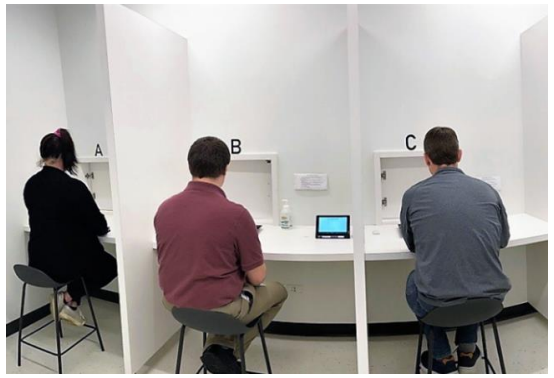
Sensory Scientists

Set up testing protocol and run test with consumers to determine if they will like the new food, buy it and prefer the new product about to be launched on the market.

Patent Attorney

Confirms the new idea does not infringe on another patent, brand or trademark. Reviews partnership opportunities, contracts & agreements.

Key roles ensure that quality products are available to the consumer



Reseach & Development (R&D)

Creates product that meets consumer needs. Tests variations of formulation that provide the best product. Packaging testing done to determine what materials protect the product.

Marketing

Establishes market/region product roll-out plan, portfolio cannibalization, sales projections, and advertisement/ communication strategy

Food Safety

Conducts storage testing in different environments followed by micro/food safety testing to ensure product will remain safe throughout distribution and consumer's pantry

Regulatory

Establishes the nutritional panel and ingredient statement along with confirming any claims on package meets county regulations

Consumer Testing

Confirms product meets the consumer expectations and they are likely to purchase the product.

Development to Commercialization

Research & Development (R&D)

- College – Food Science/Packaging
- Variable work schedule
- Indoor Office/Laboratory/Pilot Plant/ Plant Environment

Marketing

- College – Business/Marketing
- Variable work schedule
- Indoor Office

Food Safety

- College – Food Microbiology
- Variable work schedule
- Indoor Office/Plant Environment

Regulatory

- College - Food Science/Nutrition
- Variable work schedule
- Indoor Office

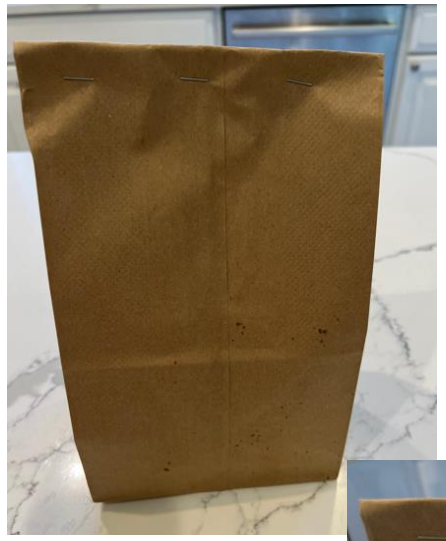
Sensory/Consumer Testing

- College – Sensory/Food Science
- Variable work schedule
- Indoor Office

Food Industry Careers – Packaging Development Hands on Experiment for Packaging Materials

Want crispy chips – packaging is key!

A typical potato chip bag is made of multiple layers of polymer materials. Polyethylene (PE) and Polypropylene (PP) films are two common plastic materials that are used. PE offering excellent moisture resistance that prevents the chips from becoming stale or soggy, and PP offering heat resistance.



Experiment:

Two bags of potato chips

1 paper bag

Stapler

1. Take a bag of potato chips and open it. Place the potato chips in a lunch size paper bag and staple it closed.
2. Allow the chips in the bag to sit in open room for minimum of 5 days.
3. After 5 days, open the paper bag along with the un-opened bag of potato chips and have each student taste both potato chips

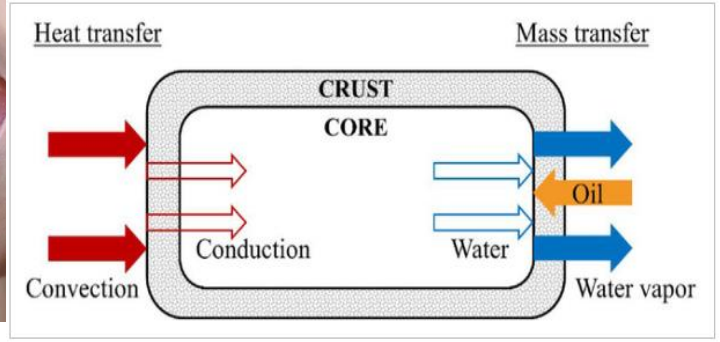
Food Industry Careers – Packaging Development Hands on Experiment for Packaging Materials

What is happening?

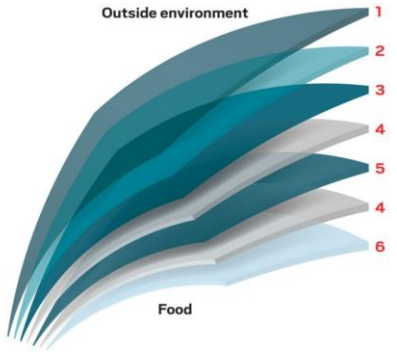
Potato chips go stale because they've gained too much moisture. That's because chips lose most of the moisture inside them during the frying process, creating a crunchy network of starch molecules.

- Potato chips have a moisture content of 1.5% - 3.5% while the typical home/school is around 40% - 50% humidity.
- Starch molecules are **hydrophilic**, meaning they attract water from the air around them. **Osmosis** refers to the movement of water molecules across a membrane trying to achieve equilibrium.
- The potato chips are gaining moisture in an attempt to reach equilibrium with the environment around them. The longer you leave them out the more moisture they will gain.

In order to keep potato chips fresh for as long as possible, manufactures fill the bags with nitrogen gas. The nitrogen gas acts as a barrier between the chips and the outside air, preventing oxygen from getting in and causing **oxidation** of the fat in the potato chip.



1. Coating to protect print
2. Outer Layer printing surface
3. Structural layer for shape and prevents tearing and puncturing
4. Tie binds layer 3 and 5 together
5. Barrier prevents oxygen/moisture from infiltrating package
6. Seal packaging



Food Industry Careers – Packaging Development Hands on Experiment for Distribution Testing

Why is my bag of chips half full?

You've probably noticed that potato chip bags seem ½ full when you open them. But why? Nitrogen in your potato chip bag protects the potato chips by keeping the bag inflated around them making a cushion that prevents them from becoming crushed during distribution.

Experiment:

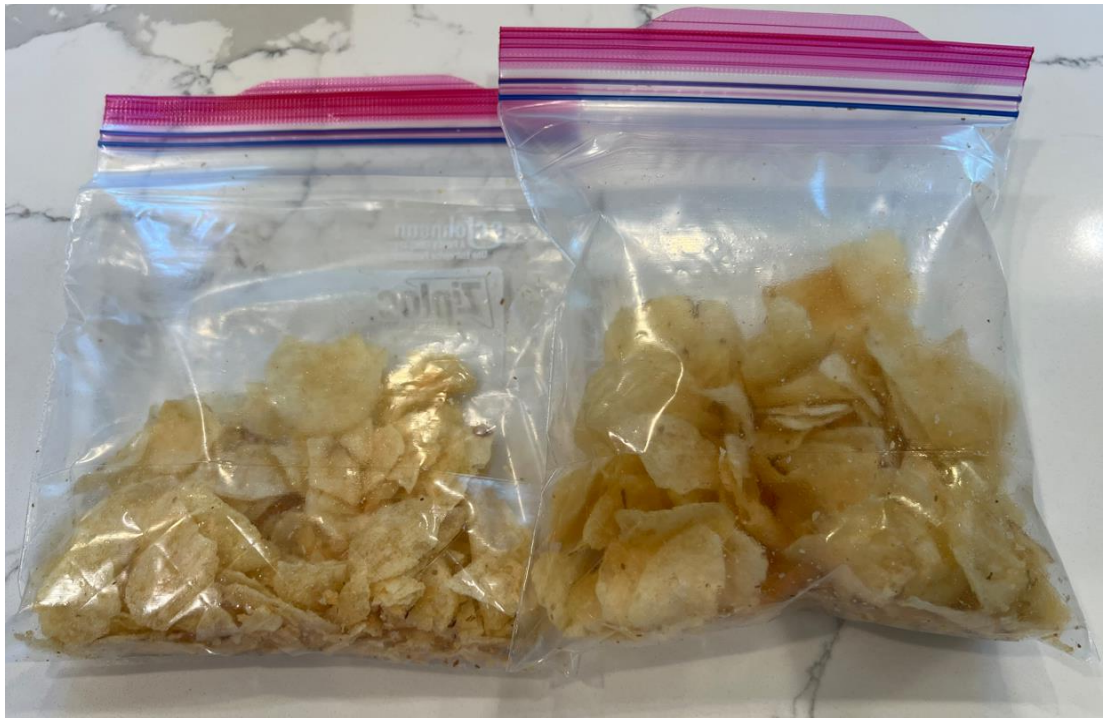
1. Take quart size bags and fill ½ way with potato chips.
2. Take a straw and insert into bag. As you blow into the bag, seal quickly so that the bag is full of air. (SEE PHOTO A)
3. Place in your "case" (you can use a small shipping box) and seal with tape. (SEE PHOTO B)
4. Drop the case from waist high 10 times.
5. Fill more quart zip lock bags ½ full with potato chips but remove as much air as possible. More bags will fit into your "case." (PHOTO C)
6. Drop this variable 10 times as well.
7. Open the cases up and ***observe*** the differences.

Food Industry Careers – Packaging Development Hands on Experiment for Distribution Testing

What happened:

Potato chip bags are usually only half full because they contain nitrogen to protect the chips from damage during handling, transportation, and storage. Nitrogen is an **inert gas** that will not expand or contract, unlike oxygen. This prevents the potato chips bags from popping when exposed to different elevations and temperatures.

The nitrogen gas will also help keep potato chips fresh. This is because it acts as a barrier between the chips and oxygen. **Oil oxidation** is an undesirable series of chemical reactions involving oxygen that degrades the quality of an oil giving a rancid flavor.



No air Full bag of air

Amy Wang

- 30+ years in the Food & Beverage Industry
- Sr. Director (Retired) The Coca-Cola Company; PepsiCo, Golden State Foods/ McDonald's
- Global Product Development, Sensory Science, Program & Change Management, Corporate Learning & Development/ Capabilities
- **Brands:** 7-Up, Baked Lays, Fanta, Dasani, PowerAde, Vitamin Water, Freestyle Beverage System, McDonald's

Amy Wei-Mei Chen Wang | LinkedIn

- **Education:** B.S. Food Science – Cornell University; M.S. Food Science – University of Georgia
- **Favorite Subject in High School:** Science - Chemistry

Commercialization to Shelf – General Process Steps

Production → Distribution → Shelf Placement → Consumer enjoyment

- **Commercialization to Shelf** is likely the most critical step in any business process.
- A misstep in this part of the process reduces the sales and profit for any business, can negatively impact brand image and reduce customer and consumer confidence in any future endeavor.

Key roles ensure that quality products are available to the consumer

Quality Control

Validates
product specifications are met for food safety, taste, appearance and aroma (sensory) and regulatory compliance before release for sale.

Warehouse

Provides proper storage, handling and inventory management of finished products for best shelf life and adherence to customer requirements.

Distribution

Enables product
arrives at customer location, customer distribution or central distribution as needed, preserving product quality and shelf life.

Sales and Marketing

Confirms store execution and product placement. Monitors product sales and feedback from the customer/consumer.

Commercialization to Shelf - (Typical) Role qualification and descriptions

Quality Control

- College
- Shift work schedule
- Indoor Manufacturing environment

Warehouse

- High School
- Shift work schedule
- Indoor Manufacturing environment

Distribution

- High School
- Shift work schedule
- Outdoor environment

Sales and Marketing

- College
- Variable work schedule
- Indoor/ Outdoor Office/Store environment

Sensory Evaluation is one scientific method to determine if product quality meets standards.

HANDS ON EXPERIMENT –
QUALITY CONTROL OF CHIPS

What you will demonstrate:

- How to use your senses to evaluate quality
- Identify sources of quality issues

SUPPLIES (FOR ONE SET)

- Sensory Evaluation Worksheet
- Lunch –size Paper Bags
- Pen or marker without odor
- 4 pieces of white paper
- 1 bag Baked Lays Salted Potato Chips
- Black Pepper or BBQ Seasoning
- Toaster Oven

Sample Prep For Sensory Evaluation Experiment

INSTRUCTIONS:

1). Divide contents of one bag of Baked Lays potato chips into 4 equal parts.
2). On separate paper bags, write on the outside "Control', "Sample 171", "Sample 245", "Sample 309"
3). Place equal parts of Baked Lays potato chips into each bag
4). Follow the instructions in the table below on how to treat the chips in each bag. Once treated, chips should be placed back into original bags. Store samples in a cool dry place for no more than 48 hours before evaluation.
5). Fold over the top of the bags until evaluation time, using the sensory worksheet for evaluation

CONTROL	Sample 171	Sample 245	Sample 309
Place chips from commercial bag directly into labeled paper bag.	1. Preheat oven to 350°F	1. Measure ½-1 teaspoon of black pepper (or BBQ seasoning)	Place chips from commercial bag directly into labeled paper bag.
	2. Place chips onto baking sheet	2. Place seasoning into sample bag containing chips	
	3. Heat for 3-5 minutes	3. Toss chips around lightly for seasoning to coat chips	

How to evaluate samples using your senses

INSTRUCTIONS: Each sample in the paper bag should be evaluated against samples in the bag labeled 'CONTROL". Each evaluator can pour out half of the chips onto white pieces of paper identified with the sample code. Keep some of the chips inside the paper bag to evaluate for flavor. Use your 5 senses (sight, smell, taste, hearing, touch) to evaluate samples. Indicate the level of difference (0-3) for each sample compared to the Control

APPEARANCE: Appearance is typically the first sensory attribute evaluated. You use your sense of sight to evaluate the samples. Compare samples to the Control for differences in color, size (whole vs broken pieces), chip surface appearance.

FLAVOR: Flavor can be evaluated in two ways, both through the sense of smell through your nose or taste in the mouth. Open the paper bag with 'Control' on it, take a deep sniff and note the aroma. Take the Sample bag and repeat, noting any difference from the Control. Reset your sense of smell by smelling the inside of your elbow between the Control and Sample bags.

TEXTURE: Texture can be evaluated through the sense of taste or sound + touch. Take the control sample chip and break in half, listen to any sounds as the chip breaks. Touch the surface of the chip to notice any residue on the chip. Do the same with the sample chip and note any differences.

SENSORY EVALUATION Worksheet

Evaluator Name: _____

Instructions: Using the 4-point scale below, evaluate the **level of difference the sample is from the control**

RATING SCALE	0	1	2	3
	Same	Slightly Different	Moderately Different	Extremely Different

Score appearance, flavor and texture using the rating scale (0-3) above compared to a CONTROL Sample				
	Sample # 171	Sample # 245	Sample # 309	Notes
APPEARANCE				
FLAVOR				
TEXTURE				

SENSORY EVALUATION Summary

INSTRUCTIONS: 1. Collect worksheet scores. 2. Calculate the average score for **each sample** (sum divided by #evaluators or worksheets). 3. Discuss differences and cause for the differences as a group.

Evaluator Name	Sample #	Appearance	Flavor	Texture
	171			
AVE				

Evaluator Name	Sample #	Appearance	Flavor	Texture
	245			
AVE				

Evaluator Name	Sample #	Appearance	Flavor	Texture
	309			
AVE				

Sensory Evaluation Discussion Guide

1. Share the average score of each sample for appearance, flavor and texture see answer table below)

Score appearance, flavor and texture using the rating scale (0-3) above compared to a CONTROL Sample			
	Sample #171	Sample #245	Sample #309
APPEARANCE	2 - 3	3	0
FLAVOR	2 - 3	3	0
TEXTURE	1 - 2	1 - 2	0

2. Discuss what issues in production could have caused the differences in the samples.

- **Sample #171:** Oven temperature too high in baking process and/or Time in Oven too long.
- **Sample #245:** Contamination with another seasoned product during production. Contamination could result if a). Filling line was not cleaned properly between production batches, b). Seasoning accidently added to the batch during production.
- **Sample #309:** Control sample. No issues. *In every evaluation, there is typically a 'blind' control (sample added to calibrate evaluators, not known to evaluators).

ACTIONS taken after evaluation: Samples #171 and #245 would not pass Quality Control evaluation and would be held from shipping to customers. The Production team would determine preventive action to ensure these issues would not happen again.

Sensory Evaluation Q & A (additional questions used for discussion)

Q: Why is sensory evaluation used in the quality control process?

A: Typically, sensory evaluation is the final check before a product is released for distribution and sale. Sensory evaluation will follow other chemical and microbiological analysis to assess if product standards have been met through the entire production process. For food production, sensory evaluation is critical as products are sold for consumption. The sample may pass other prior analysis but may not pass sensory analysis.
For example, sample #1 may be in the acceptable range for chemical tests such as moisture content or salt content but would clearly not be an acceptable sample based on other sensory parameters.

Q: Why are samples given codes (ie #171, #245, #309)?

A: Samples are given random 3-digit numerical codes to help eliminate bias in the evaluation process. Bias in the evaluation process may produce false positives or false negatives if the code is perceived as 'hints' for the samples. Best practice dictates that 3-digit codes such as '911', '411', area codes are not used because there is meaning attached to these numbers and could cause bias.

Q: Why are we using a 4-point scale?

A: There are many types of scales used in sensory evaluation depending on the objective of the experiment. In this case, we are using a typical degree of DIFFERENCE scale that is used to determine quality. The number of points on a scale help to differentiate between samples while making it relatively simple for everyone to use. You could have more points to differentiate but you should balance the simplicity and differentiation for the user.

Q: Why do we use average scores vs single evaluator scores to determine if the product passes quality assessment?

A: Average scores help to minimize any unintended differences NOT due to the chips themselves. This is often called 'noise'. Sources of noise include: physiological sensitivity differences between evaluators, carry-over effects from one sample to another, other bias uncontrolled by the experiment.

Q: What are some things that could happen if these chips that did not meet quality standards were sold?

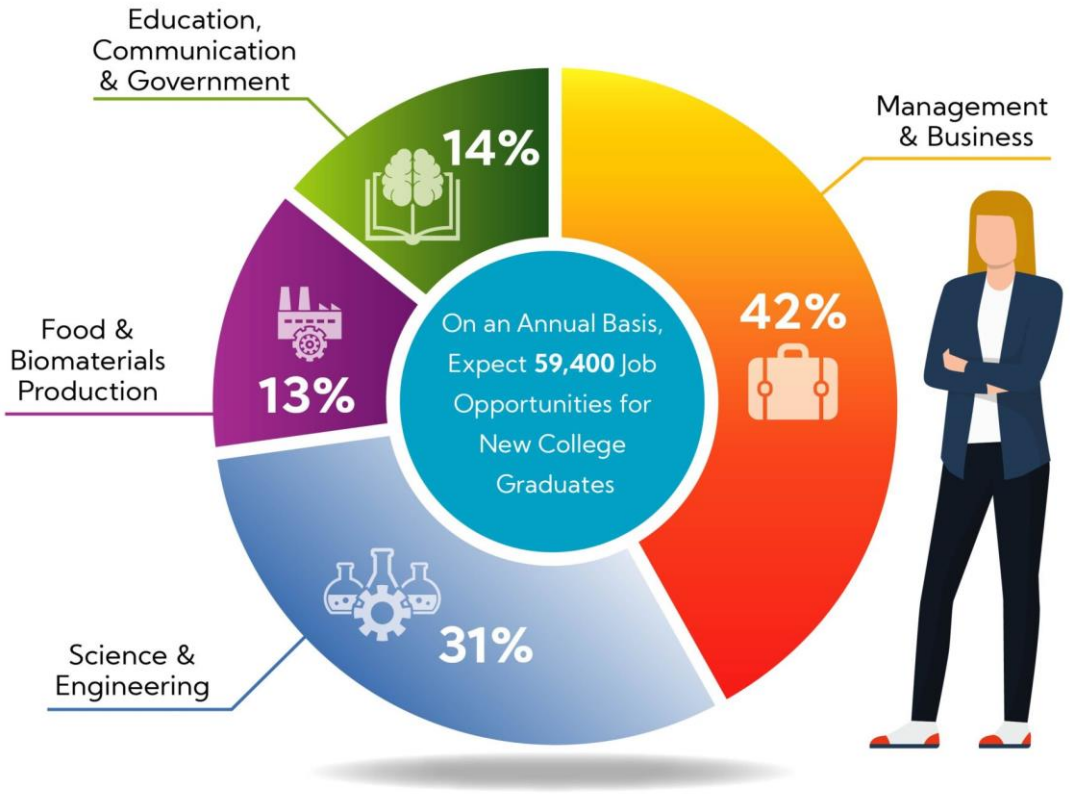
A: If samples were shipped to customers, repercussions include: 1). Damage to trademark/brand, 2). Food safety issue (if someone was allergic to undeclared BBQ seasoning ingredients), 3). Recall due to undeclared ingredient in BBQ seasoning (food regulations/labeling).

Job Outlook (2020-2025)

With a **2.6% annual growth rate**, a research study out of Purdue University looked at job opportunities in Food, Agriculture, Renewable Natural Resources and the Environment (FARNRE).

59,400 jobs available annually in food.

Food industry employs about 10% of adults in US, 14.5 million people.



