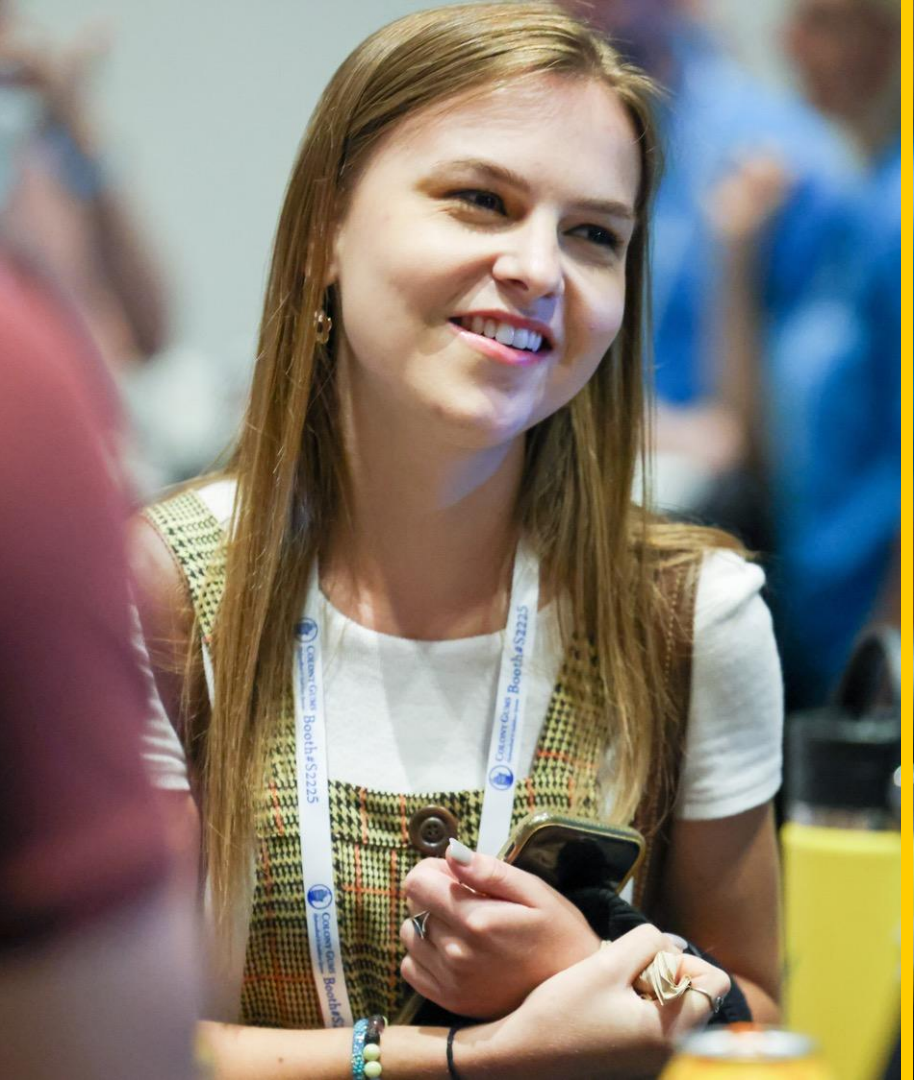


IFT Science of Food: June Educator Event

June 17, 2026

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

IFT | Feeding Tomorrow Fund

Welcome & Agenda

Welcome, Sign In, and Overview	5 minutes
Introduction to Food Industry (Katie)	25 minutes
The Science of Taste & Smell (Katie)	30 minutes
The Science of Eggs (Linda)	25 minutes
Break - gather ingredients	5 minutes
Egg Experiments (Linda)	25 minutes
Careers in the Food Industry (Linda)	25 minutes
Close & Questions	10 minutes

Objectives & Goals

- Increase awareness that food science is a part of everything we eat/drink.
  - Appreciation for using food science examples to help teach scientific concepts.
- 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.
- Utilize educational resources available on IFT & McCormick Flavor Solutions website to easily integrate the science of food into curriculum.
  - Create a network of food experiments that teach scientific concepts.
- Attract curious and innovative minds.
  - Encourage students that are passionate about science & problem solving, to consider a **career** in the food industry.

Overview

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.

Overview

Feeding the minds that feed the world

Envision wh… …e when they work together: providing e… …stainable food supply.

IFT Feeding Tomorrow Fund

We sha…

Fee… …sts con…

CFSF Ch… Fo… Fou…

…try professionals

McCormick Flavor Solutions

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.

Next Generation Science Standards

NEXT GENERATION SCIENCE STANDARDS
For States, By States

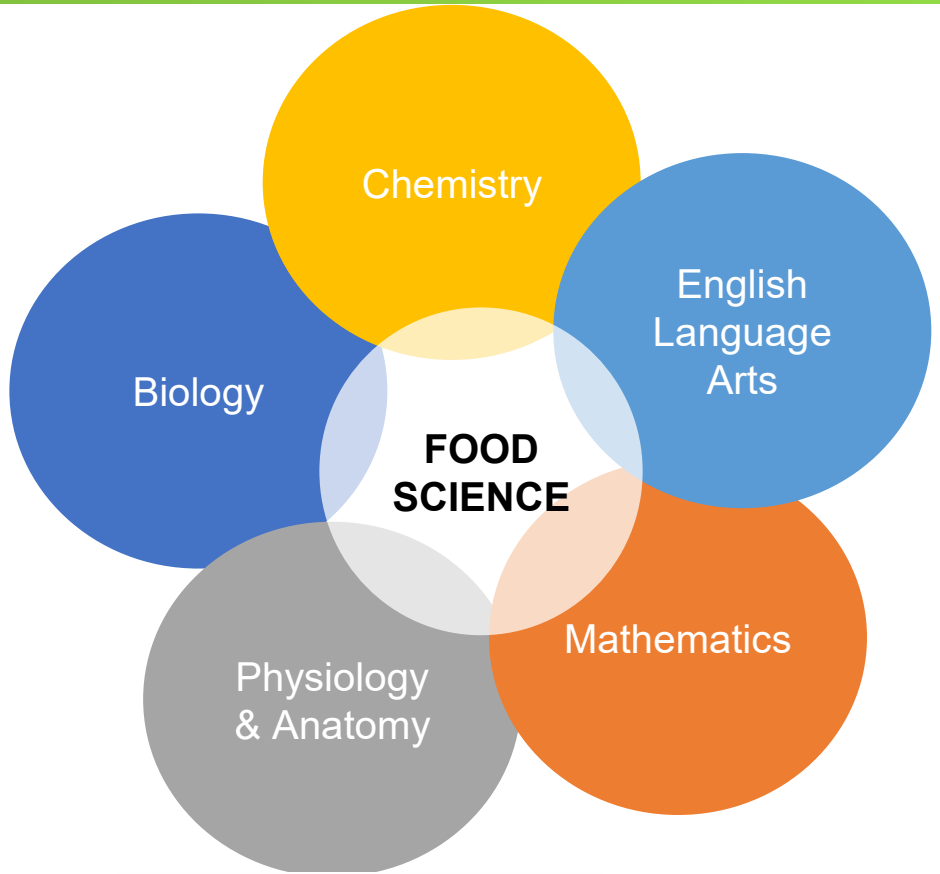
Practices

- Demonstrations
- Hands on Activities

Cross Cutting Concepts

- Interdisciplinary connections

Disciplinary Core Ideas



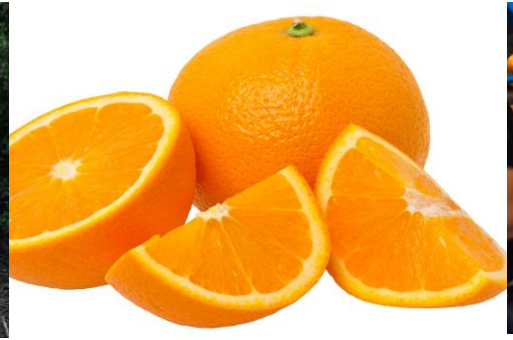
IFT feeding the minds that feed the world

Flavorsolutions

CFSF Chicagoland Food Science Foundation

The food we eat...





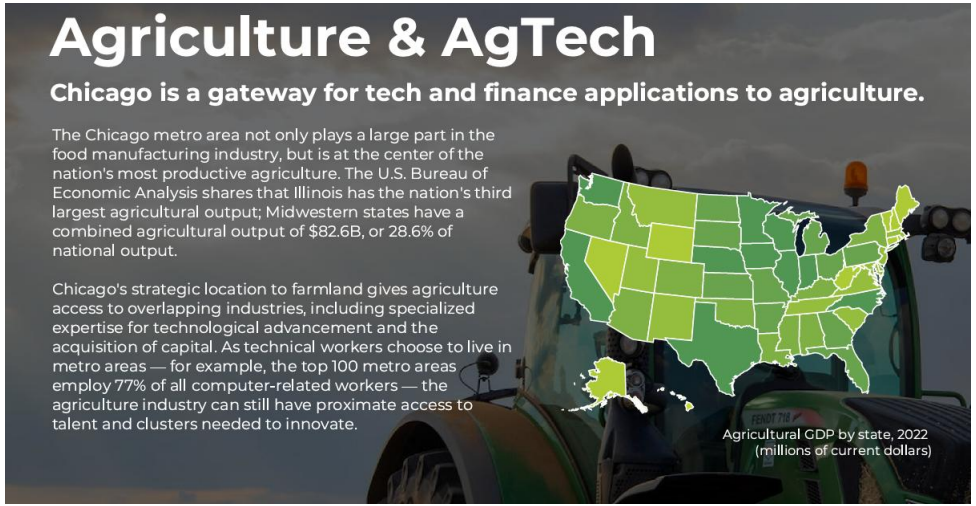


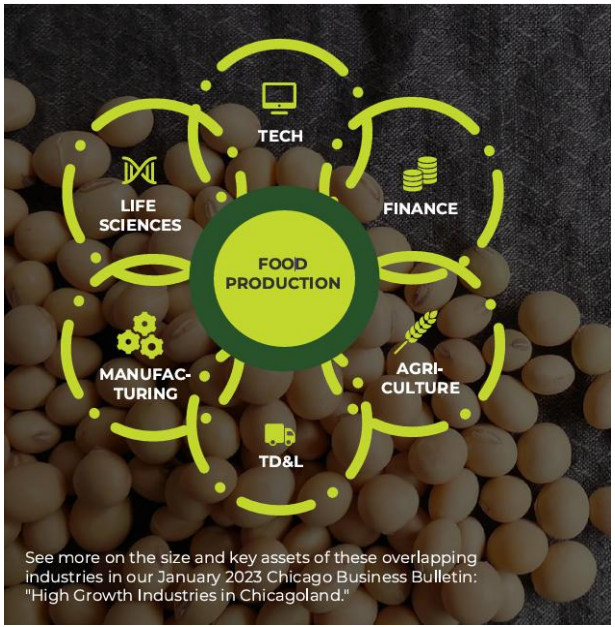


What IS the food industry?

What IS the food industry?

Food Industry *is* Food & Beverage Manufacturing, *is not* restaurants, food service, etc.





Food Industry Facts

- Global food industry is ~ **$8.71 Trillion/year sales, with 6% growth**
- US Food Industry is just shy of **$1.2 Trillion.**
- Major Food hubs for food manufacturing include: the Major Metro Areas

The largest in the nation is: Chicagoland's Food and Beverage industry

- 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.*

Food Industry Segments

1. **Suppliers**
   - Farms
   - Ingredients in the foods you eat (grain, sweeteners, vitamins, colors, flavors, etc)
   - Packaging
   - Equipment (testing, manufacturing)
2. **Manufacturers**
   - Processors (Dairies, Millers)
   - Refineries
   - Distilleries
   - Bakeries
   - Food manufacturers (Pepsi, Nestle, Kraft, Wrigley, Tyson, etc)
3. **Users**
   - Hospitals
   - Restaurants
   - Schools & Universities
   - Consumers

What IS the food industry?

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. Danone 

Brands you may not know they own:

1. Gerber, Purina Pet, Häagen-Dazs
2. Quaker, Tropicana, Doritos
3. Goose Island, Corona, Beck, Labatt, Fosters
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, diverse portfolio of international convenience products
8. Food ingredients (cocoa, oils, flour, hydrocolloids, starches, more)
9. Honest, Vitamin Water, Powerade, Zico, Gold Peak tea
10. International Delight, Silk, Activia, evian & infant nutrition

Food Industry Fun Facts

1. The military is one of the largest consumers/users of food science, MRE meals.
2. About ⅓ of all the world's food is wasted.
3. 1 in 4 Hazelnuts ends up in a jar!
4. Expiration dates on bottled water, has nothing to do with the water.
5. Froot Loops are all the same flavor.
6. Flaming hot Cheetos were invented by a Janitor
7. Lima beans are deadly – raw lima beans have lethal amounts of cyanide in them – just cook them!
8. The organic food movement, started as a very "local" mentality re: produce.
9. Food tastes different when you are flying.
10. Space travel would not be possible without Food Science.

What IS the food industry?

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

IFT feeding the minds that feed the world

Flavorsolutions

CFSF Chicagoland Food Science Foundation

The Science of Food & Flavor

Katie Sudler – McCormick

- 25 years in the Flavor Industry, supporting Food& Beverage Companies
- **Current Role:** Sr. Manager, Educational Platforms at McCormick & Company
  - Customer Programming - Flavor University, Industry Engagement & PR, Community Education
- **Past Roles:** Food Regulations, Business Unit Marketing, Corporate Marketing, PR, Community Education, Trade Shows
- **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 & Consumer Sciences

Katie Sudler – McCormick

McCormick Brands

Flavors

Let's level set!

Nutrition Facts

9 servings per container

Serving size 2/3 cup (95g)

Amount per serving

Calories 240

	% Daily Value*
Total Fat 14g	18%
Saturated Fat 9g	45%
Trans Fat 0g	
Cholesterol 40mg	13%
Sodium 50mg	2%
Total Carbohydrate 25g	9%
Dietary Fiber 1g	4%
Total Sugars 24g	
Includes 19g Added Sugars	38%
Protein 4g	

Vit. D 0.1mcg 0% • Calcium 120mg 10%

Iron 0.4mg 2% • Potassium 200mg 4%

*The % Daily Value tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

Cream, Skim Milk, Milk, Sugar, Coconut Oil, Cocoa (processed with alkali), Peanut Oil, Pasteurized Egg Yolks, Cocoa, Natural Peppermint Flavor, Natural Flavor, Tara Gum, Guar Gum, Soy Lecithin .

What's your flavor?

Your beverage choice may depend on:

- Temperature outside
- Day of the week
- What you are doing
- Where you are
- Who you are with
- Convenience
- and more

Why teach about food?

- As consumers, it's pertinent to know more about the food we consume!
  - Your students are already familiar with food!
- Inherent interest
  - They are being "fed" information about cooking, nutrition, trends, new products on social media
- Interdisciplinary

- Students love playing with their food!

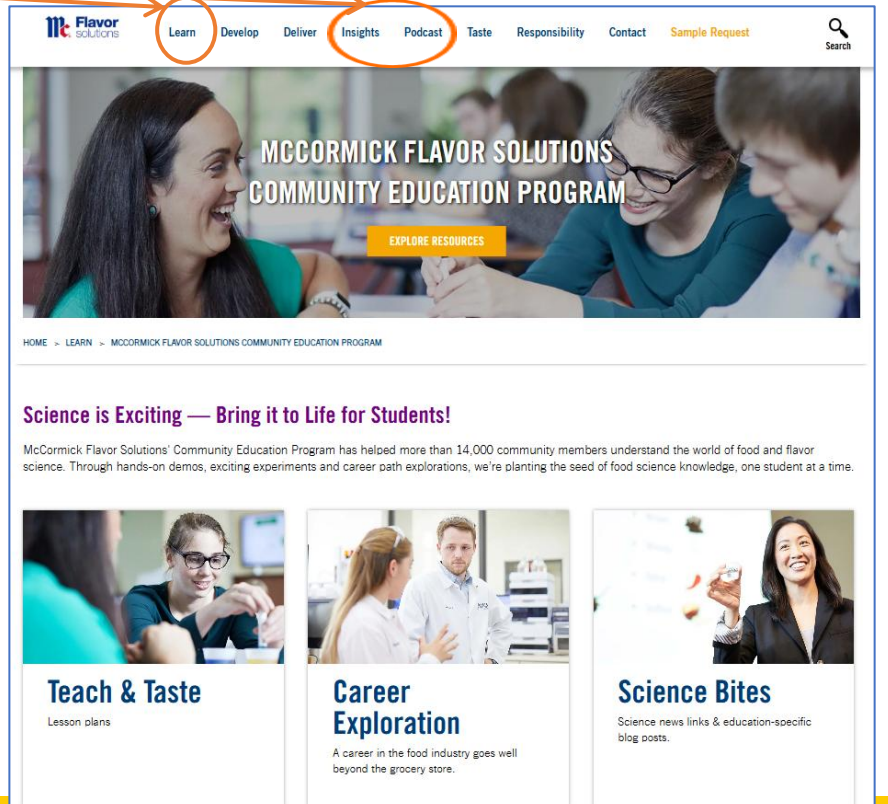
  Taste the "science".

McCormick Flavor Solutions Resources

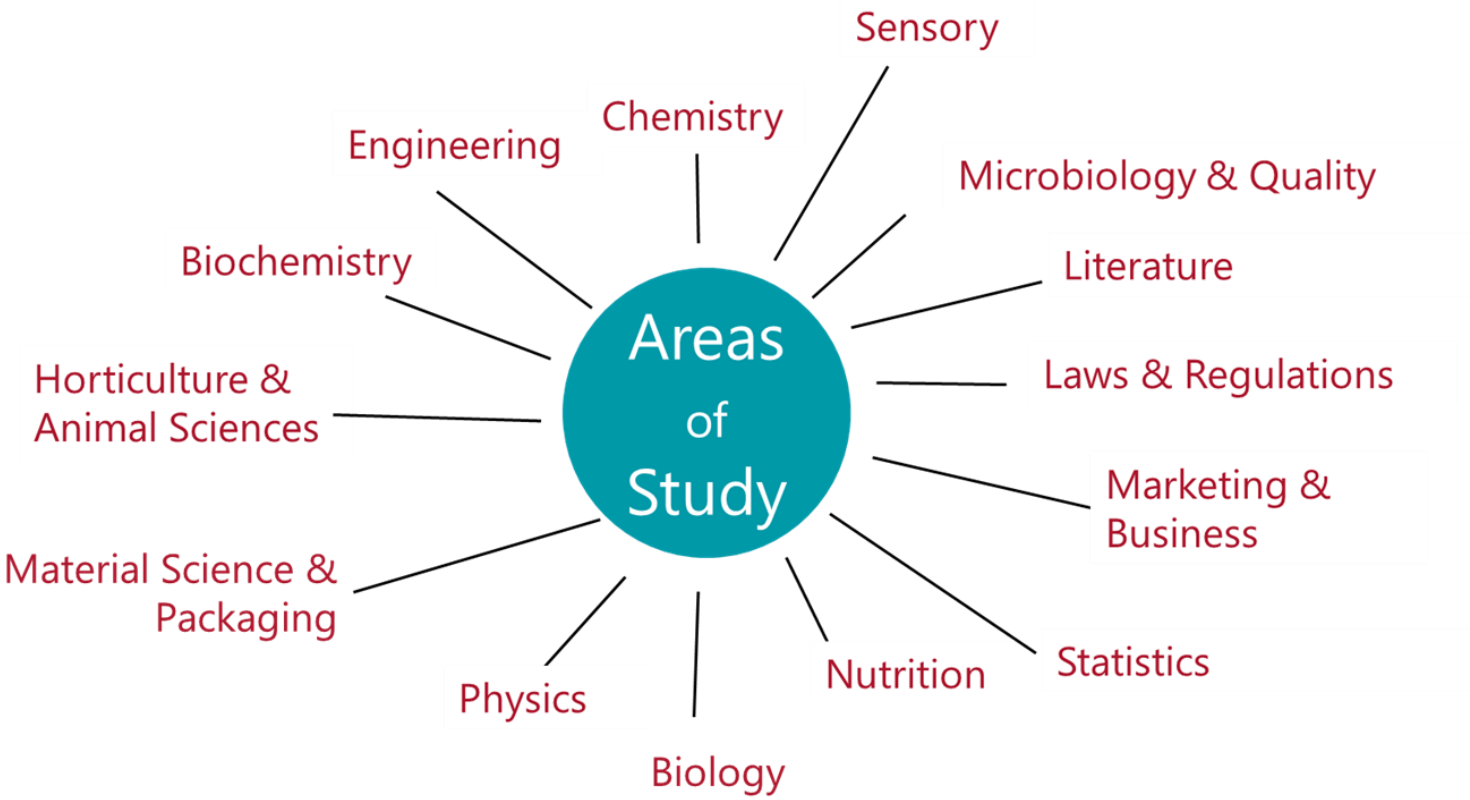
https://www.mccormickflavor.com/learn/discover-fona-food-science-for-young-minds

McCormick Flavor Solutions

- **Teach & Taste**
  - Lesson Plans & Demonstrations
- **Career Exploration**
  - FONA Employee short career videos
- **Science Bites**
- **Insights: Trend & White Papers**
- **Podcast:** with technical & marketing



What do Food Scientists study?



