



# 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



# 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.



## 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.



## Feeding the minds that feed the world

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# Next Generation Science Standards



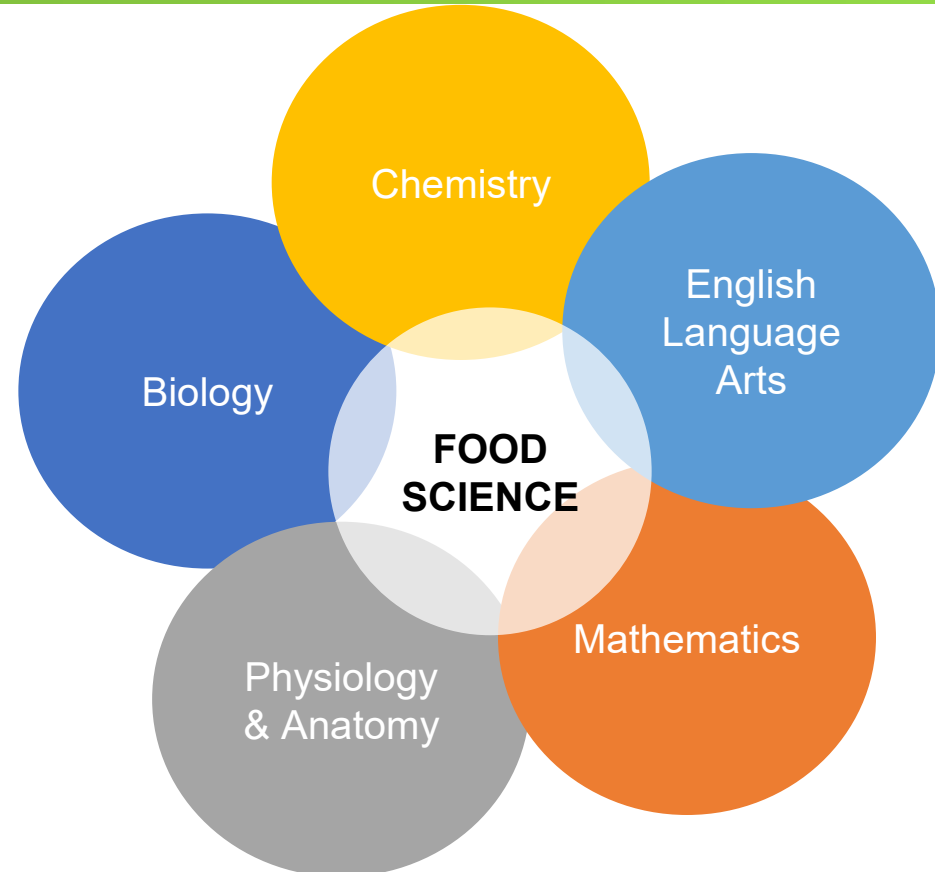
## Practices

- Demonstrations
- Hands on Activities

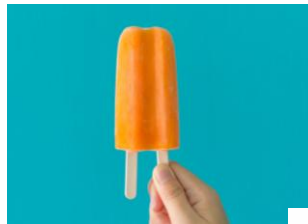
## Cross Cutting Concepts

- Interdisciplinary connections

## Disciplinary Core Ideas



## 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.

## Agriculture & AgTech

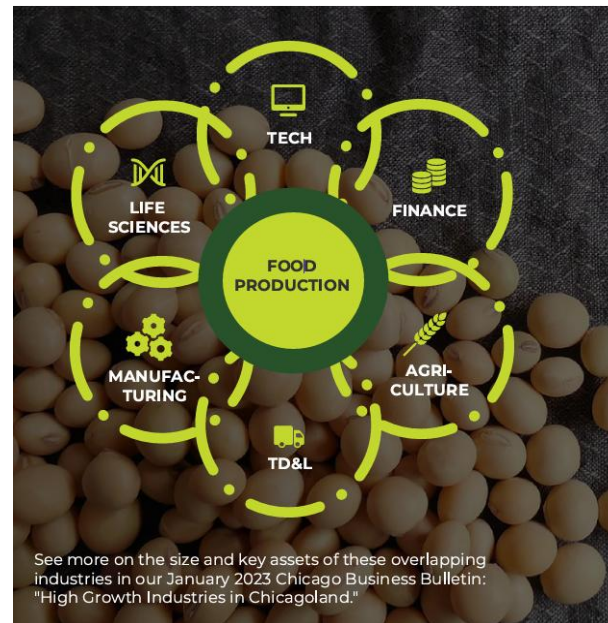
Chicago is a gateway for tech and finance applications to agriculture.

The Chicago metro area not only plays a large part in the food manufacturing industry, but is at the center of the nation's most productive agriculture. The U.S. Bureau of Economic Analysis shares that Illinois has the nation's third largest agricultural output; Midwestern states have a combined agricultural output of \$82.6B, or 28.6% of national output.

Chicago's strategic location to farmland gives agriculture access to overlapping industries, including specialized expertise for technological advancement and the acquisition of capital. As technical workers choose to live in metro areas — for example, the top 100 metro areas employ 77% of all computer-related workers — the agriculture industry can still have proximate access to talent and clusters needed to innovate.



Agricultural GDP by state, 2022  
(millions of current dollars)



See more on the size and key assets of these overlapping industries in our January 2023 Chicago Business Bulletin: "High Growth Industries in Chicagoland."

# What IS the food industry?

## 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.*



# What IS the food industry?

## 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   
  
ONE PLANET. ONE HEALTH

### 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

# What IS the food industry?

## Food Industry Fun Facts

1. The military is one of the largest consumers/users of food science, MRE meals.
2. About  $\frac{1}{3}$  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.



# The Science of Food & Flavor

# Katie Sudler – McCormick



McCormick Flavor solutions



- 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

## McCormick Brands



Flavors

# Let's level set!



Nutrition Facts	
9 servings per container	
Serving size 2/3 cup (95g)	
Amount per serving	
<b>Calories</b>	<b>240</b>
% 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

**Learn** Develop Deliver **Insights** Podcast Taste Responsibility Contact [Sample Request](#) Search

### MCCORMICK FLAVOR SOLUTIONS COMMUNITY EDUCATION PROGRAM

[EXPLORE RESOURCES](#)

HOME > LEARN > MCCORMICK FLAVOR SOLUTIONS COMMUNITY EDUCATION PROGRAM

#### Science is Exciting — Bring it to Life for Students!

McCormick Flavor Solutions' Community Education Program has helped more than 14,000 community members understand the world of food and flavor science. Through hands-on demos, exciting experiments and career path explorations, we're planting the seed of food science knowledge, one student at a time.