43 IFT Higher Education Review Board Food Science Approved Undergraduate Programs (US)

- Alabama A & M University
- Brigham Young University
- California Polytechnic State University
- California Polytechnic State University - Pomona
- California State University, Fresno
- Clemson University
- Colorado State University
- Cornell University
- Iowa State University
- Kansas State University
- Louisiana State University
- Michigan State University
- Mississippi State University
- North Carolina A & T University
- North Carolina State University
- North Dakota State University
- Oregon State University
- Pennsylvania State University
- Purdue University
- Rutgers
- South Dakota State University
- Texas A & M University
- The Ohio State University
- Tuskegee University
- University of Arkansas
- University of California - Davis
- University of Delaware
- University of Florida
- University of Georgia
- University of Idaho/Washington State University
- University of Illinois
- University of Kentucky
- University of Maine
- University of Maryland
- University of Massachusetts
- University of Minnesota
- University of Missouri
- University of Nebraska-Lincoln
- University of Tennessee
- University of Wisconsin-Stout
- University of Wisconsin-Madison
- Utah State University
- Virginia Tech

Everyday Skills to bring into the Workplace

- Adaptability
- Collaboration
- Communication
- Conflict Resolution
- Creativity
- Critical Thinking
- Leadership
- Flexibility
- Growth Mindset
- Problem Solving
- Project Management
- Teamwork

Food Science Resources

Resources:
McCormick FONA

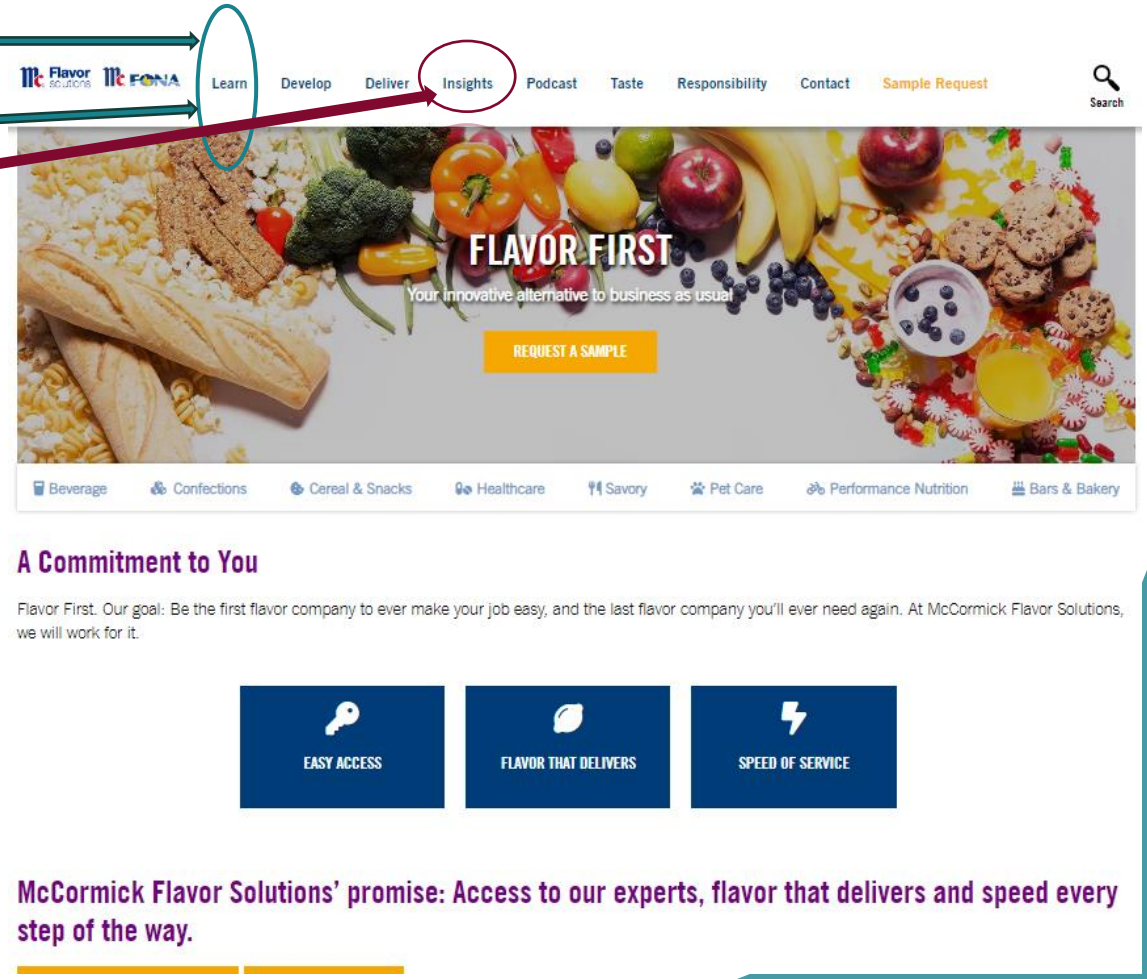
https://www.mccormickfona.com/

- Teach & Taste
  - Lesson Plans & Demonstrations
- Career Exploration
  - FONA Employee short career videos
- Trend & White Papers

https://www.mccormickscienceinstitute.com/
Together with research institutions study & communicate the health benefits of culinary herbs and spices.

https://www.mccormickforchefs.com/en-us/our-difference/spice-stories
Feeling spicy? Get to know some of our spices!

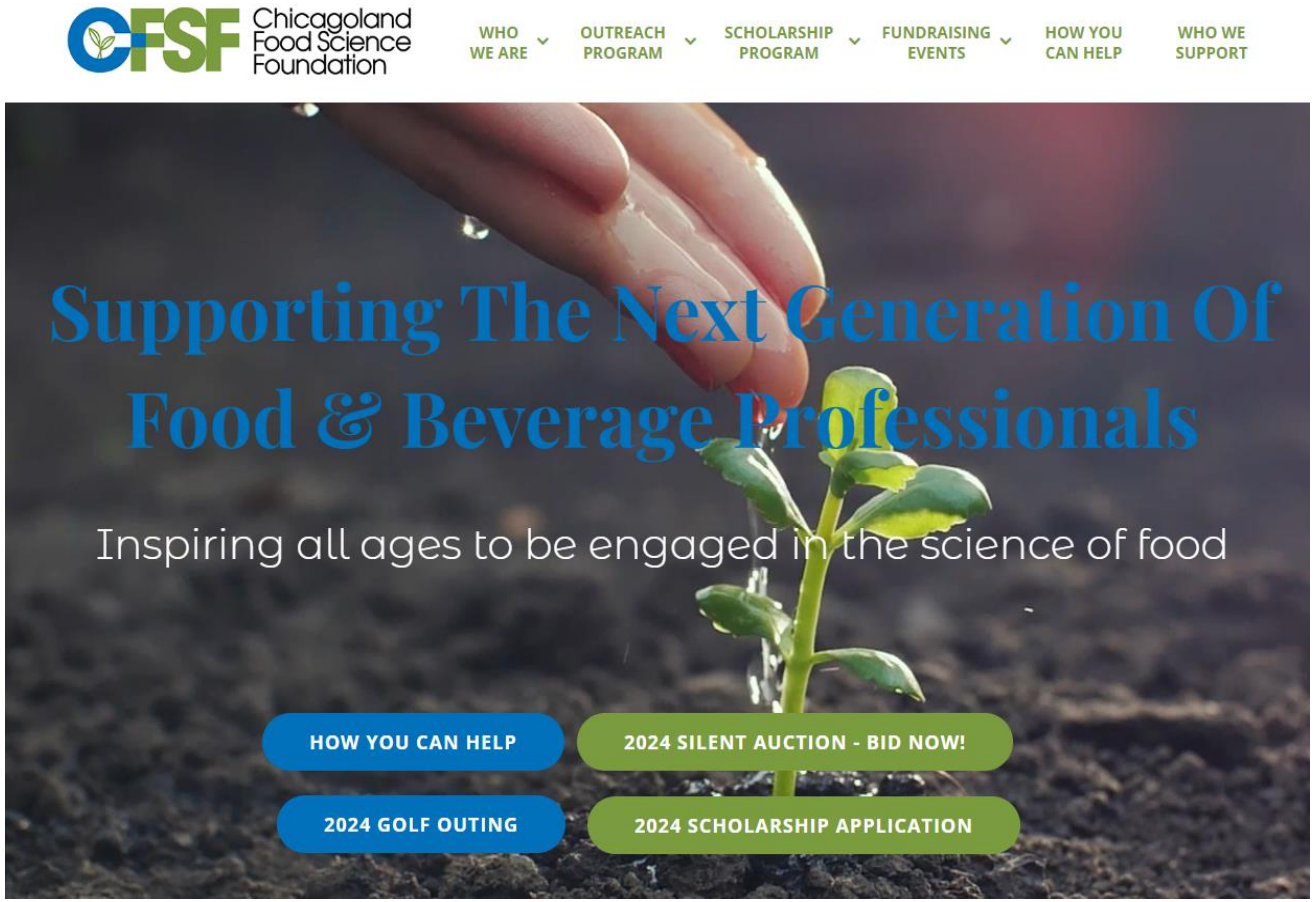
https://www.mccormickforchefs.com/en-us
Collection of trends, 2024 Flavor Forecast, recipes, inspiration, and other resources.



Resource:
Chicagoland Food Science Foundation

https://chicagofoodscience.org/

- CFSF supports the next generation of Food & Beverage Professionals
  - College scholarships for your students (including graduating Seniors from HS).
  - Works with your school to customize events about Food Industry.

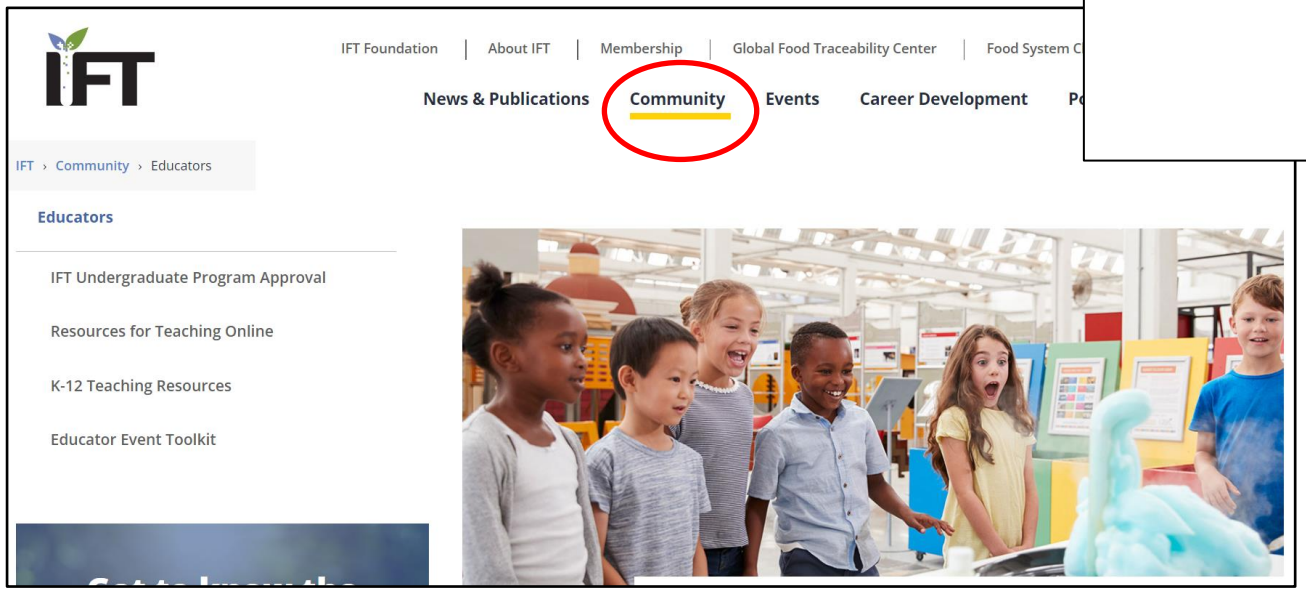


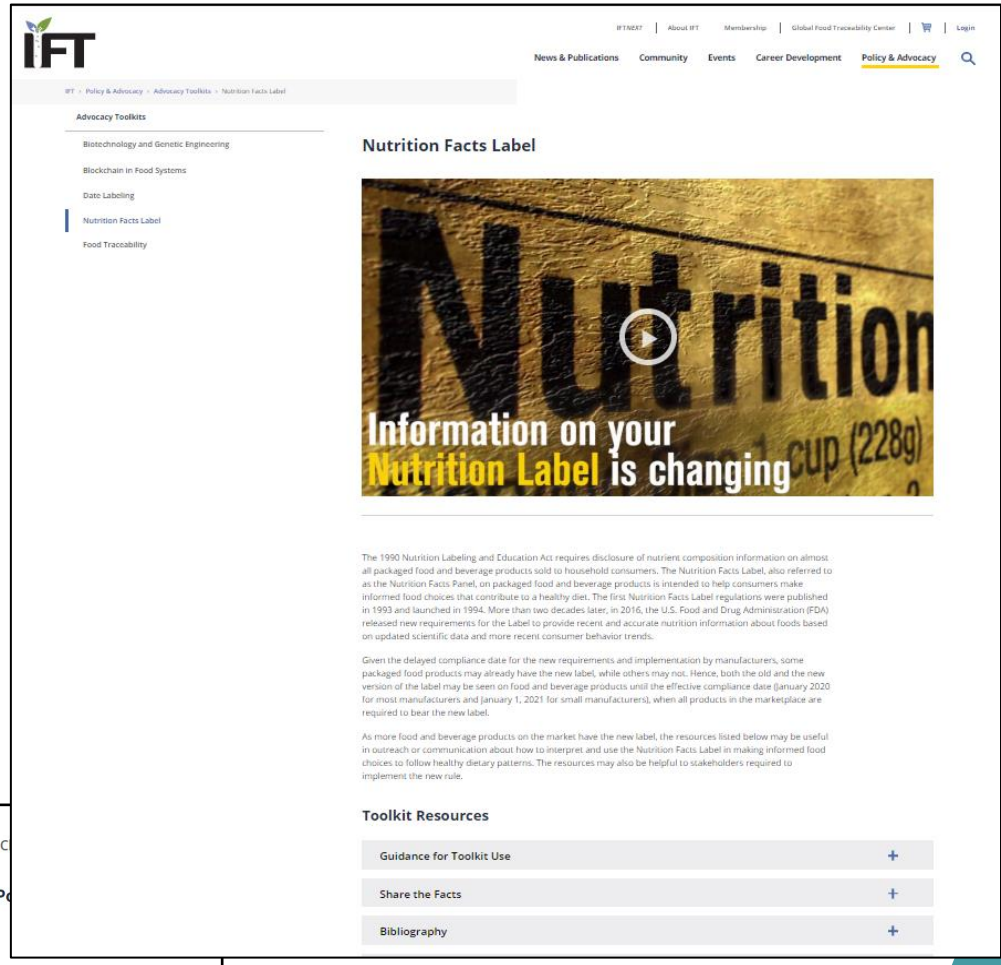
Resource:
Institute of Food Technologist

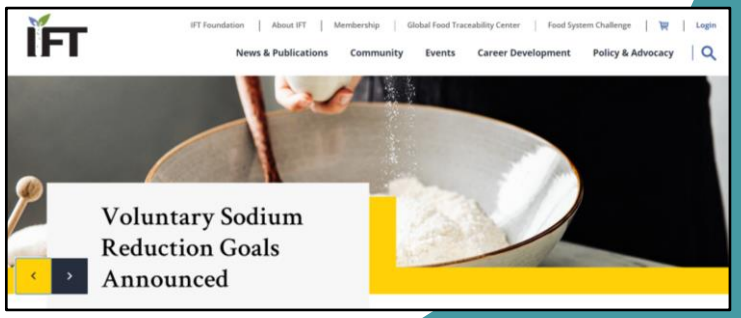
https://www.ift.org/

- The IFT is the professional organization for food industry professionals.
- The group communicates all things the food industry needs to know – changes, laws, improvements, new technologies, research, consumer trends and more!

For Educators!



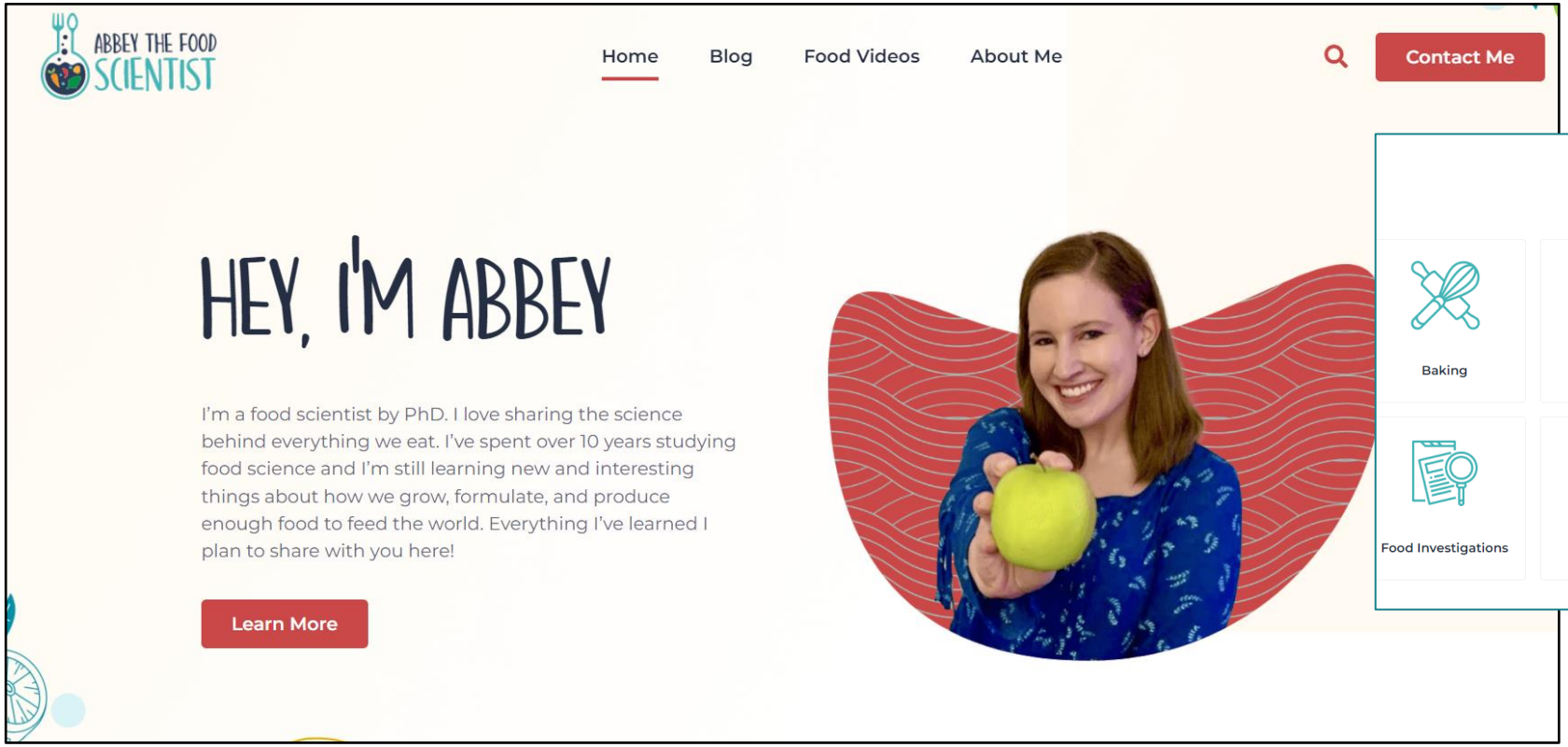


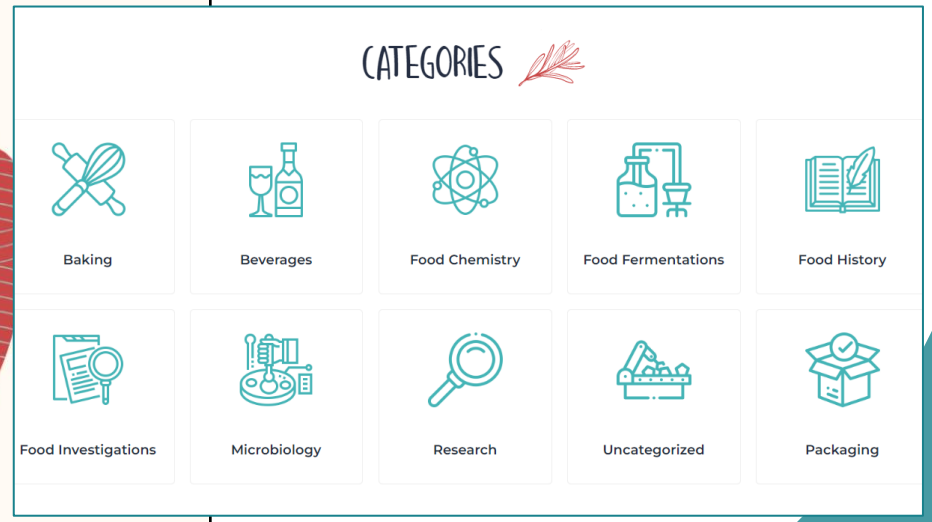


Abbey The Food Scientist

https://abbeythefoodscientist.com/

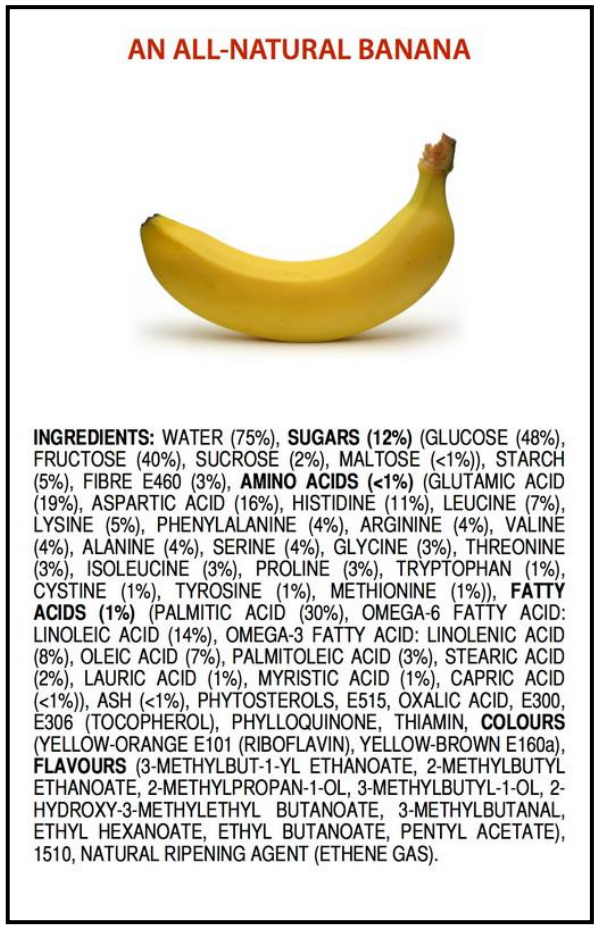
Abby is a Ph.D. food scientist, researcher, teacher, and YouTuber. She has created many YouTube videos and written a blog.