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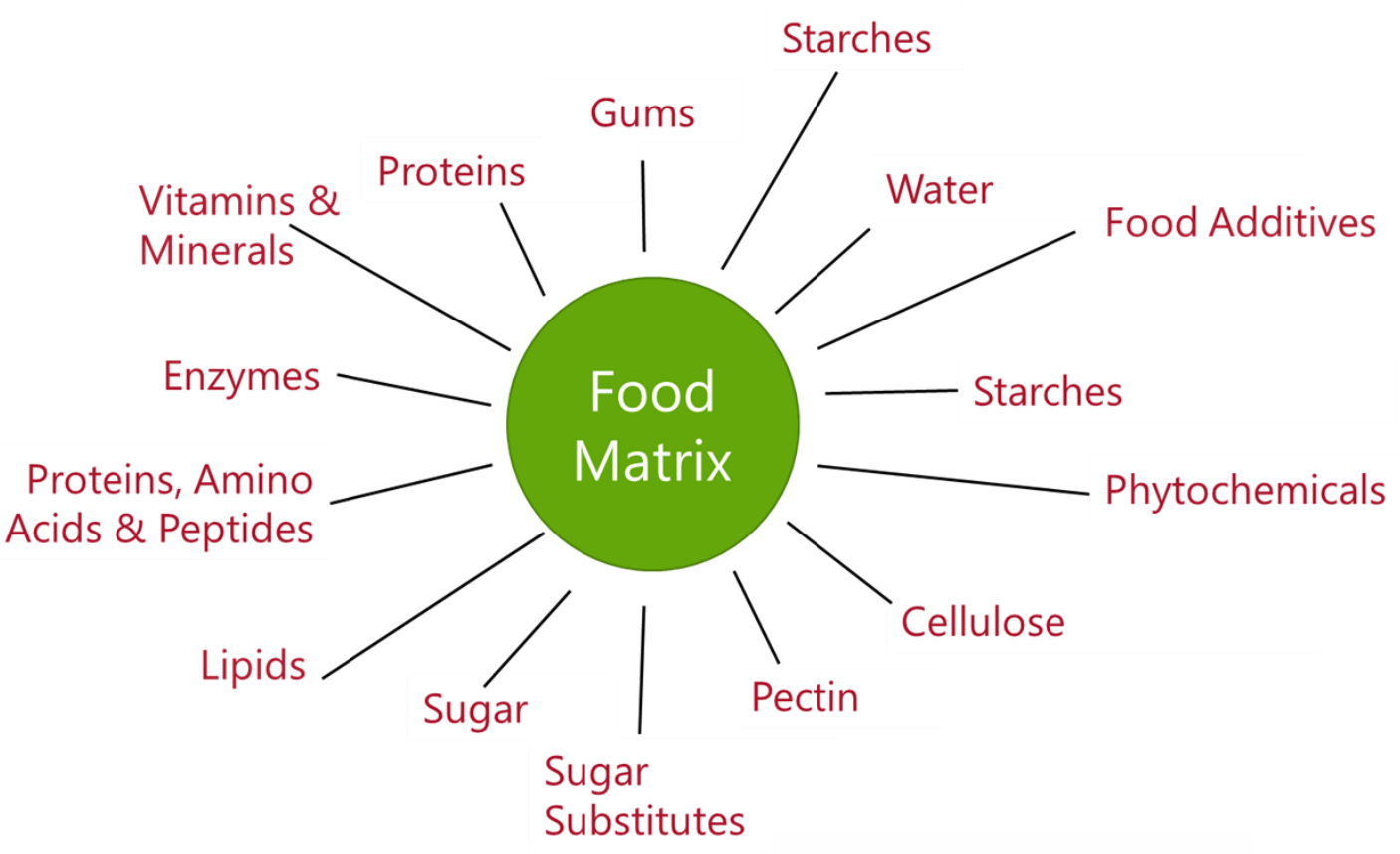
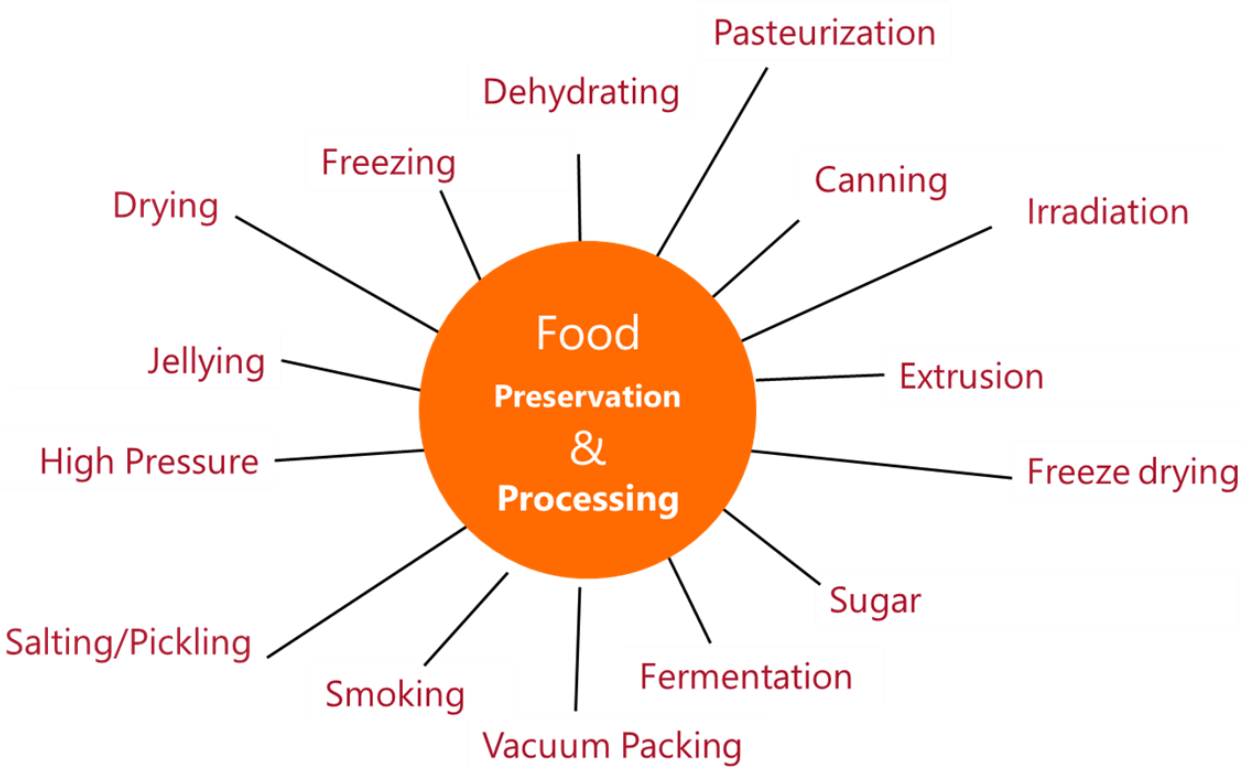


What do Food Scientists understand?



What do Food Scientists understand?

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.*

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.

Top Concerns or Areas of Interest

Hunger In the US:

- 12.7% households had food insecurity at some point in the year
- Children in 7.8% of households are food insecure
- Globally, children under 5: 45% of all child deaths occur from poor nutrition.
  - 5.6% are overweight
  - 7.5% are wasting
  - 22.2% are stunting

Food Safety

Food Waste ½ of all food globally is wasted

Water usage and shortage

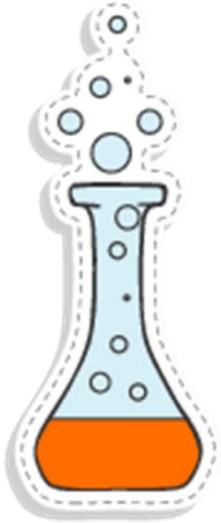
Environmental concerns & demand better packaging options

Ingredients in our food

"Poverty is the principle cause of hunger, hunger is a cause of poverty."
www.worldhunger.org

Chemicals in Our Food

Before we talk about food & flavor we need to take a few steps back and talk about **Chemicals.**

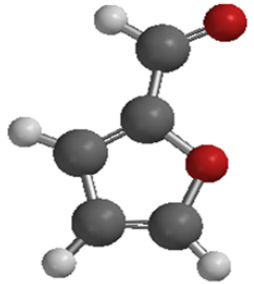


Chemicals in Our Food

What is a CHEMICAL?

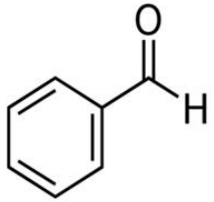
Chemicals in Our Food

- Chemicals are the backbone of everything we see, smell, touch and experience.
- Chemicals can be organic, natural or artificial.
- Chemicals can be toxic, neutral or healthy for us.
- Chemicals can be acids, neutral pH or bases.
- Chemicals are everywhere!
- A chemical is made of elements.



Chemicals in Our Food

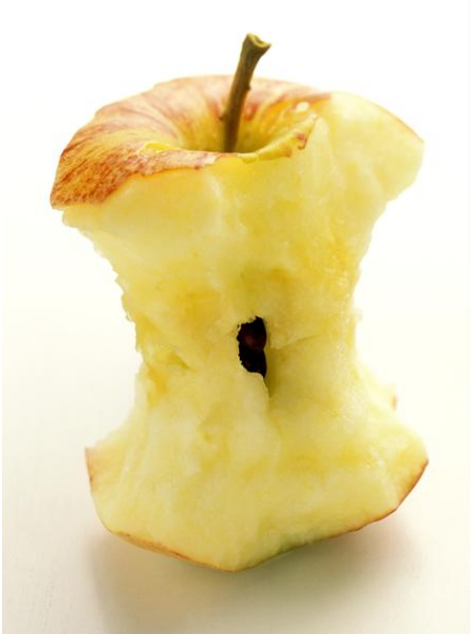
A building block of a flavor...



Benzaldehyde

*Lanthanide series	lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.04
**Actinide series	actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendelevium 101 Md [258]	nobelium 102 No [259]

Chemicals in Our Food



What do you smell?

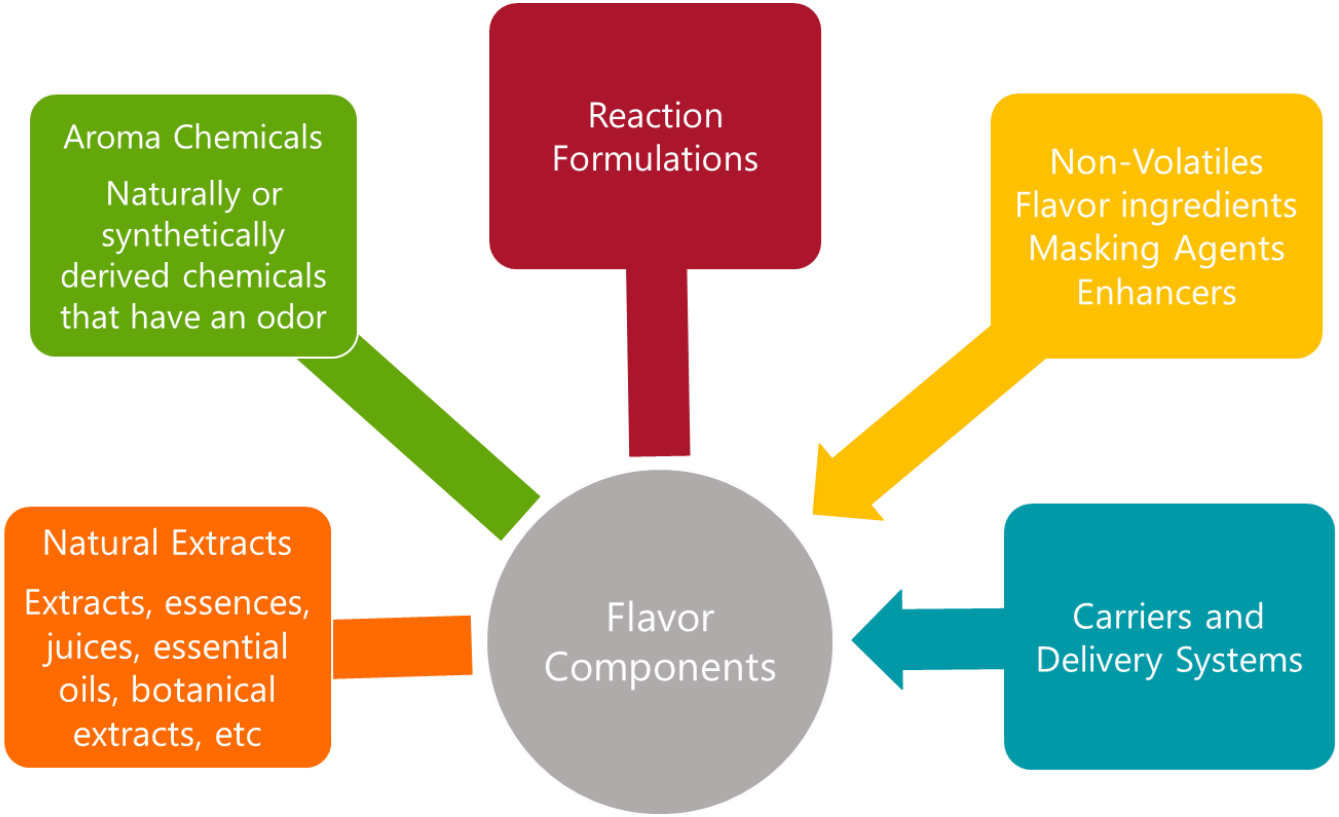
Ingredients in All-Natural Produce

INGREDIENTS: AQUA (82.2%), **SUGARS (12.8%)** (GLUCOSE (52%), FRUCTOSE (42%), GALACTOSE (5%), MALTOSE (<1%), SUCROSE (<1%)), FIBRE E460 (2.1%), ASH, **FATTY ACIDS (1.6%)** (OCTADECAENOIC ACID (24%), OMEGA-6 FATTY ACID: OCTADECADIENOIC ACID (24%), OMEGA-3 FATTY ACID: OCTADECATRIENOIC ACID (23%), HEXADECANOIC ACID (14%), OCTADECANOIC ACID (<1%), HEXADECAENOIC ACID (<1%), TETRADECANOIC ACID (<1%)) **AMINO ACIDS (<1%)** (ASPARTIC ACID (57%), GLUTAMIC ACID (9%), PROLINE (4%), SERENE (3%), LEUCINE (3%), ALANINE (3%), LYSINE (3%), PHENYLALANINE (2%), GLYCINE (2%), THREONINE (2%), VALINE (2%), ARGININE (2%), HISTIDINE (2%), ISOLEUCINE (2%), TYROSINE (1%), METHIONINE (1%), CYSTEINE (1%), TRYPTOPHAN (1%)), **COLOURS** (E160a, E161b, E161c), E300, E307, CHOLINE, PHYTOSTEROLS, **FLAVOURS** ((Z)-3-HEXENOL, 2-HEPTANONE, CINNAMIC ALCOHOL, CINNAMIC ALDEHYDE, (E)-2,6-NONANEDIENAL, (E)-2-HEXENAL, HEXANAL, EUGENOL, LINALOOL, BENZALDEHYDE, PHENYLACETALDEHYDE).

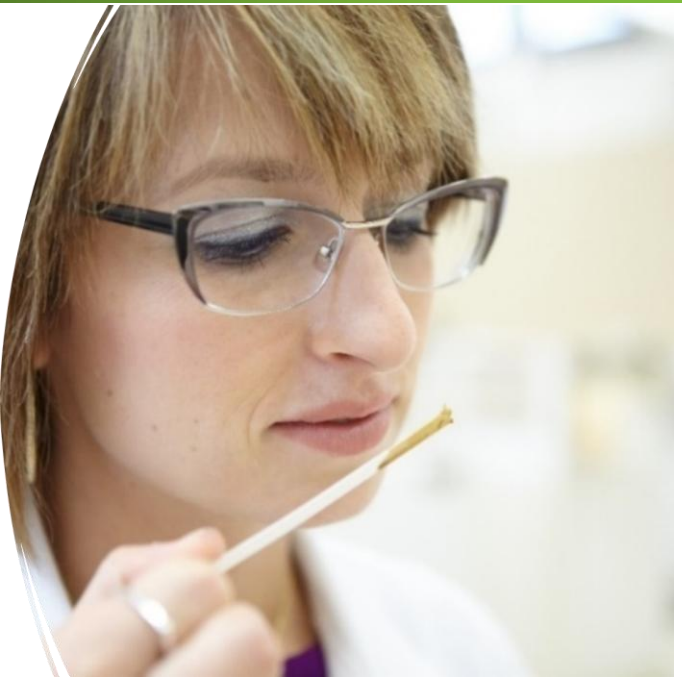
37 Aroma Chemicals in Cherry

Acetaldehyde, 2-methylpropanal, 3-methylbutanal, hexanal, (*E*)-2-hexenal, octanal, nonanal, decanal, **benzaldehyde**, (*E*,*Z*)-2,6-nonadienal, *β*-phenylacetaldehyde, ethyl acetate, ethyl butanoate, ethyl hexanoate, methyl salicylate, ethyl hexadecanoate, acetic acid, 3-methylbutanoic acid, pentanoic acid, hexanoic acid, octanoic acid, decanoic acid, limonene, linalool, menthol, geranylacetone, 6-methyl-5-hepten-2-one, 1-butanol, 1-pentanol, 1-hexanol, (*Z*)-3-hexen-1-ol, 3-methylbutanol, 1-octen-3-ol, 1-octanol, *α*-phenethyl alcohol, 1-nonanol, benzyl alcohol, *β*-phenethyl alcohol

Flavor Chemistry - Ingredients/Raw Materials



CAREER - Flavor Chemist (aka Flavorist)



Flavor Chemists tend to specialize and become experts in specific areas of flavor chemistry.

- Flavor profile
- Application
- Traditional vs. process flavors

Certification Process

- Training is 7-years minimum
- Must train under a Certified Flavorist
- First test with The Society of Flavor Chemists at 5-year (Apprentice)
- Certification exam at 7 years

**Chef vs Flavor Chemist - both create flavors by understanding how food/chemicals work synergistically together.*
**The Society of Flavor Chemists is the certifying body for Flavorists. For more information - https://flavorchemist.org/*
*IOFI – International Organization of the Flavor Industry, Glossary of terms found at https://iofi.org/resources/glossary

Idea for a lesson

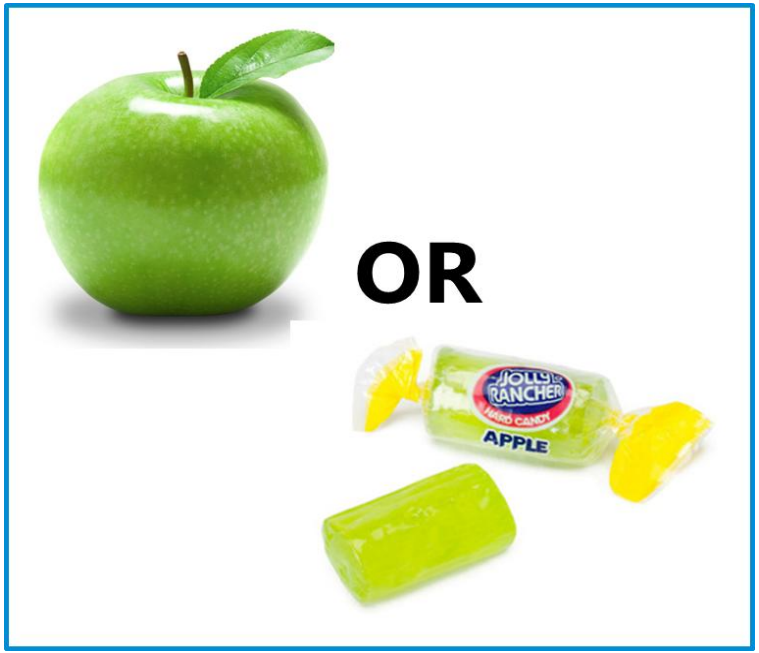
Flavor Creation

Flavor chemists create all the flavors for foods around the world.

- Natural, organic & artificial flavors
- You can talk about flavor chemistry and food science/product development, purchasing, quality of products.

=

Chemicals in Our Food



Espino-Díaz, Miguel et al. “Biochemistry of Apple Aroma: A Review.” *Food Technology and Biotechnology* 54.4 (2016): 375–397. *PMC*. Web. 19 Feb. 2018. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5253989/

Using our senses when we eat

Why are flavors important in food?