#### Teach & Taste

Lesson plans

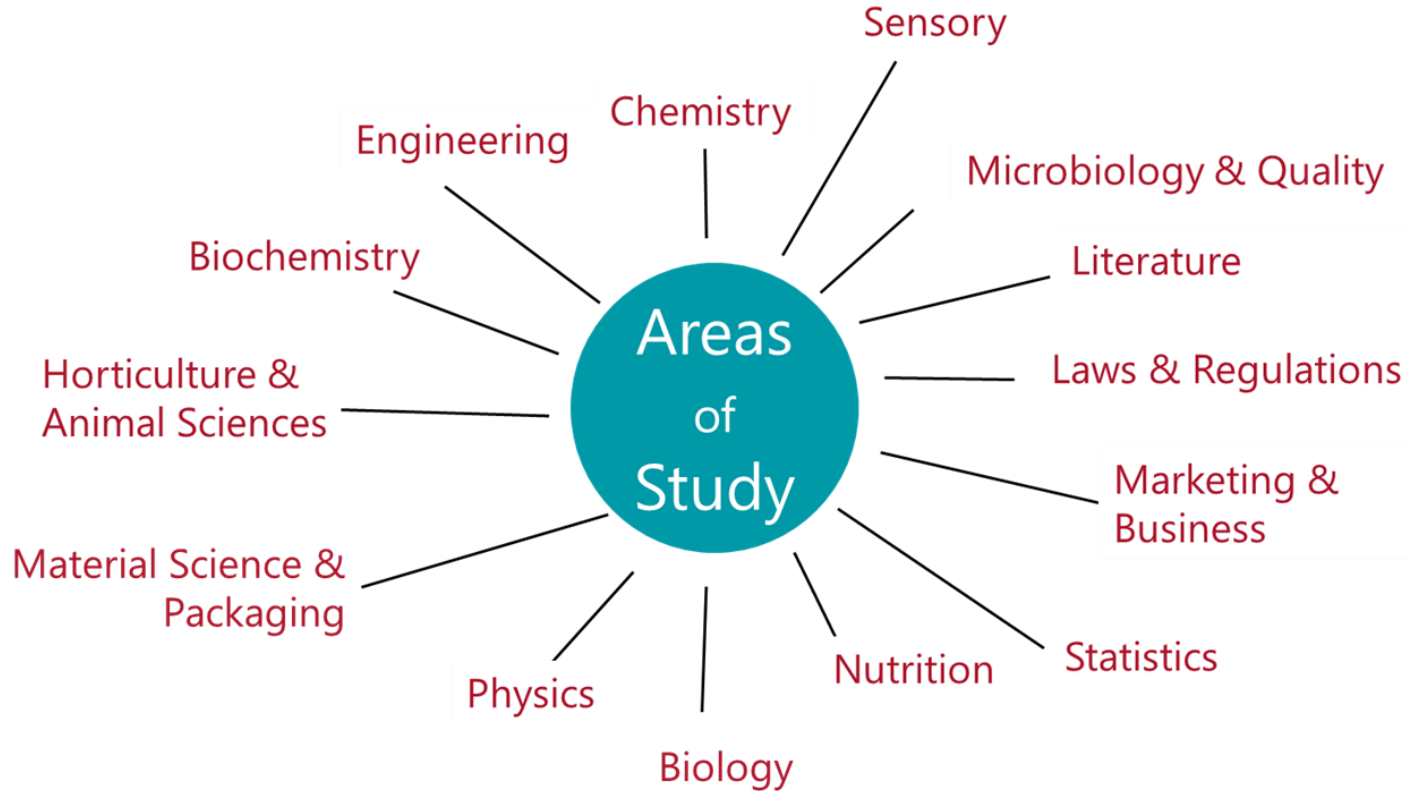
#### Career Exploration

A career in the food industry goes well beyond the grocery store.

#### Science Bites

Science news links & education-specific blog posts.

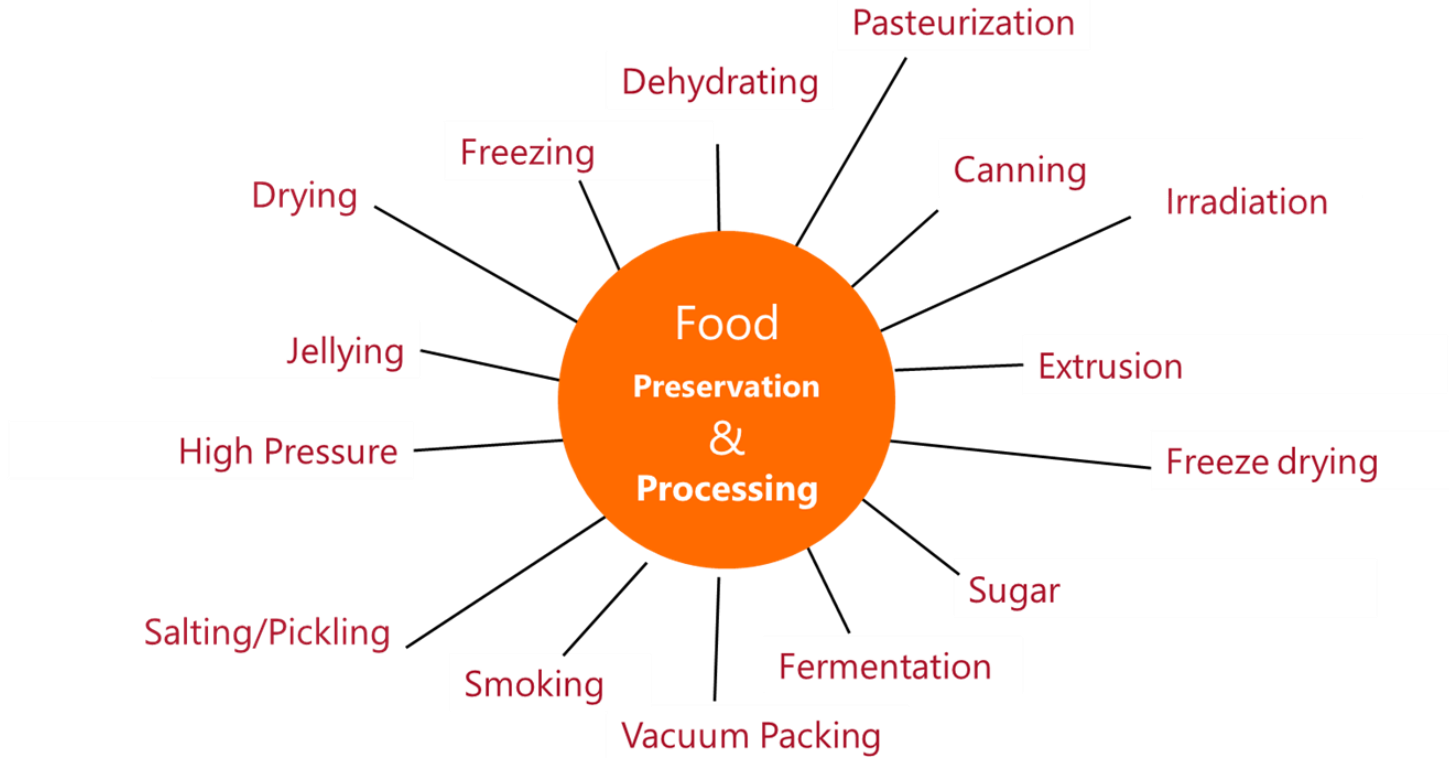
# What do Food Scientists study?



# What do Food Scientists study?



# 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** 1/2 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](http://www.worldhunger.org)



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

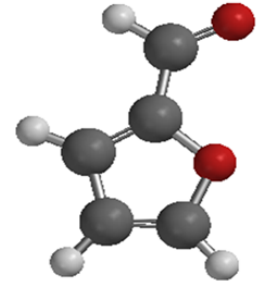


## What is a CHEMICAL?



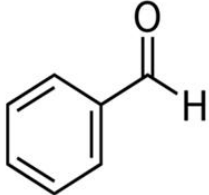
# Chemicals in Our Food

- 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

hydrogen 1 H 1.0079	beryllium 4 Be 9.0122	boron 5 B 10.81	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	helium 2 He 4.0026
lithium 3 Li 6.941	magnesium 12 Mg 24.305	aluminum 13 Al 26.982	silicon 14 Si 28.086	phosphorus 15 P 30.974	sulfur 16 S 32.065	chlorine 17 Cl 35.453	neon 10 Ne 20.180
sodium 11 Na 22.990	calcium 20 Ca 40.078	potassium 19 K 39.098	scandium 21 Sc 44.956	arsenic 33 As 74.922	selecnium 34 Se 78.96	bromine 35 Br 79.904	argon 18 Ar 39.948
potassium 19 K 39.098	strontium 38 Sr 87.62	rubidium 37 Rb 85.468	yttrium 39 Y 88.906	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	krypton 36 Kr 83.80
cesium 55 Cs 132.91	barium 56 Ba 137.33	francium 87 Fr [223]	zirconium 40 Zr 91.224	bismuth 83 Bi 208.98	polonium 84 Po [209]	astatine 85 At [210]	xenon 54 Xe 131.29
radium 88 Ra [226]	actinium 89 Ac [227]		niobium 41 Nb 92.906	thallium 81 Tl 204.38	lead 82 Pb 207.2	radon 86 Rn [222]	

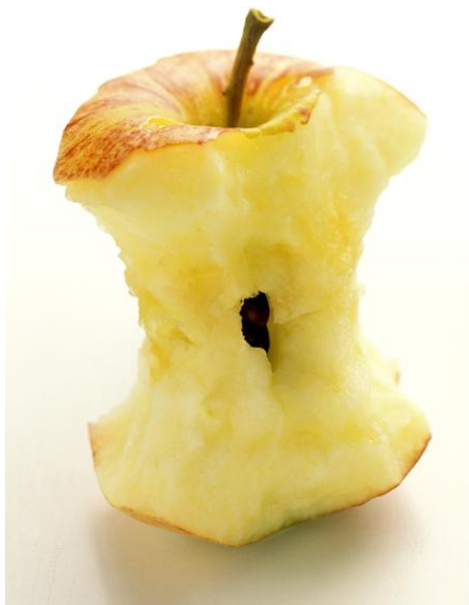


\* Lanthanide series

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
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]