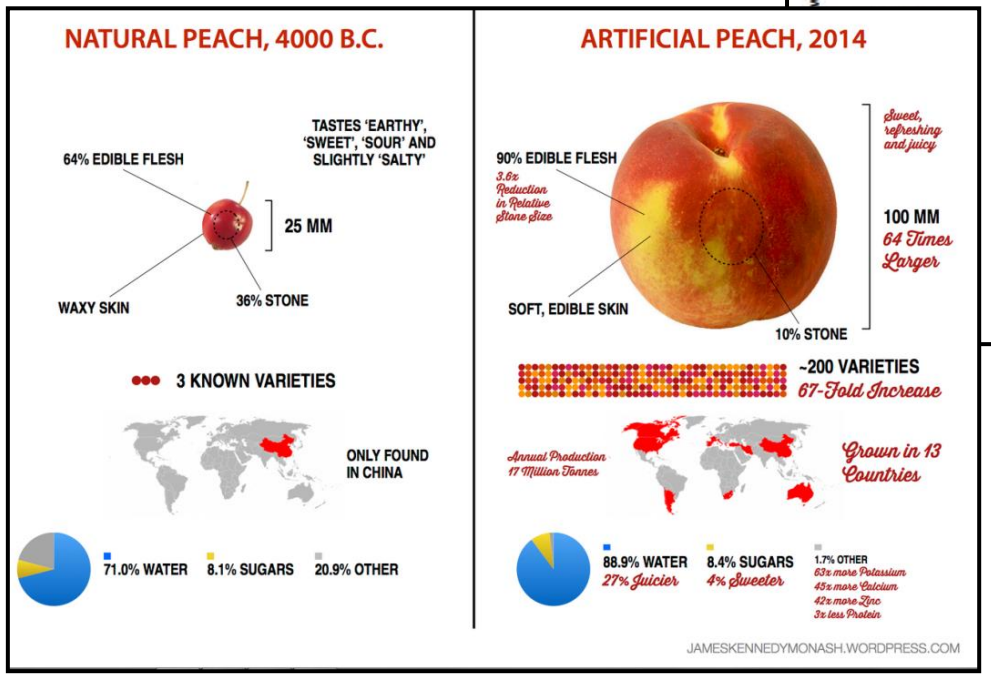


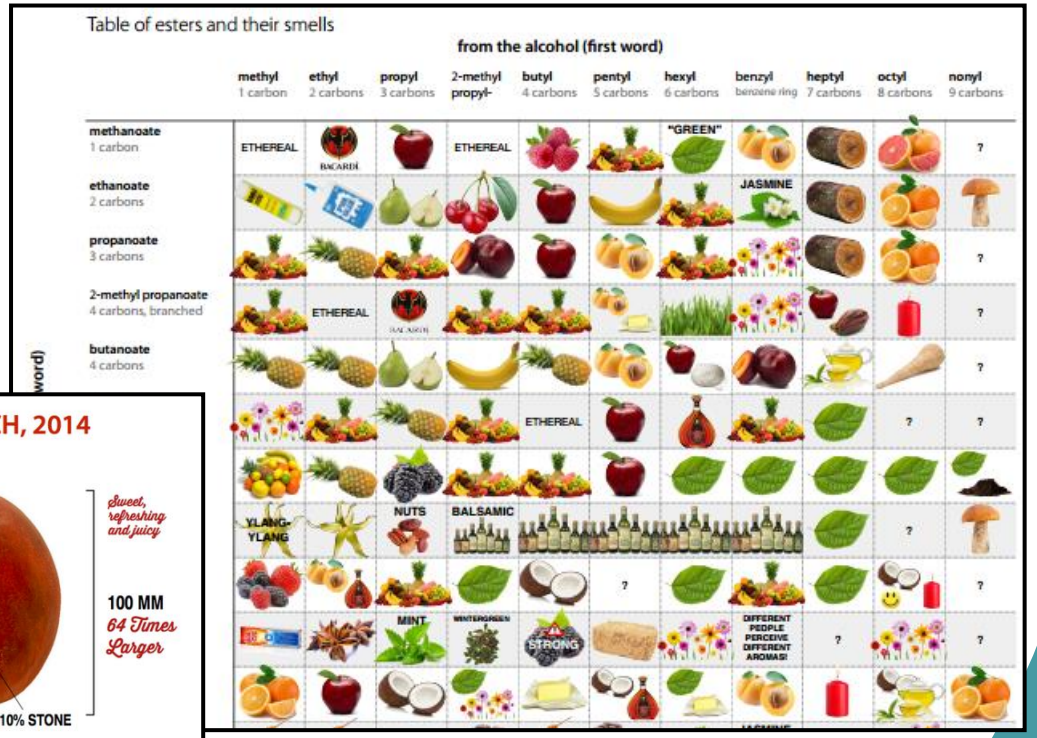
Resource:
James Kennedy - Australia Chemistry Teacher

https://jameskennedymonash.wordpress.com/



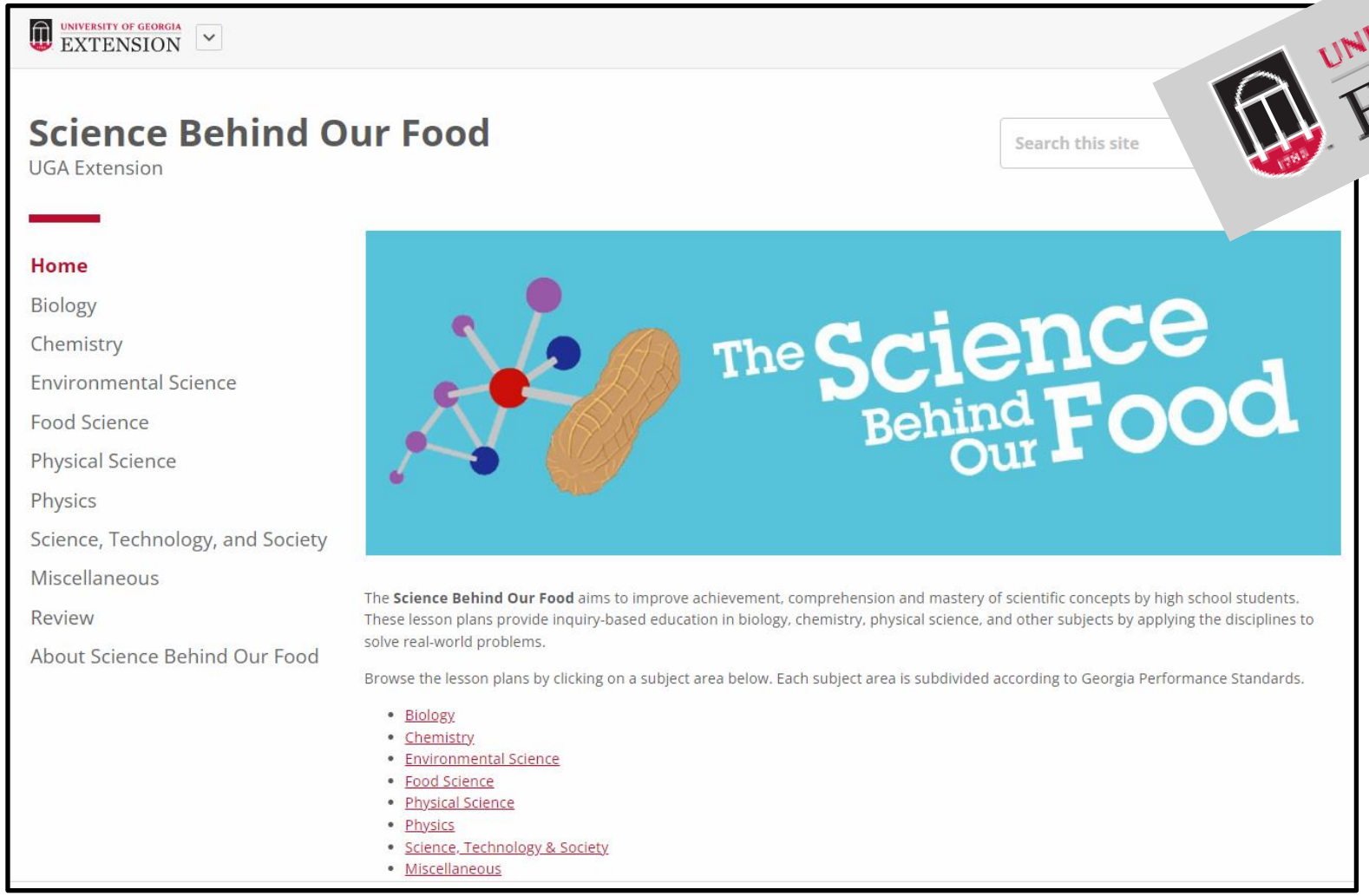
- Infographics
- Chemophobia
- Natural vs. Artificial
- Chemistry of everything!





Resource:
University of Georgia - Extension

https://extension.uga.edu/programs-services/science-behind-our-food.html



IFT Resources

- IFT HERB Approved Programs
- Cue Career Videos
- Pathful Virtual Classroom Visits
- Run your own educator event!

Thank You!

- **Sign Out for Illinois PD Hours and Session Attendance**

- **Thank you to Chicagoland Food Science Foundation for generously providing 100 $75 gift cards!**
  - ***Recipients will be notified via email next week***
  - ***Please complete the feedback survey to receive your gift card***

- **Reach out to Christina Ginardi at cginardi@ift.org**
- **Slides, recording, and feedback survey will be sent to you by early next week.**

Christina Ginardi – cginardi@ift.org

IFT | Feeding Tomorrow Fund

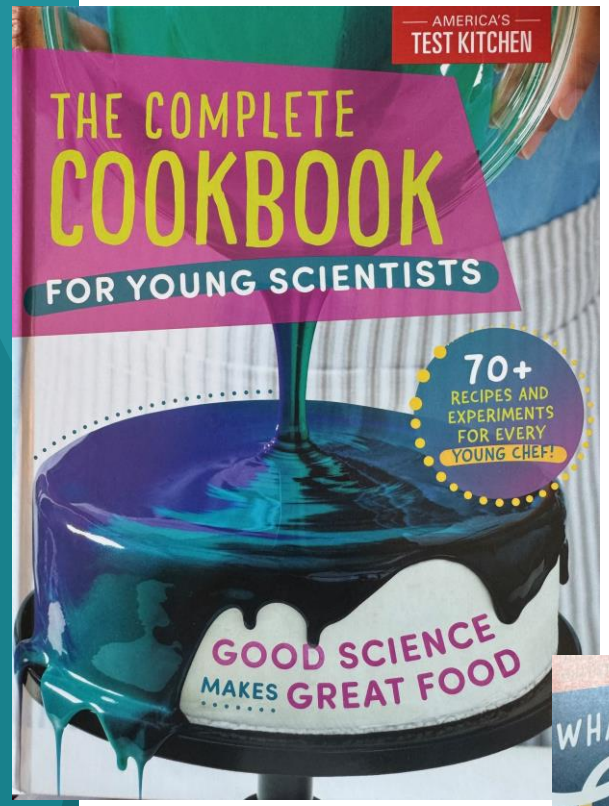
Appendix

IFT | Feeding Tomorrow Fund

Food Science Resources

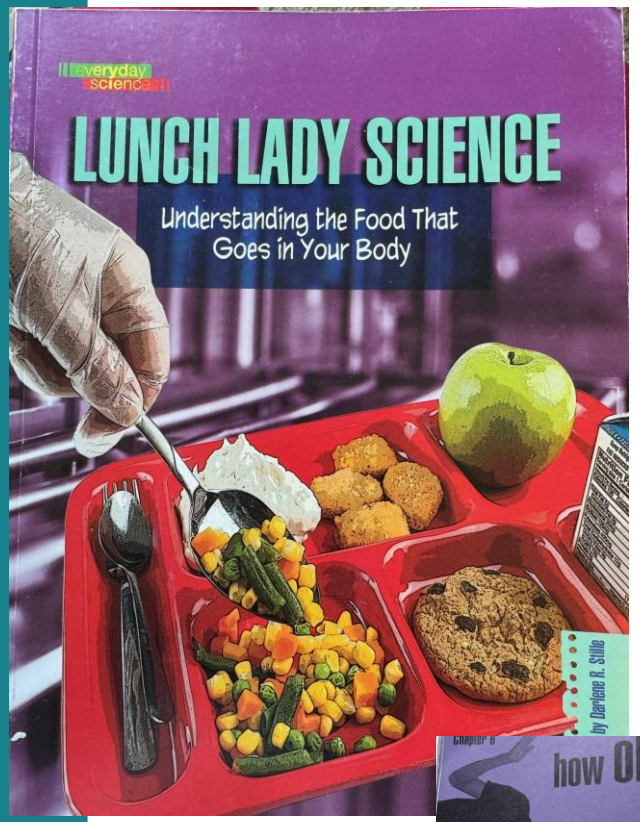
Resources- Book

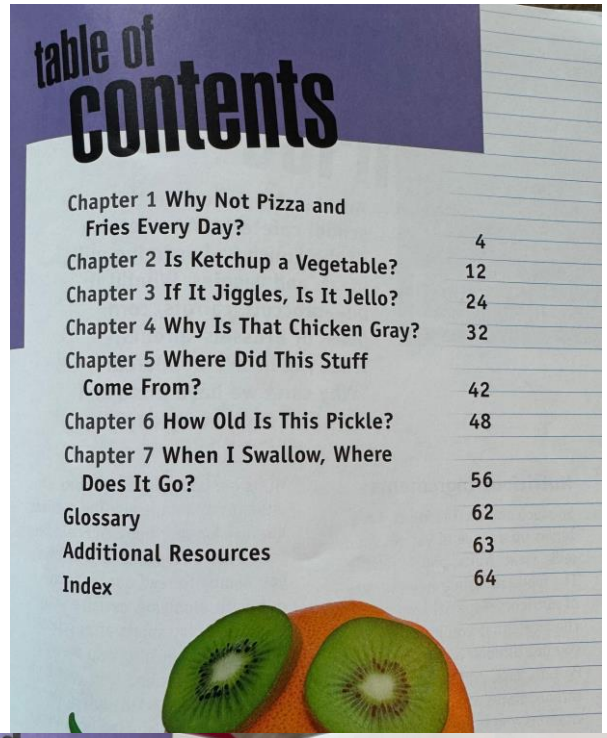
The Complete Cookbook for Young Scientists – *Good Science makes Great Food*, by America's Test Kitchen



Resources- Book

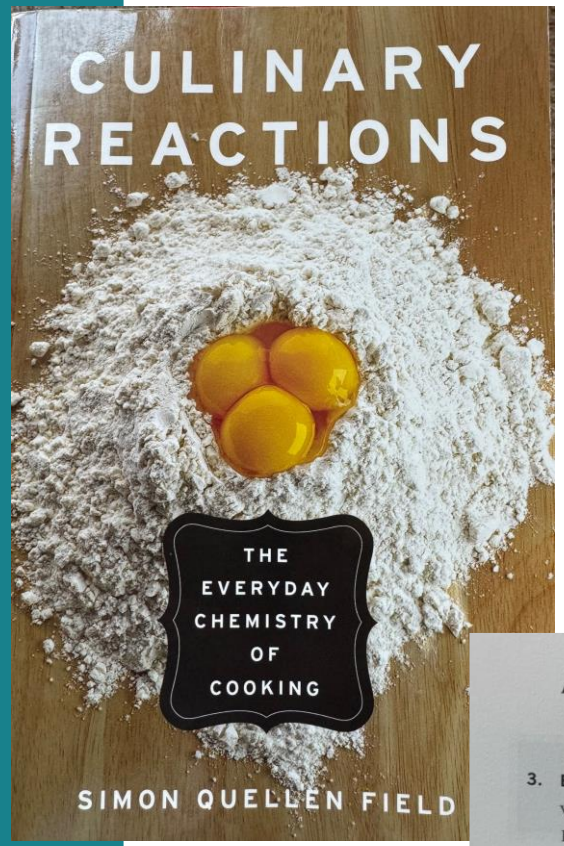
Lunch Lady Science – Understanding the Food That Goes in Your Body, by Darlene R. Stille

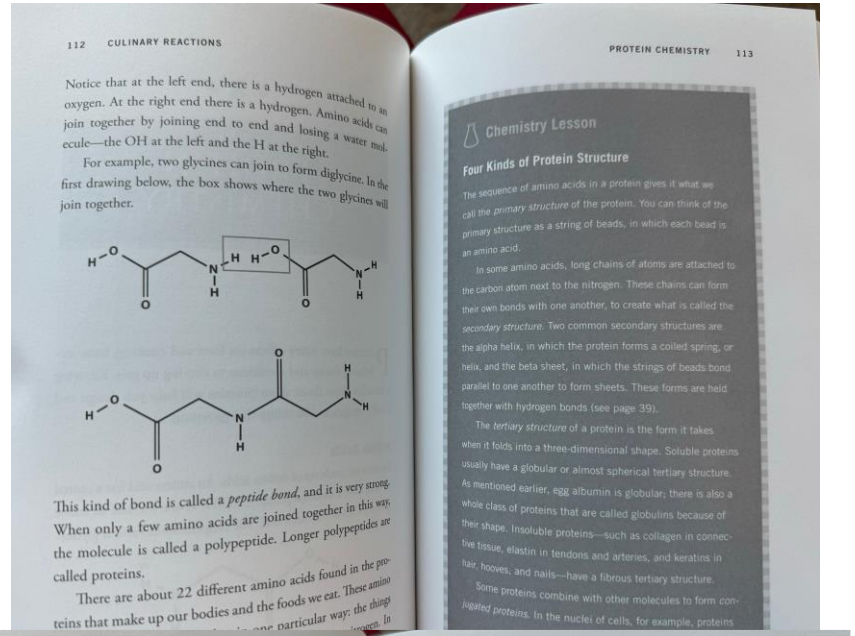




Resources- Book

Culinary Reactions – The Everyday Chemistry of Cooking, by Simon Quellen Field




112 CULINARY REACTIONS

Notice that at the left end, there is a hydrogen attached to an oxygen. At the right end there is a hydrogen. Amino acids can join together by joining end to end and losing a water molecule—the OH at the left and the H at the right.

For example, two glycines can join to form diglycine. In the first drawing below, the box shows where the two glycines will join together.

This kind of bond is called a *peptide bond*, and it is very strong. When only a few amino acids are joined together in this way, the molecule is called a polypeptide. Longer polypeptides are called proteins.

There are about 22 different amino acids found in the proteins that make up our bodies and the foods we eat. These amino

PROTEIN CHEMISTRY 113

Chemistry Lesson

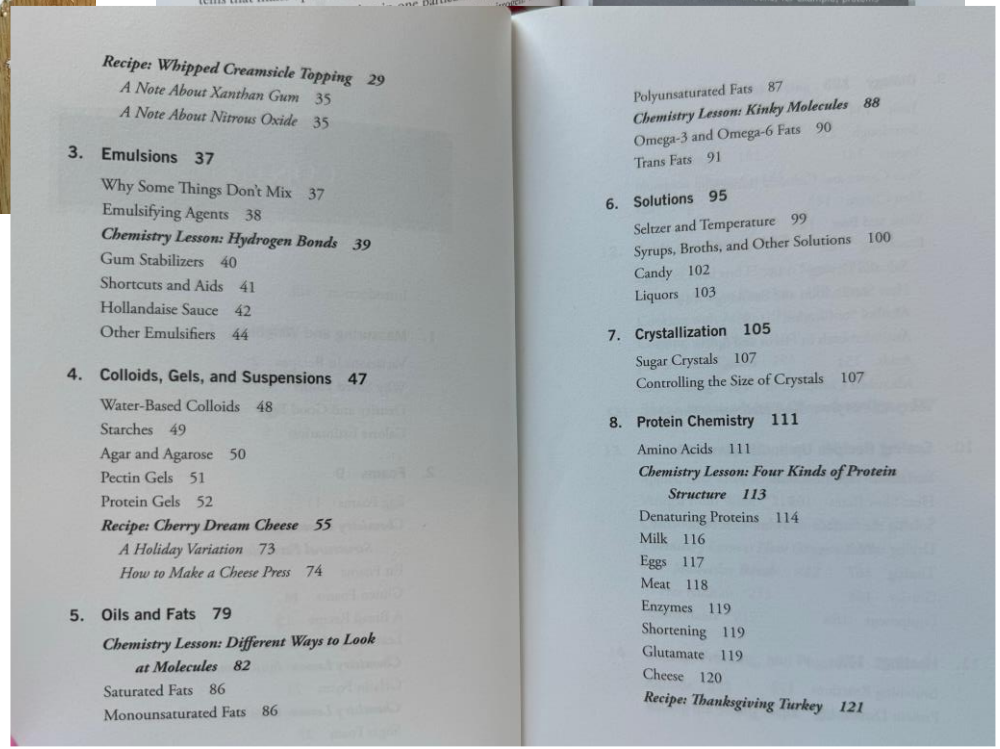
Four Kinds of Protein Structure

The sequence of amino acids in a protein gives it what we call the *primary structure* of the protein. You can think of the primary structure as a string of beads, in which each bead is an amino acid.

In some amino acids, long chains of atoms are attached to the carbon atom next to the nitrogen. These chains can form their own bonds with one another, to create what is called the *secondary structure*. Two common secondary structures are the alpha helix, in which the protein forms a coiled spring, or helix, and the beta sheet, in which the strings of beads bond parallel to one another to form sheets. These forms are held together with hydrogen bonds (see page 39).

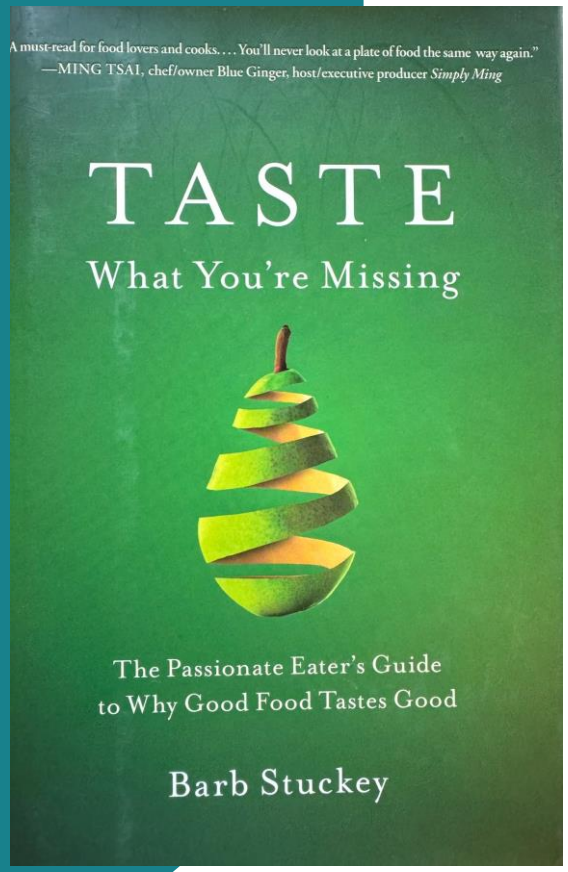
The *tertiary structure* of a protein is the form it takes when it folds into a three-dimensional shape. Soluble proteins usually have a globular or almost spherical tertiary structure. As mentioned earlier, egg albumin is globular; there is also a whole class of proteins that are called globulins because of their shape. Insoluble proteins—such as collagen in connective tissue, elastin in tendons and arteries, and keratins in hair, hooves, and nails—have a fibrous tertiary structure.