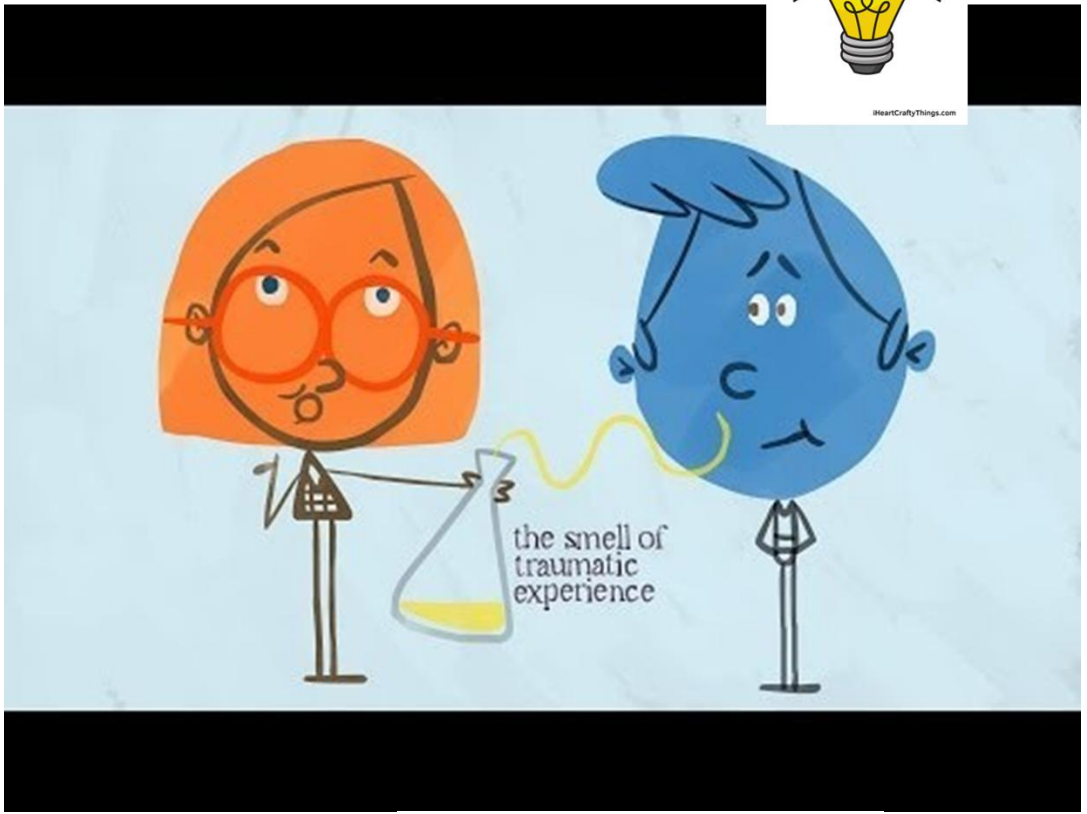
80-90% of what you experience as "**flavor**" *is* **aroma**.

Ted Ed Lesson

TedEd has ‘watch+think+discuss+dig deeper’

On the liknk provided:

http://ed.ted.com/lessons/how-do-we-smell-rose-eveleth



Aroma - Two ways we perceive aroma

Orthonasal Pathway

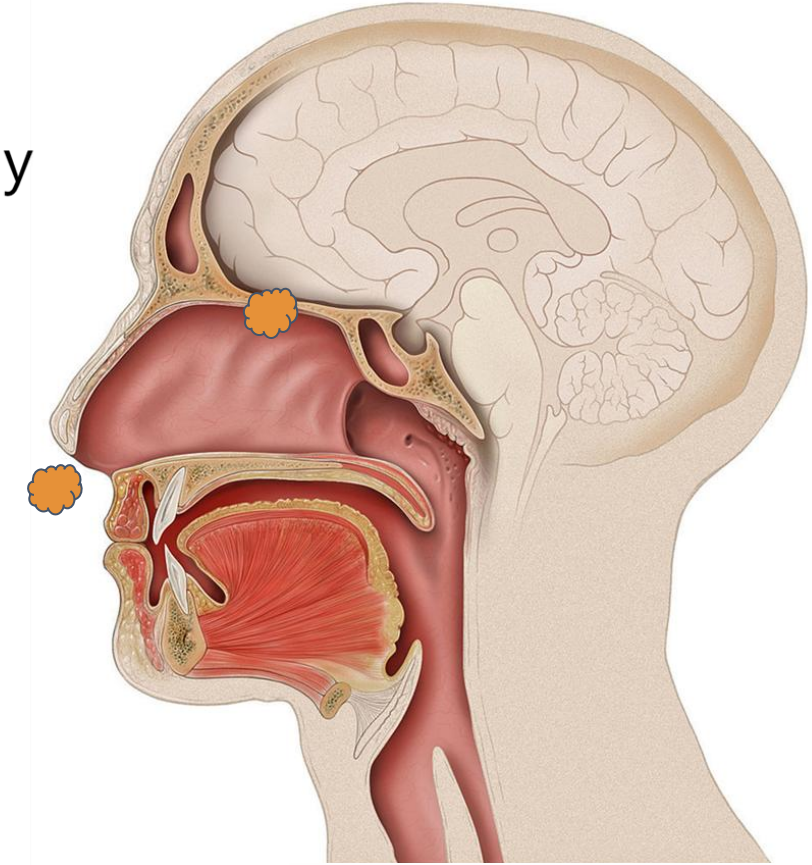


Fig. 8. Cross sectional depiction of naso-oral cavity

Aroma - Two ways we perceive aroma

Retronasal Pathway

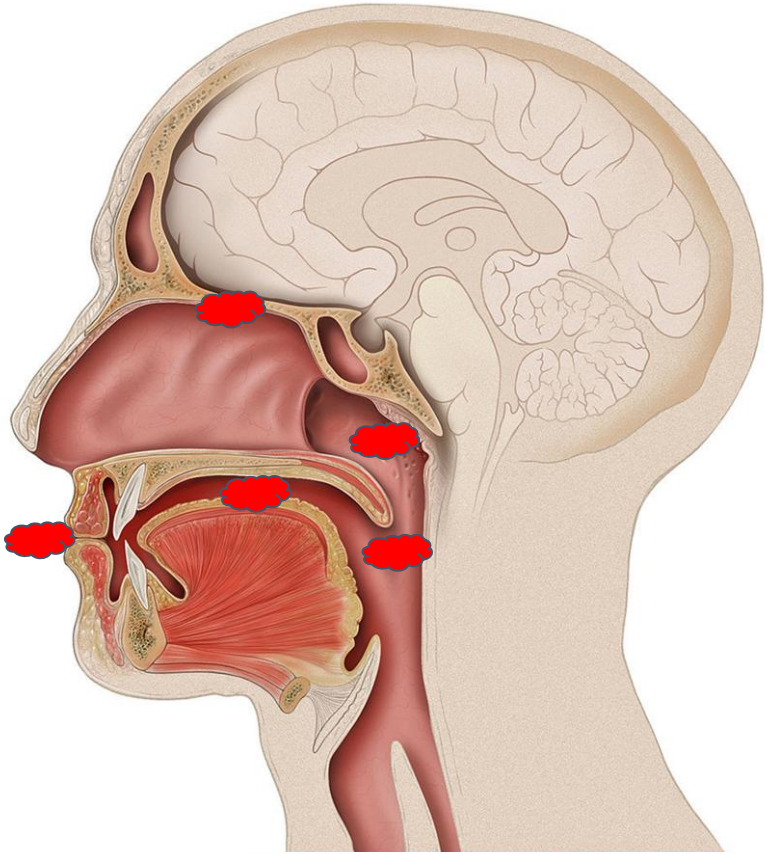
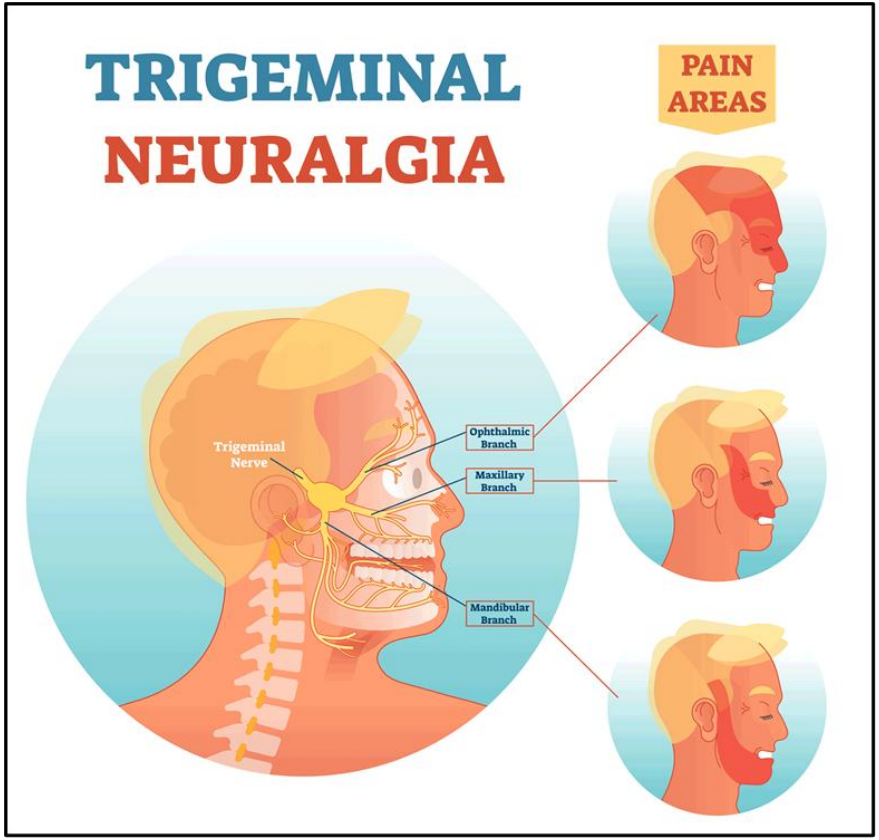


Fig. 8. Cross sectional depiction of naso-oral cavity

Trigeminal Nerve - Sensations

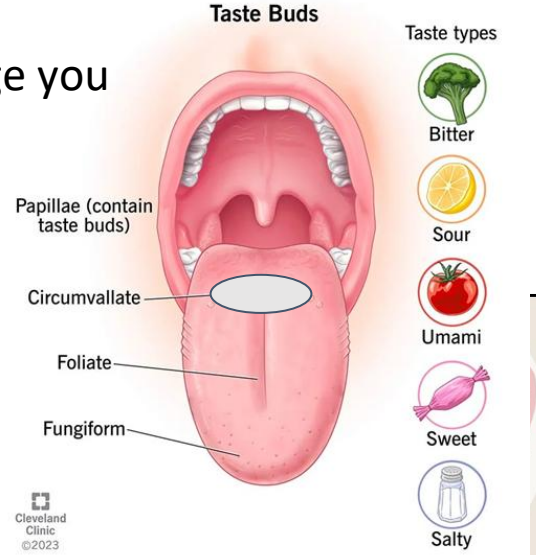
- Sensations serve and intensify the eating experience.
- 3 branches - Each provides sensation to different areas of the face:
  - Ophthalmic (eye)
  - Maxillary (nose & upper jaw)
  - Mandibular (lower jaw)
- Examples include:
  - Chili pepper can irritate your eyes, your nose and your mouth.
  - Onion may only irritate your eyes.
  - Cooling may irritate your nose and mouth.

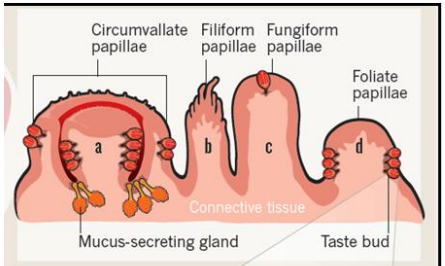


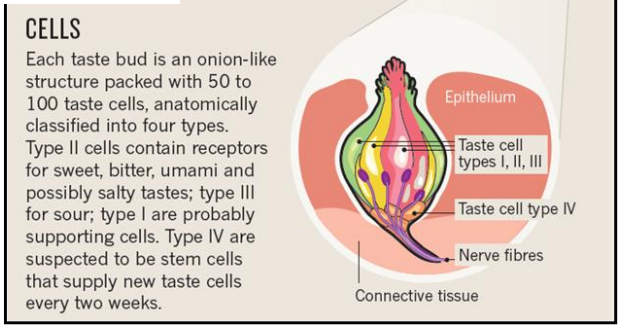
Taste Buds

Your taste buds are designed to protect your body. They will alert you if the food/beverage you are eating is okay for you to consume.

- **48% of taste buds are - Circumvallate**
  8-14, back of tongue
- **0% of taste buds are – Filiform**
  Tactile response
- **18% of taste buds are - Fungiform**
  Mostly at tip of tongue
- **34% of taste buds are - Foliate**
  20 ridges and 600 taste buds per side







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Flavorsolutions
CFSF Chicagoland Food Science Foundation

Using our senses when we eat

Are you a super taster?

- Every person has a unique tongue print.
- A person produces 1-liter of saliva a day!
- Taste buds are renewed very 6 – 8 days.
- Natural loss of taste buds starts at 45 years old.

TRY THIS!
Grab PTC paper to see if you are a super taster.

TRY THIS!
An onion and apple taste the same… their different flavors are due to their different smells. They both have similar amounts of water, sugars, texture – but the aroma is what tells your brain, that is an apple (or an onion)!

Using our senses when we eat

https://jenndavid.com/colors-that-influence-food-sales-infographic/

Influence of Color

Can you taste in color?

- "The results of side-by-side tests show that people will sometimes rate an appropriately colored drink (imagine a pinkish- red drink) as sweeter than an inappropriately colored (say, green) comparison drink. Such results can be obtained even if the latter drink has as much as 10% more added sugar."

https://www.sciencefriday.com/articles/can-taste-color/

IFT feeding the minds that feed the world | McCormick Flavorsolutions | CFSF Chicagoland Food Science Foundation

Influence of Color

Crystal Pepsi Launched in 1992

EZ Squirt Ketchup, Launched in 2000

Why is sound important during eating?

"Researchers at Brigham Young University and Colorado State University have found that the noise your food makes while you're eating can have a significant effect on how much food you eat."

- Crunch Effect
- "The effect comes from the sound of mastication: chewing, chomping, crunching."
- Un-plug while eating!
- Depending on the snack, the noise can reach 63 decibels. (Normal conversations are around 60 dB; rustling leaves, 20 dB.)

Idea for a lesson

Each lab group does research on the importance of each of the senses and why they are important in the consumption of food.

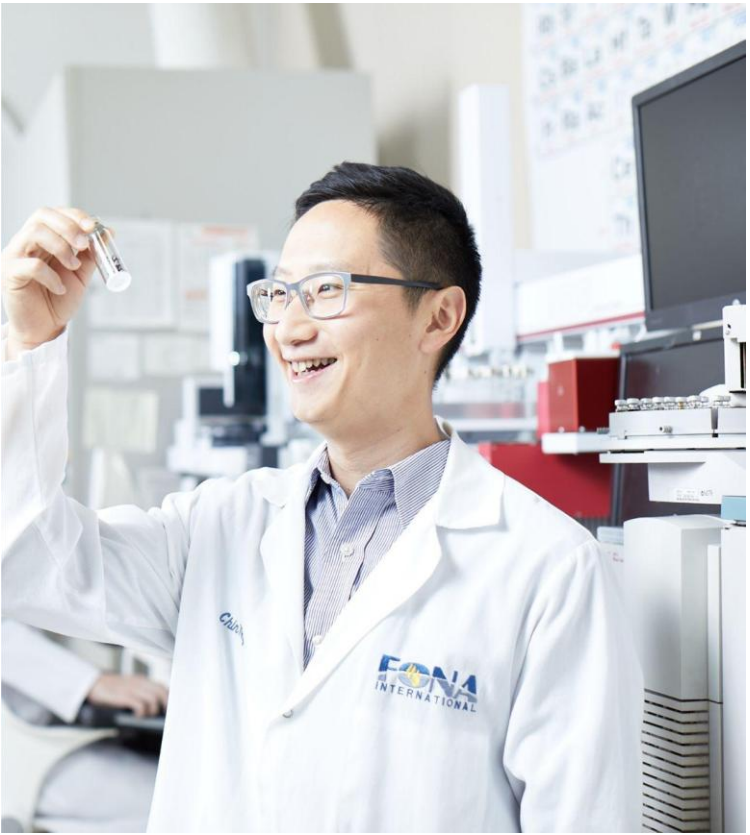
- Present research to the class

Each group needs to create fun demonstration to show the reason this sense is important.

Examples include:

- Blue colored orange drink, vs orange drink. Which is more flavorful? What is it?
- Soggy vs crunchy potato chips (or a regular potato chip vs kettle chip)
- Eating with a blindfold on (Skittles – what is the flavor of each one?)
- Listen to various ASMR audio or videos to see what physical sensations are stimulated.
- Music while eating (scary, drama, pop, classical, etc)

CAREER - Analytical & Physical Chemists



Analytical Chemists use chromatography better understand chemical composition of food & flavors.

- CSI for food

  (chemicals, caffeine, sugars, proteins, vitamins, minerals)

Physical Chemists do physical testing on food when an ingredient needs to change, key characteristics in the food do not change.

- Meltability
- Flowability
- Breakability
- Spreadability

CAREER - Sensory Scientist

Sensory Science is a scientific discipline used to evoke, measure, analyze, and interpret those responses to products that are perceived by the senses of sight, smell, touch, taste, and hearing (Stone and Sidel 1993)“.

- **Study of:**
  - Food Science
  - Psychology
  - Statistics
  - Trends

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Wrap it up

Your students do not realize the variety of careers you are learning about today, exist!

- Your favorite flavor is made of volatile, aroma chemicals, and made by a flavor chemist.
- The senses, while it may seem elementary to learn about them in middle & in high school, are extremely important because our bodies respond to stimuli (food, beverage, aroma).
  - Sensory scientists are constantly using statistics to qualify if products will be desired by consumers.
  - PhD level research is being done on these all the time!

The Science of Eggs

Linda Perucca

- Business Development Director SciTech Patent Art
- Food Science Degree from Purdue University
- Worked in the Food Industry for 30 years
  - Tony's Pizza, Division of Schwan's Sales Enterprise
  - Kraft Foods
  - Mondelez International
- Work experience in Product Development, Quality and Margin Improvement on brands like Kraft Mac and Cheese, DiGiorno and Tombstone Pizzas, and Kraft Cheese.
- 10 years in Patent Management and Intellectual Property Strategy
- Board of Director for the Chicagoland Food Science Foundation

Contact information: Lindap23954@gmail.com

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Flavorsolutions

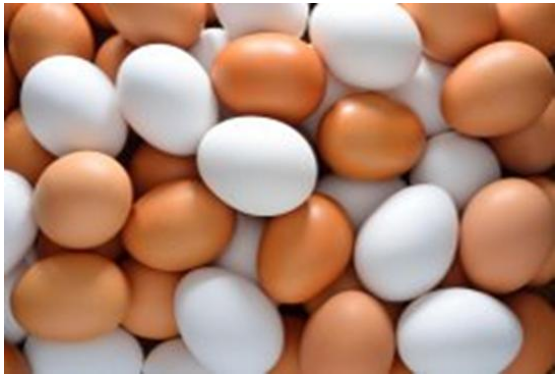
CFSF Chicagoland Food Science Foundation

Fun Facts about Eggs

- May is National Egg Month!
- Americans eat 280 eggs a year!
- Hens produce an egg about every 24 hours
- The hens diet determines the shade of the yolk
- Eggs are good for 3-4 weeks after the "sell by day" on the carton
- You should refrigerate your eggs in USA
- Boiled eggs spin faster than raw eggs

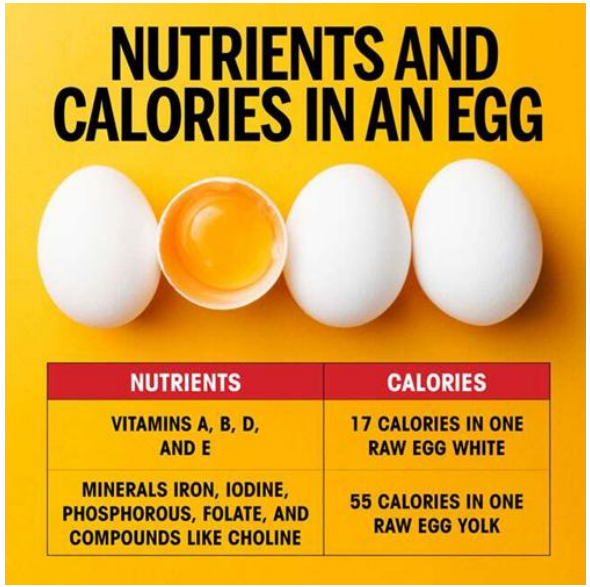
Food Myths about Eggs

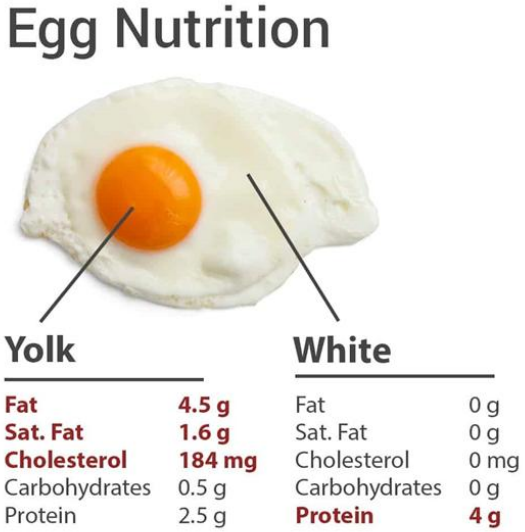
- Eggs can make your blood cholesterol level high and should be avoided
- Brown Eggs are healthier than White Eggs
- Blood spots in an egg are bad
- Free-Range vs Cage- Free
- You will get Salmonella if you eat raw eggs