\*\* Actinide series

# Chemicals in Our Food



# What do you smell?



# Ingredients in All-Natural Produce

## ALL-NATURAL CHERRIES



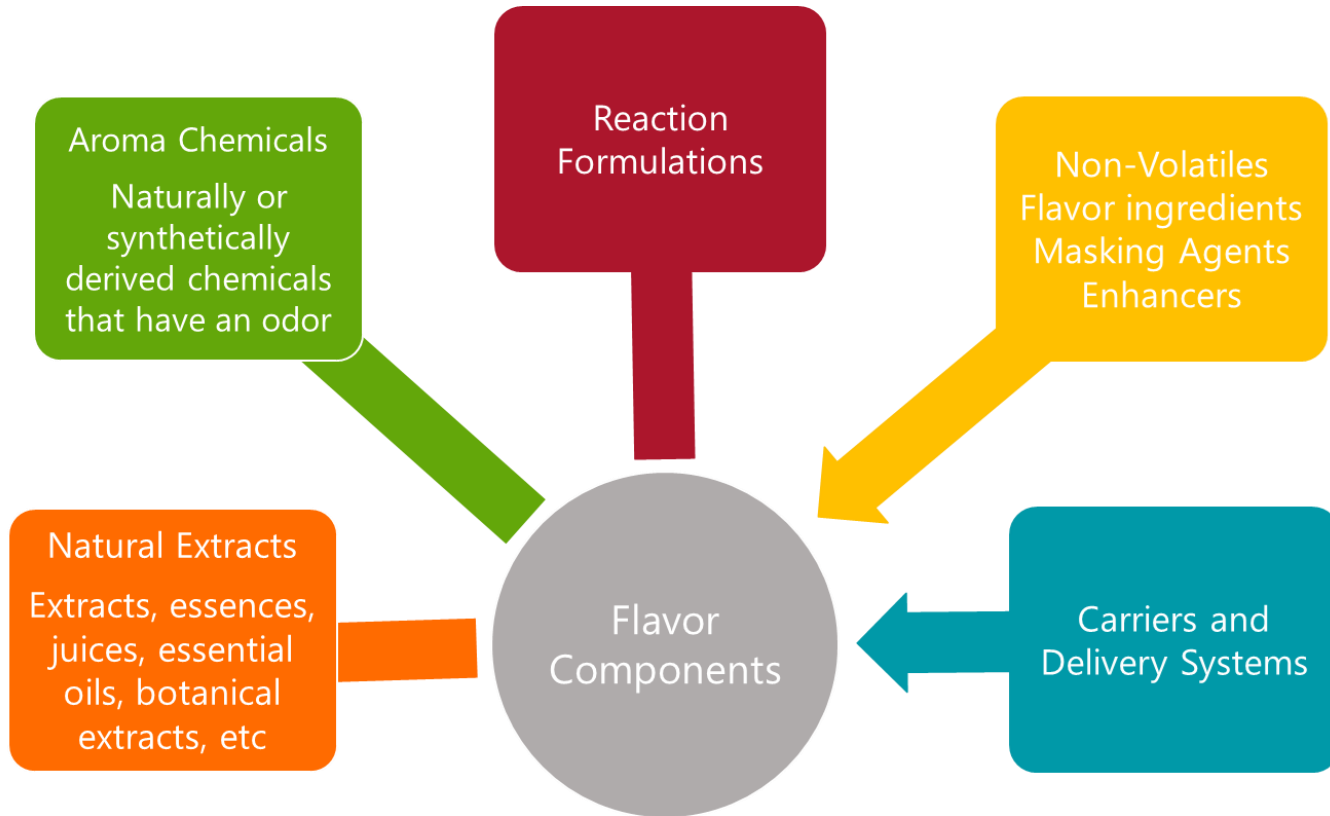
**INGREDIENTS:** **AQUA (82.2%)**, **SUGARS (12.8%)** (GLUCOSE (52%), FRUCTOSE (42%), GALACTOSE (5%), MALTOSE (<1%), SUCROSE (<1%)), FIBRE E460 (2.1%), ASH, **FATTY ACIDS (1.6%)** (OCTADECAENOIC ACID (24%), OMEGA-6 FATTY ACID: OCTADECADIENOIC ACID (24%), OMEGA-3 FATTY ACID: OCTADECATRIENOIC ACID (23%), 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,  $\beta$ -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,  $\alpha$ -phenethyl alcohol, 1-nonanol, benzyl alcohol,  $\beta$ -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



iHeartCraftyThings.com

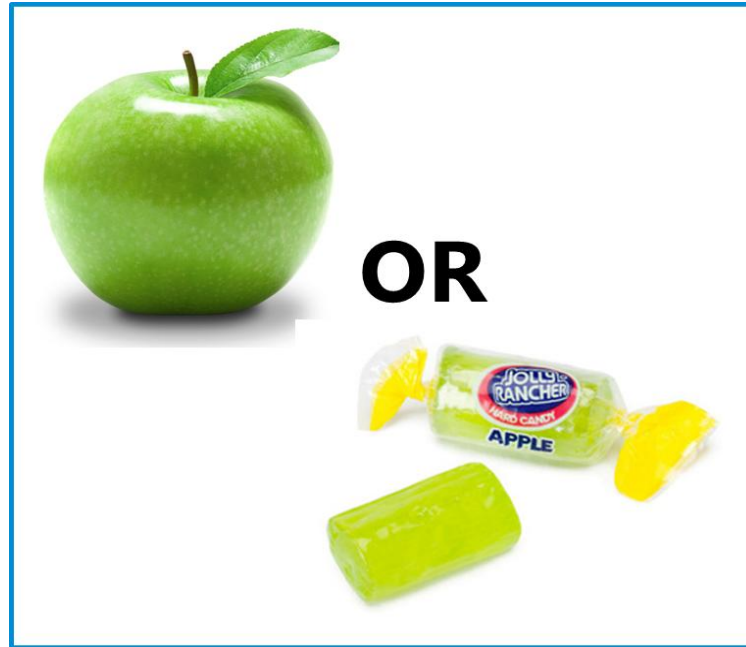
## Flavor Creation

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





HeartCraftyThings.com

## Why are flavors important in food?





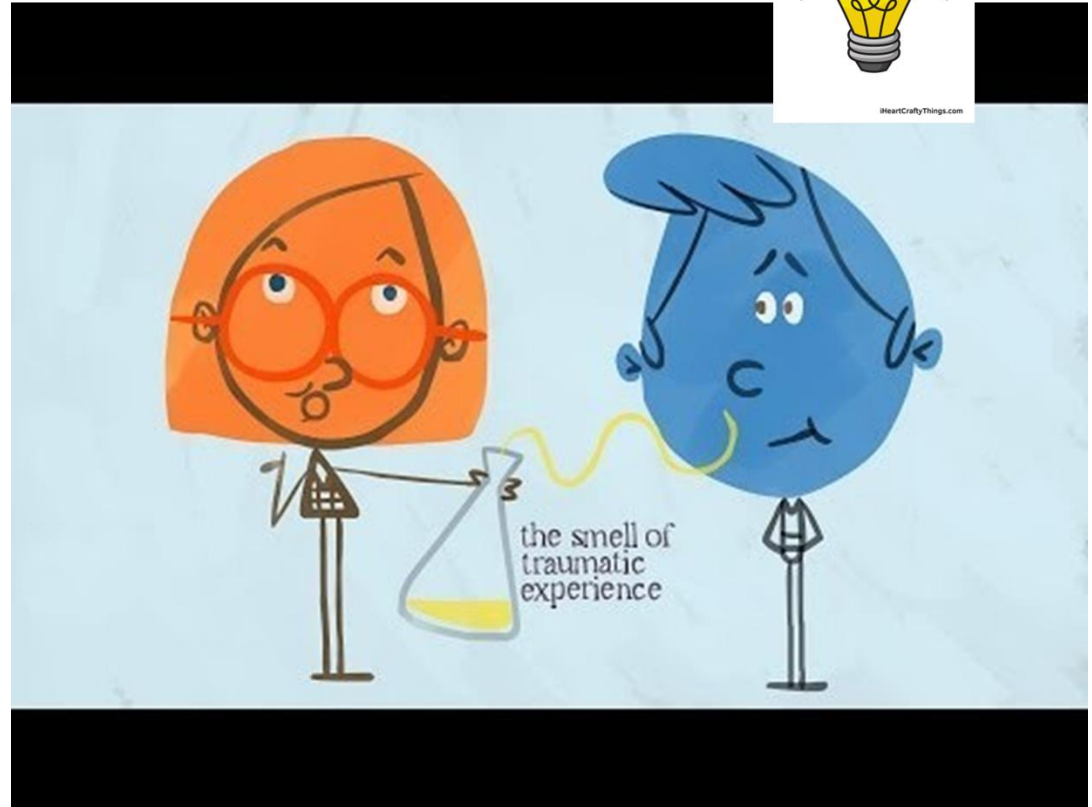
80-90% of  
what you  
experience as  
**“flavor”** *is*  
**aroma.**