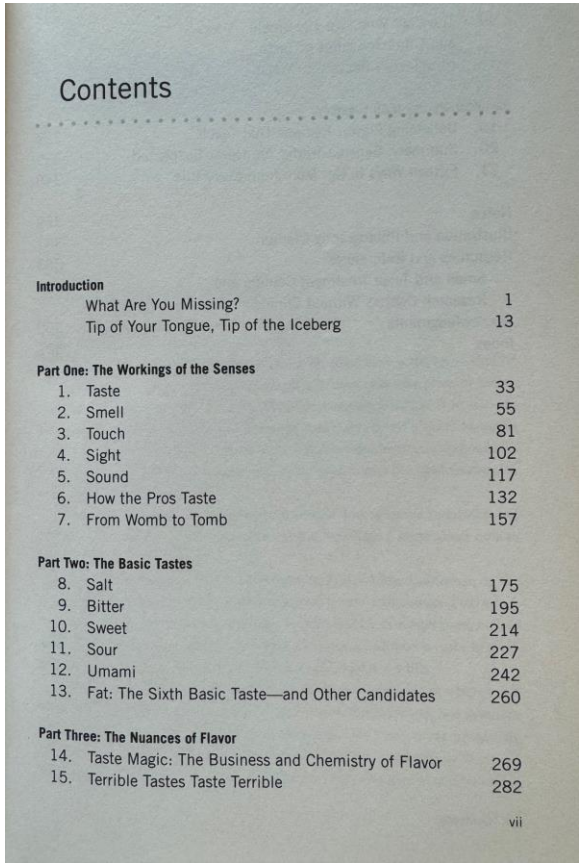
Some proteins combine with other molecules to form conjugated proteins. In the nuclei of cells, for example, proteins



Resources- Book

Taste What You're Missing, by Barb Stuckey





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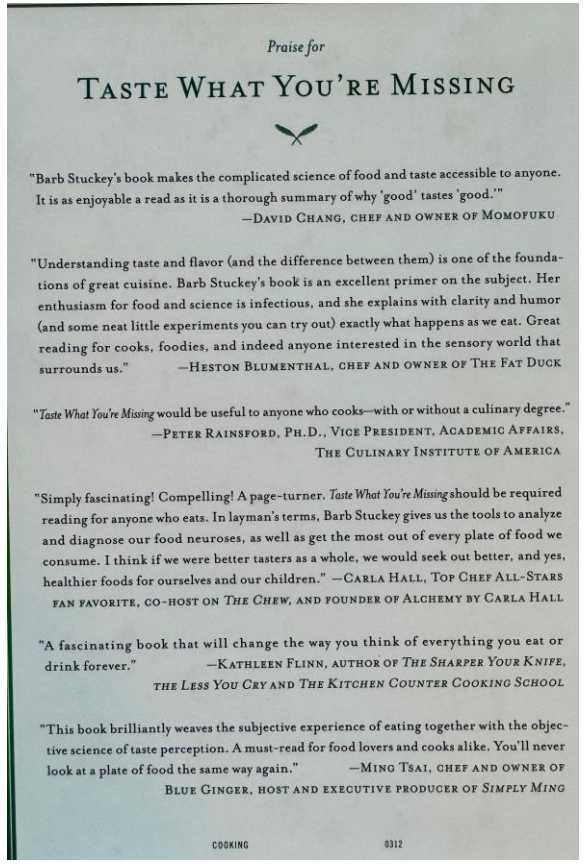


Praise for

TASTE WHAT YOU'RE MISSING

"Barb Stuckey's book makes the complicated science of food and taste accessible to anyone. It is as enjoyable a read as it is a thorough summary of why 'good' tastes 'good.'"
—DAVID CHANG, CHEF AND OWNER OF MOMOFUKU

"Understanding taste and flavor (and the difference between them) is one of the foundations of great cuisine. Barb Stuckey's book is an excellent primer on the subject. Her enthusiasm for food and science is infectious, and she explains with clarity and humor (and some neat little experiments you can try out) exactly what happens as we eat. Great reading for cooks, foodies, and indeed anyone interested in the sensory world that surrounds us." —HESTON BLUMENTHAL, CHEF AND OWNER OF THE FAT DUCK

"*Taste What You're Missing* would be useful to anyone who cooks—with or without a culinary degree."
—PETER RAINSFORD, PH.D., VICE PRESIDENT, ACADEMIC AFFAIRS, THE CULINARY INSTITUTE OF AMERICA

"Simply fascinating! Compelling! A page-turner. *Taste What You're Missing* should be required reading for anyone who eats. In layman's terms, Barb Stuckey gives us the tools to analyze and diagnose our food neuroses, as well as get the most out of every plate of food we consume. I think if we were better tasters as a whole, we would seek out better, and yes, healthier foods for ourselves and our children." —CARLA HALL, TOP CHEF ALL-STARS FAN FAVORITE, CO-HOST ON *THE CHEW*, AND FOUNDER OF ALCHEMY BY CARLA HALL

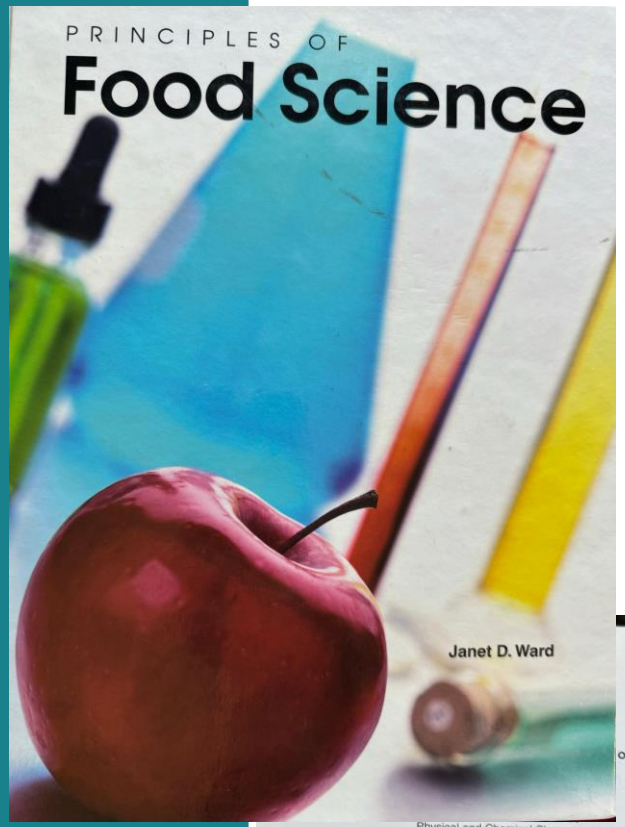
"A fascinating book that will change the way you think of everything you eat or drink forever." —KATHLEEN FLINN, AUTHOR OF *THE SHARPER YOUR KNIFE, THE LESS YOU CRY* AND *THE KITCHEN COUNTER COOKING SCHOOL*

"This book brilliantly weaves the subjective experience of eating together with the objective science of taste perception. A must-read for food lovers and cooks alike. You'll never look at a plate of food the same way again." —MING TSAI, CHEF AND OWNER OF BLUE GINGER, HOST AND EXECUTIVE PRODUCER OF *SIMPLY MING*

COOKING 0312

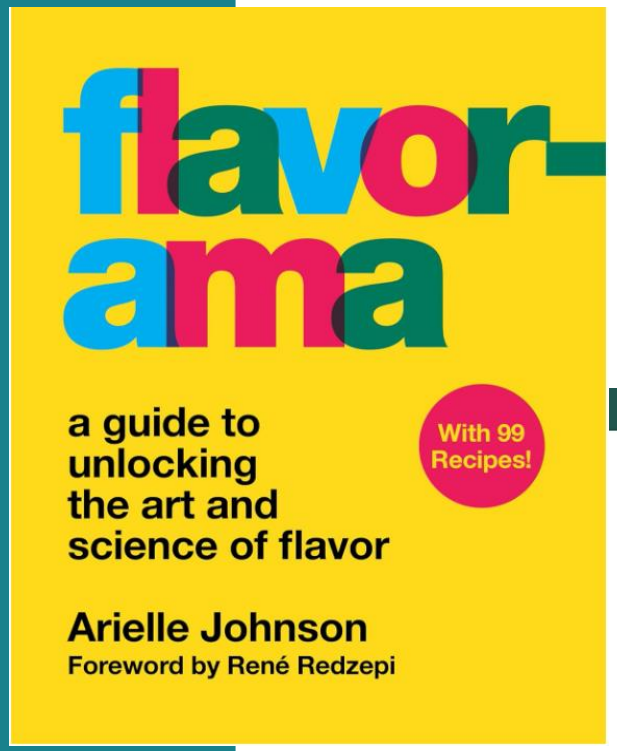
Resources- Textbook

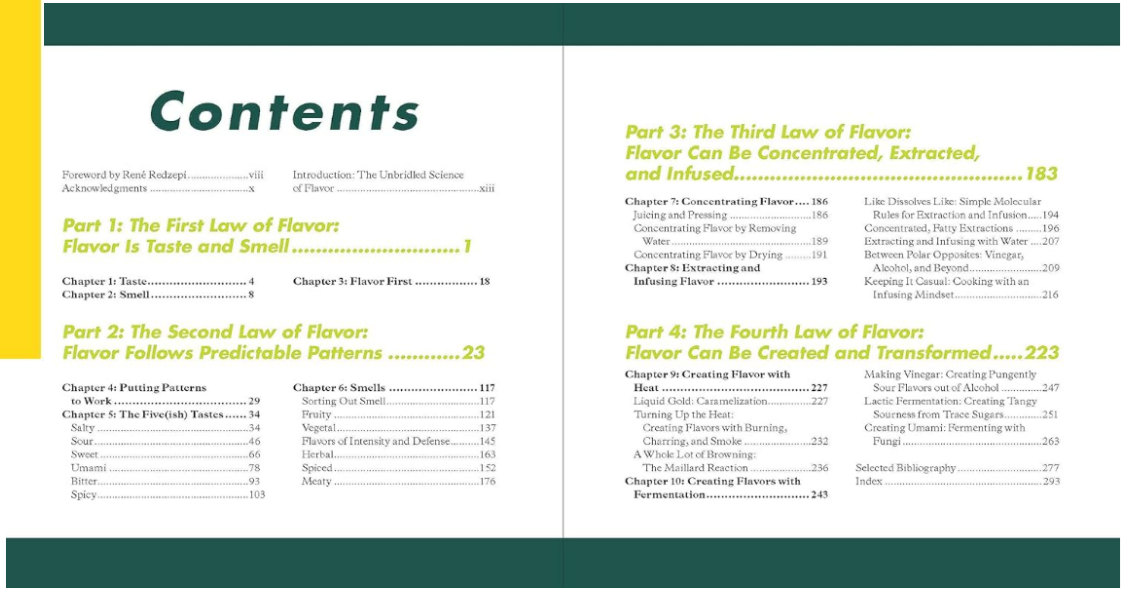
Principles of Food Science, by Janet D. Ward



Resources- Textbook

Flavor-ama, a guide to unlocking the art and science of flavor
by, Arielle Johnson

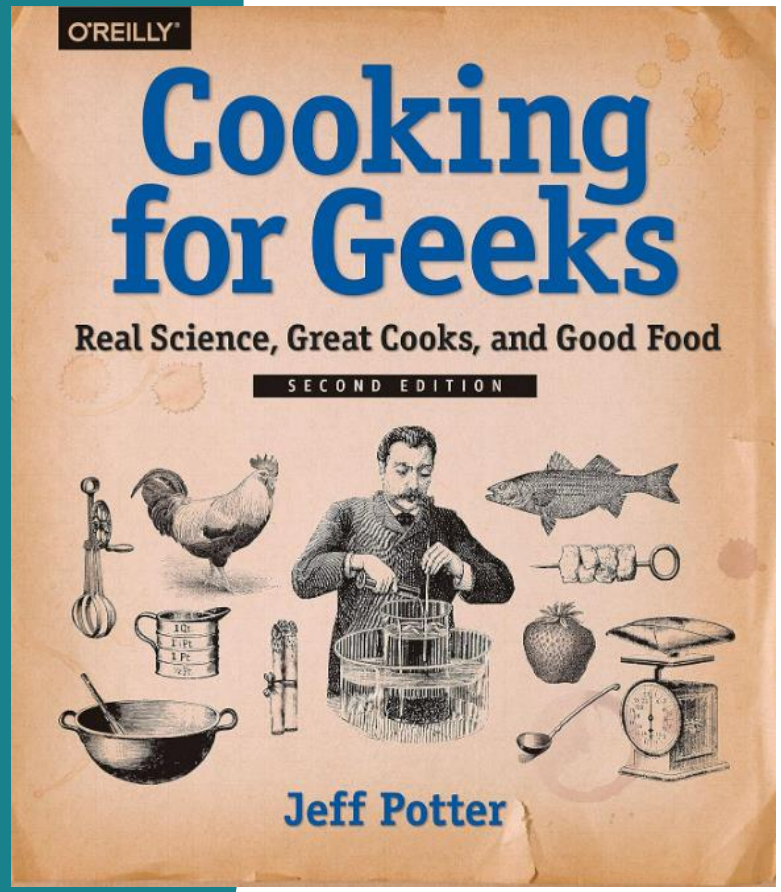




Contents

Resources- Textbook

Cooking for Geeks: Real Science, Great Cooks, and Good Food. By, Jeff Potter



Overview from Amazon:
Why do we cook the way we do? Are you the innovative type, used to expressing your creativity instead of just following recipes? Do you want to learn to be a better cook or curious about the science behind what happens to food as it cooks? More than just a cookbook, Cooking for Geeks applies your curiosity to discovery, inspiration, and invention in the kitchen. Why do we bake some things at 350°F/175°C and others at 375°F/190°C? Why is medium-rare steak so popular? And just how quickly does a pizza cook if we overclock an oven to 1,000 F/540 C? Author and cooking geek Jeff Potter provides the answers to these questions and more, and offers his unique take on recipes -- from the sweet (a patent-violating chocolate chip cookie) to the savory (slow-cooked brisket).
This book is an excellent and intriguing resource for anyone who enjoys cooking or wants to experiment in the kitchen.

Resources

- **McCormick FONA**

  Career Videos, Demos, etc

  https://www.mccormickfona.com/learn/discover-fona-food-science-for-young-minds
- **Institute of Food Technologists** (*IFT)*

  Magazine, Educators, Research

  https://www.ift.org/
- **International Food Information Council**

  https://ific.org/
- **Alton Brown (Podcast, Videos, Recipes, etc)**

  http://altonbrown.com
- **National Center for Case Study Teaching in Science**

  https://www.nsta.org/case-studies/all
- **FEMA Flavor & Extract Manufacturers Association**

  https://www.femaflavor.org/
- **Society of Flavor Chemists**

  http://flavorchemists.com/

Resources:
McCormick FONA

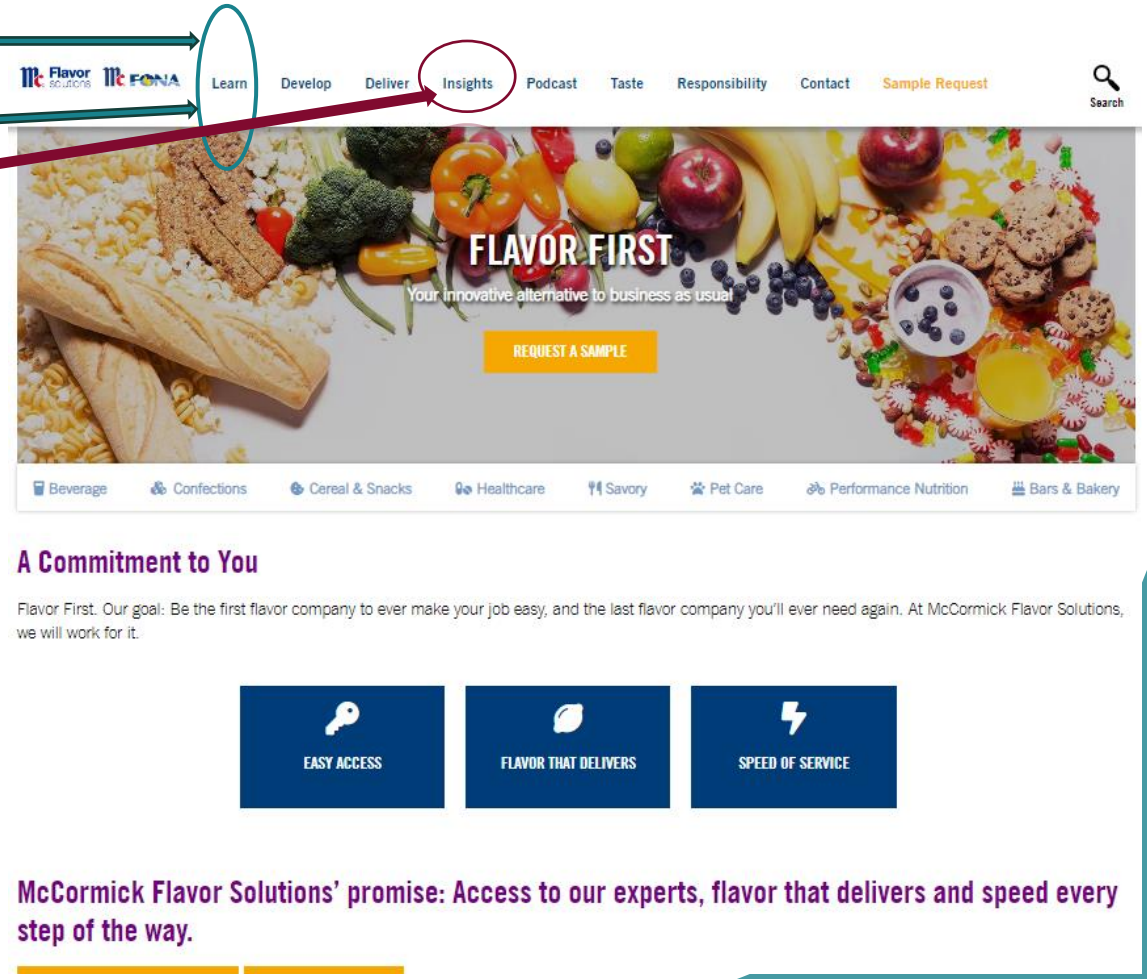
https://www.mccormickfona.com/

- Teach & Taste
  - Lesson Plans & Demonstrations
- Career Exploration
  - FONA Employee short career videos
- Trend & White Papers

https://www.mccormickscienceinstitute.com/
Together with research institutions study & communicate the health benefits of culinary herbs and spices.

https://www.mccormickforchefs.com/en-us/our-difference/spice-stories
Feeling spicy? Get to know some of our spices!

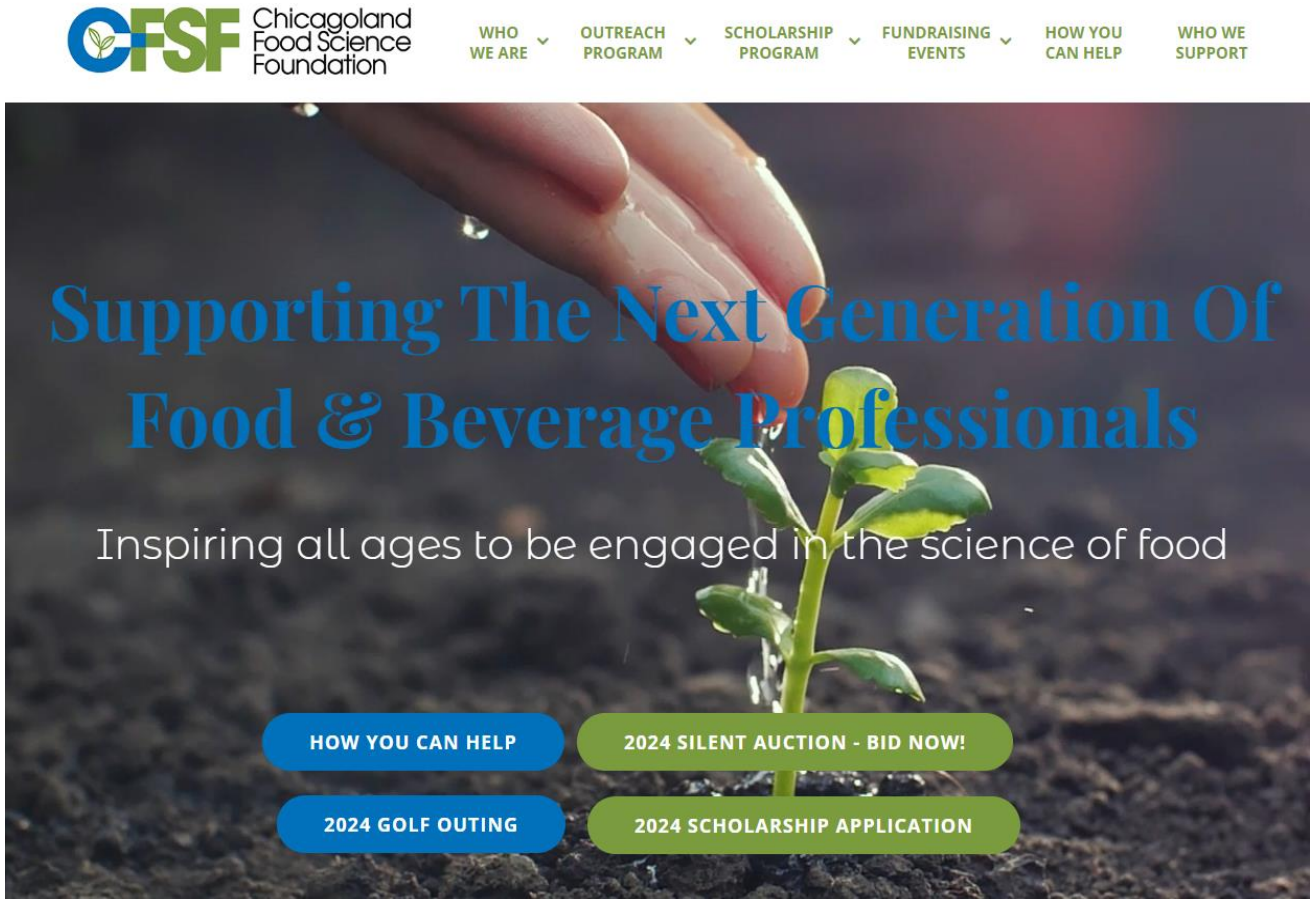
https://www.mccormickforchefs.com/en-us
Collection of trends, 2024 Flavor Forecast, recipes, inspiration, and other resources.



Resource:
Chicagoland Food Science Foundation

https://chicagofoodscience.org/

- CFSF supports the next generation of Food & Beverage Professionals
  - College scholarships for your students (including graduating Seniors from HS).
  - Works with your school to customize events about Food Industry.

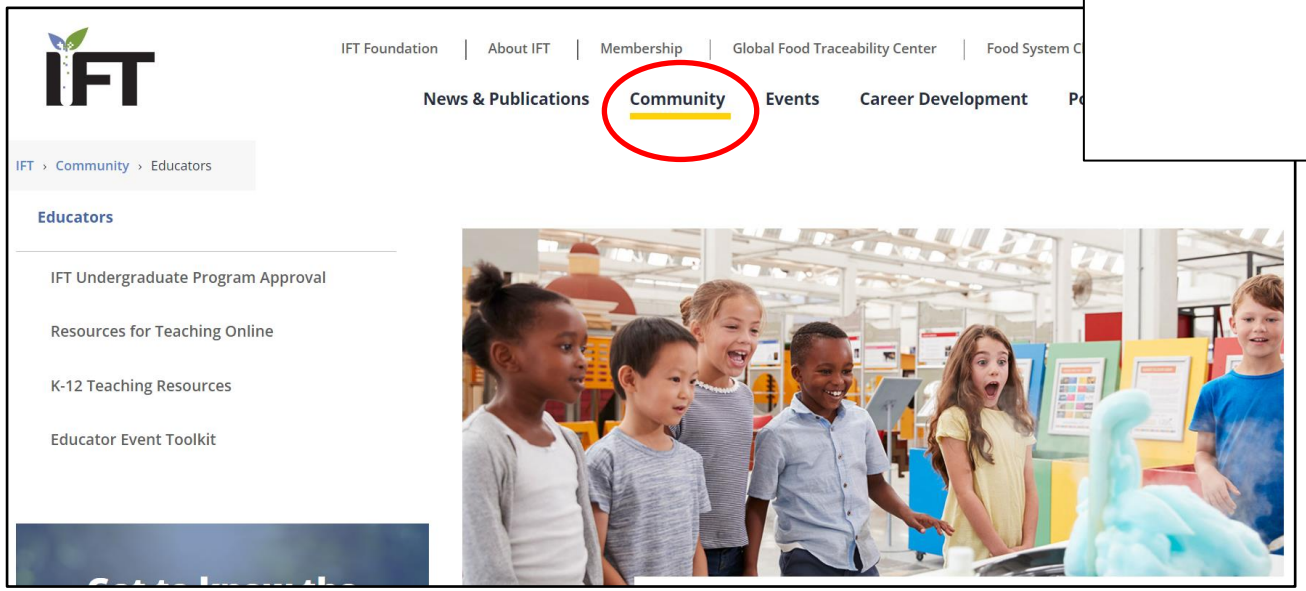


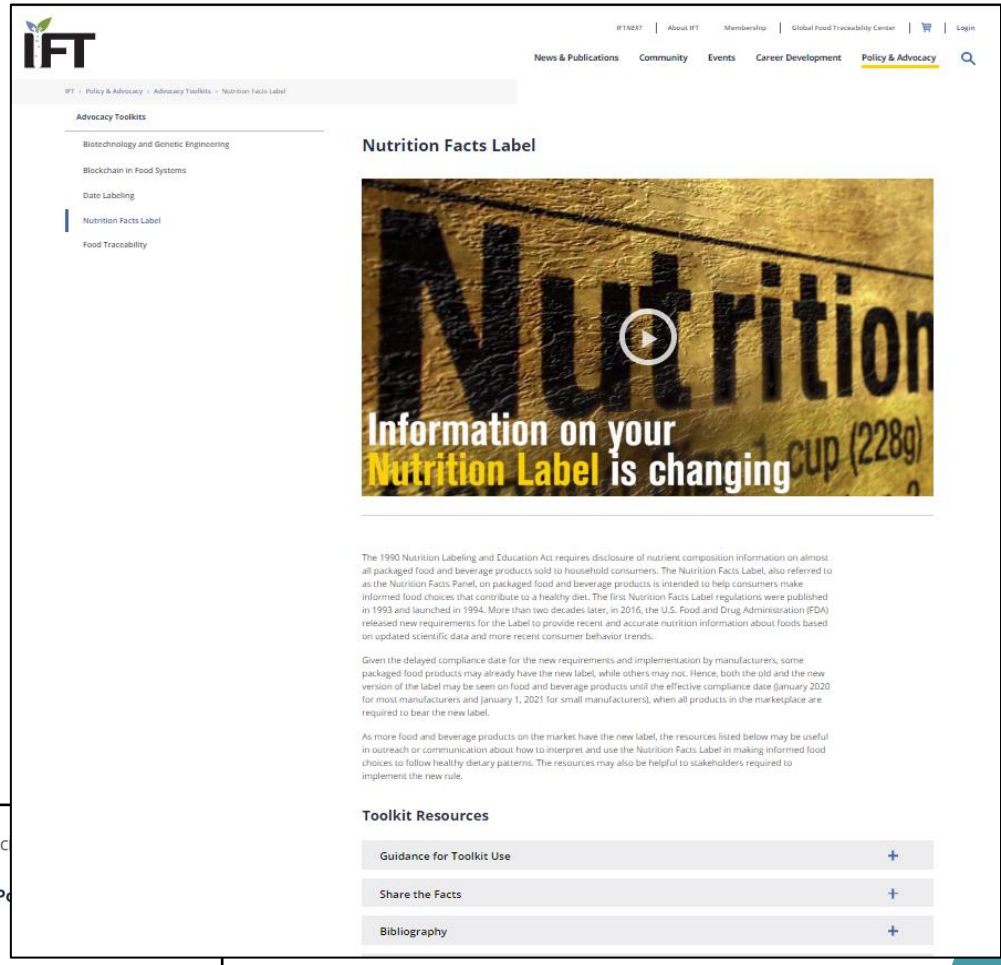
Resource:
Institute of Food Technologist

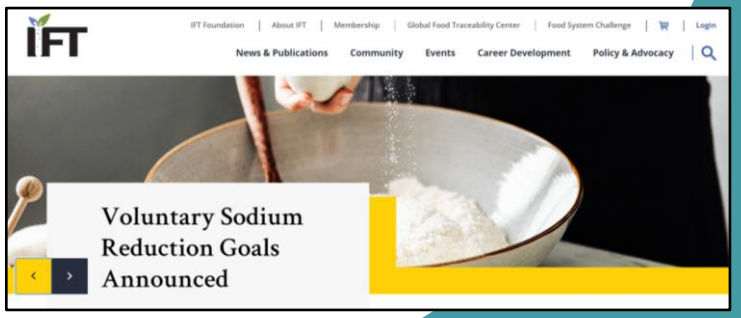
https://www.ift.org/

- The IFT is the professional organization for food industry professionals.
- The group communicates all things the food industry needs to know – changes, laws, improvements, new technologies, research, consumer trends and more!