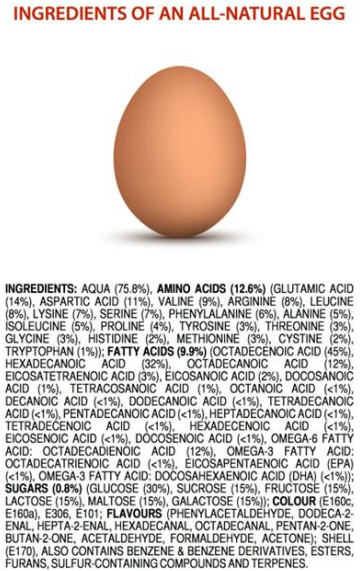


Nutrition of an Egg

Eggs are about 90% water into which about 10% proteins (including albumins, mucoproteins, and globulins) are dissolved

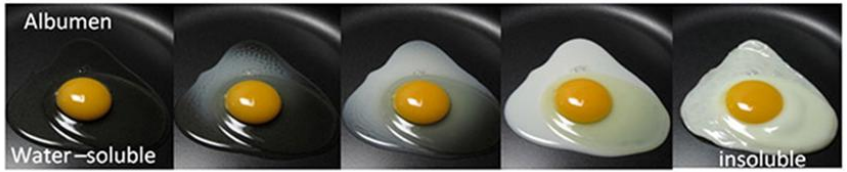




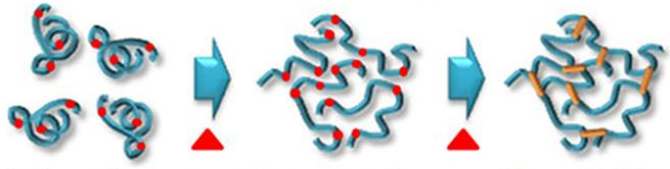


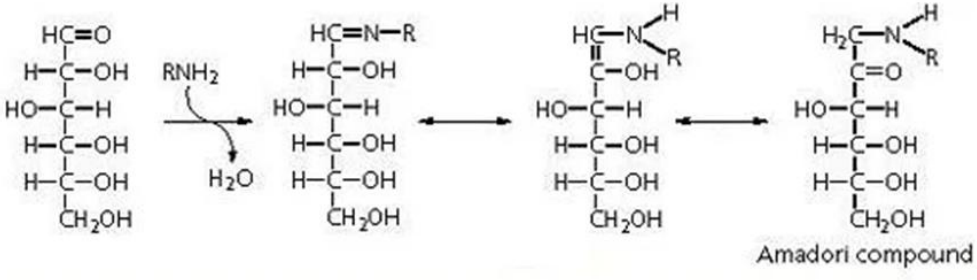
Chemistry & Eggs

(a)

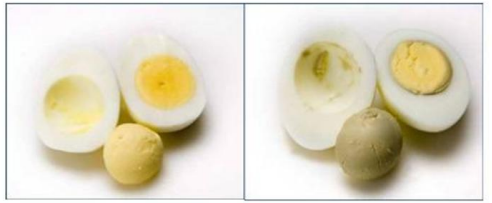


(b) Protein Thermal Irreversible Denaturation

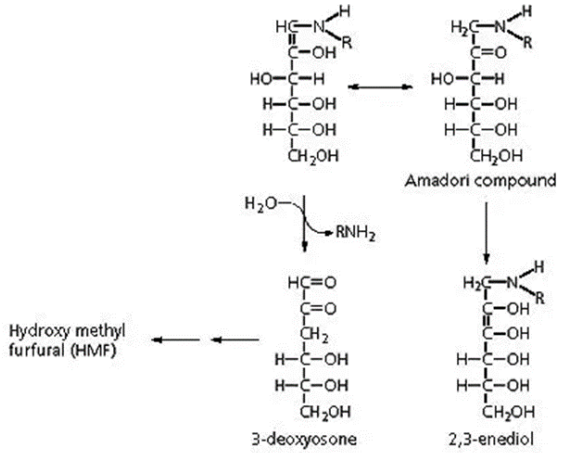




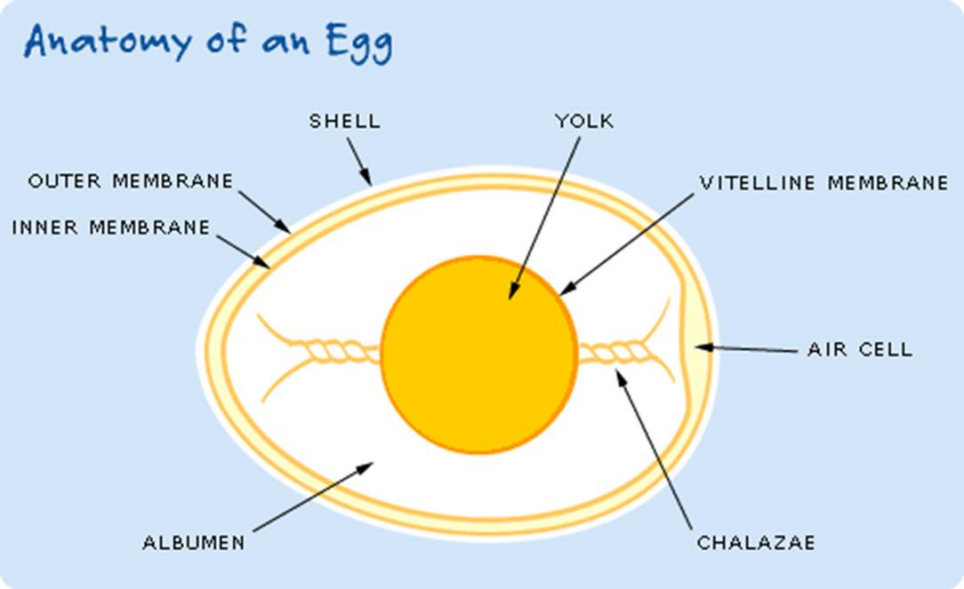
Hard-Cooked Eggs



Properly hard-boiled eggs (left) are uniformly cooked through and gold colored. A green discoloration covers the yolk when in-shell eggs are overcooked (right).



The fresher the egg the thinker the albumen and the yolk will be in the center. The chalaza is a twisted rope that helps keep it centered and weakens as the egg ages.



Food Science & Eggs

Eggs role in Cooking and Baking

- Binding Agent
- Coat or Seal Food
- Add color or shine
- Leavening Agent
- An Emulsifier
- A Thickener

Foods we love because of Eggs

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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”

Eggs Experiments

Chemical Reaction to form Ferrous Sulfide

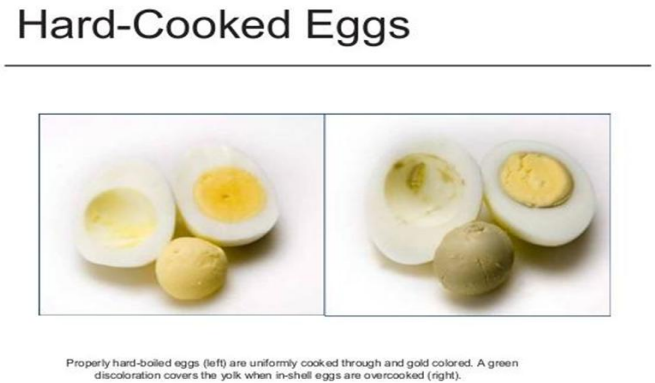
Hard Boiled Eggs

A greenish-gray ring around a hard-boiled egg yolk is caused by a chemical reaction between sulfur from the egg white and iron from the yolk

Experiment

4 eggs
2 pots
Water
Tongs
2 bowls of ice water

1. Place 2 eggs in each pot.
2. Add enough cold water to each pot to cover the eggs by one inch.
3. Pot #1 – turn heat on the pot and bring to rolling boil. Reduce to simmer and continue cooking for 9 minutes. After 9 minutes, take eggs out of water and put in ice bath. Leave in ice for 15 minutes.
4. Pot #2 – turn heat on the pot and bring to rolling boil. Keep heat on high and boil for 20 minutes. After 20 minutes, take eggs out of water and put in ice bath. Leave in ice for 15 minutes.
5. Peel eggs from pot #1 and #2 and cut open to observe difference.



Properly hard-boiled eggs (left) are uniformly cooked through and gold colored. A green discoloration covers the yolk when in-shell eggs are overcooked (right).

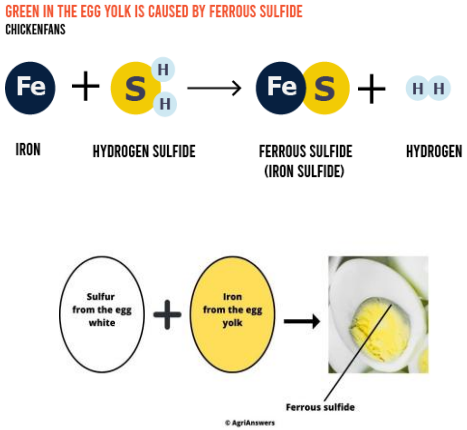
Chemical Reaction to form Ferrous Sulfide

Hard Boiled Eggs

A greenish-gray ring around a hard-boiled egg yolk is caused by a chemical reaction between sulfur from the egg white and iron from the yolk

What is happening?

- Boiling an egg is a chemical change because the proteins in the egg undergo denaturation and coagulation, which changes their structure and properties irreversibly.
- Denaturation is when heat is applied during boiling to disrupt the weak hydrogen bonds that hold the protein molecules in a folded shape. This causes the proteins to unfold or unravel.
- Coagulation happens after denatured proteins interact with each other, forming new disulfide bonds with forms a network of interconnected proteins. This process solidifies the egg.
- When eggs go through denaturation and coagulation, the proteins break down, releasing hydrogen sulfide gas.
- The hydrogen sulfide reacts with iron compounds in the yolk, forming iron sulfide, which is a gray-green compound. The longer the proteins are cooked, the more iron sulfide green ring.
- While the green ring may look unappealing, it is safe to eat.



Maillard Browning Reaction

Eggs as a coating agent to add color and flavor

Eggs are often used on top of pastries to add a golden color, shiny surface, and toasted flavor.

Experiment

1 egg
1 refrigerated pie crust
Small bowl
Fork
Baking Sheet
Pastry brush
Oven

1. Crack an egg into a small bowl and beat with a fork.
2. Open refrigerated pie crust and unroll onto baking sheet. If wanting to use for multiple groups cut into smaller sizes.
3. Using the pastry brush, brush ½ of each piece with the beaten egg – often called the egg wash.
4. Bake in 350F oven for 10-12 minutes.

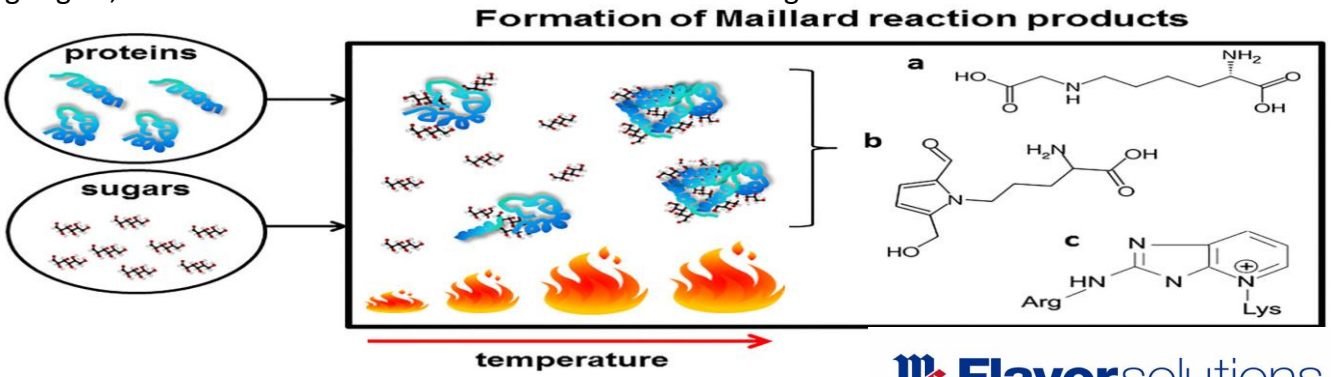
Maillard Browning Reaction

Eggs as a coating agent to add color and flavor

Eggs are often used on top of pastries to add a golden color, shiny surface, and toasted flavor

What is happening?

- When eggs are cooked, especially at higher temperatures (above 250F), the amino acids found in the proteins of eggs react with the reducing sugars naturally present in the eggs.
- The Maillard Browning Reaction produces a golden-brown color and also creates new flavor compounds, contributing to the nutty toasted or savory taste that many associate with cooked eggs.
- The Maillard reaction and caramelization are both non-enzymatic browning reactions that occur when food is heated, but they involve different chemical processes and create distinct flavors and aroma profiles. The Maillard reaction occurs between amino acids and reducing sugars, while caramelization involves the breakdown of sugars alone.



An Edible Oil in Water Emulsion

Mayonnaise

An oil-in water (O/W) emulsion is a type of emulsion where oil droplets are dispersed within a continuous water phase. This means the oil phase is broken down into small droplets that are suspended in the water.

Experiment



1 large egg yolk (room temp)
1 Tablespoon Lemon Juice
1 cup Oil (You can use the oil of your choice)
¼ teaspoon salt
1 bowl large enough to mix your mayonnaise
1 whisk

1. Add the egg yolk, lemon juice and salt to mixing bowl.
2. Use whisk to combine until you start to see air bubbles.
3. **SLOWLY** drizzle the oil into the egg mixer whisking continuously. Mixture will start to thicken and lighten as oil is combined.

Variations on the experiment

Add second egg yolk or 1 Tablespoon mustard
Add oil fast
Add different flavored oil

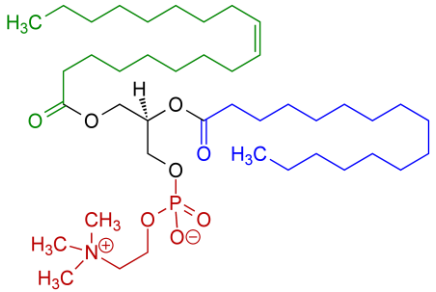
An Edible Oil in Water Emulsion

Mayonnaise

An oil-in water (O/W) emulsion is a type of emulsion where oil droplets are dispersed within a continuous water phase. This means the oil phase is broken down into small droplets that are suspended in the water.

What is happening?

- Eggs contain an emulsifier called lecithin, which is a type of phospholipid.
- Phospholipids are a lipid molecule that has a hydrophilic (water-loving) head and a hydrophobic (oil-loving) tail. This structure allows it to bind both oil and water molecules, preventing them from separating.
- Lecithin is found primary in egg yolks, but is also found in mustard and is crucial for creating stable emulsions.
- When oil is added slowly, the egg yolk can surround each droplet and bind it to the rest of the mixture. If the oil is added too quickly, the egg yolk doesn't have time to emulsify the droplets and they clump together, causing the mayonnaise to break.
- Lecithin is also important in the human body, where it helps with fat digestion by breaking down large fat globules into smaller ones, which makes it easier for the body to absorb the fat.



An example of a phosphatidylcholine, a type of phospholipid in egg lecithin. Red - choline and phosphate group; Black - glycerol; Green - unsaturated fatty acid; Blue - saturated fatty acid

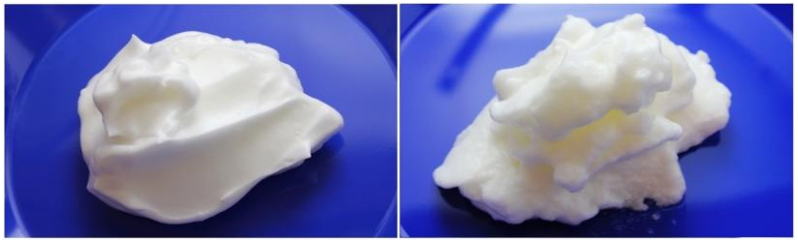
Egg Foam

Egg Foam

Egg foams are used to create light, airy textures in a variety of products like meringues, souffles, angel food cake and marshmallows.

Experiment

1 cup Egg Whites (use fresh egg white and not pasteurized)
½ teaspoon cream of tartar
Two bowls
Mixer with whip attachment



- Bowl #1 - Put ½ cup **cold** egg white into mixing bowl and beat with electric mixer for 4 minutes. Have the students measure the volume.
- Bowl #2 – Put ½ cup **room temperature** egg white and cream of tartar into electric mixer and beat for 4 minutes. Have the students measure the volume.
- Allow both bowls of whipped egg whites to sit for 2 hours. Have the student measure the amount of liquid from each.

Variations on the experiment

- Change the length of time you whip egg whites and see how over or under mixing effects the volume. Try 2 minutes and 6 minutes.
- Add a little egg yolk to the egg white and see how it effects the whipped volume.
- Add 2 Tablespoons of sugar slowly to the egg whites while whipping and see how it effects the whipped volume and liquid.

Egg Foam

Egg Foam

Egg foams are used to create light, airy textures in a variety of products like meringues, souffles, angel food cake and marshmallows.

What is happening?

- Beating egg whites forces air into the liquid, stretching and unfolding the protein molecules. This process, known as denaturation, changes the protein's shape, breaking its internal bonds.

- The unfolded proteins which have both hydrophillic (water-attracting) and hydrophobic (water-repelling) regions, arrange themselves around the air bubbles. The hydrophillic parts interact with the water in the egg white, while the hydrophobic parts are attracted to the air with the bubbles. This network provides the structural support needed to create a stable foam.

- Cream of tartar and sugar both help make the foam more stable. However, cream of tartar is considered better. While the sugar stabilizes egg whites by binding water and adding viscosity, cream of tartar acts as an acid, lowering the pH and further stabilizing the foam structure. Cream of tartar also speeds up the whipping process and prevents overbeating.

- Even a small amount of fat (part of the egg yolk) can interfere with foam formation by coating the proteins and preventing them from interacting with each other. It will reduce the foam volume.

- An egg foam can release water due to syneresis, a process where the foam collapses and liquid separates out. Over-beating your egg foam will make syneresis worse.

How to Pasteurize your eggs

You may want to pasteurize your uncooked eggs before using them to reduce the chances of foodborne illness. It's simple to do.

Step 1 – place the eggs you want to pasteurize in pan in one single layer. Cover with water so that there is about 1 inch above the eggs. Then remove your eggs. You don't want them in there until the water is the right temperature.

Step 2 – Heat the water to 140 degree F using a thermometer to monitor the temperature. You need to watch very closely as any temperature warmer than 142 degree F is going to start cooking the egg.

Step 3 – Place your (room temperature) eggs in the water. Heat the eggs for 3 1/2 * minutes. Make sure the temperature of the water never goes above 142 degree F

Step 4 – Transfer your pasteurized eggs into a bowl of cold water to stop the heating process. Then store them in the fridge to use later.

Note – 3 1/2 minutes is for medium eggs. If you are using extra-large eggs, then you need to heat them for 5 minutes.

Wrap it up

Eggs can come in many forms

Dried eggs, egg whites, egg yolk, vs whole egg

…and are used for a variety of reasons

Binding agents, coat or seal food, add color or shine, leavening agent, emulsifier, and thickener

Every ingredient in food products serves a purpose - either nutrition, structural, flavor, desired characteristic or enhancement , etc.

Let basic food ingredients to help teach your students about subjects like Nutrition, Chemistry, Biology, Mathematics and more

Careers in the Food and Beverage Industry

Careers in the Food and Beverage Industry

Today we are talking a lot about Food Science. However, it takes a lot of different careers and companies to create products for the grocery store shelves!

In the following slides, you will see a simple depiction of the process from an idea to product creation to a finished good on the shelf, for you to purchase and bring home to eat. The actual process can take 1 – 2 years.

How does a product get to your grocery store?

Career: Consumer Insights Analyst, Sales

Research is done to understand consumers. They collect data regarding sales trends and consumer satisfaction of current products in that category. The data helps determine where consumers needs are not currently being met.

Common Degree: Marketing, Business

Idea → Grocery Store

How does a product get to your grocery store?

Career: Consumer and Sensory Testing

Digital concepts are put in front of consumers to test out the product idea believed to fill the gap not met by current products on the market.

Common Degree: Food Science and Sensory Science

Idea → Grocery Store

How does a product get to your grocery store?

Career: Culinary

Culinary develops a “gold standard” product like you would find at a restaurant where things are prepared-to-order in small batches, using seasonal fresh ingredients

Common Degree: Culinary

Idea → Grocery Store

How does a product get to your grocery store?

Career: Research Scientist or Ingredient Scientist

Scientist research novel or new ingredients to understand functionality, benefits, and applications of use.

Common Degree: Chemistry, Biochemistry or Food Science

Idea → Grocery Store

How does a product get to your grocery store?

Career: Product Development

A product is created from the concept and data the consumer insights team has collected. Characteristics like color, flavors, health benefits, costs and sustainability are just some of the things considered when developing a product.