**TedEd has  
'watch+think+discuss+dig  
deeper'**

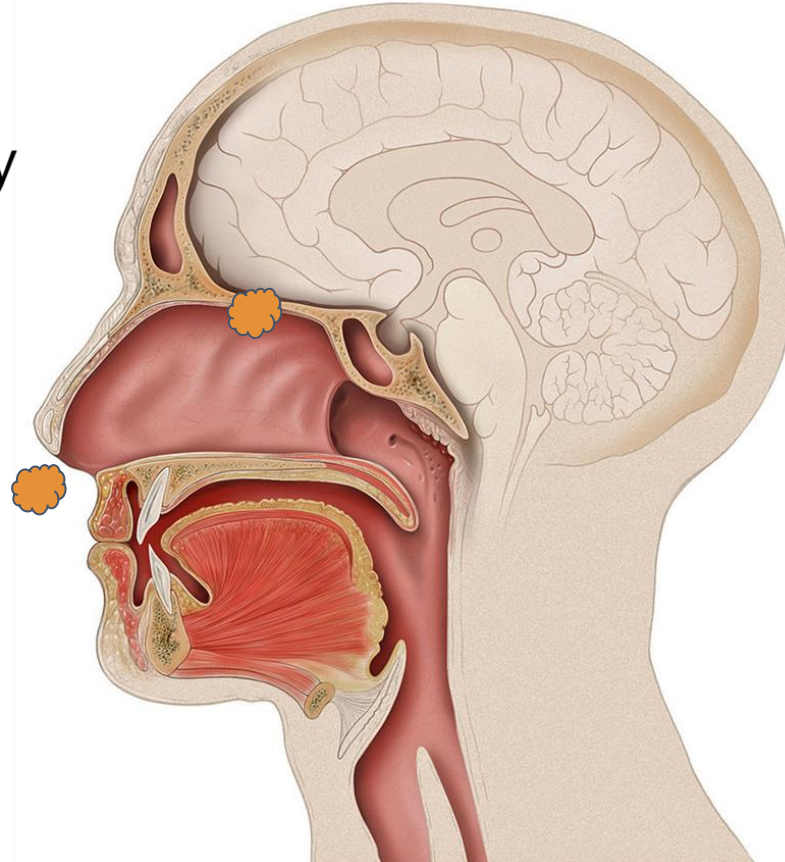
On the link provided:

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



# Aroma - Two ways we perceive aroma

## Orthonasal Pathway

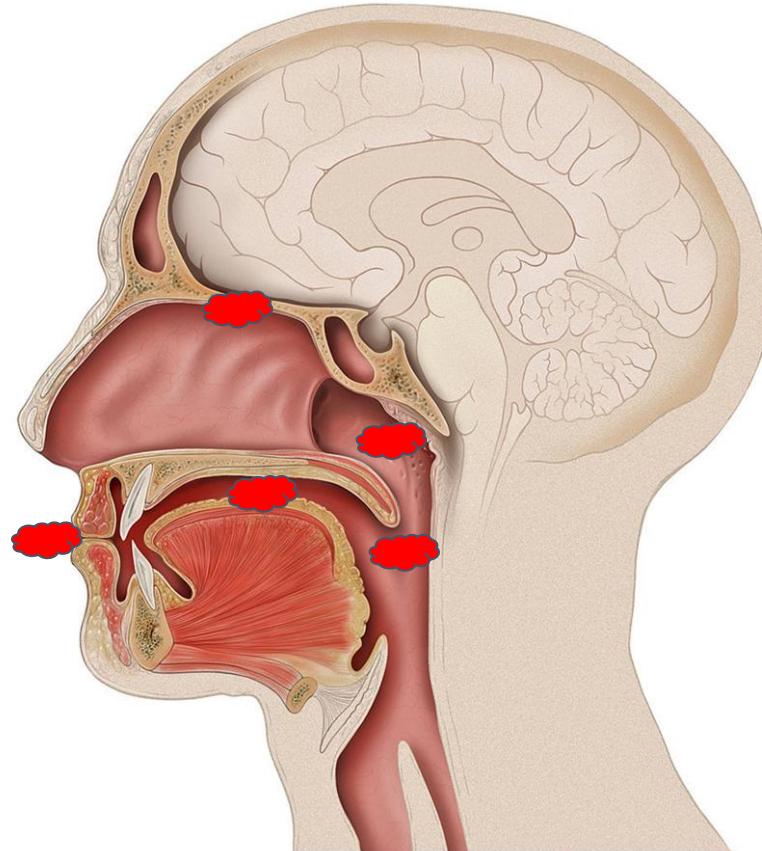


**Fig. 8. Cross sectional depiction of naso-oral cavity**

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# Aroma - Two ways we perceive aroma

## Retronasal Pathway

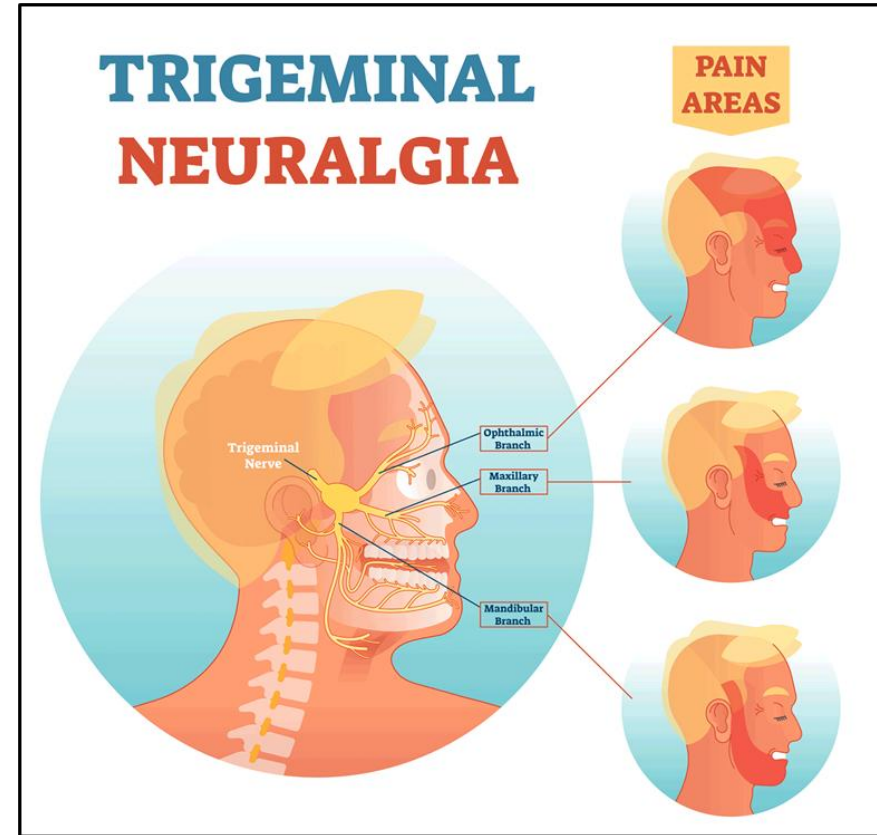


**Fig. 8. Cross sectional depiction of naso-oral cavity**

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# Trigeminal Nerve - Sensations