For Educators!

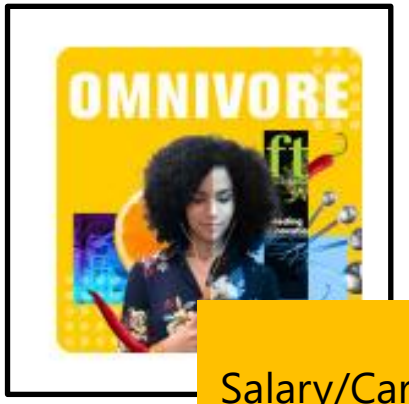




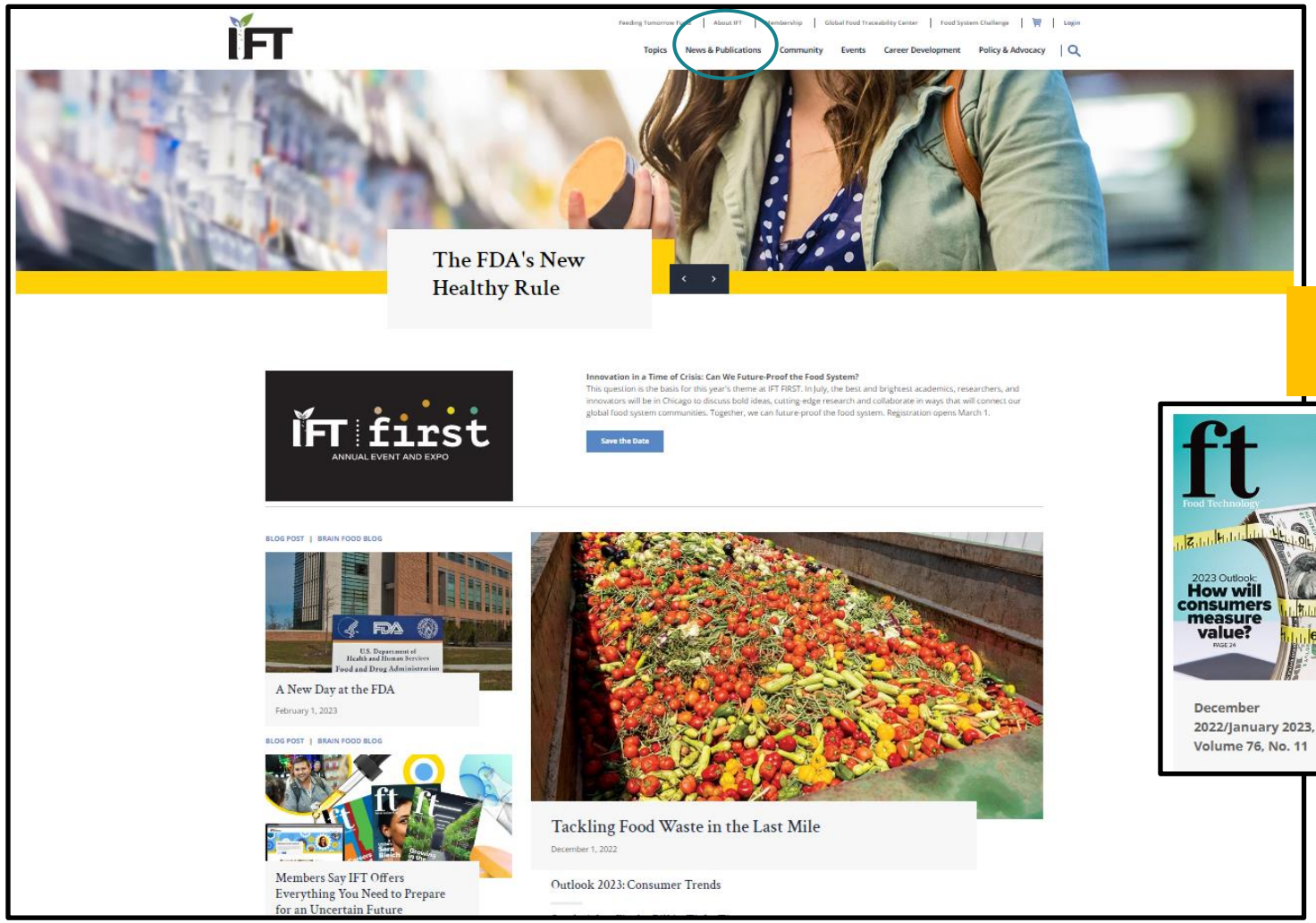


Resource:
Institute of Food Technologist

https://www.ift.org/news-and-publications/podcasts/omnivore



PODCAST:
Salary/Career Trends, Sandwiches on the menu, Food Waste, Sensory, Pet food, etc

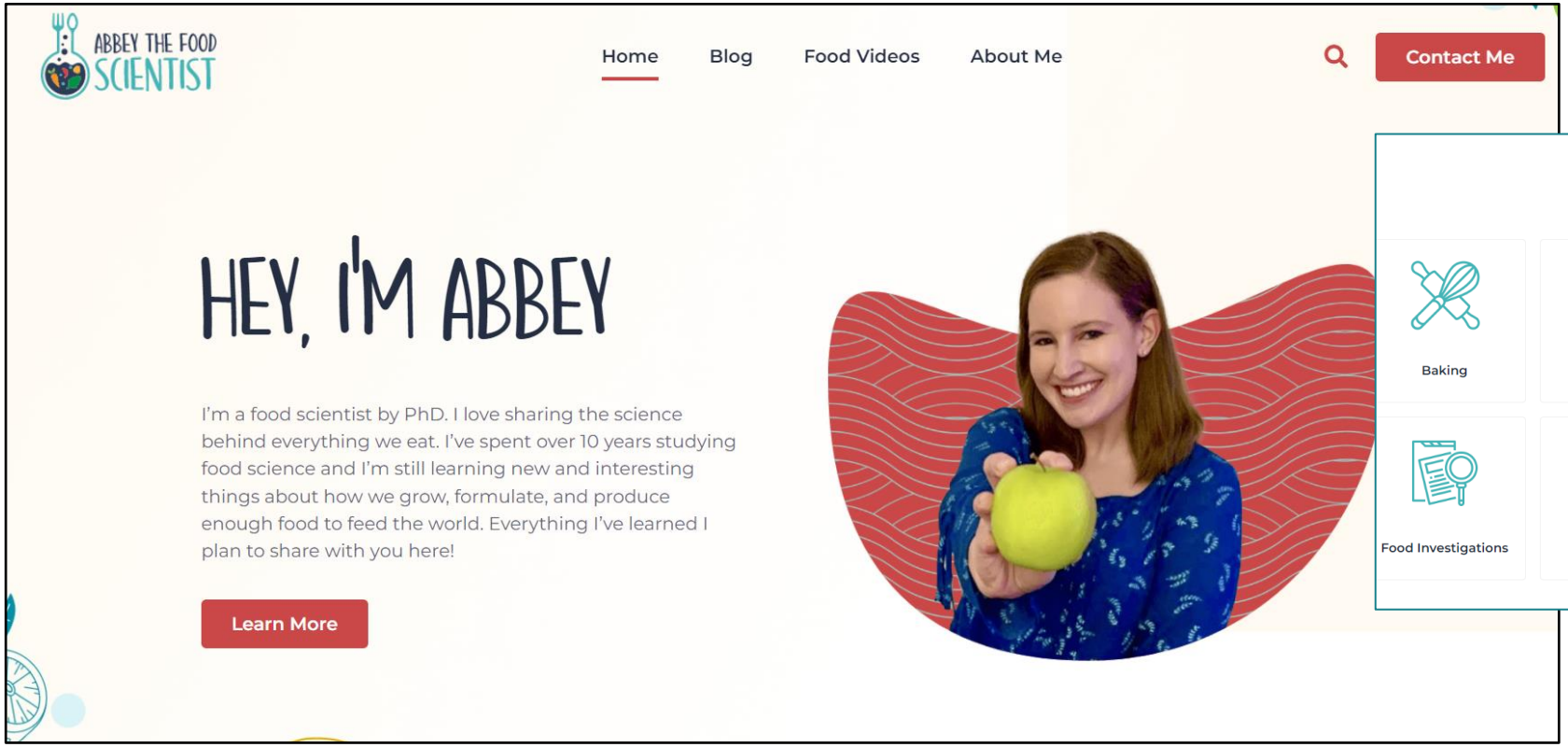


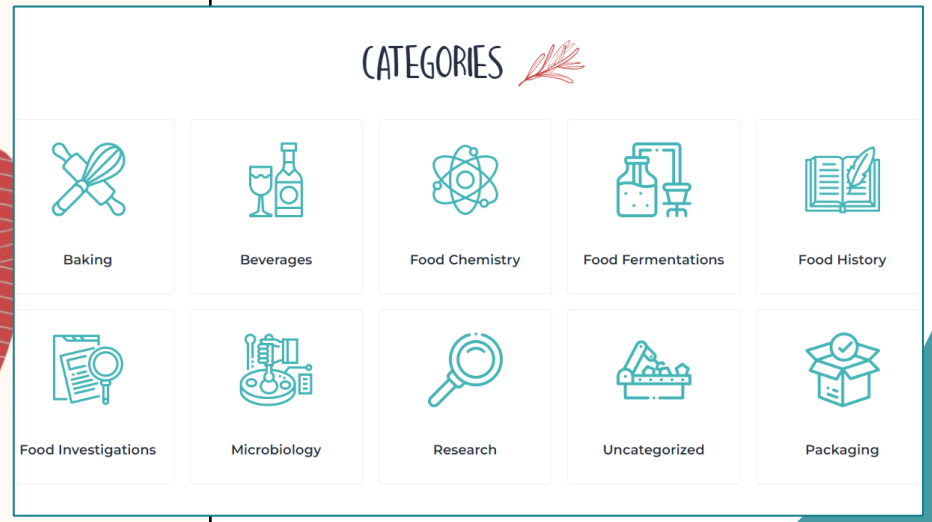
FOOD TECHNOLOGY MAGAZINE:

Abbey The Food Scientist

https://abbeythefoodscientist.com/

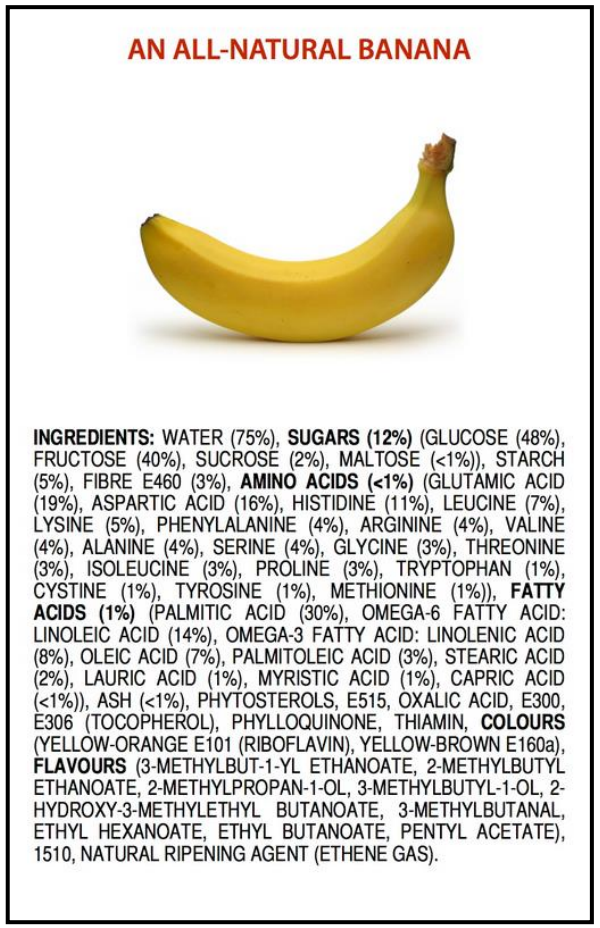
Abby is a Ph.D. food scientist, researcher, teacher, and YouTuber. She has created many YouTube videos and written a blog.



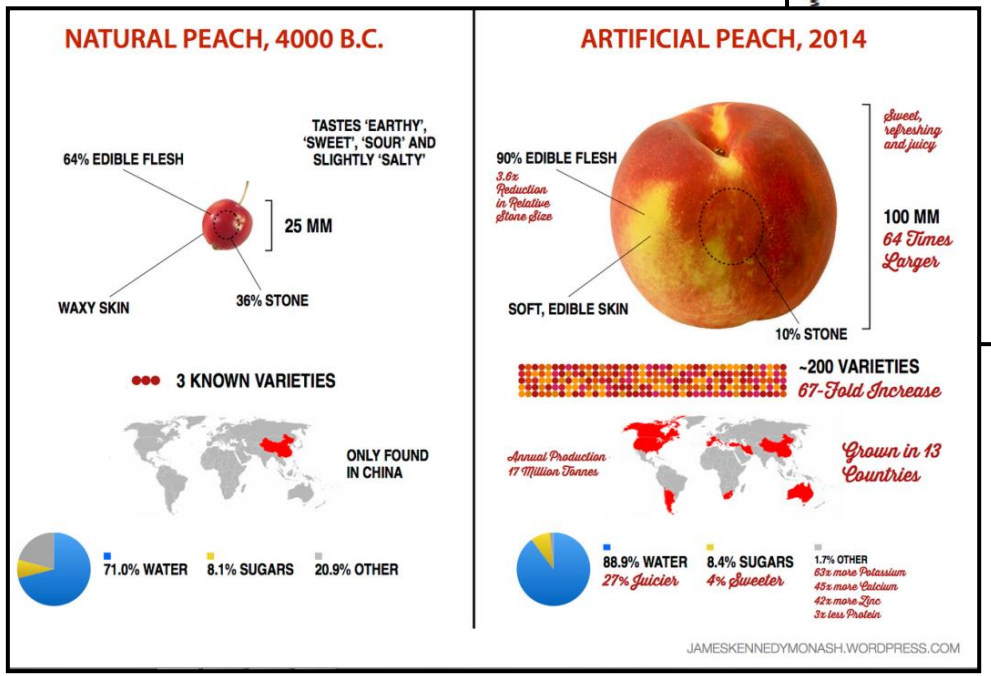


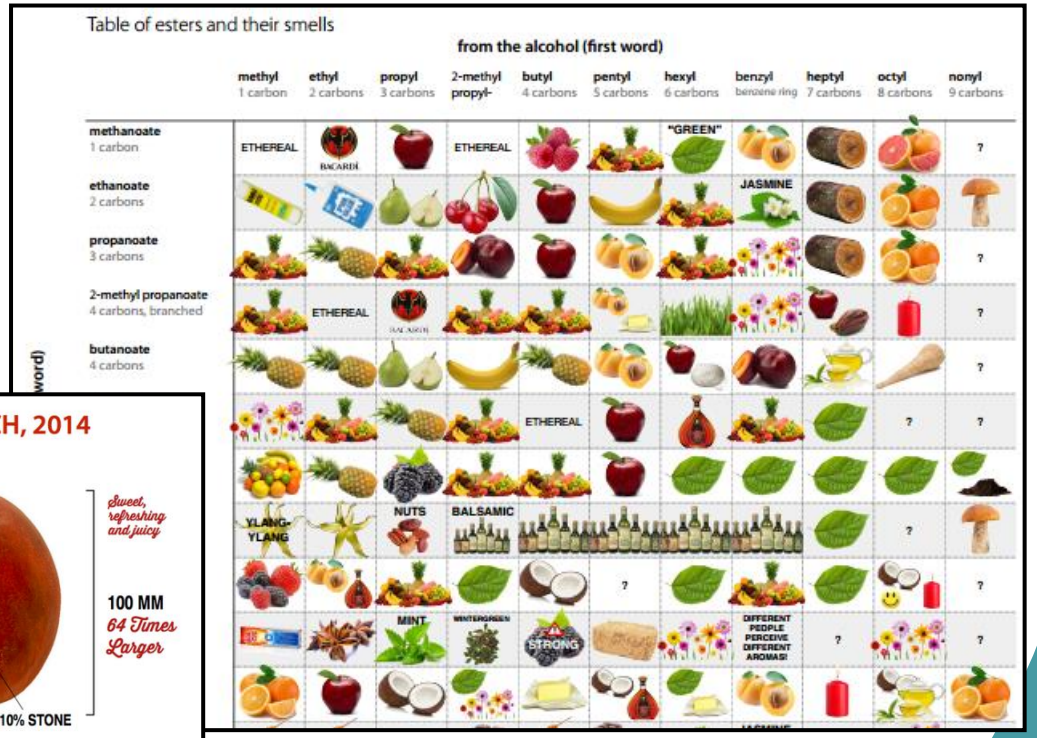
Resource:
James Kennedy - Australia Chemistry Teacher

https://jameskennedymonash.wordpress.com/



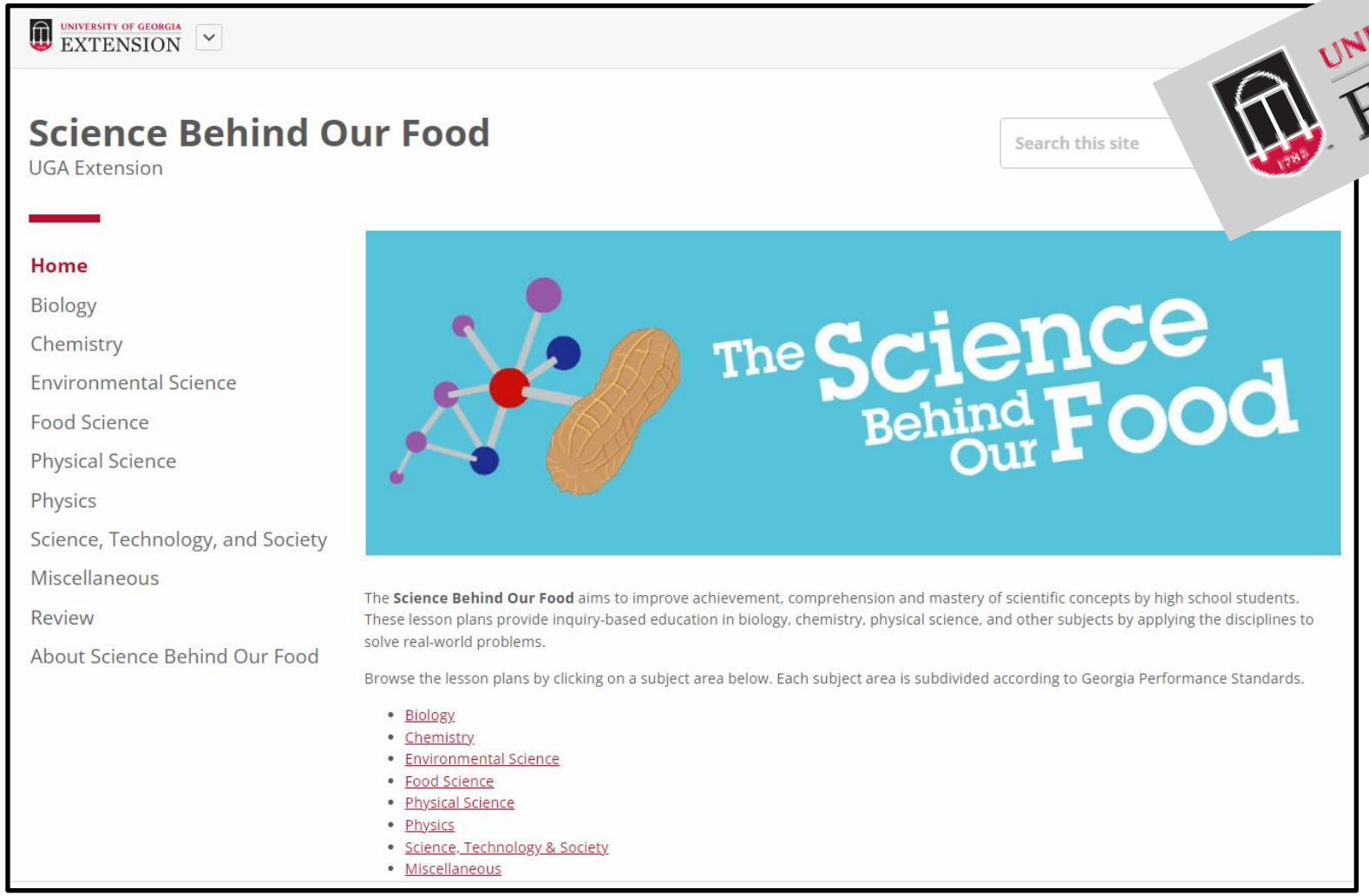
- Infographics
- Chemophobia
- Natural vs. Artificial
- Chemistry of everything!