Common Degree: Food Science and Chemical Engineering

Idea → Grocery Store

Flavored Chip Development

Product developers continuously create new and exciting potato chip flavors to attract consumers and encourage repeat purchases. Developing a successful flavored chip requires selecting appropriate processing methods, equipment, and seasoning blends to achieve the desired taste and quality. In this experiment, you will explore the chip flavoring process by choosing from different production options based on the equipment available. You will also have the opportunity to select pre-made flavor blends or create your own custom seasoning combination. Through these decisions, you will gain insights into the product development process and the factors that influence the final flavor and appeal of potato chips.

Experiment:

½ bag of lightly salted potato chips for each method or flavor
1 paper bag or Zip Lock bag for each method or flavor
½ teaspoon seasonings of choice – Ranch, Taco, Barbecue

Option #1 - Microwave Oven

1. Place ½ bag of potato chips in microwave safe bowl.
2. Microwave for 30 seconds.
3. Transfer warm chips to bag.
4. Sprinkle seasoning over potato chips.
5. Shake bag until chips are coated.

Flavored Chip Development

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Experiment:

½ bag of lightly salted potato chips for each method or flavor
1 paper bag or Zip Lock bag for each method or flavor
½ teaspoon seasonings of choice – Ranch, Taco, Barbecue

Option #2 - Oven

1. Place ½ bag of potato chips on oven safe pan.
2. Bake in oven at 350 F for 5 minutes.
3. Transfer warm chips to bag.
4. Sprinkle seasoning over potato chips.
5. Shake bag until chips are coated.

Flavored Chip Development

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Experiment:

½ bag of lightly salted potato chips for each method or flavor
1 paper bag or Zip Lock bag for each method or flavor
½ teaspoon seasonings of choice – Ranch, Taco, Barbecue

Option #3 – Oil Spray (like Pam)

1. Place ½ bag of potato chips on pan.
2. Spray with light coating of oil spray.
3. Transfer to bag.
4. Sprinkle seasoning over potato chips.
5. Shake bag until chips are coated.

Flavored Chip Development

Product developers continuously create new and exciting potato chip flavors to attract consumers and encourage repeat purchases. Developing a successful flavored chip requires selecting appropriate processing methods, equipment, and seasoning blends to achieve the desired taste and quality. In this experiment, you will explore the chip flavoring process by choosing from different production options based on the equipment available. You will also have the opportunity to select pre-made flavor blends or create your own custom seasoning combination. Through these decisions, you will gain insights into the product development process and the factors that influence the final flavor and appeal of potato chips.

Experiment:

½ bag of lightly salted potato chips for each method or flavor
1 paper bag or Zip Lock bag for each method or flavor
½ teaspoon seasonings of choice – Ranch, Taco, Barbecue

Option #4 – No treatment

1. Place ½ bag of potato chips into bag.
2. Sprinkle seasoning over potato chips.
3. Shake bag until chips are coated.

What is happening?

The science of seasoning potato chips is a mix of food chemistry. Physics, and sensory perception. A season blend might look simple – salt and flavor powders – but getting it to stick evenly, taste intense, and survive packing requires a surprising amount of engineering.

Why seasoning sticks to chips

Freshly fried chips emerge coated with a thin layer of oil. This oil acts like an adhesive. Potato chips are highly porous. During frying, oil enters these microscopic pores. When the chip is warmed, the oil can move through the pore network more readily, making the surface feel greasier. Small amounts of residual moisture and trapped air inside the chip expand when heated. This can help push some oil outward through the porous structure. As oil reaches the surface, seasoning particles can become more saturated with oil, making them look darker or more intensely colored.

The no treatment experiment should have very little seasoning on the chip and most of the seasoning still at the bottom of the bag.

Commercially, the potato chips are removed from the frier and immediately transferred to a rotating drum that will gently tumble the chips while seasonings are added. This creates an even coating of seasoning while not breaking the chips.

Seasoning Development

Product Developers create seasonings for different applications like flavoring potato chips and coating of meats. You can purchase a variety of flavors in your grocery store or create blends on your own. When you create your own, it allows for your customization depending on your flavor desires. For example, are you a spicy or mild taster? Do you like more garlic? The formulas below are brought to you from the laboratories and test kitchens of McCormick Flavor Solutions.

Experiment: "Ranch-type"

½ cup Buttermilk Powder
1 Tablespoon dried Parsley
1 Tablespoon Garlic Powder
1 Tablespoon Onion Powder
2 teaspoon dried Dill
1 teaspoon freeze dried Chives
½ teaspoon Black Pepper

1. Measure each ingredient into a mixing bowl.
2. Mix thoroughly together, so no spices are clumping together with whisk or spoon.

Ideas for modifications
Option #1 – use 4 teaspoons dried Dill
Option #2 – use 4 teaspoon Garlic Powder
Option #3 – use ¾ teaspoon Black Pepper
Option #4 – use your imagination

Seasoning Development

Product Developers create seasonings for different applications like flavoring potato chips and coating of meats. You can purchase a variety of flavors in your grocery store or create blends on your own. When you create your own, it allows for your customization depending on your flavor desires. For example, are you a spicy or mild taster? Do you like more garlic? The formulas below are brought to you from the laboratories and test kitchens of McCormick Flavor Solutions.

Experiment: Taco Seasoning

1 Tablespoon Chili Powder
1 Tablespoon Salt
1 teaspoon Garlic Powder
½ teaspoon Onion Powder
1 teaspoon Turmeric
¾ teaspoon Cumin
¾ teaspoon Cayenne Pepper Powder
¼ teaspoon dried Oregano

1. Measure each ingredient into a mixing bowl.
2. Mix thoroughly together, so no spices are clumping together with whisk or spoon.

Ideas for modifications
Option #1 – use 1 teaspoon Cayenne Pepper Powder
Option #2 – use 1 ½ teaspoons Garlic Powder
Option #3 – use 2 teaspoon salt
Option #4 – use your imagination

How does a product get to your grocery store?

Career: Packaging Development

A package is created from the concept and data the consumer insights team has collected. Characteristics like degradable and recyclable materials, shape of container, ability to carry are just some of the things considered when developing a package.

Common Degree: Packaging Science

Idea → Grocery Store

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

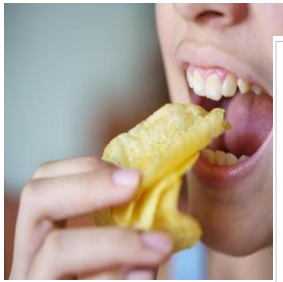
1. Take a bag of potato chips and open it. Place the potato chips in a lunch size paper bag and staple it closed.
2. Allow the chips in the bag to sit in open room for minimum of 5 days.
3. After 5 days, open the paper bag along with the un-opened bag of potato chips and have each student taste both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

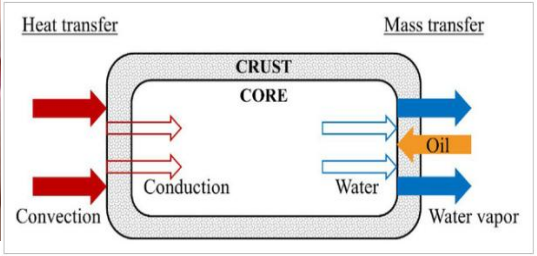
What is happening?

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.

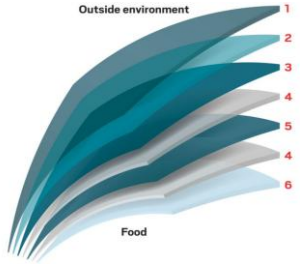
- Potato chips have a moisture content of 1.5% - 3.5% while the typical home/school is around 40% - 50% humidity.
- Starch molecules are **hydrophilic**, meaning they attract water from the air around them. **Osmosis** refers to the movement of water molecules across a membrane trying to achieve equilibrium.
- 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



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.

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**

How does a product get to your grocery store?

Career: Marketing

How will the company talk to the consumers about the product and get them to try it? Will there be TV ads, magazine ads, coupons, social media? What makes the product stand out against all other competition? What will the price be and where will it be found in the grocery store? How much is projected to sell to order materials.

Common Degree: Marketing

Idea → Grocery Store

How does a product get to your grocery store?

Career: Consumer and Sensory Testing

Once a product/packaging has initial development, it will be given to consumers to taste/experience. Feedback is collected of what they liked and what needs to be improved.

Common Degree: Food Science and Sensory Science

Idea → Grocery Store

How does a product get to your grocery store?

Career: Product Development

Adjustments are made to the product based on what the consumers said in the consumer test.

Common Degree: Food Science

Idea → Grocery Store

How does a product get to your grocery store?

Career: Flavor Chemist

Chemist develop flavors using natural and synthetic approved flavors, chemicals and extracts. They use creative and artistic talent along with various analytical tools including Gas Chromatography and Mass Spectrometry.

Common Degree: Chemistry, Biology, Food Science

Idea → Grocery Store

How does a product get to your grocery store?

Career: Packaging Development

Adjustments are made to the packaging based on what the consumers said in the consumer test.

Common Degree: Packaging Science

Idea → Grocery Store

How does a product get to your grocery store?

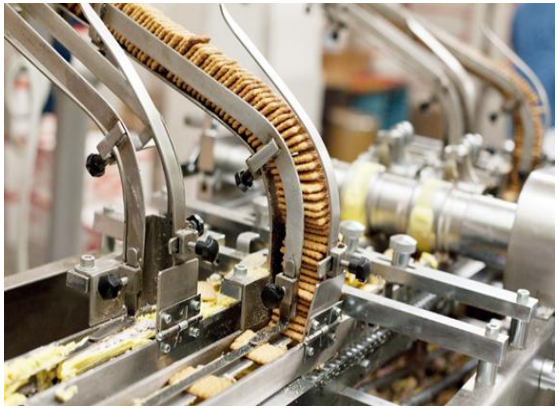
Career: Procurement

Ingredients are sourced from around the world in the volumes projected to be needed. They work with suppliers to ensure responsible practices are in place. Contracts are put into place with suppliers.

Common Degree: Economics or Supply Chain Management

Idea → Grocery Store

How does a product get to your grocery store?



Career: Food Engineering/ Process and Product Development

Test runs are done on plant equipment to see if the product changes at all after running in large scale. They write process design proposals for capital purchase and install into facilities.

Common Degree: Engineering, Food Science or Chemical Engineering

Idea → Grocery Store

How does a product get to your grocery store?

Career: Food Safety/Quality Control

Food safety specialist, inspectors and managers work to ensure compliance with regulations, conduct inspections, and implement safety protocols at various stages of the food production and distribution chain. This is done to ensure the quality and safety of food products, protecting public health, and preventing foodborne illnesses.

Common Degree: Microbiology or Food Science

Idea → Grocery Store

How does a product get to your grocery store?

Career: Consumer Testing

The product is re-tested with consumers to ensure they still like it and likely purchase it. Brand names are attached to the product to understand impact of legacy brands and new introductions.

Common Degree: Food Science

Idea → Grocery Store

How does a product get to your grocery store?

Career: Regulatory Compliance

The label for the product is developed. Ingredient statements, nutritional information and claims, instructions for preparation is needed.

Common Degree: Food Science or Regulatory Compliance

Idea → Grocery Store

How does a product get to your grocery store?

Career: Food Attorney

Reviews all marketing, labeling, and any communication to ensure all food laws and regulations are being complied. Ensure inventions are protected with patents.

Common Degree: Food Science, Engineering, or Chemistry plus JD Law

Idea → Grocery Store

How does a product get to your grocery store?

Career: Manufacturing/Operations

Production of the product begins. Product and packaging quality, line speeds, and wastes are just some of the things monitored

Common Degree: Engineering or Business Management

Idea → Grocery Store

How does a product get to your grocery store?

Career: Plant Quality

Samples of the product and packaging are taken throughout the assembly line and tested to ensure it still meets quality standards. Equipment is also tested to ensure it has properly been cleaned for food safety.

Common Degree: Food Science/ Microbiology

Idea → Grocery Store

How does a product get to your grocery store?

Career: Transportation and Logistics

Product is shipped from the plant to various distribution centers on its way to the grocery shelf.

Common Degree: Business and Supply Chain Management

Idea → Grocery Store

How does a product get to your grocery store?

Career: Grocery Store Merchant

Product is placed on the grocery store shelf for consumers to purchase.

Idea → Grocery Store

Educational Application

Chemistry & Organic Chemistry: mixtures, density, emulsions, concentrations, solutions & MORE

Biology & Physiology/Anatomy: Senses & taste, Smell/Memory, Biologically wired to desire sweet & fat, impact of growing population, water use in agriculture, structure, & MORE

Mathematic: Statistic, data analysis, consumer preferences, concentrations/conversions, cost of food waste, % loss, , & MORE

Social & Cultural: social changes due to globalization of food, impact of increase middle income-globally, hunger, food waste, water usage, & MORE

Economic: actual cost vs time cost as it relates to food & cooking, financial impact of globalization on small farmers and specialized products, & MORE

Health & Nutrition: Wheat, Eggs and Milk are all fundamentally necessary for a balanced diet & a wholesome approach to good nutrition, & MORE

Why use food to teach your content?

1. Food is interdisciplinary!
2. To tackle big problems like:
   Sustainability, Water usage, Hunger, Feeding the growing population 8 bn → 10 bn in 2050.
3. It takes a huge effort to create new products for the grocery store shelves.
   - from Idea to shelf, minimum 1 year
   - if creating a cutting edge product, it could be many years.
4. We need your students to become problem solvers for the next generation!
   Engineers, Developers, Science Communicators, Regulations, Manufacturers and more!
5. Relating what you are teaching to FOOD, allows students to grasp, relate & remember scientific concepts easier.

Food will always impact your students' lives!

The next time you reach for your favorite food or drink, think about all the science and careers behind your favorite food!

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Questions

Next Steps for Students

- Learn more about where you can get a Food Science Degree!
- Undergraduate Programs

Food Science Textbooks

- "Introductory Foods" by Barbara Scheule (ISBN-13: 9780134552767)
- "What Einstein Told His Cook: Kitchen Science Explained" by Robert L. Wolke
- "The Hungry Scientist Handbook" by Patrick Buckley and Lily Bins (ISBN-13 : 978-0061238680)
- "Cooking for Geeks: Real Science, Great Hacks, and Good Food" By Jeff Potter (ISBN-13: 978-0596805883)
- "The Science of Good Food" by David Joachim and Andrew Schloss w/ A. Phillip Handel, PhD. (ISBN-13: 978-0778801894)
- "Foods: Experimental Perspectives" by Margaret McWilliams (ISBN-13: 9780134204581

Thank You!

Sign Out for Illinois PD Hours!

Thank you to Chicagoland Food Science Foundation for generously providing, $7,500 for gift cards!

Recipients will be notified via email next week

Reach out to Christina Ginardi at cginardi@ift.org

Slides, recording, and feedback survey will be sent to you by early next week.

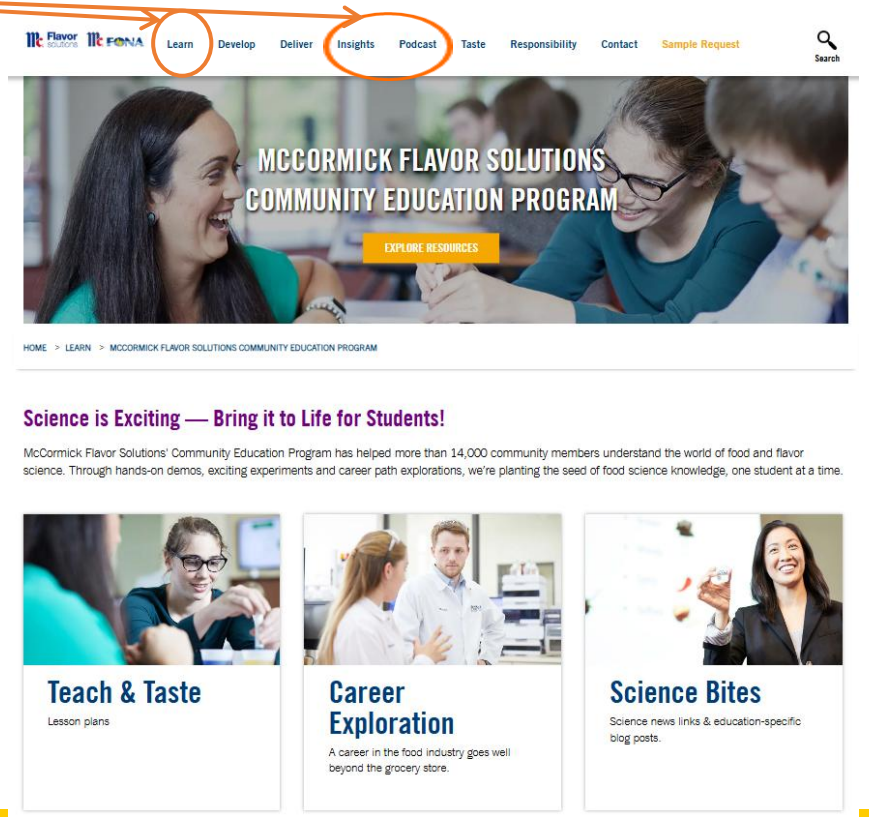
Food Science Resources

Katie Sudler

McCormick Flavor Solutions

https://www.mccormickfona.com/learn/discover-fona-food-science-for-young-minds

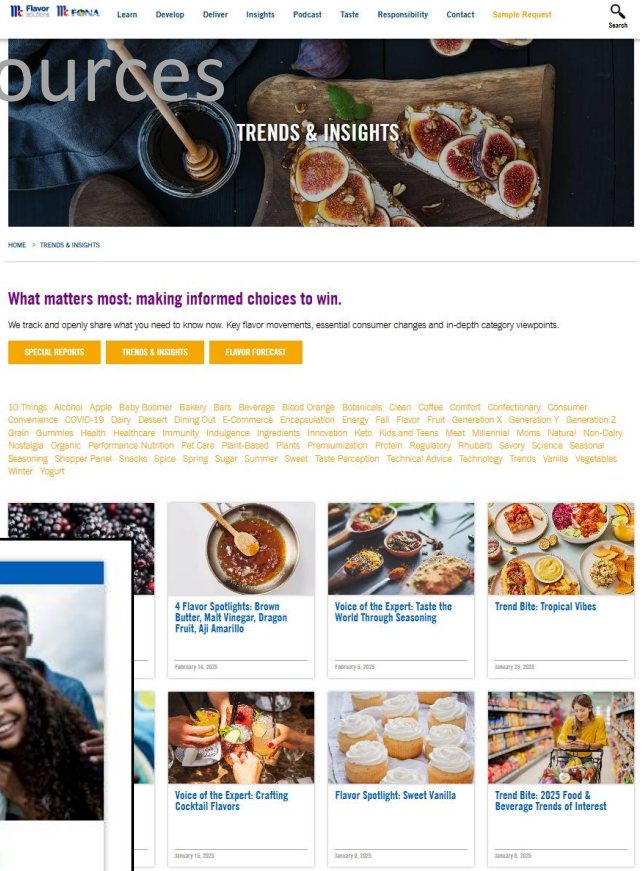
- **Teach & Taste**
  - Lesson Plans & Demonstrations
- **Career Exploration**
  - FONA Employee short career videos
- **Science Bites**
- **Trend & White Papers**
- **Podcast** (with technical & marketing)
- Sign up to be a **taste tester**!