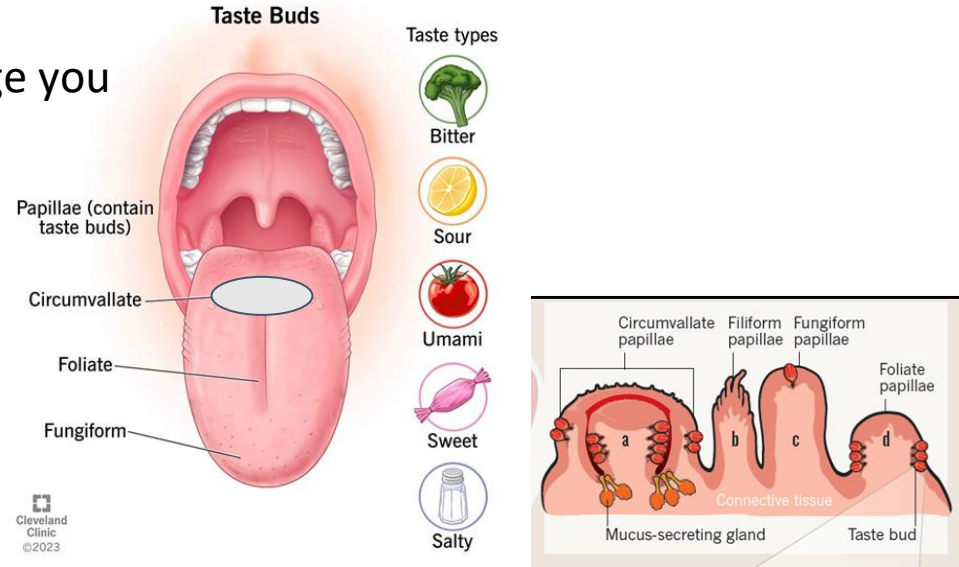
- Sensations serve and intensify the eating experience.
- 3 branches - Each provides sensation to different areas of the face:
  - Ophthalmic (eye)
  - Maxillary (nose & upper jaw)
  - Mandibular (lower jaw)
- Examples include:
  - Chili pepper can irritate your eyes, your nose and your mouth.
  - Onion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

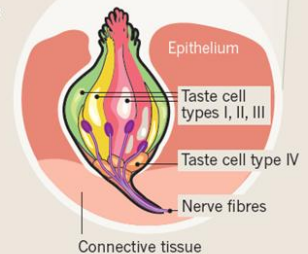
- **48% of taste buds are - Circumvallate**  
8-14, back of tongue
- **0% of taste buds are – Filiform**  
Tactile response
- **18% of taste buds are - Fungiform**  
Mostly at tip of tongue
- **34% of taste buds are - Foliate**  
20 ridges and 600 taste buds per side



## CELLS

Each taste bud is an onion-like structure packed with 50 to 100 taste cells, anatomically classified into four types.

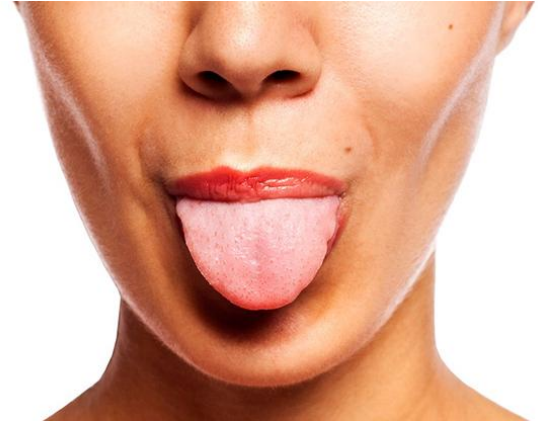
Type II cells contain receptors for sweet, bitter, umami and possibly salty tastes; type III for sour; type I are probably supporting cells. Type IV are suspected to be stem cells that supply new taste cells every two weeks.



# 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 every 6 – 8 days.
- Natural loss of taste buds starts at 45 years old.



©HeartCraftyThings.com

## **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

# COLORS that influence FOOD SALES

HOW CAN YOU BEST USE COLOR TO YOUR ADVANTAGE  
IN YOUR GOURMET FOOD RETAIL PACKAGING?

## RED



One of the chief food colors, red evokes the taste buds and stimulates the appetite.

## GREEN



Green connotes eco-friendliness and healthy, however, it can also be unappetizing.

## YELLOW



Commonly used in food to get noticed and grab attention.

## ORANGE



Orange is a blend of red and yellow, naturally lends itself to food as another appetizing color.



## BLUE

Not commonly found in nature, therefore can be unappetizing if not used correctly.



## PURPLE

Similar to blue but more common in nature. Warm tones are more appetizing than cool tones.



## BLACK

Black signifies elegant, sleek and high-end. For food packaging however, the color brown often takes the place of black as a more appetizing color.



## BROWNS & EARTH TONES

Browns are warm, appetizing, wholesome, natural. Be careful as the earthy, natural look is overplayed in the specialty food sector.



## BRIGHTS

Bright colors connote pops of flavor—such as sweets and desserts.



## SUBDUED & MUTED

Subdued and muted colors signify rich, deep and complex flavors of food.

## WHITE



White connotes clean and pure, but it can also look stark, plain and sterile.

Colors used in product packaging should denote product flavor when applicable.

<https://jenn david.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/>



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.

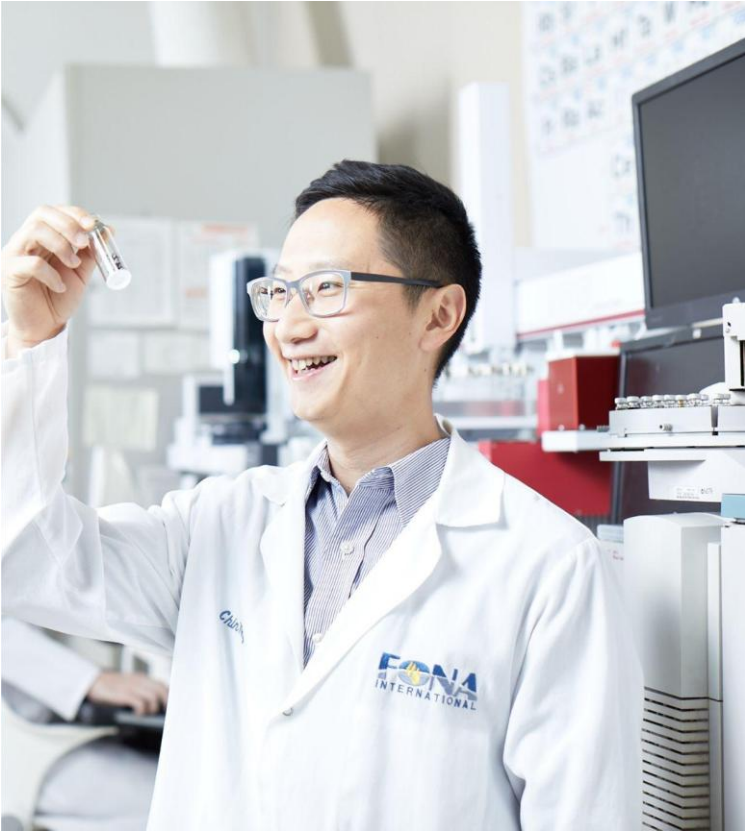
- Present research to the class

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)

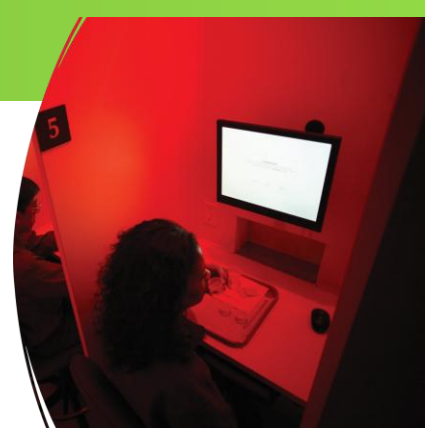
**Physical Chemists** do physical testing on food when an ingredient needs to change, key characteristics in the food do not change.