Resource:
University of Georgia - Extension

https://extension.uga.edu/programs-services/science-behind-our-food.html



Resource:
Science History Institute

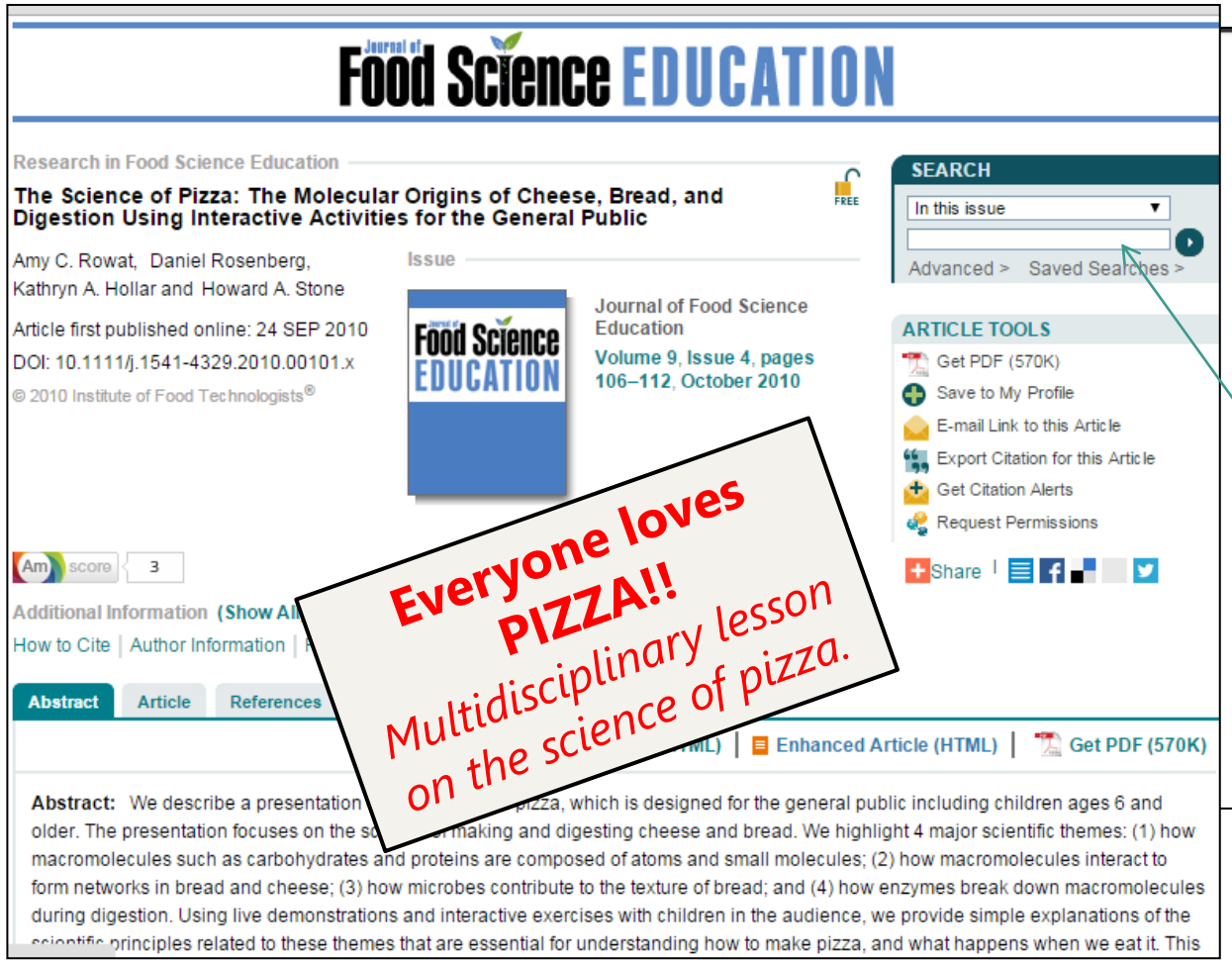
https://digital.sciencehistory.org/

- Digital collections researching food, water, health & nutrition, women in science and more.
- Historical reference for scientific knowledge.

Resource:
IFT: Journal of Food Science Education

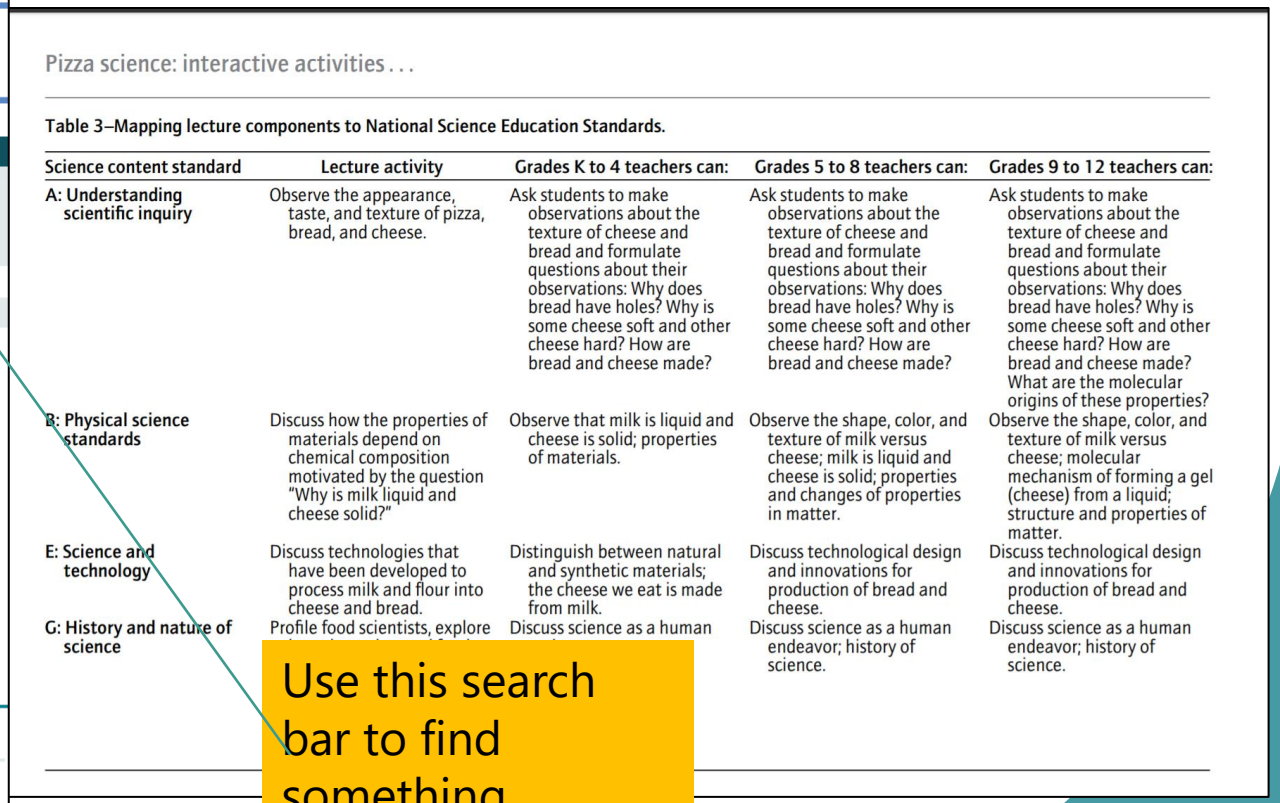
http://www.ift.org/knowledge-center/read-ift-publications/journal-of-food-science-education.aspx

Journal of Food Science Education (IFT.org – Knowledge center-IFT Publications)



Everyone loves PIZZA!!

Multidisciplinary lesson on the science of pizza.



Pizza science: interactive activities . . .

Table 3–Mapping lecture components to National Science Education Standards.

Science content standard	Lecture activity	Grades K to 4 teachers can:	Grades 5 to 8 teachers can:	Grades 9 to 12 teachers can:
A: Understanding scientific inquiry	Observe the appearance, taste, and texture of pizza, bread, and cheese.	Ask students to make observations about the texture of cheese and bread and formulate questions about their observations: Why does bread have holes? Why is some cheese soft and other cheese hard? How are bread and cheese made?	Ask students to make observations about the texture of cheese and bread and formulate questions about their observations: Why does bread have holes? Why is some cheese soft and other cheese hard? How are bread and cheese made?	Ask students to make observations about the texture of cheese and bread and formulate questions about their observations: Why does bread have holes? Why is some cheese soft and other cheese hard? How are bread and cheese made? What are the molecular origins of these properties?
B: Physical science standards	Discuss how the properties of materials depend on chemical composition motivated by the question "Why is milk liquid and cheese solid?"	Observe that milk is liquid and cheese is solid; properties of materials.	Observe the shape, color, and texture of milk versus cheese; milk is liquid and cheese is solid; properties and changes of properties in matter.	Observe the shape, color, and texture of milk versus cheese; molecular mechanism of forming a gel (cheese) from a liquid; structure and properties of matter.
E: Science and technology	Discuss technologies that have been developed to process milk and flour into cheese and bread.	Distinguish between natural and synthetic materials; the cheese we eat is made from milk.	Discuss technological design and innovations for production of bread and cheese.	Discuss technological design and innovations for production of bread and cheese.
G: History and nature of science	Profile food scientists, explore	Discuss science as a human	Discuss science as a human endeavor; history of science.	Discuss science as a human endeavor; history of science.

Use this search bar to find something relating to your classroom topics!

Resource:

National Future Farmers of America (FFA)

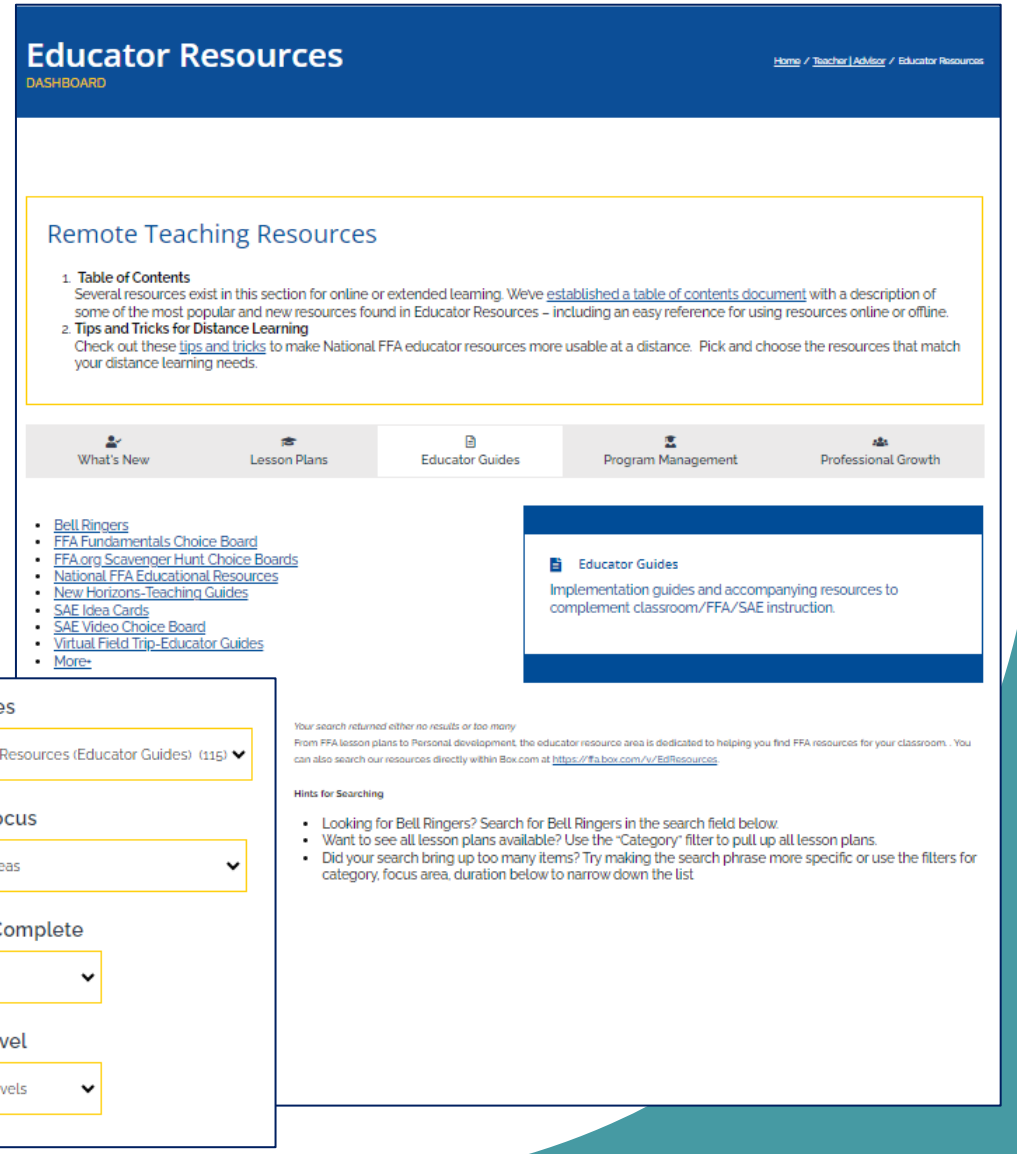
Food Science Educator Resources

https://www.ffa.org/my-toolbox/instructor/educator-resources/

https://ffa.app.box.com/v/EducationalResources *(more links to additional resources)*

464 Lesson Plans & Curriculum
AND
115 Companion Resources
(aka Educator Guides)

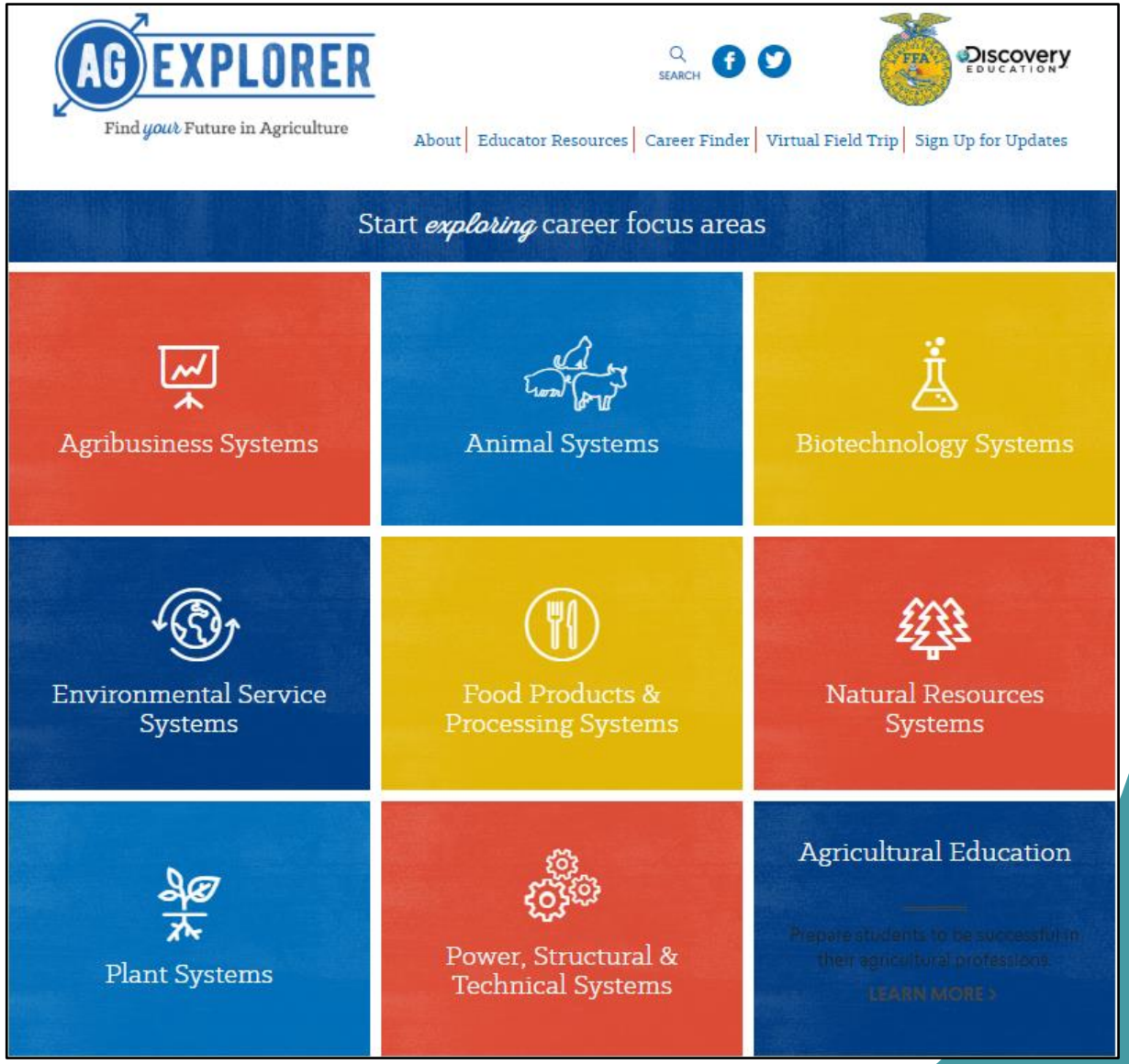
Including:
Bell Activities
Current Events
Career Exploration
(see next slide for AgExplorer)



Resource:
Ag Explorer

https://agexplorer.ffa.org/

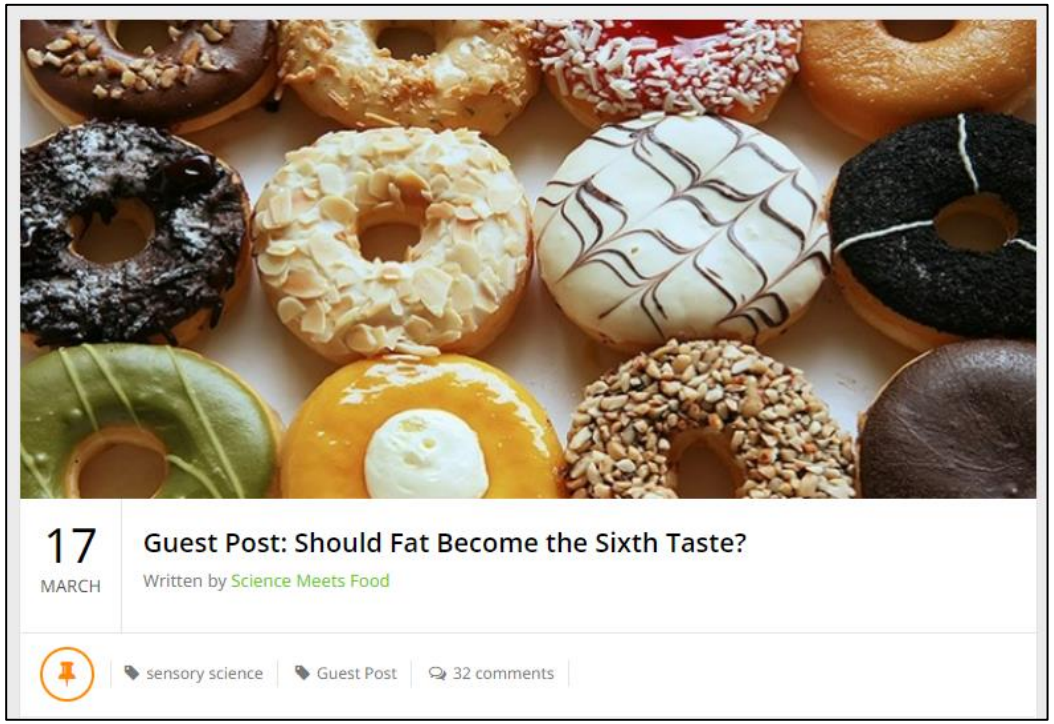
- Virtual Field Trips
  - Current videos on interesting companies
- Career Finder
  - Descriptions about 100's of careers in the various areas of business



Resource:
Science Meets Food

https://sciencemeetsfood.org/

Institute Food Technology Student Association



Resource:
FDA - Science & Our Food Supply

https://www.fda.gov/food/foodscienceresearch/toolsmaterials/scienceandthefoodsupply/default.htm

Science & Our Food Supply – FDA
Food Safety & Food Nutrition Lessons for Middle & High School

Nutrition

Science and Our Food Supply: Using the Nutrition Facts Label to Make Healthy Food Choices (2017 Edition)

When it comes to making science, consumer sciences, and health relevant for your students, what better way than to apply it to something that's part of their everyday lives? Food gives you an ideal springboard for introducing the science that is at the heart of nutrition and exploring the impact that daily food and beverage choices can have on overall health.

This nutrition-based curriculum introduces students to the fundamentals of healthy food choices, using the Nutrition Facts label as the starting point, and may be used separately or in conjunction with the food safety curriculum. With engaging hands-on activities, students will become aware of calories, serving size, and the nutrients to get "more of" and "less of." Designed for use by middle level and high school teachers, the emphasis is on an inquiry approach that is customizable to science, health, and/or family and consumer science classes, aligning with current education standards in these curriculum areas.

Your students will learn about:

- Using the Nutrition Facts Label
- Serving Size and Calories
- Sugar in Beverages
- Sodium in Snack Foods
- Meal Planning
- Healthy Eating Away from Home

Nutrition Middle Level Guide (PDF 5MB) | Nutrition High School Guide (PDF 5MB)

Food Safety

Science and Our Food Supply: Investigating Food Safety from Farm to Table (2014 Edition)

FDA in collaboration with the *National Science Teachers Association* (NSTA) have created *Science and Our Food Supply: Investigating Food Safety from Farm to Table*, an innovative, interactive supplementary curriculum for use in middle level and high school science classes. An advisory board of experienced teachers just like you developed and tested the materials.

Food safety has become an important national focus. Each year, approximately one sixth of the U. S. population has mild to severe illnesses caused by pathogens in food — and more than 3,000 people die from them. Learning food safety science will enable your students to better understand decisions and practices that may affect their personal health. It will encourage them to step up to the plate and take an active role in preventing foodborne illness.

This curriculum is linked to current education standards.

In each guide you'll find in-depth activities and labs covering this broad range of topics:

- Bacteria, including Foodborne Pathogens
- Proper food storage and handling
- Pasteurization Technology
- The Science of Cooking a Hamburger
- DNA Fingerprinting
- Outbreak Analysis

Food Safety Middle Level Guide (PDF 8MB) | Food Safety High School Guide (PDF 8MB)

The FDA will send a packet of information with activities included -**FREE**!