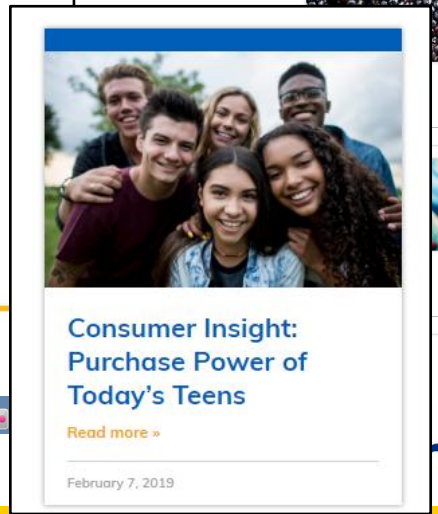


McCormick Flavor Solutions Resources

https://www.mccormickfona.com/category/trends-insights

- White Papers
- Trend Information





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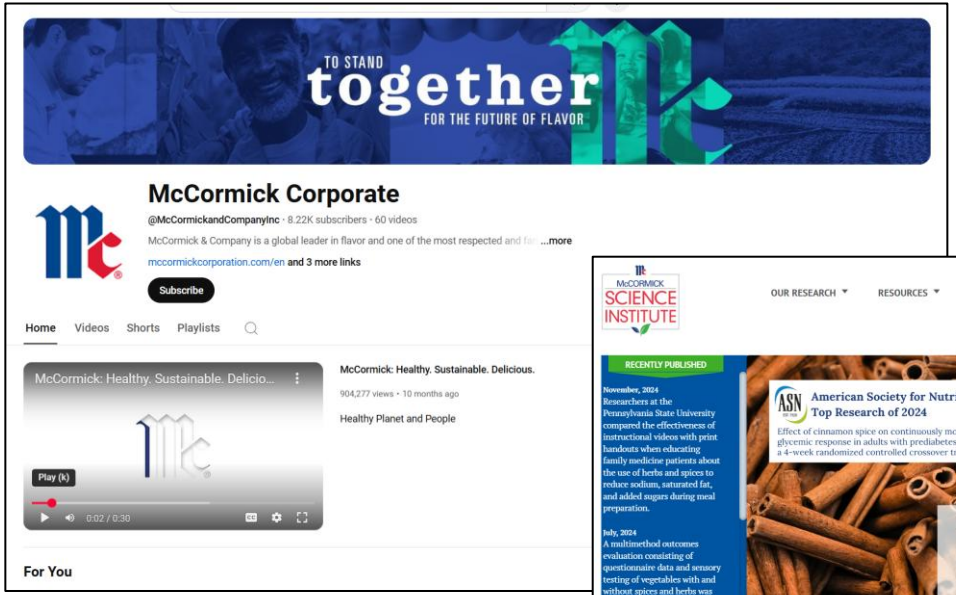
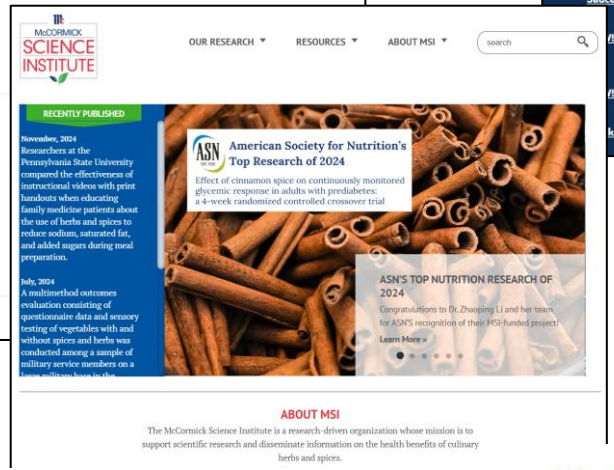
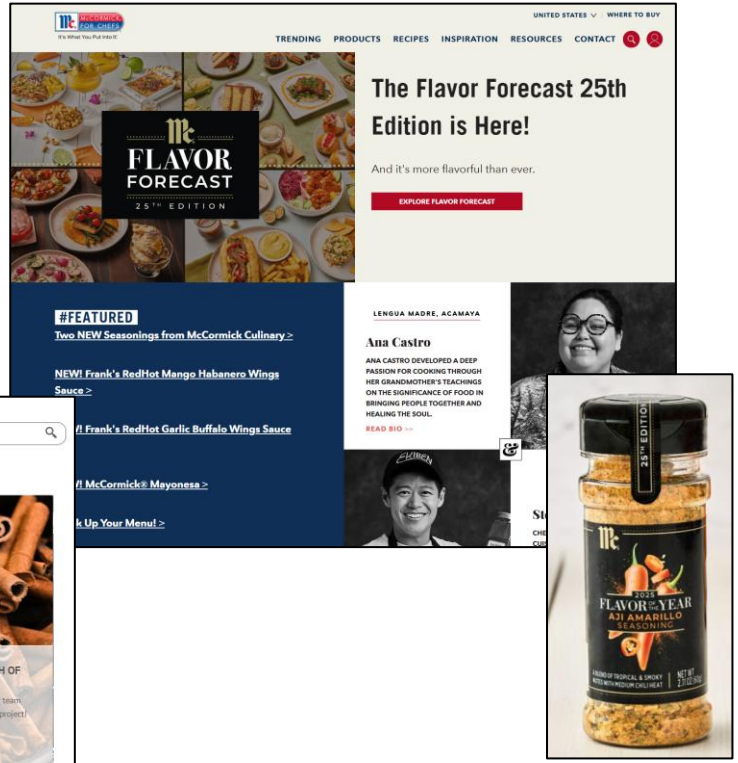
McCormick & Company

https://www.mccormickforchefs.com/en-us

YouTube: @McCormickandCompanyInc







https://www.mccormickscienceinstitute.com/

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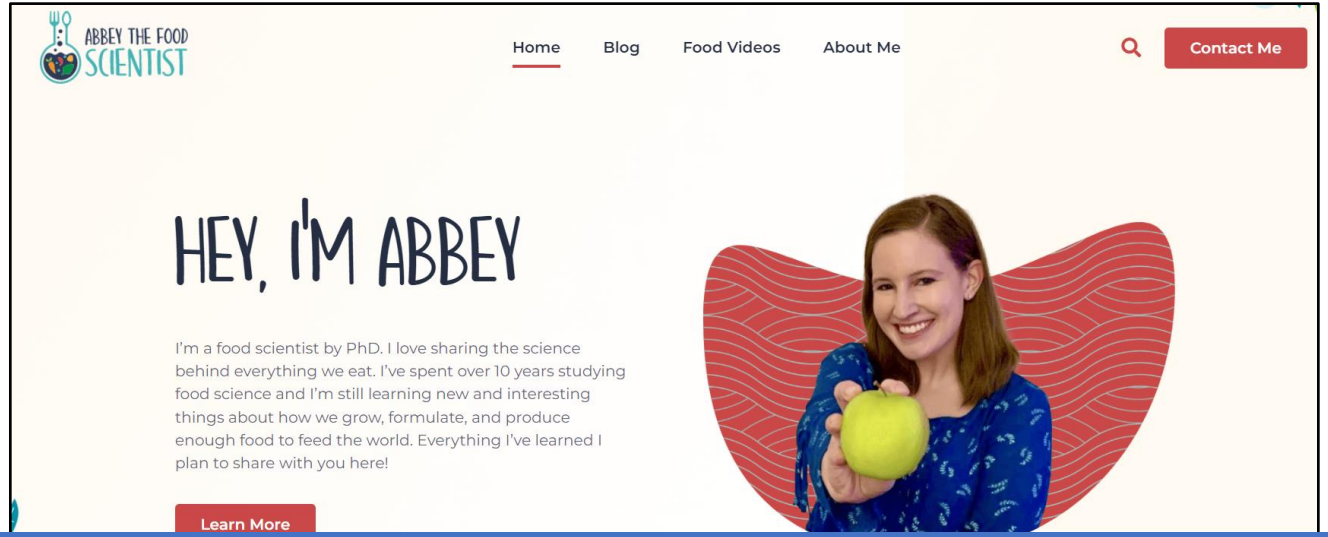
Abby the Food Scientist

https://abbeythefoodscientist.com/



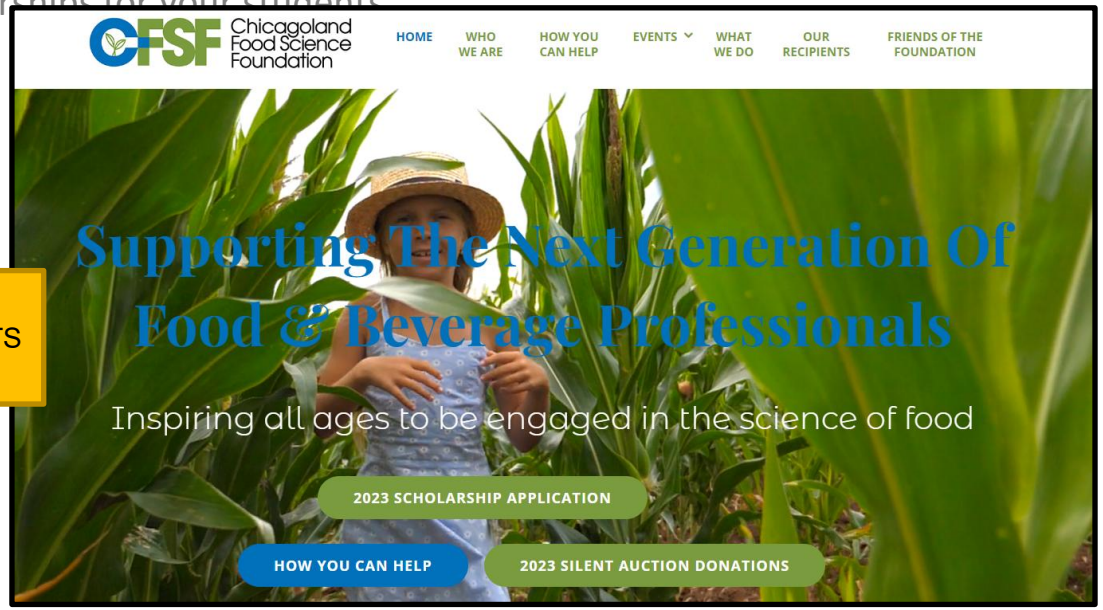
- Abby is a food scientist & researcher. Abbey The Food Scientist – Explanation of all things food!
- Blog & Videos and more great videos on YouTube @AbbeytheFoodScientist

Chicagoland Food Science Foundation

https://chicagofoodscience.org/

- CFSF supports the next generation of Food & Beverage Professionals
  - College scholarships for your students

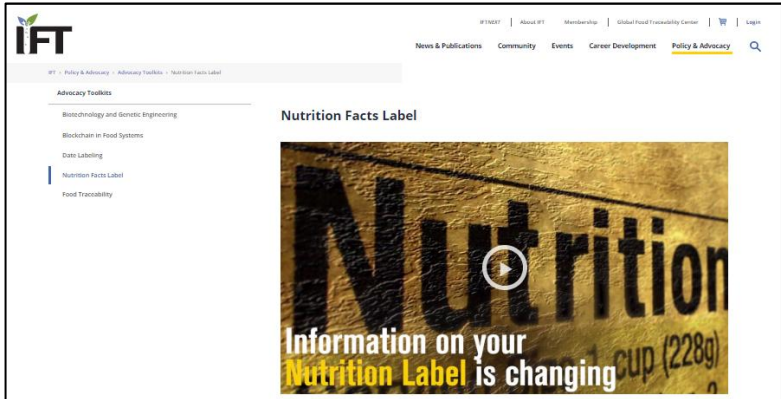
SCHOLARSHIPS FOR STUDENTS

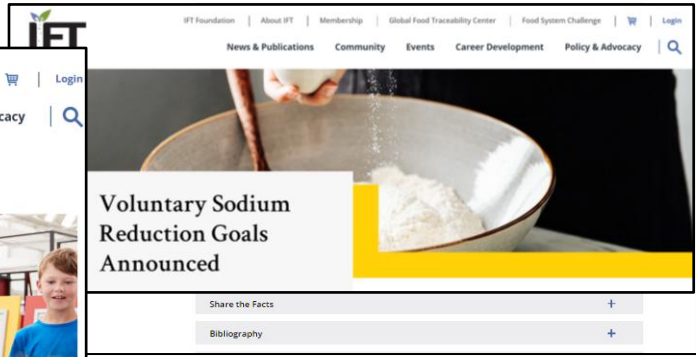


IFT: Institute of Food Technologist

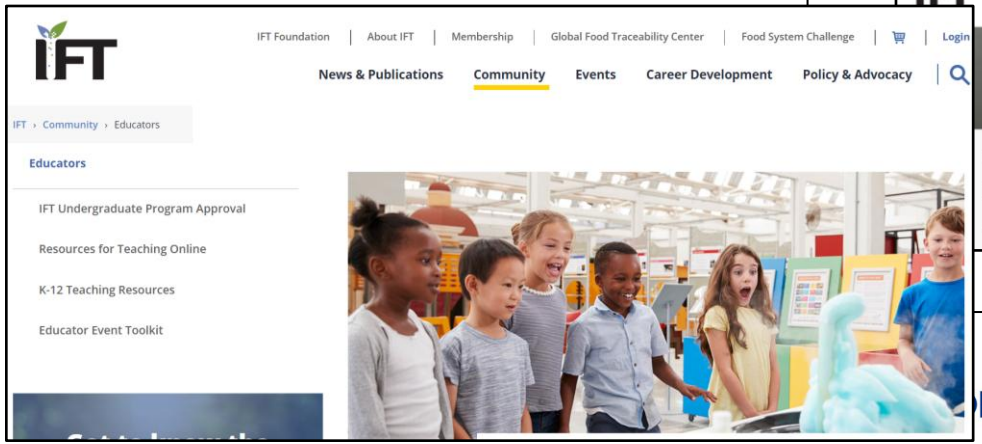
https://www.ift.org/

- 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!



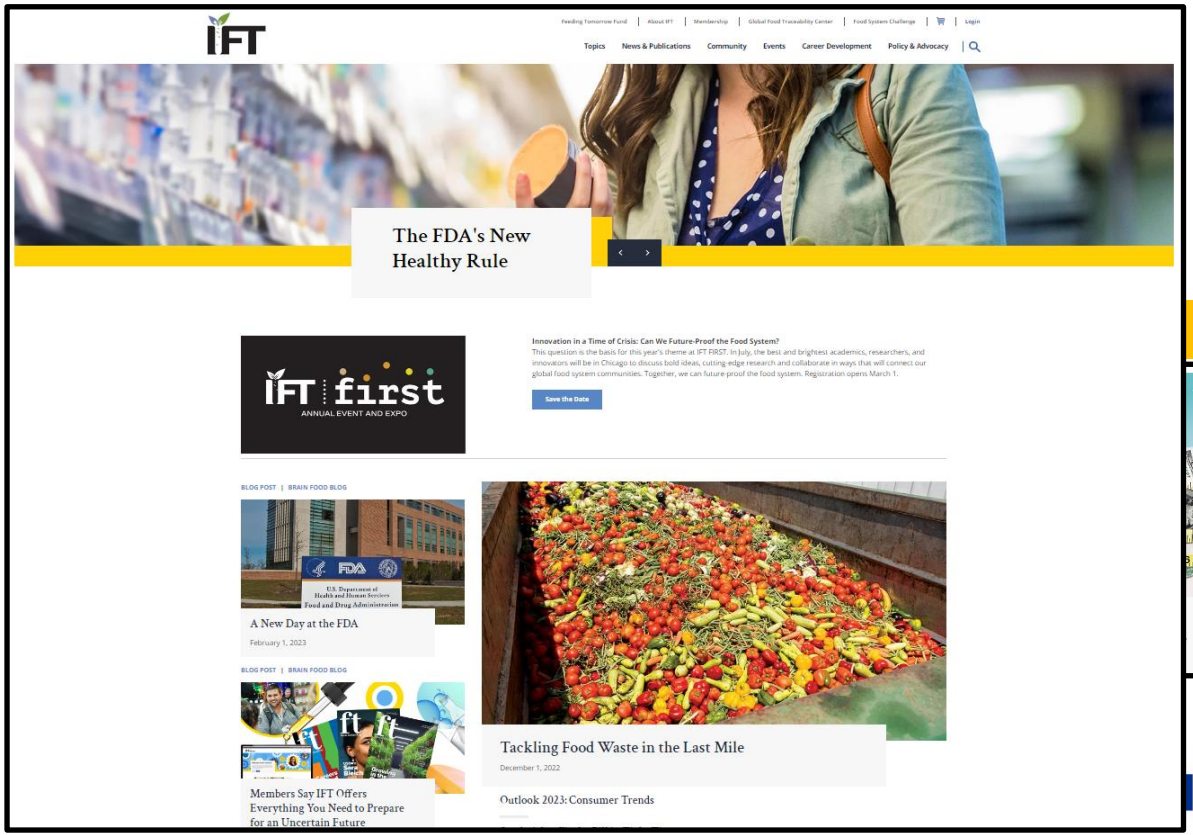


For Educators!



IFT: 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:

flavorsolutions

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Ag Explorer

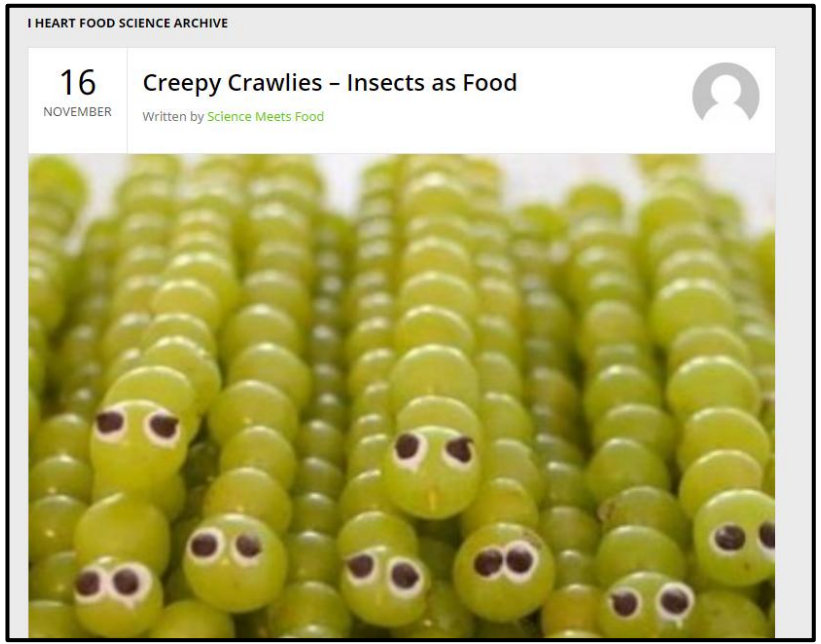
https://www.agexplorer.com/

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

Science Meets Food-Blog

http://sciencemeetsfood.org/

Institute Food Technology Student Association



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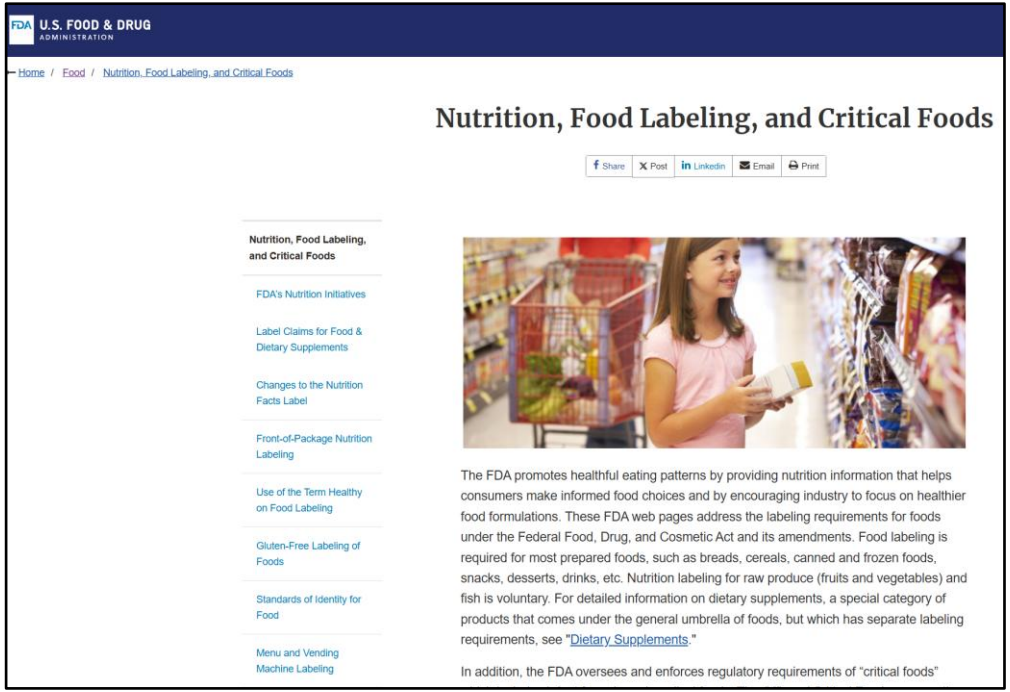
FDA resource – Food Additives

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

FDA resource – Food Additives

https://www.fda.gov/food/nutrition-food-labeling-and-critical-foods



- FDA has a few older, but still appropriate **labs** (Nutrition)
- **Food Additives** (Food Science)
- **Food Allergies** (Food Science, Culinary Arts, Health)
- **Standards of Identity**