- 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



## 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](mailto:Lindap23954@gmail.com)



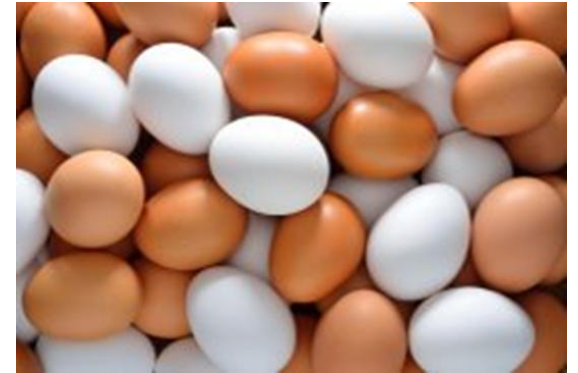
# Fun Facts about Eggs

- 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

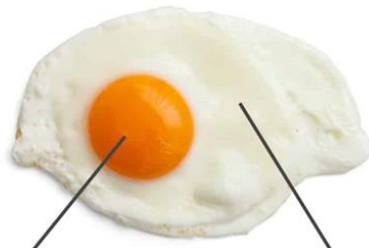
Eggs are about 90% water into which about 10% proteins (including albumins, mucoproteins, and globulins) are dissolved

## NUTRIENTS AND CALORIES IN AN EGG



NUTRIENTS	CALORIES
VITAMINS A, B, D, AND E	17 CALORIES IN ONE RAW EGG WHITE
MINERALS IRON, IODINE, PHOSPHOROUS, FOLATE, AND COMPOUNDS LIKE CHOLINE	55 CALORIES IN ONE RAW EGG YOLK

## Egg Nutrition



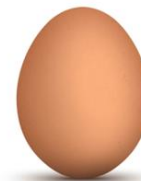
### Yolk

**Fat** 4.5 g  
**Sat. Fat** 1.6 g  
**Cholesterol** 184 mg  
 Carbohydrates 0.5 g  
 Protein 2.5 g

### White

Fat 0 g  
 Sat. Fat 0 g  
 Cholesterol 0 mg  
 Carbohydrates 0 g  
**Protein** 4 g

### INGREDIENTS OF AN ALL-NATURAL EGG



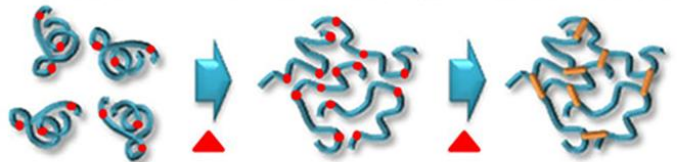
**INGREDIENTS:** AQUA (75.8%), **AMINO ACIDS (12.6%)** (GLUTAMIC ACID (14%), ASPARTIC ACID (11%), VALINE (9%), ARGININE (8%), LEUCINE (8%), LYSINE (7%), SERINE (7%), PHENYLALANINE (6%), ALANINE (5%), SOLEICINE (5%), PROLINE (4%), TYROSINE (3%), THREONINE (3%), GLYCINE (3%), HISTIDINE (2%), METHIONINE (3%), CYSTINE (2%), TRYPTOPHAN (1%); **FATTY ACIDS (9.9%)** (OCTADECENOIC ACID (45%), HEXADECANOIC ACID (32%), OCTADECANOIC ACID (12%), EICOSATETRAENOIC ACID (3%), EICOSANOIC ACID (2%), DOCOANOIC ACID (1%), TETRACOSANOIC ACID (1%), OCTANOIC ACID (<1%), DECANOIC ACID (<1%), DODECANOIC ACID (<1%), TETRADECANOIC ACID (<1%), PENTADECANOIC ACID (<1%), HEPTADECANOIC ACID (<1%), TETRADECENOIC ACID (<1%), HEXADECENOIC ACID (<1%), EICOSENOIC ACID (<1%), DOCOSENOIC ACID (<1%), **OMEGA-6 FATTY ACID:** OCTADECADIENOIC ACID (12%), **OMEGA-3 FATTY ACID:** OCTADECATRIENOIC ACID (<1%), EICOSAPENTAENOIC ACID (EPA) (<1%), **OMEGA-3 FATTY ACID:** DICOSAHEXAENOIC ACID (DHA) (<1%); **SUGARS (0.8%)** (GLUCOSE (30%), SUCROSE (15%), FRUCTOSE (15%), LACTOSE (15%), MALTULOSE (15%), GALACTULOSE (15%); **COLOR** (E160a, E160b, E306, E101); **FLAVOURS** (PHENYLACETALDEHYDE, DODECA-2-ENAL, HEPTA-2-ENAL, HEXADECANAL, OCTADECANAL, PENTAN-2-ONE, BUTAN-2-ONE, ACETALDEHYDE, FORMALDEHYDE, ACETONE); SHELL (E170). ALSO CONTAINS BENZENE & BENZENE DERIVATIVES, ESTERS, FURANS, SULFUR-CONTAINING COMPOUNDS AND TERPENES.

# Chemistry & Eggs

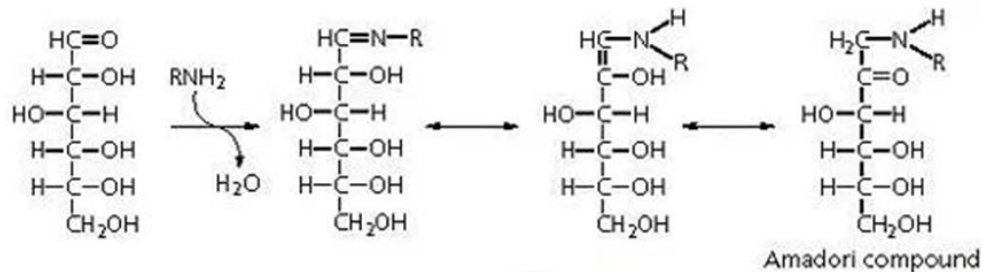
(a)



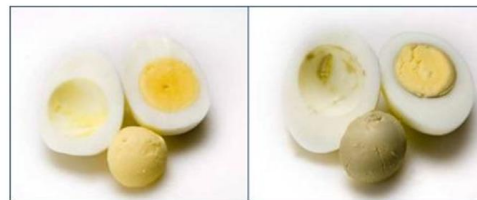
(b) Protein Thermal Irreversible Denaturation



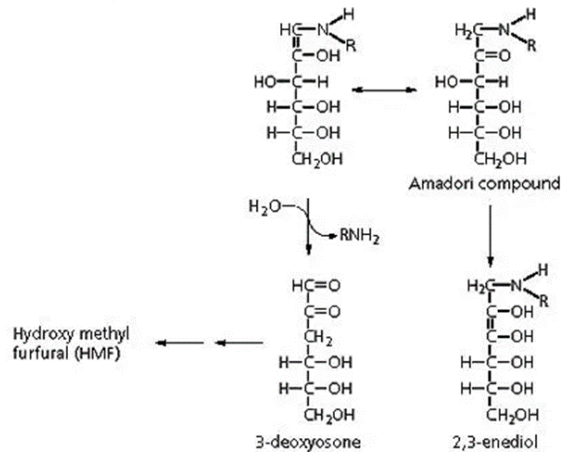
Native albumen      Denaturation      Crosslinking  
 • : -SH                      - : S-S



## Hard-Cooked Eggs

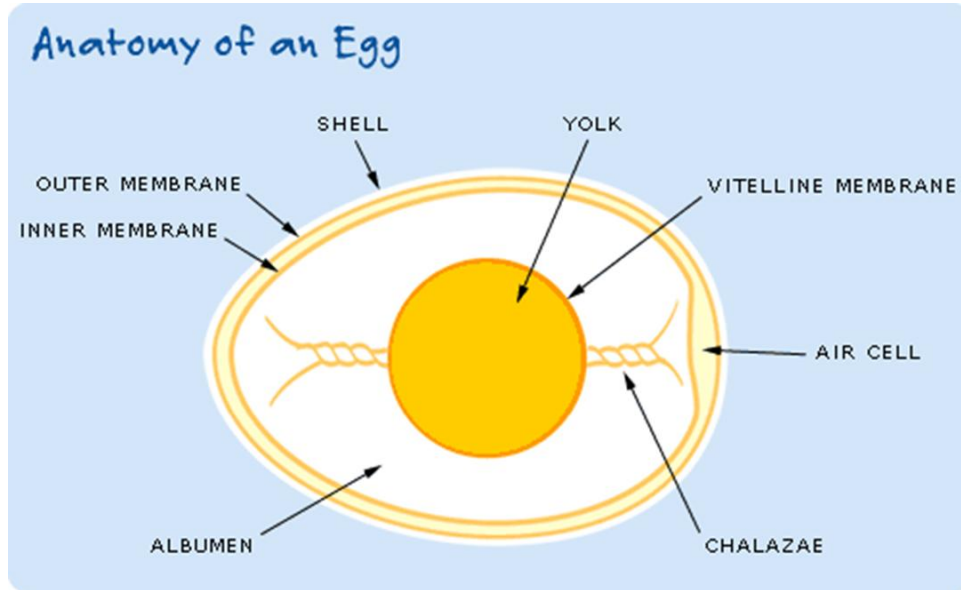


Properly hard-boiled eggs (left) are uniformly cooked through and gold colored. A green discoloration covers the yolk when in-shell eggs are overcooked (right).