Resource:
FDA resource – Food Additives

https://www.fda.gov/Food/IngredientsPackagingLabeling/ucm115326.htm

Types of Ingredients	What They Do	Examples of Uses	Names Found on Product Labels
Emulsifiers	Allow smooth mixing of ingredients, prevent separation Keep emulsified products stable, reduce stickiness, control crystallization, keep ingredients dispersed, and to help products dissolve more easily	Salad dressings, peanut butter, chocolate, margarine, frozen desserts	Soy lecithin, mono- and diglycerides, egg yolks, polysorbates, sorbitan monostearate
Stabilizers and Thickeners, Binders, Texturizers	Produce uniform texture, improve "mouth-feel"	Frozen desserts, dairy products, cakes, pudding and gelatin mixes, dressings, jams and jellies, sauces	Gelatin, pectin, guar gum, carrageenan, xanthan gum, whey
pH Control Agents and acidulants	Control acidity and alkalinity, prevent spoilage	Beverages, frozen desserts, chocolate, low acid canned foods, baking powder	Lactic acid, citric acid, ammonium hydroxide, sodium carbonate
Leavening Agents	Promote rising of baked goods	Breads and other baked goods	Baking soda, monocalcium phosphate, calcium carbonate
Anti-caking agents	Keep powdered foods free-flowing, prevent moisture absorption	Salt, baking powder, confectioner's sugar	Calcium silicate, iron ammonium citrate, silicon dioxide
Humectants	Retain moisture	Shredded coconut, marshmallows, soft candies, confections	Glycerin, sorbitol
Yeast Nutrients	Promote growth of yeast	Breads and other baked goods	Calcium sulfate, ammonium phosphate
Dough Strengtheners and Conditioners	Produce more stable dough	Breads and other baked goods	Ammonium sulfate, azodicarbonamide, L-cysteine
Firming Agents	Maintain crispness and firmness	Processed fruits and vegetables	Calcium chloride, calcium lactate
Enzyme Preparations	Modify proteins, polysaccharides and fats	Cheese, dairy products, meat	Enzymes, lactase, papain, rennet, chymosin
Gases	Serve as propellant, aerate, or create carbonation	Oil cooking spray, whipped cream, carbonated beverages	Carbon dioxide, nitrous oxide

Resource:
Applied Food Science & STEM

https://ift.onlinelibrary.wiley.com/doi/10.1111/j.1541-4337.2010.00127.x

Comprehensive REVIEWS in Food Science and Food Safety

Comprehensive REVIEWS in Food Science and Food Safety

Feeding the World Today and Tomorrow: The Importance of Food Science and Technology

An IFT Scientific Review

by John D. Floros, Rosetta Newsome, William Fisher
Gustavo V. Barbosa-Cánovas, Hongda Chen, C. Patrick Dunne, J. Bruce German, Richard L. Hall, Dennis R. Heldman, Mukund V. Karwe, Stephen J. Knabel, Theodore P. Labuza, Daryl B. Lund, Martina Newell-McGloughlin, James L. Robinson, Joseph G. Sebranek, Robert L. Shewfelt, William F. Tracy, Connie M. Weaver, and Gregory R. Ziegler

To link to the article, simply Google: *"Comprehensive Review in Food Science & Food Safety 'Feeding The World Today & Tomorrow'"*

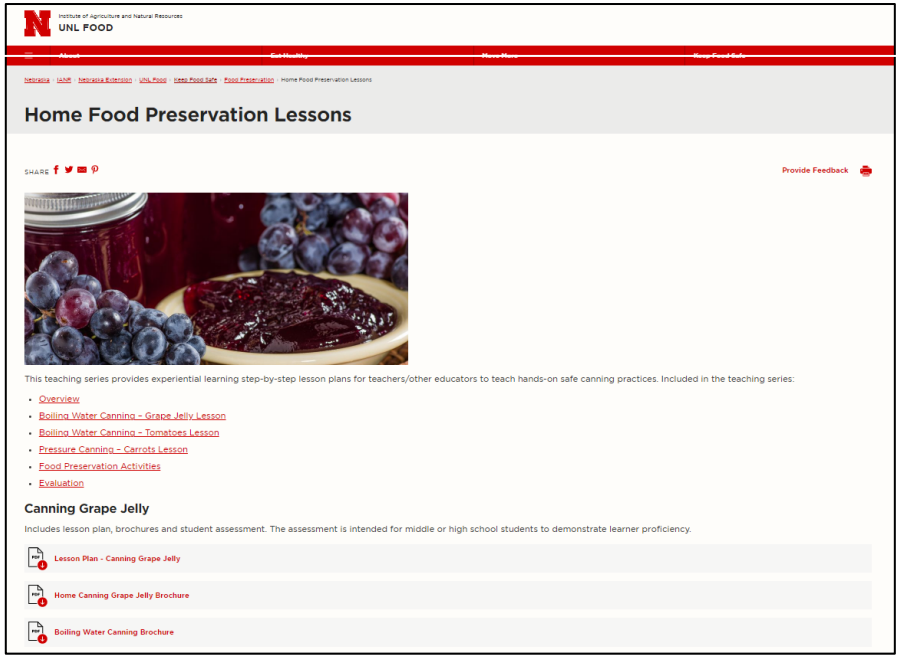
Applications of Disciplines Involved in Food Science and Technology

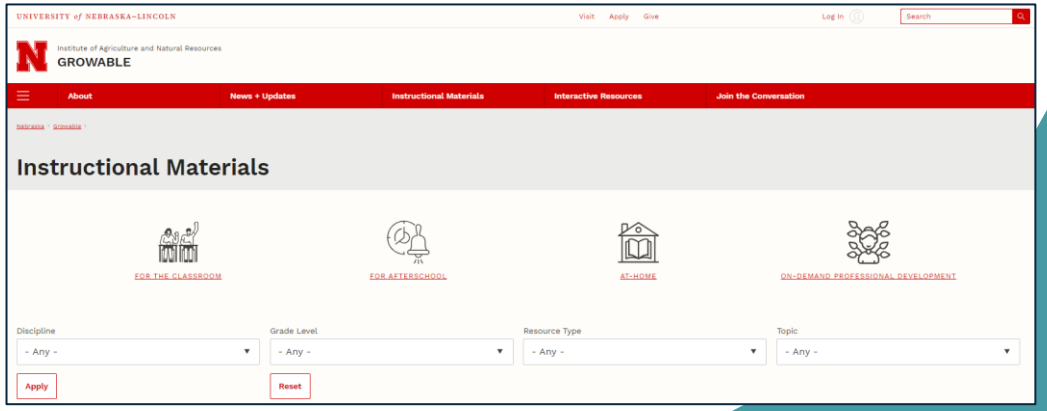
Discipline	Examples of Food Science and Technology Applications
Biology, Cell Biology	Understanding of postharvest plant physiology, food quality, plant disease control, and microbial physiology; food safety
Biotechnology	Rice with increased content of beta-carotene (vitamin A precursor); enzymes for cheesemaking, breadmaking, and fruit juice manufacture
Chemistry	Food analysis, essential for implementing many of the applications listed here; improved food quality; extended shelf life; development of functional foods (foods and food components providing health benefits beyond basic nutrition)
Computer Science	Food manufacturing process control, data analysis
Genomics	Understanding of plant and animal characteristics; improved control of desirable attributes; rapid detection and identification of pathogens
Materials Science	Effective packaging; understanding of how materials properties of foods provide structure for texture, flavor, and nutrient release
Microbiology	Understanding of the nature of bacteria (beneficial, spoilage, and disease-causing microorganisms), parasites, fungi, and viruses, and developments and advances in their detection, identification, quantification, and control (for example, safe thermal processes for commercial sterilization); hygiene; food safety
Nutrition	Foods fortified with vitamins and minerals for health maintenance; functional foods for addressing specific health needs of certain subpopulations; development of diets that match human nutrient requirements; enhanced health and wellness
Physics, Engineering	Efficient food manufacturing processes to preserve food attributes and ensure food safety; pollution control; environmental protection; waste reduction efforts
Sensory Science	Understanding of chemosenses (for example, taste and odor) to meet different flavor needs and preferences
Toxicology	Assessment of the safety of chemical and microbiological food components, food additives

Resource:
Univ. of Nebraska Lincoln – Food Science Labs

1. Food Innovation Center Virtual Tour - https://innovate.unl.edu/food-innovation-center
2. Food Safety - https://food.unl.edu/food-safety
3. Food Safety Lunch hour videos - https://nemep.unl.edu/food-safety-lunch-hour
4. Game Based Learning about Genetic Engineering & Biotechnology https://growable.unl.edu/tags/hs-ets1-3
5. Home Food Preservation Lab - https://food.unl.edu/home-food-preservation-lessons

6. Institute of Ag & Natural Resources GROWABLE instructional materials & interactives https://growable.unl.edu/instructional-materials

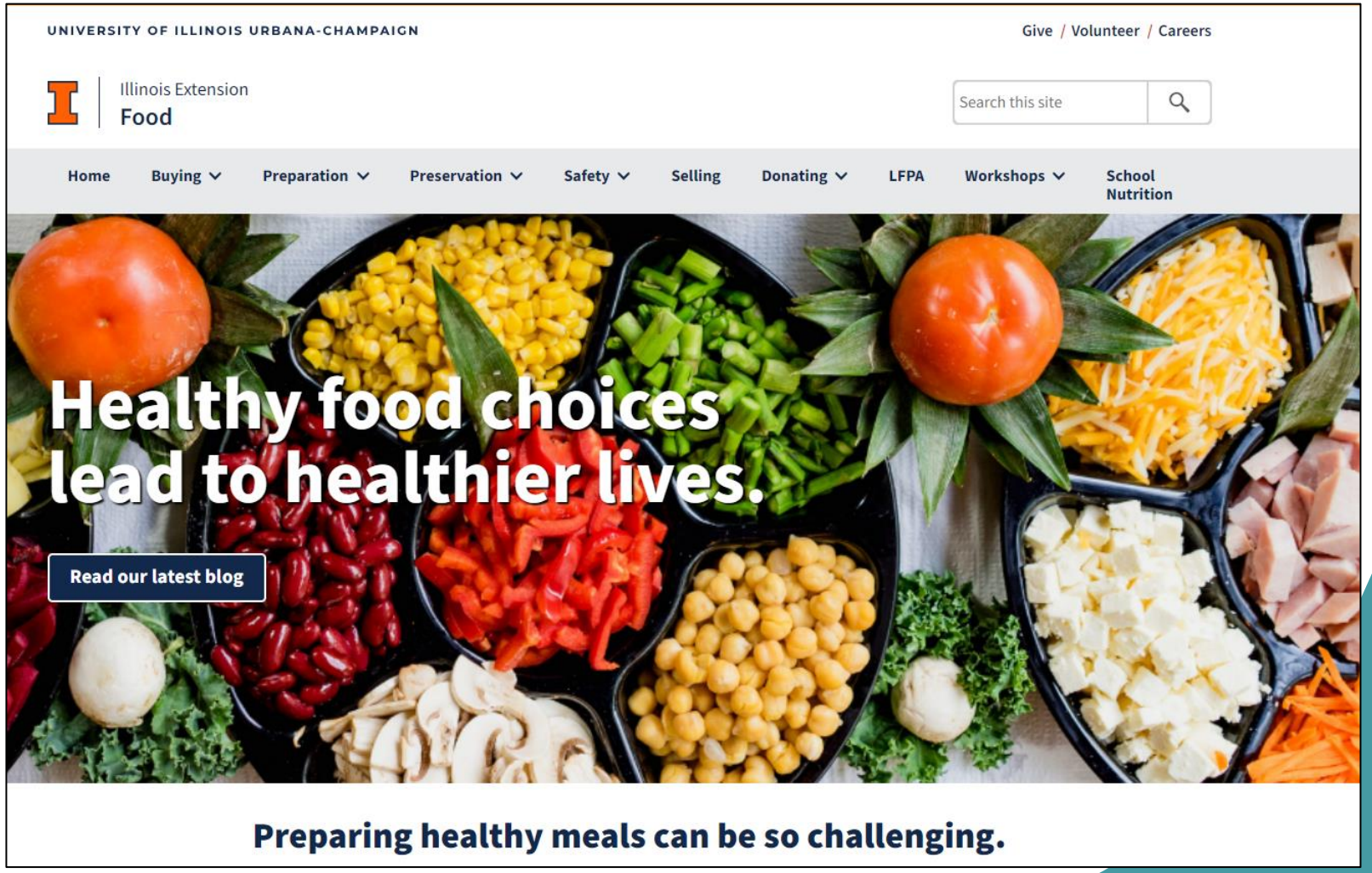




Resource:
Univ. of Illinois Extension

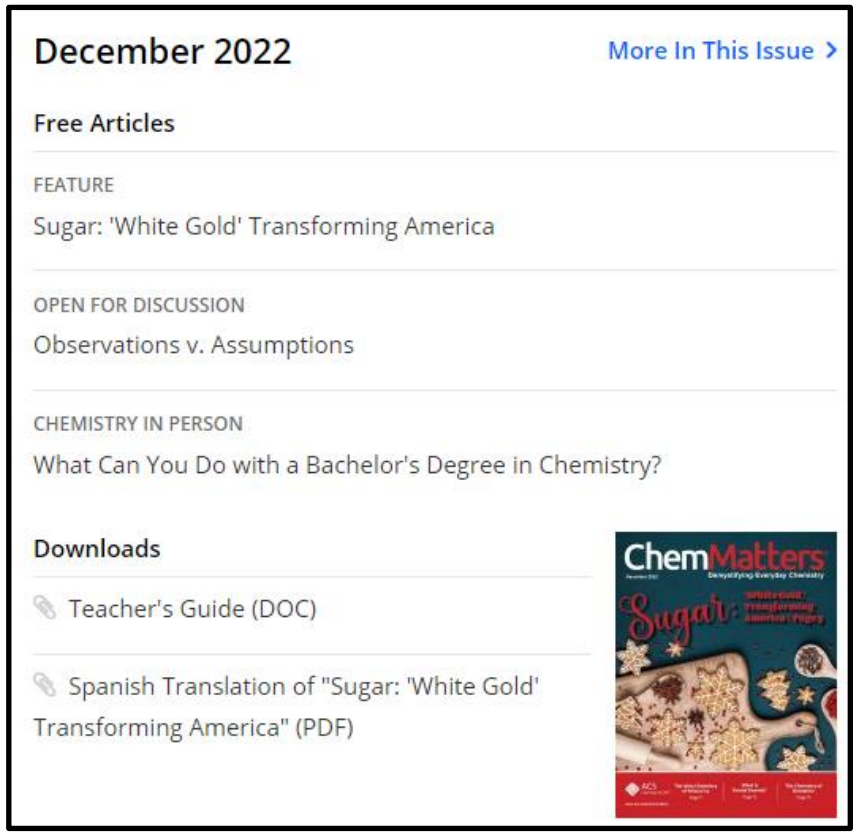
https://extension.illinois.edu/food

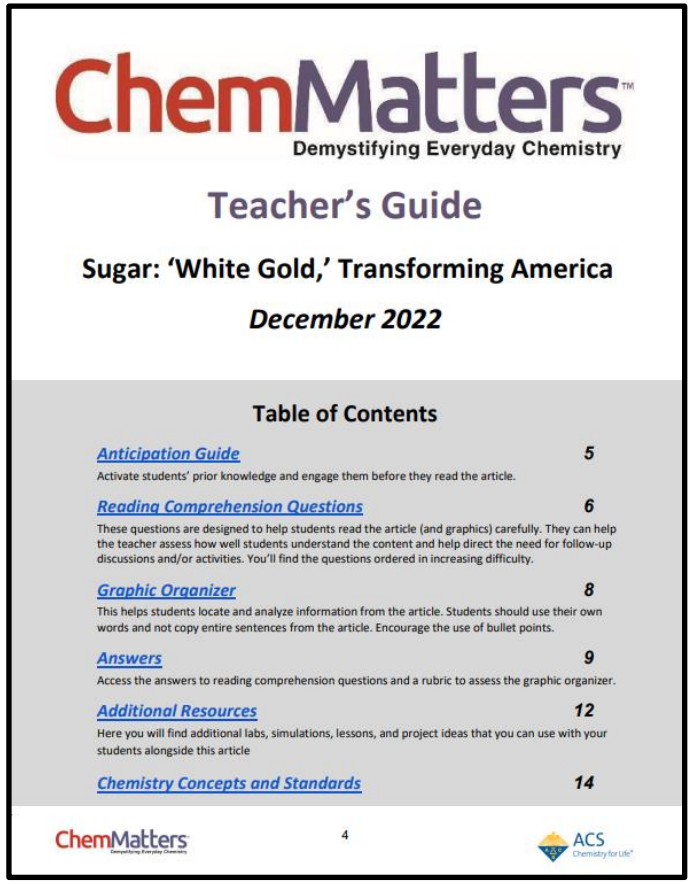
- Food Safety
- Food Preservation
- Food Waste



Resource:
American Chemical Society - ChemMatters

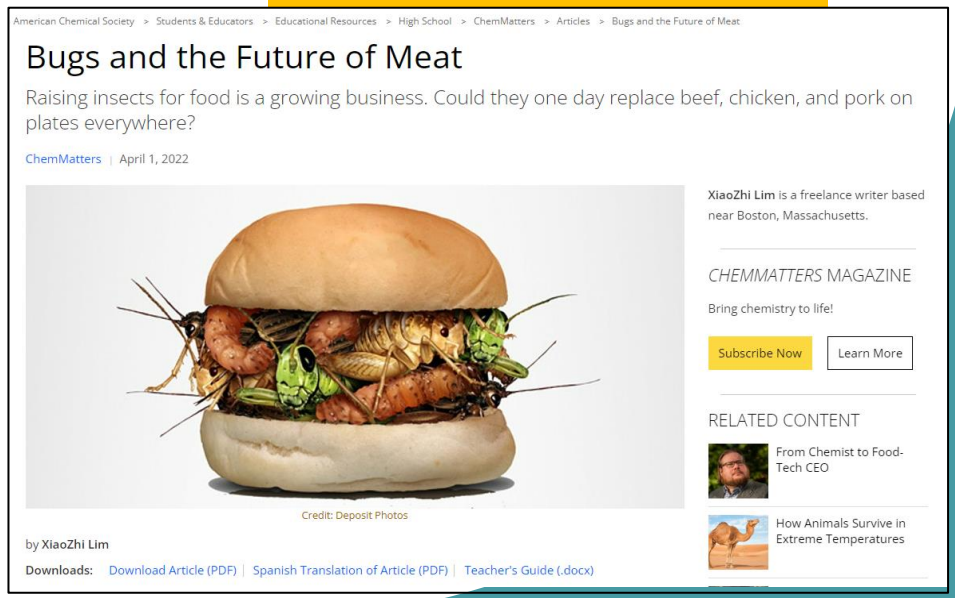
http://www.acs.org/content/acs/en/education/resources/highschool/chemmatters.html





ChemMatters has a lot of information on-line, full lessons with videos, activities, etc. across a wide range of food & non-food topics.

It's a GREAT Resource!!



Resource:
ACS: Food & Cooking Chemistry

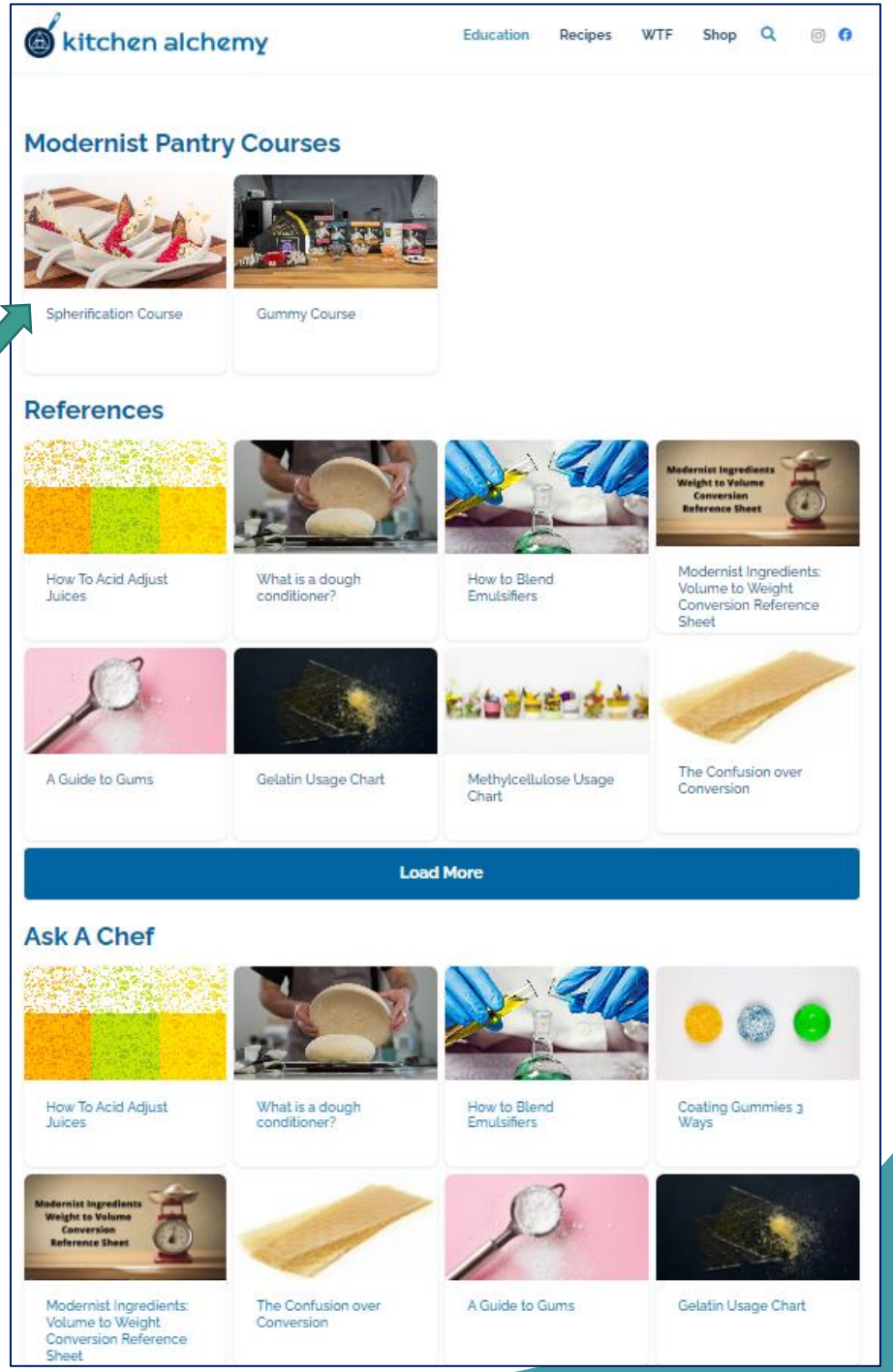
https://www.acs.org/content/acs/en/education/students/highschool/chemistryclubs/activities/food-and-chemistry.html

From ACS.org, the pathway to get to the ChemClub activities.