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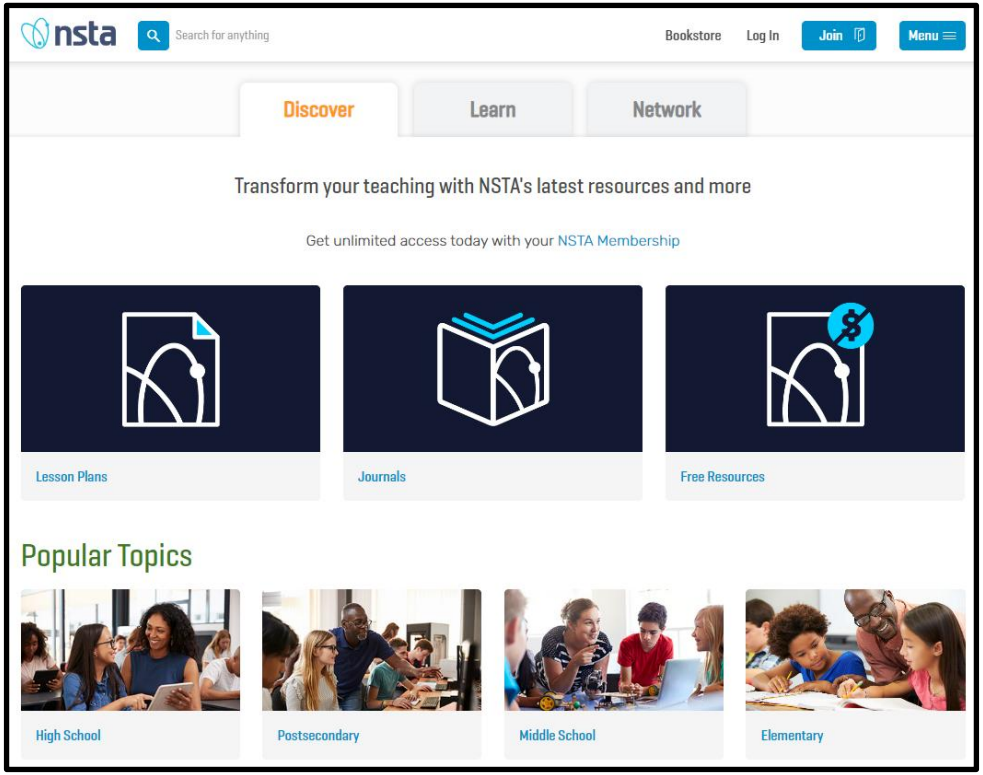
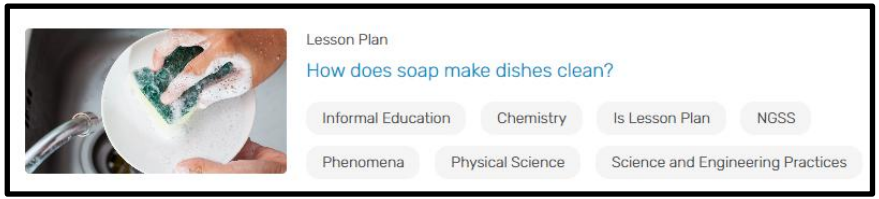
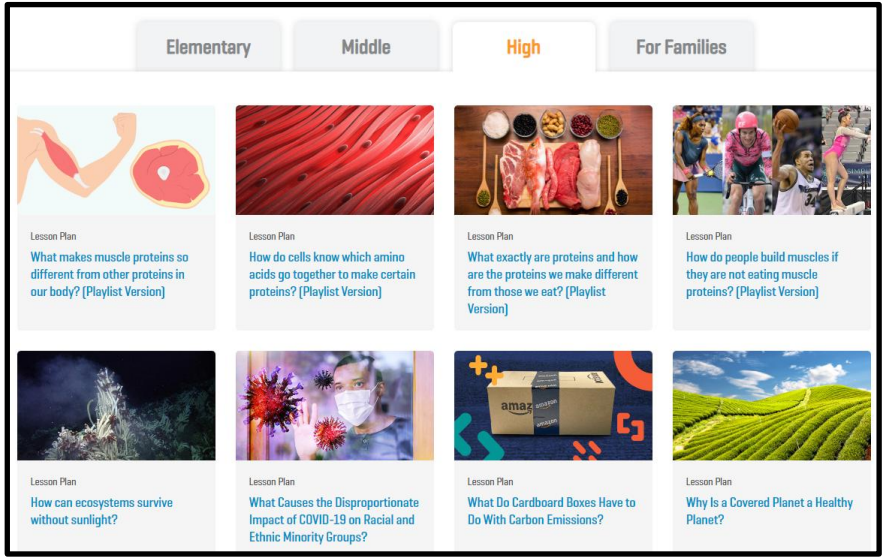
National Science Teachers Assn.

http://www.nsta.org/conferences/fda.aspx







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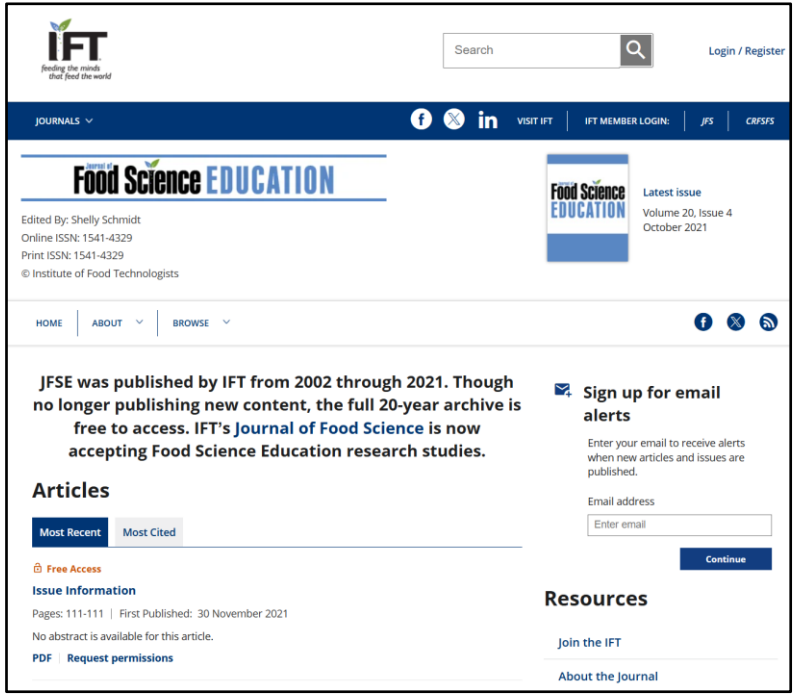
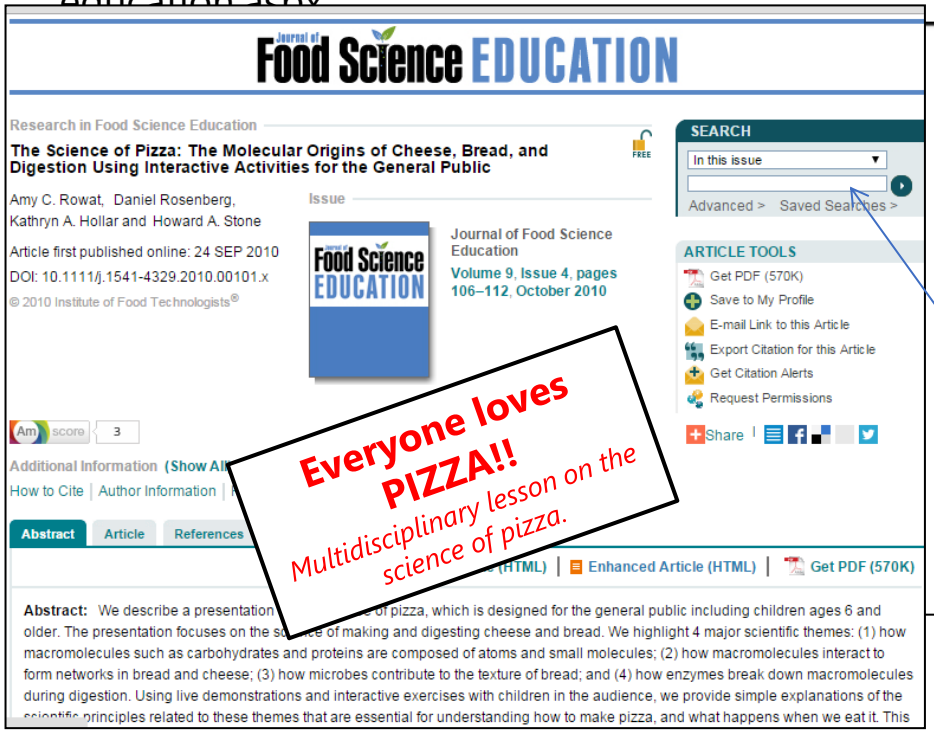
Journals for Food Science Education

https://ift.onlinelibrary.wiley.com/



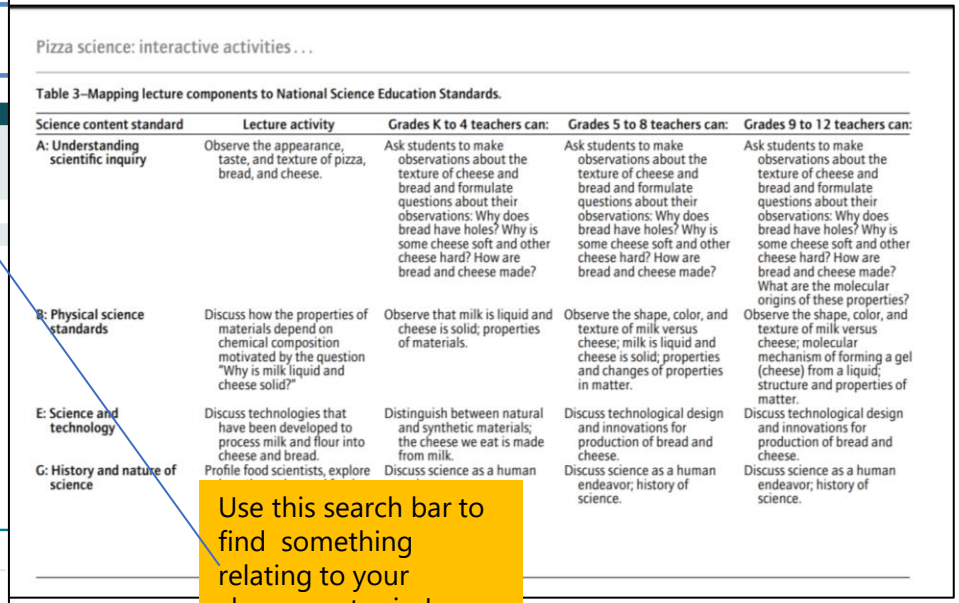
IFT: Journal of Food Science Education

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



Everyone loves PIZZA!!

Multidisciplinary lesson on the science of pizza.



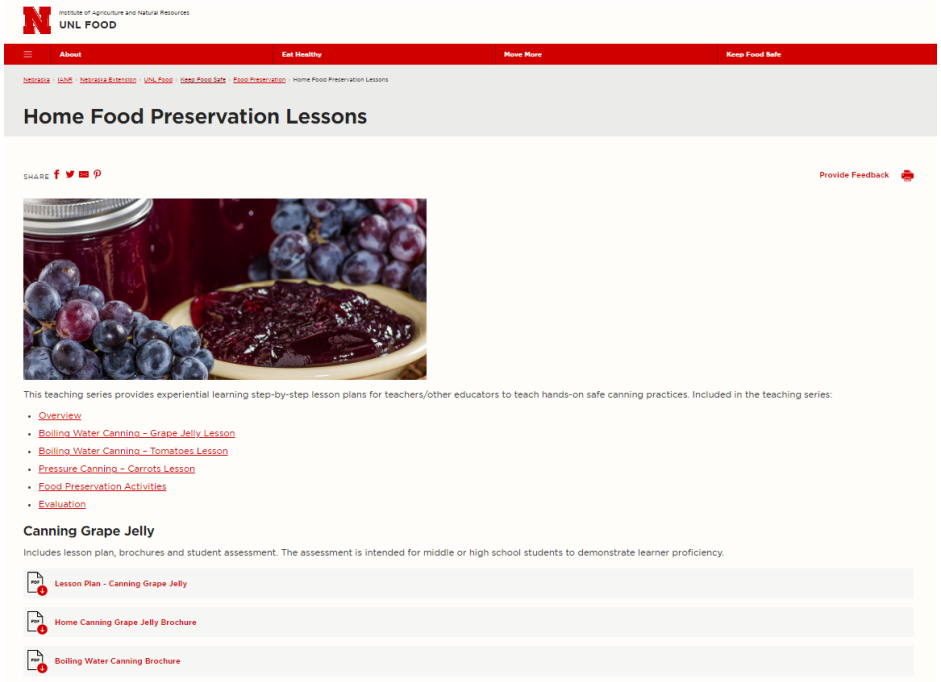
Use this search bar to find something relating to your classroom topics!

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**

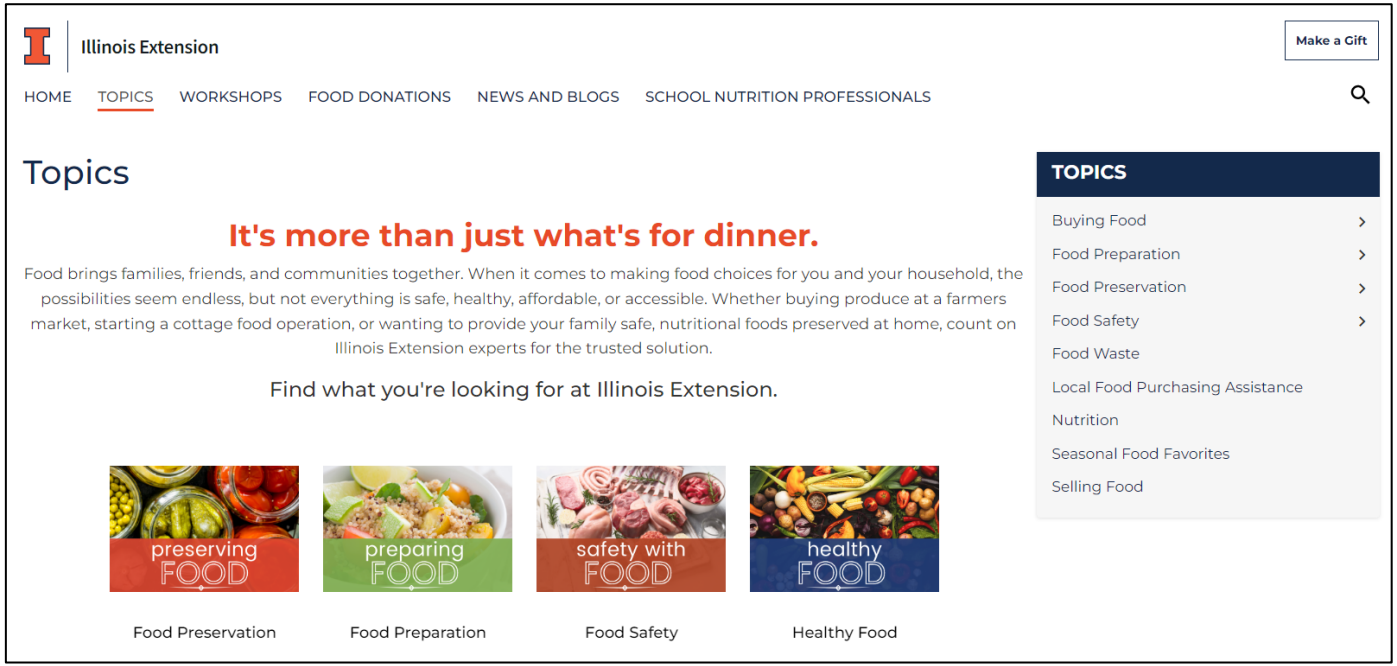
https://growable.unl.edu/tags/hs-ets1-3

5. **Home Food Preservation Lab** - https://food.unl.edu/home-food-preservation-lessons



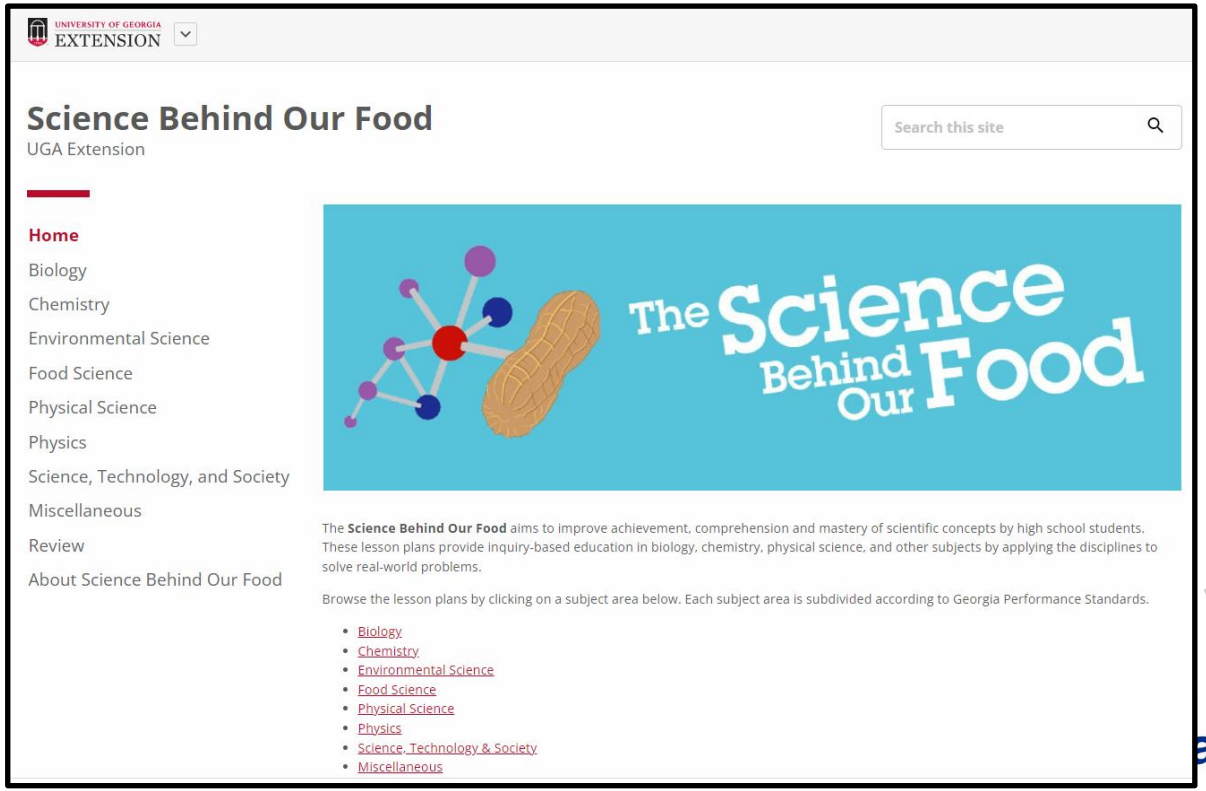
University of Illinois – Food related Labs

1. Food Safety - https://extension.illinois.edu/food



University of Georgia – Science of Food

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



UNIVERSITY OF GEORGIA EXTENSION

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American Chemical Society-ChemMatters

ChemMatters Online
Demystifying Everyday Chemistry

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

More In This Issue >

February 2025

Free Articles

FEATURE
Can Plants Fuel Champions?

OPEN FOR DISCUSSION
Chemistry Is the Foundation of Life, But What Does It Mean to Be Alive?

CHEMISTRY IN PERSON
Why Your Sense of Smells Is Basically Infinite

Downloads

Teacher's Guide (DOC)

Spanish Translation of "Can Plants Fuel Champions?" (PDF)

CHEM IN PERSON

Why Your Sense of Smells Is Basically Infinite

Steven Munger loves the sour smell of a butane lighter. The hydrocarbon, butane, is colorless and odorless, but sulfurous additives give it a stench that's almost objectively foul. Almost. To Munger, a neuroscientist who studies our chemical senses, the aroma conjures memories of his grandfather's lighters. He remembers playing with lighters, flipping them open and lighting them. "The smell was everywhere," Munger says.

Smells can create lasting memories and can be used to trigger deeply buried memories. "A fish smell might be unappealing," Munger says. But if you grew up spending time on boats around family members who fish, you might respond more positively. The same chemical smell can elicit different meanings for different people, and in different contexts.

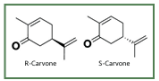
Unlike sight, sound, and touch, the smells and tastes we sense are all chemicals. The associations we peg to chemicals have long captivated Munger. He first studied chemical sensing in crustaceans as a college student before moving on to lab mammals such as mice. He is now a professor at the University of Virginia in Charlottesville, Virginia, studying the mysteries of our chemical senses.

In this interview, Munger discusses his roundabout journey into chemistry and the mysteries of smell and taste that have kept him fascinated throughout his career. –*Mari G. Lary*

Steven Munger

EDUCATION
- B.S.: Biology, University of Virginia
- Ph.D.: University of Florida

WHAT HE DOES NOW
Professor and Co-Director of Research, Otolaryngology at University of Virginia



S-(+)-carvone imparts caraway seeds with their distinctive scent

Did you always expect to study chemical senses or chemistry in general?
I was not a great chemistry student. It didn't really click for me. I ended up approaching it from the biological side.

How did biology lure you into chemistry?
By pure chance. When I was an undergraduate, I was interested in neuroscience and marine biology and looking to work in a lab. One professor had been working on the reflex of mantis shrimp, which can [punch] the water and stun its prey. Well, they weren't working on that project anymore, but they were studying the sense of smell in crayfish.

I just became really fascinated with sensory biology in general—how we understand the world around us.

What fascinated you about the chemical senses?
With smell and taste you get this complexity where your nervous system has to tease apart different chemicals and then put them back together in some way.

What do you mean?
Taste is simpler. There are dedicated receptor proteins in taste buds tuned to recognize different types of chemicals. The way they're wired into the brain dictates what detecting those chemicals mean. There's a receptor that recognizes sugars and chemicals we know as sweeteners. There's another group of receptors that recognize alkaloids and other chemicals for bitterness. Then there's salt, and sour, and umami. And that's about it.

There's also an innate "hedonic valence." Basically: Do you like it or not? If you give sugar to a baby, they will smack their lips and smile if they're old enough. It's innately appetizing and pleasant. If you give the baby a pure bitter compound, they will grimace and stick their tongue out and try to get it out of their mouth. It is innately aversive, and that's because a lot of bitter-tasting compounds are poisonous.

How is smell more complicated?
For the most part, smell is about learning. There are cells with specialized receptors in your nose—we have about 400 different odorant receptor genes—but sensing is more about pattern recognition. If you get the aroma of pizza, which has a bunch of different chemicals, our best understanding is that they're activating receptors to different degrees. That elicits a pattern that your brain had previously learned to associate with pizza, because when you first smelled it, you were sitting in front of a pizza.