## Biology & Eggs

The fresher the egg the thicker 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



that skinny chick can bake



# 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

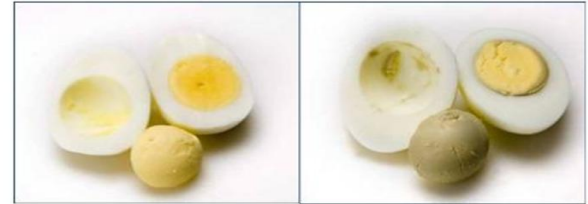
A greenish-gray ring around a hard-boiled egg yolk is caused by a chemical reaction between sulfur from the egg white and iron from the yolk

## 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.

## 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).

# Chemical Reaction to form Ferrous Sulfide

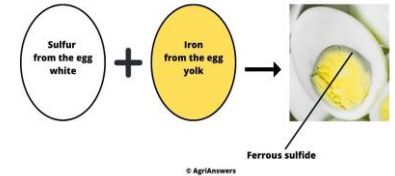
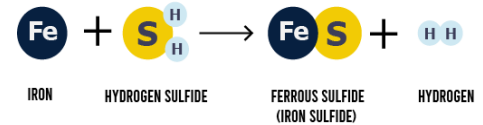
## Hard Boiled Eggs

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.

GREEN IN THE EGG YOLK IS CAUSED BY FERROUS SULFIDE  
CHICKENFANS



# 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  $\frac{1}{2}$  of each piece with the beaten egg – often called the egg wash.
4. Bake in 350F oven for 10-12 minutes.



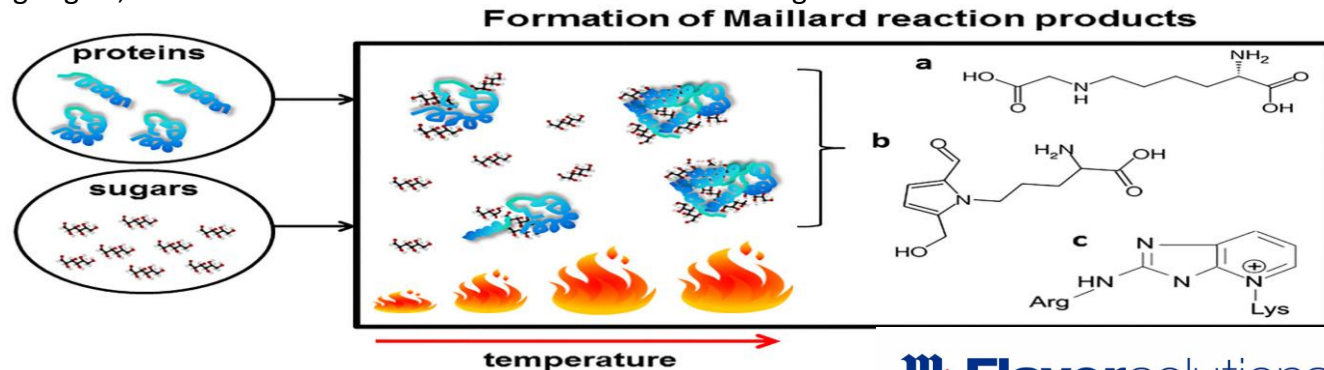
# Maillard Browning Reaction

## 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

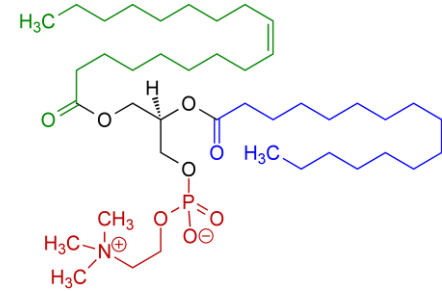
# An Edible Oil in Water Emulsion

## 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.

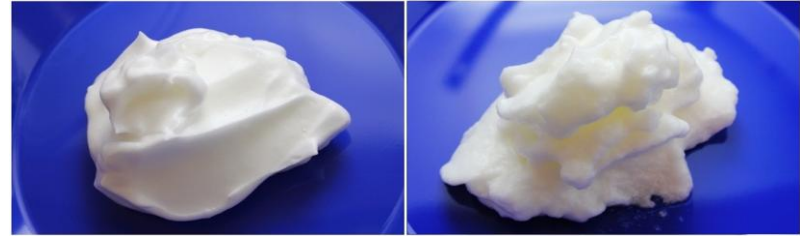
## Experiment

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 hydrophilic (water-attracting) and hydrophobic (water-repelling) regions, arrange themselves around the air bubbles. The hydrophilic 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

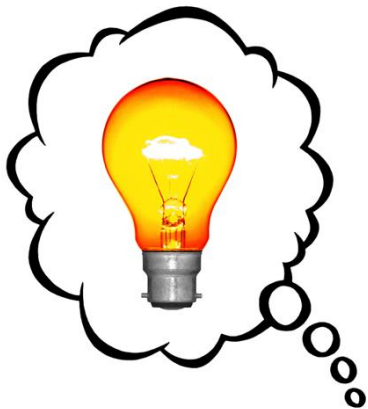
# Careers in the Food and Beverage Industry



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**

Scientists 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



# Food Industry Careers - Product Development Hands on Experiment Flavored Chip Development

## 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.



# Food Industry Careers - Product Development Hands on Experiment Flavored Chip Development

## 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 #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.



# Food Industry Careers - Product Development Hands on Experiment Flavored Chip Development

## 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 #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.



# Food Industry Careers - Product Development Hands on Experiment Flavored Chip Development

## 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

# 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



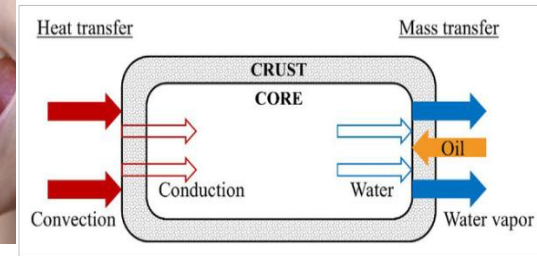
# Food Industry Careers – Packaging Development Hands on Experiment for Packaging Materials

## What is happening?

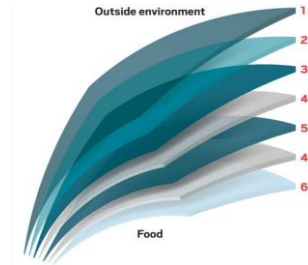
Potato chips go stale because they've gained too much moisture. That's because chips lose most of the moisture inside them during the frying process, creating a crunchy network of starch molecules.

- 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, manufacturers 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  $\frac{1}{2}$  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  $\frac{1}{2}$  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  $\frac{1}{2}$  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

## 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

Chemists 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

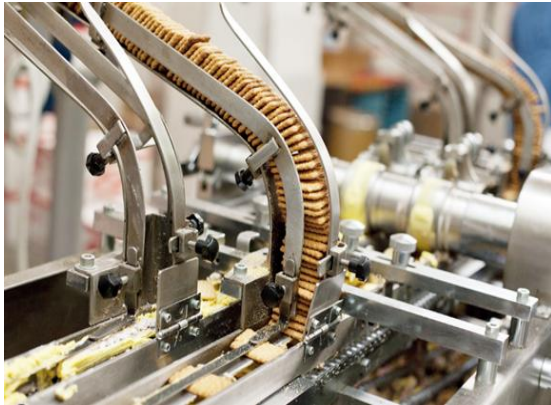
Ingredients are sourced from around the world in the volumes projected to be needed. They work with suppliers to ensure responsible practices are in place. Contracts are put into place with suppliers.