Resource:
Modernist Pantry
Kitchen Alchemy

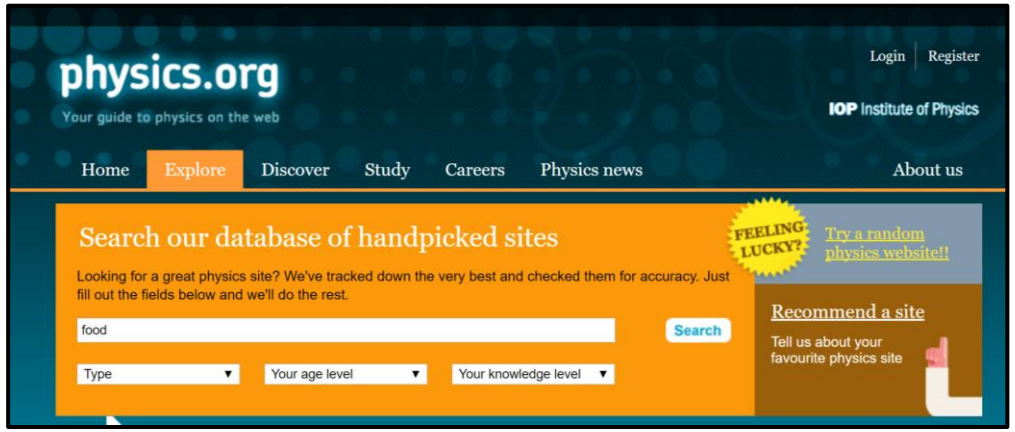
https://blog.modernistpantry.com/education/

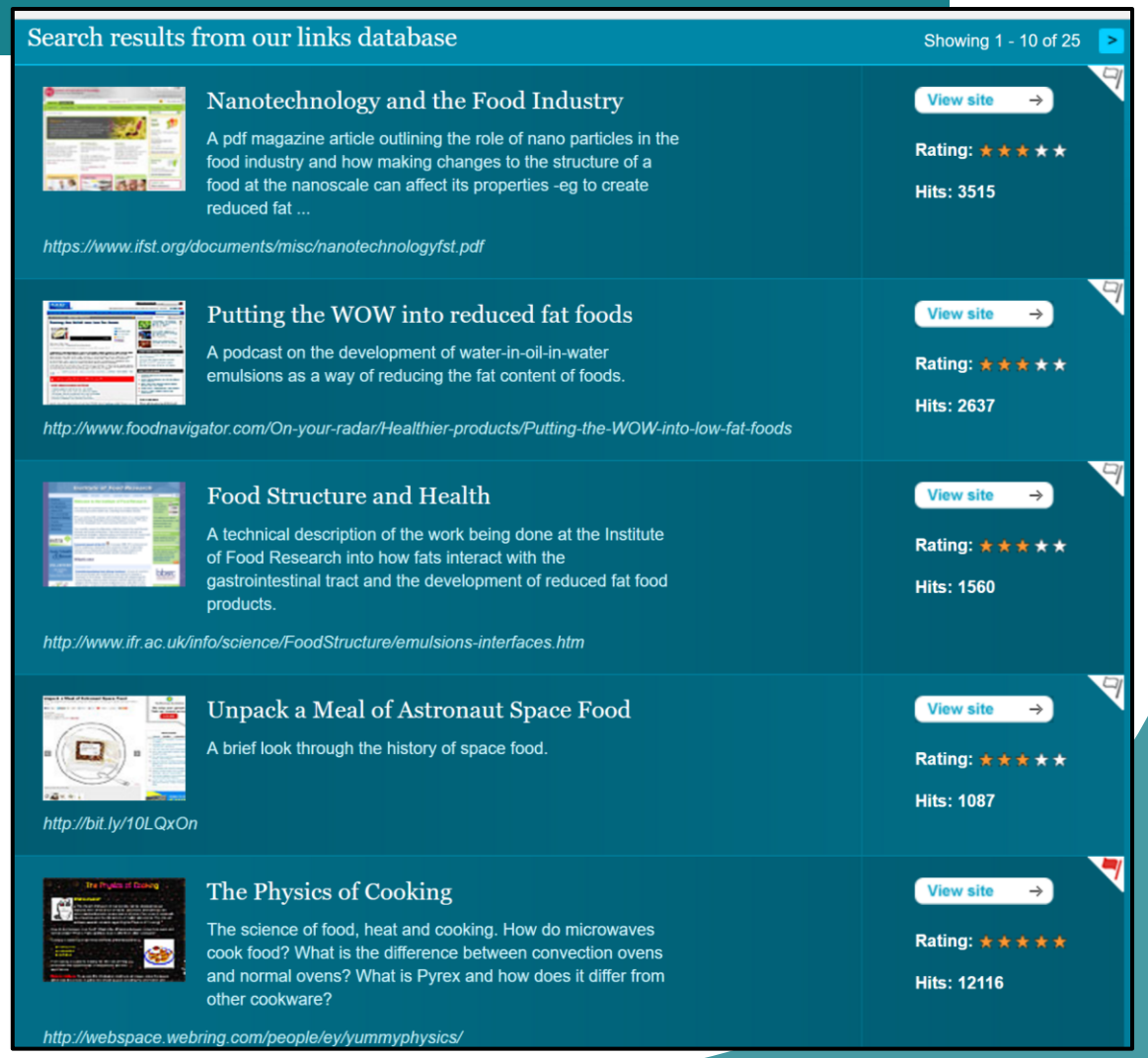
One of my favorite experiments is Molecular Gastronomy or Culinary Sphereification - you can buy 'food grade' ingredients and watch the videos to create a cool lab for your students!



Teach Physics with Food!

http://www.physics.org/explore.asp





Resources:
Food Loss & Food Waste

Food and Agriculture Organization of the United Nations

http://www.fao.org/save-food/resources/keyfindings/infographics

Resources:
Global Water Issues

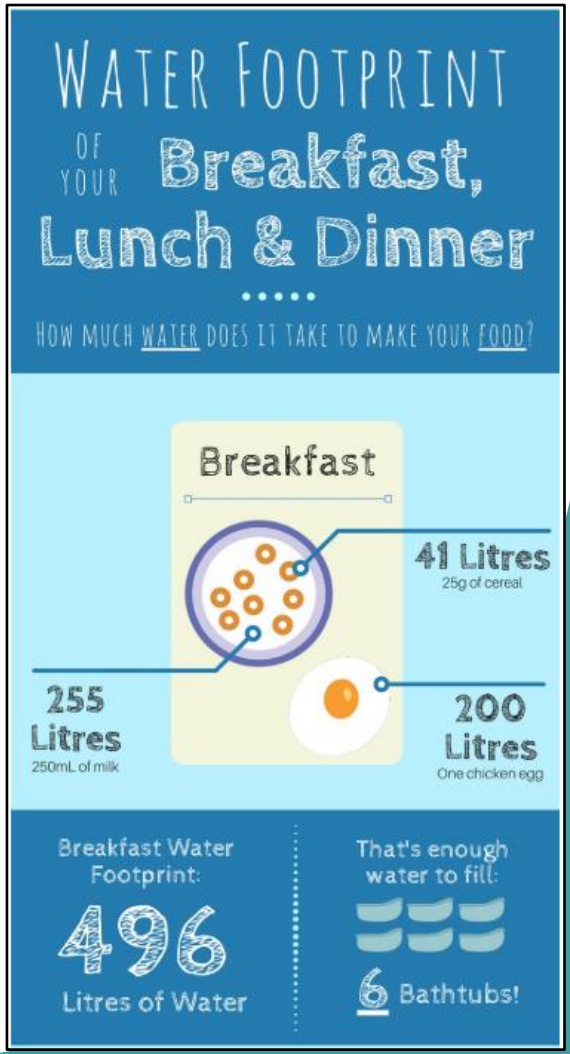
WATER FOOTPRINT® CALCULATOR

- Water Calculator

  https://www.watercalculator.org/

- Cape Town, South Africa will turn off it's Taps!
  https://news.nationalgeographic.com/2018/02/cape-town-running-out-of-water-drought-taps-shutoff-other-cities/

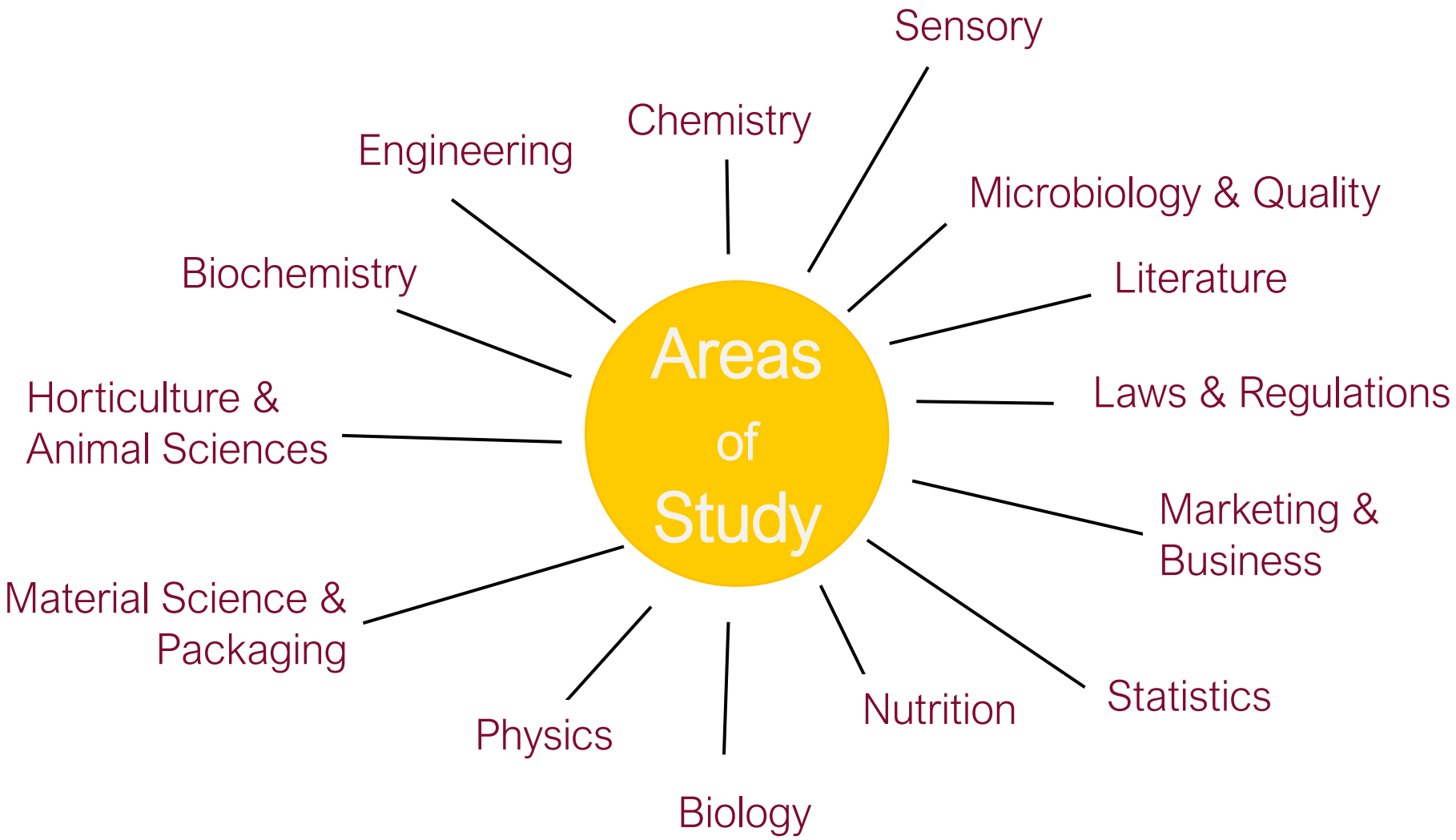
- Water Footprint, National Geographic:
  https://www.youtube.com/watch?v=2T_n0oi9YdY
  - 13 gal water=1 gal fuel, 30 gal water=1 glass of wine
  - Agriculture consumes about 80% water consumed.



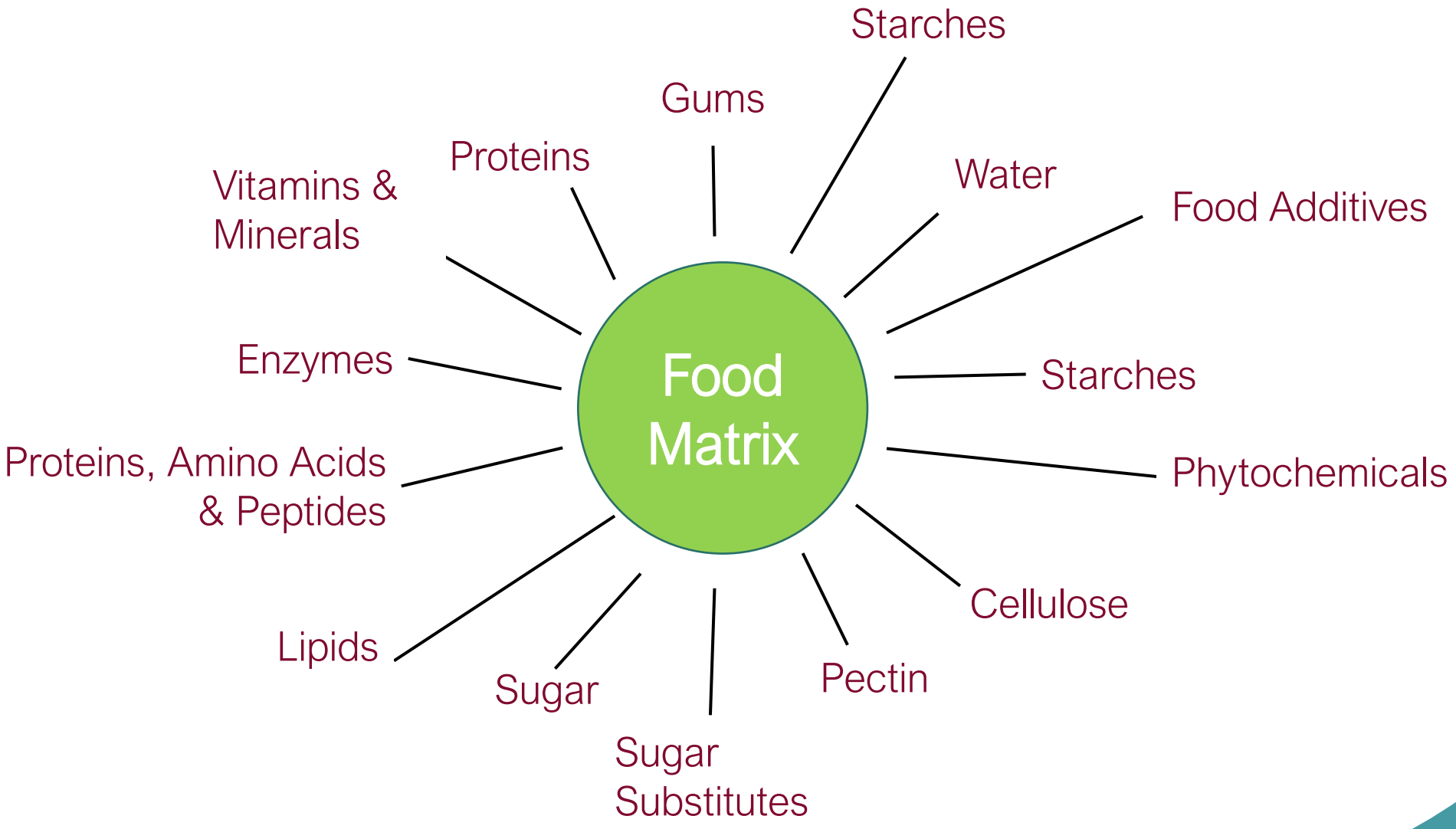
Resources:
Monell Taste & Smell Institute

http://www.monell.org

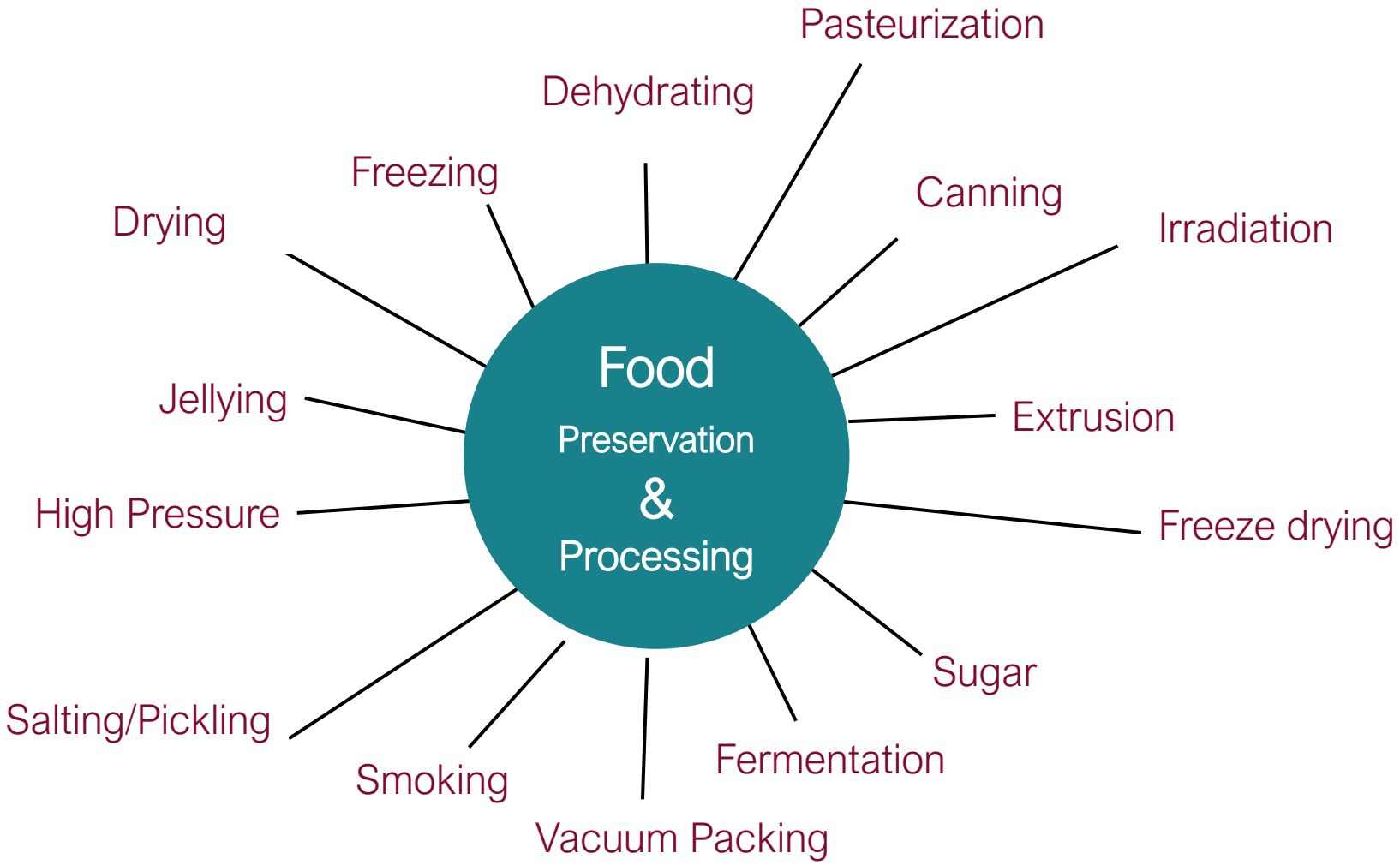
What is Food Science?



Food Scientists study...



Food Scientists understand



Let's experiment!

- **Let's experiment with flavor varieties and seasoning blends.**
  - Who makes the flavors or seasonings?

    Flavor Chemists are speciality chemists that create all the flavored products for every product around the world. They are trained by committing to a 7-year apprenticeship, where they study and work to learn about every seasoning and flavor ingredient used in food & beverages.
- **Flavor & seasonings are considered 'ingredients' in finished food and beverages.**
  - When you look at the ingredient statements, there is a company behind each ingredient. Each company employs scientists, business professionals, engineering, and manufacturing professionals.
- **Developing flavors and seasonings is a fun job; having the opportunity to influence a finished product's success is very rewarding!**
- **Example of a company that sells flavors to food & beverage companies:** McCormick Flavor solutions

Create a Seasoning (Slide 2/3)

Mixing up a taco seasoning

Flavors can be liquid or dry. In a lab setting, components are mixed to create new taste experiences, or to emulate something that is a desired flavor. Spices mixed together are also called seasonings, another form of a dried or powdered flavors. Flavors can be made with everyday kitchen spices, not just in a lab! In this lab, we will explore the world of flavors and create our own taco seasoning. It's easy to buy a taco seasoning at the store, but even better to make your own. You can personalize your seasoning based on your taste preferences!

Approximate Time needed for demonstration:

- 5 minutes

Ingredients you will need:

- 1 tablespoon chili powder
- 1 tablespoon salt
- 1 teaspoon garlic
- ½ teaspoon onion
- 1 teaspoon turmeric
- ¾ teaspoon cumin
- ¾ teaspoon cayenne
- ¼ teaspoon of oregano
- 1 tablespoon + 1.25 teaspoons flour

And 1 bag of chips (Potato chips or tortilla chips) to season

Or, the seasoning can be added to ground turkey/chicken/beef, sour cream or greek yogurt.

Equipment you will need:

1. Mixing bowl
2. Spoon
3. Microwave safe bowl (*if you are seasoning chips*)
4. Large zipper baggie (*if you are seasoning chips*)

Instructions:

1. Gather mixing bowl and spoon
2. Pour each ingredient into the bowl
3. Mix thoroughly together, so no spices are clumping together.
   - We just made a taco seasoning. You can use this in many ways! You can season your cooked meat for tacos, add to sour cream or Greek yogurt for a southwest chip dip or use it to season chips. If you want to season chips, follow the instructions below.

Flavor solutions

Science demonstration provided by McCormick Flavor Solutions, 2024
https://www.fona.com/learn/discover-fona-food-science-for-young-minds/

Mixing up a seasoning

Instructions to season chips (if you so choose):

a. To season chips, grab a microwave safe bowl.
b. Put 1-2 hands full of chips into the bowl.
c. Microwave chips for 30 seconds.
d. Dump the warm chips into a zip lock baggie.
e. Sprinkle on the seasoning into the bag & shake until the seasoning is coating the chips.

What's happening?

When we mix this seasoning together, it is very similar to what we do here in the lab every day, just with a slightly different set of ingredients.

Flavors rely on the sense of smell and taste (see **Experiment-How do you taste?** to see how aroma affects how something tastes).

Many of the chemicals that we use are for the smell part of taste. Without these, what we call volatiles, taste would be limited to only what our tongues can detect.

The tongue is limited to five different tastes called the basic taste.

The spices that we used in our lab today give off both a volatile perception and a basic taste response. Together, these are what cause the seasoning to taste like tacos.

If you chose to season potato chips or tortilla chips, when the chips were warmed in the microwave the oils are released from the chip and come to the surface. When the chips shake in the baggie with the seasoning, it allows the seasoning to adhere to the oils and stick to the chips.

Delicious!

Flavor solutions

Science demonstration provided by McCormick Flavor Solutions, 2024
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For more inspiration: https://youtu.be/W8U85lnZKc8?si=NtrY8xzY4YHKyIKH

Create a Seasoning (slide 3/3)

Using the instructions on previous slide, created a variation of chips. Change the seasoning, chip or snack base and create a whole new eating experience!

Buttermilk Ranch Seasoning

1. ½ cup Buttermilk Powder
2. 1T dried Parsley
3. 1T Garlic Powder
4. 1T Onion Powder
5. 2 t dried Dill
6. 1 t freeze dried Chives
7. ½ t black pepper

Barbecue Seasoning

1. ¾ + 1/8 teaspoon garlic powder
2. ½ + 1/8 teaspoon onion powder
3. 1 teaspoon salt
4. 1 teaspoon tomato powder
5. ½ +1/8 teaspoon vinegar powder
6. ¾ + 1/8 teaspoon sugar
7. 1+1/4 teaspoon powdered BBQ sauce flavor
8. 1/8 teaspoon powdered hickory or beechwood smoke

Other experiments to demonstrate the science of food - as suggested in the chat by other educators

- Talk about yeast & fermentation in bread making.
- Herb lesson, create simple syrups with various herbs for various flavored iced teas.
- Egg unit - Egg as an emulsifier to make Mayo. Or investigate how heat & acids affect egg protein.
- Ice cream to investigate colligative properties on solutions.
- Pizza dough – from flour to elastic dough, gluten development, it forms a 'net' to catch carbon dioxide.
- AP Chem - Chemistry of food & baking
- Making cultures in biology class
- Milk to Yogurt
- Caramelization of sugar
- Make butter, all the various stages & phases cream goes through.

**Anything used for an experiment regarding food, ensure your ingredients are 'food grade' and 'safe for consumption.'*

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