So, in smell chemistry, a handful of receptors combine for an almost infinite number of patterns?
Exactly. The term that we use is "combinatorial coding." Also, chemicals might activate the same receptor but do so to different degrees. And we don't understand all of it, because we only look in certain parts of the brain well enough to see those patterns.

Given that the brain wiring of smell is so complicated, how do you study it?
We tend to work with "monomolecular" odorants. Single chemicals like isoamyl acetate, which you would recognize if you've ever smelled banana candy. Another is R-(-)- and S-(+)-carvone. They are chemically identical enantiomers, or left-handed or right-handed mirrors of each other, but one smells like spearmint and the other smells like caraway seeds.

How do our chemical senses affect the rest of the body?
There's a question about how much interplay there is in taste recognition of nutrients and your body preparing to metabolize those nutrients. How much do your nutritional needs feed back to the taste system to affect your dietary choices?

Do you have advice for students for whom chemistry may not be clicking?
It's not something to be afraid of. Chemistry is something to define your relationship with. We are bags of chemicals, and everything we're interacting with involves chemistry.

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!!

Flavorsolutions

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ACS: Food & Cooking Chemistry

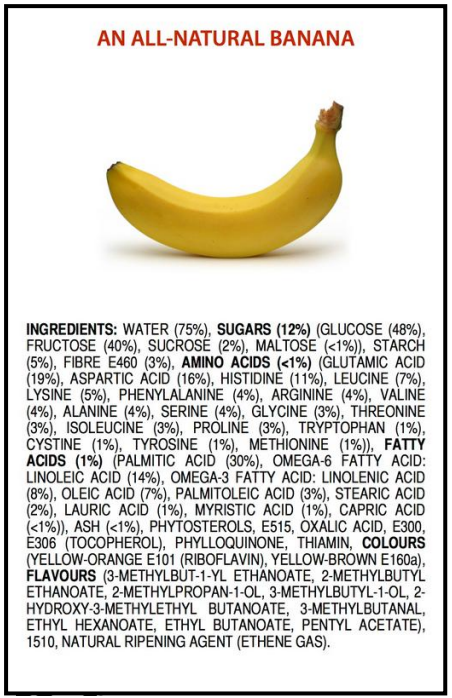
https://www.acs.org/content/acs/en/education/students/highschool/chemistryclubs/activities/food-and-chemistry.html

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

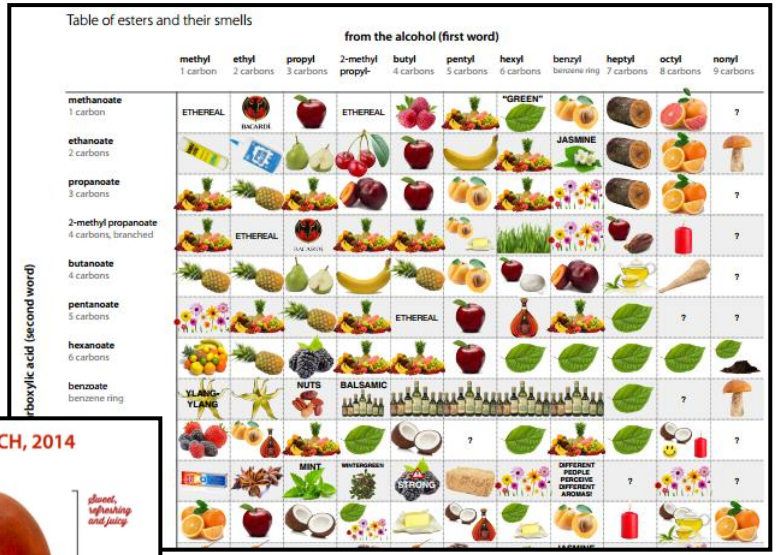
James Kennedy Blog

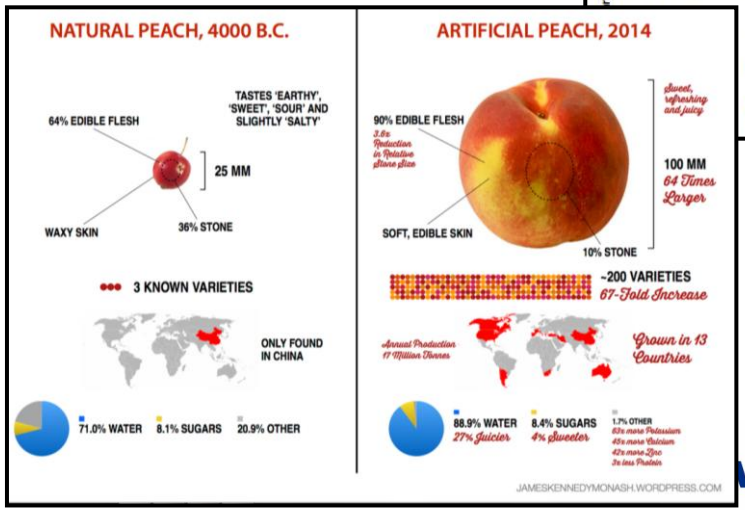
https://jameskennedymonash.wordpress.com/

Chemistry Teacher Australia



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





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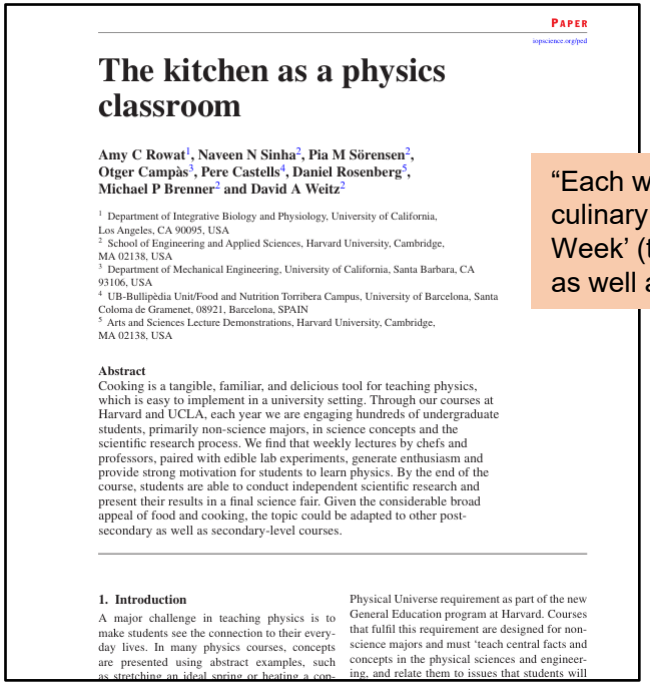
The Kitchen as a Physics Lab!

https://legacy.ibp.ucla.edu/research/rowat/Publications_files/Rowat.Phys.Edu.2014.pdf



PAPER

iopscience.org/ped

The kitchen as a physics classroom

Amy C Rowat[1], Naveen N Sinha[2], Pia M Sörensen[2], Otger Campàs[3], Pere Castells[4], Daniel Rosenberg[5], Michael P Brenner[2] and David A Weitz[2]

[1] Department of Integrative Biology and Physiology, University of California, Los Angeles, CA 90095, USA
[2] School of Engineering and Applied Sciences, Harvard University, Cambridge, MA 02138, USA
[3] Department of Mechanical Engineering, University of California, Santa Barbara, CA 93106, USA
[4] UB-Bullipèdia Unit/Food and Nutrition Torribera Campus, University of Barcelona, Santa Coloma de Gramenet, 08921, Barcelona, SPAIN
[5] Arts and Sciences Lecture Demonstrations, Harvard University, Cambridge, MA 02138, USA

Abstract

Cooking is a tangible, familiar, and delicious tool for teaching physics, which is easy to implement in a university setting. Through our courses at Harvard and UCLA, each year we are engaging hundreds of undergraduate students, primarily non-science majors, in science concepts and the scientific research process. We find that weekly lectures by chefs and professors, paired with edible lab experiments, generate enthusiasm and provide strong motivation for students to learn physics. By the end of the course, students are able to conduct independent scientific research and present their results in a final science fair. Given the considerable broad appeal of food and cooking, the topic could be adapted to other post-secondary as well as secondary-level courses.

1. Introduction

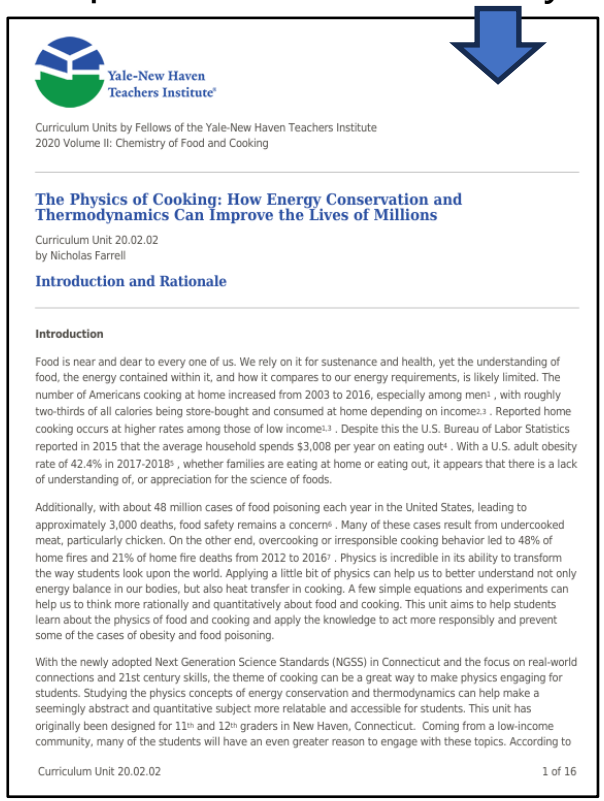
A major challenge in teaching physics is to make students see the connection to their everyday lives. In many physics courses, concepts are presented using abstract examples, such as stretching an ideal spring or heating a con-

Physical Universe requirement as part of the new General Education program at Harvard. Courses that fulfil this requirement are designed for non-science majors and must 'teach central facts and concepts in the physical sciences and engineering, and relate them to issues that students will

"Each week focuses on a single scientific idea that is essential to numerous culinary examples. This idea is introduced through the 'Equation of the Week' (table 1), then elaborated through lectures by professors and chefs, as well as a recipe prepared by the students during their lab section."

The Kitchen as a Physics Lab!

https://teachersinstitute.yale.edu/curriculum/units/files/20.02.02.pdf



Yale-New Haven Teachers Institute

Curriculum Units by Fellows of the Yale-New Haven Teachers Institute
2020 Volume II: Chemistry of Food and Cooking

The Physics of Cooking: How Energy Conservation and Thermodynamics Can Improve the Lives of Millions

Curriculum Unit 20.02.02
by Nicholas Farrell

Introduction and Rationale

Introduction

Food is near and dear to every one of us. We rely on it for sustenance and health, yet the understanding of food, the energy contained within it, and how it compares to our energy requirements, is likely limited. The number of Americans cooking at home increased from 2003 to 2016, especially among men[1] , with roughly two-thirds of all calories being store-bought and consumed at home depending on income[2,3] . Reported home cooking occurs at higher rates among those of low income[1,3] . Despite this the U.S. Bureau of Labor Statistics reported in 2015 that the average household spends $3,008 per year on eating out[4] . With a U.S. adult obesity rate of 42.4% in 2017-2018[5] , whether families are eating at home or eating out, it appears that there is a lack of understanding of, or appreciation for the science of foods.

Additionally, with about 48 million cases of food poisoning each year in the United States, leading to approximately 3,000 deaths, food safety remains a concern[6] . Many of these cases result from undercooked meat, particularly chicken. On the other end, overcooking or irresponsible cooking behavior led to 48% of home fires and 21% of home fire deaths from 2012 to 2016[7] . Physics is incredible in its ability to transform the way students look upon the world. Applying a little bit of physics can help us to better understand not only energy balance in our bodies, but also heat transfer in cooking. A few simple equations and experiments can help us to think more rationally and quantitatively about food and cooking. This unit aims to help students learn about the physics of food and cooking and apply the knowledge to act more responsibly and prevent some of the cases of obesity and food poisoning.

With the newly adopted Next Generation Science Standards (NGSS) in Connecticut and the focus on real-world connections and 21st century skills, the theme of cooking can be a great way to make physics engaging for students. Studying the physics concepts of energy conservation and thermodynamics can help make a seemingly abstract and quantitative subject more relatable and accessible for students. This unit has originally been designed for 11th and 12th graders in New Haven, Connecticut. Coming from a low-income community, many of the students will have an even greater reason to engage with these topics. According to

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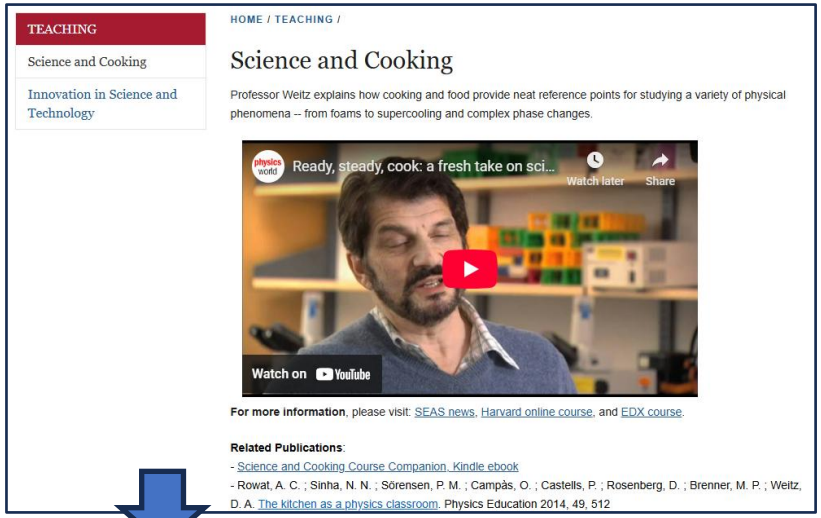

TEACHING

Science and Cooking

Innovation in Science and Technology

HOME / TEACHING /

Science and Cooking

Professor Weitz explains how cooking and food provide neat reference points for studying a variety of physical phenomena -- from foams to supercooling and complex phase changes.

For more information, please visit: SEAS news, Harvard online course, and EDX course.

Related Publications:

- Science and Cooking Course Companion, Kindle ebook
- Rowat, A. C. ; Sinha, N. N. ; Sörensen, P. M. ; Campàs, O. ; Castells, P. ; Rosenberg, D. ; Brenner, M. P. ; Weitz, D. A. The kitchen as a physics classroom. Physics Education 2014, 49, 512

https://weitzlab.seas.harvard.edu/science-and-cooking

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Food Loss & Food Waste

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

Food and Agriculture Organization of the United Nations

IFT feeding the minds that feed the world

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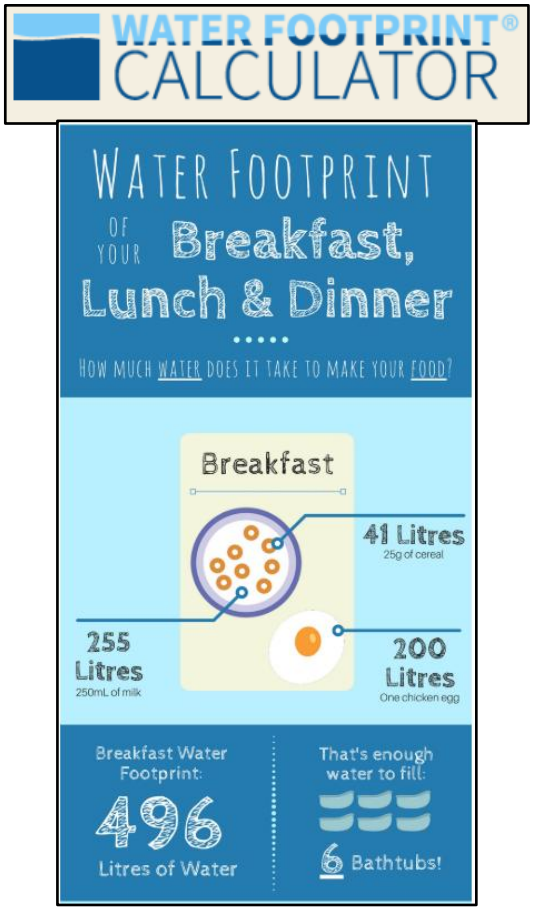
Global Water Issues

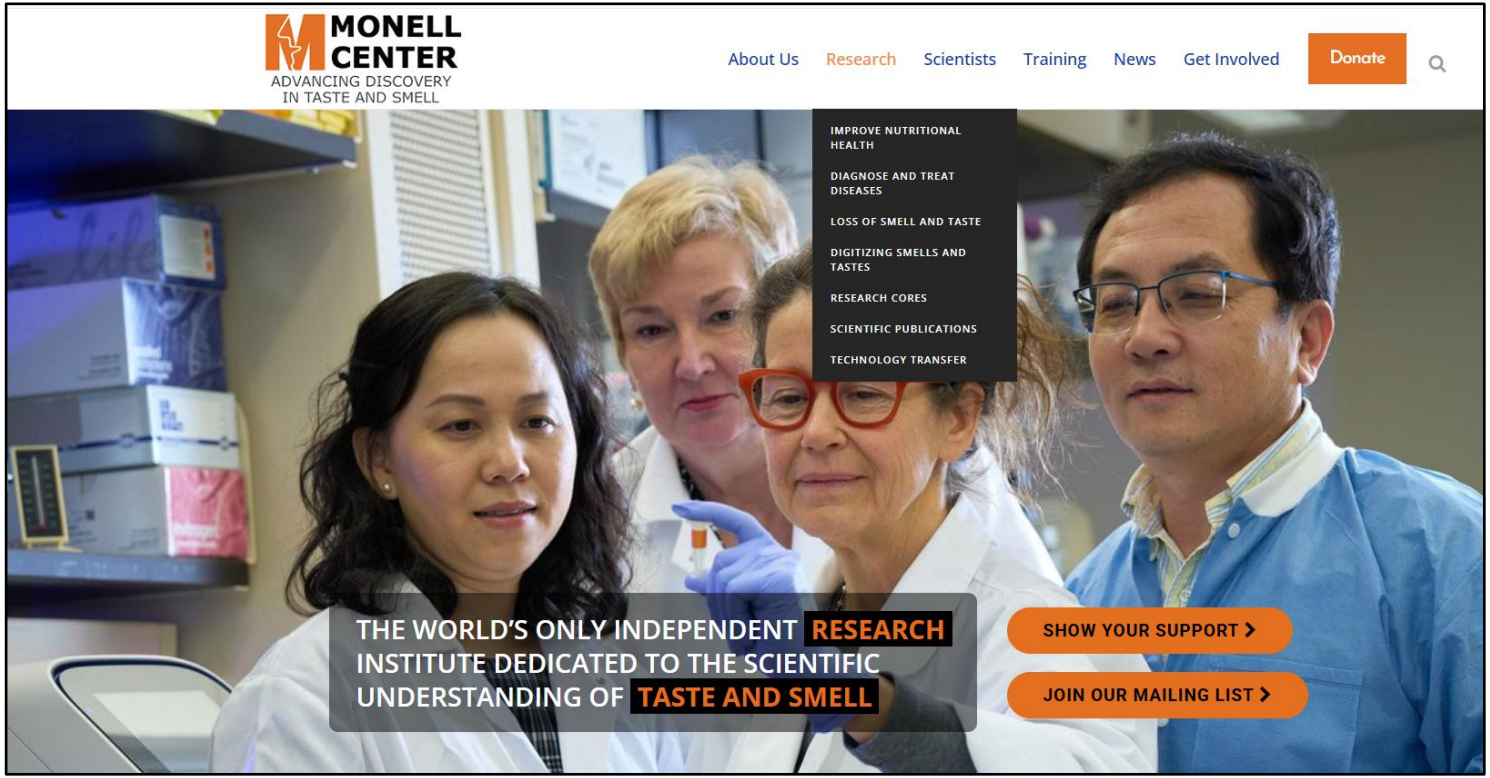
- Water Calculator

  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.



Monell Taste & Smell Institute

https://monell.org/smellandtasteforlife/



Additional Resources

- **Alton Brown** (http://altonbrown.com)
- **FEMA Flavor & Extract Manufacturers Association** (https://www.femaflavor.org/)
- **Society of Flavor Chemists** (http://flavorchemists.com/)
- **Discovery Education & IFT** (http://school.discoveryeducation.com/foodscience/college_resources.html#careers)
- **International Food Information Council (IFIC)** offers a lot of food information related webinars https://ific.org/what-we-do-education-cpe/ (more appropriate for educators or industry professionals)
- **Research Chef's Association (RCA)** past issues of Culinology Magazine - https://www.culinology.org/education/culinology-magazine

Additional Resources

- **UK version of IFT** has some labs online for High school - https://www.ifst.org/lovefoodlovescience/resources
- **FDA** has a few older, but still appropriate labs – (Nutrition) - https://www.fda.gov/food/nutrition-food-labeling-and-critical-foods
- **Partnership for Food Safety Education** (K-12 Curriculum): https://www.fightbac.org/
- **Scientific America** – Science Buddies Experiments: https://www.scientificamerican.com/author/science-buddies/