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

**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!**

A top-down view of three black bowls filled with golden-brown potato chips, arranged on a light green surface. Each bowl contains a white plastic dipping cup. The bowls are arranged in a triangular pattern: one at the top, one at the bottom left, and one at the bottom right. A yellow text box is overlaid on the left side of the image.

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

# Questions

# Next Steps for Students

- Learn more about where you can get a Food Science Degree!
- [Undergraduate Programs](#)



**IFT HERB**  
Approved Undergraduate Programs  
Food Science and Food Technology

**Approved Programs in 2025**

 **42** Domestic  
 **52** International

Domestic vs. International Programs: 44.7% Domestic

**+6** New International Submissions Approved  
(Submitted in 2025, approved for 2026-2031)

### Programs Per Country

 United States <b>42</b>	 Chile <b>1</b>
 China <b>13</b>	 Lebanon <b>1</b>
 Malaysia <b>5</b>	 Argentina <b>1</b>
 Canada <b>5</b>	 Costa Rica <b>1</b>
 Indonesia <b>5</b>	 Honduras <b>1</b>
 Thailand <b>3</b>	 Ireland <b>1</b>
 Australia <b>2</b>	 New Zealand <b>1</b>
 Ecuador <b>2</b>	 Taiwan <b>1</b>
 South Africa <b>2</b>	 United Arab Emirates <b>1</b>
 Vietnam <b>2</b>	 Pakistan <b>1</b>
 Mexico <b>1</b>	



# 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!

amazon.com  
gift card



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](mailto: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  
COMMUNITY EDUCATION PROGRAM

EXPLORE RESOURCES

HOME > LEARN > MCCORMICK FLAVOR SOLUTIONS COMMUNITY EDUCATION PROGRAM

## Science is Exciting — Bring it to Life for Students!

McCormick Flavor Solutions' Community Education Program has helped more than 14,000 community members understand the world of food and flavor science. Through hands-on demos, exciting experiments and career path explorations, we're planting the seed of food science knowledge, one student at a time.



### Teach & Taste

Lesson plans



### Career Exploration

A career in the food industry goes well beyond the grocery store.



### Science Bites

Science news links & education-specific blog posts.

# McCormick Flavor Solutions Resources

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

- White Papers
- Trend Information



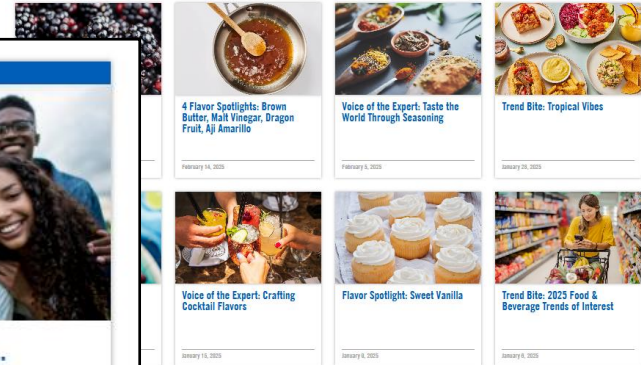
HOME > TRENDS & INSIGHTS

## What matters most: making informed choices to win.

We track and openly share what you need to know now. Key flavor movements, essential consumer changes and in-depth category viewpoints.

[SPECIAL REPORTS](#) [TRENDS & INSIGHTS](#) [FLAVOR FORECAST](#)

10 Things: Alcohol Apple Baby Boomer Bakery Bars Beverage Blood Orange Botanicals Clean Coffee Comfort Confectionary Consumer Convenience COVID-19 Dairy Dessert Dining Out E-Commerce Encapsulation Energy Fall Flavor Fruit Generation X Generation Y Generation Z Grain Gummies Health Healthcare Immunity Indulgences Ingredients Innovation Keto Kids and Teens Meat Millennial Morris Natural Non-Dairy Nostalgia Organic Performance Nutrition Pet Care Plant-Based Plants Premiumization Protein Regulatory Rhubarb Savory Seasonal Seasoning Shopper Panel Snacks Spice Spring Sugar Summer Sweet Taste Perception Technical Advice Technology Trends Vanilla Vegetables Winter Yogurt



SPECIAL REPORT



## VANILLA: NAVIGATING THE PERFECT STORM

Vanilla. Access to the beloved ingredient is facing some obstacles. A combination of factors has created the perfect storm that has completely knocked vanilla —knocking supply chains completely out of whack. Yet, the movement is moving forward. Therefore, natural vanilla—marketed as such—has become completely out of whack. Yet, the movement is moving forward. How can product developers navigate this storm? How can they meet their label requirements? How can they ensure their products meet their label requirements? Let's take a look at vanilla's current market, the challenges it faces, and solutions to these challenges, along with considerations for product developers.

Flavor & Food Trend Information



## Consumer Insight: Purchase Power of Today's Teens

Read more >


February 7, 2019

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# McCormick & Company

YouTube: @McCormickandCompanyInc



**McCormick Corporate**  
@McCormickandCompanyInc · 8.22k subscribers · 60 videos  
McCormick & Company is a global leader in flavor and one of the most respected and fair...more  
[mccormickcorporation.com/en](https://mccormickcorporation.com/en) and 3 more links


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McCormick: Healthy. Sustainable. Delicio...  
904,277 views · 10 months ago  
Healthy Planet and People

For You

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



UNITED STATES ▾ WHERE TO BUY

TRENDING PRODUCTS RECIPES INSPIRATION RESOURCES CONTACT

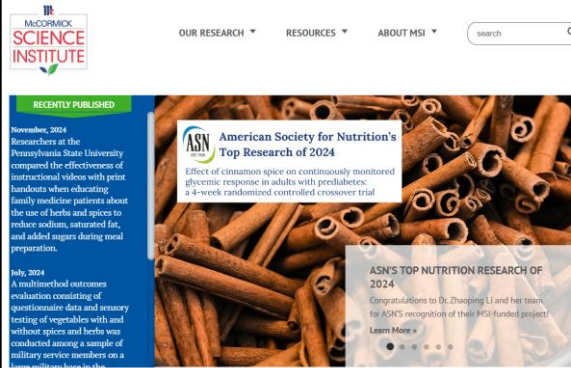
## The Flavor Forecast 25th Edition is Here!

And it's more flavorful than ever.

EXPLORE FLAVOR FORECAST

#FEATURED  
Two NEW Seasonings from McCormick Culinary >

NEW! Frank's RedHot Mango Habanero Wings Sauce >



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RECENTLY PUBLISHED

November, 2024  
Researchers at the Pennsylvania State University compared the effectiveness of instructional videos with print handouts when educating family medicine patients about the use of herbs and spices to reduce sodium, saturated fat, and added sugars during meal preparation.

July, 2024  
A multimethod outcomes evaluation consisting of questionnaire data and sensory testing of vegetables with and without spices and herbs was conducted among a sample of military service members on a...

### American Society for Nutrition's Top Research of 2024

Effect of cinnamon spice on continuously monitored glyemic response in adults with prediabetes: a 4-week randomized controlled crossover trial

ASN'S TOP NUTRITION RESEARCH OF 2024  
Congratulations to Dr. Zhaoqing Li and her team for ASN's recognition of their MSI-funded project!

Learn More >

ABOUT MSI  
The McCormick Science Institute is a research-driven organization whose mission is to support scientific research and disseminate information on the health benefits of culinary herbs and spices.



LENGUA MADRE, ACAMAYA

**Ana Castro**  
ANA CASTRO DEVELOPED A DEEP PASSION FOR COOKING THROUGH HER GRANDMOTHER'S TEACHINGS ON THE SIGNIFICANCE OF FOOD IN BRINGING PEOPLE TOGETHER AND HEALING THE SOUL.  
READ BIO >

Frank's RedHot Garlic Buffalo Wings Sauce

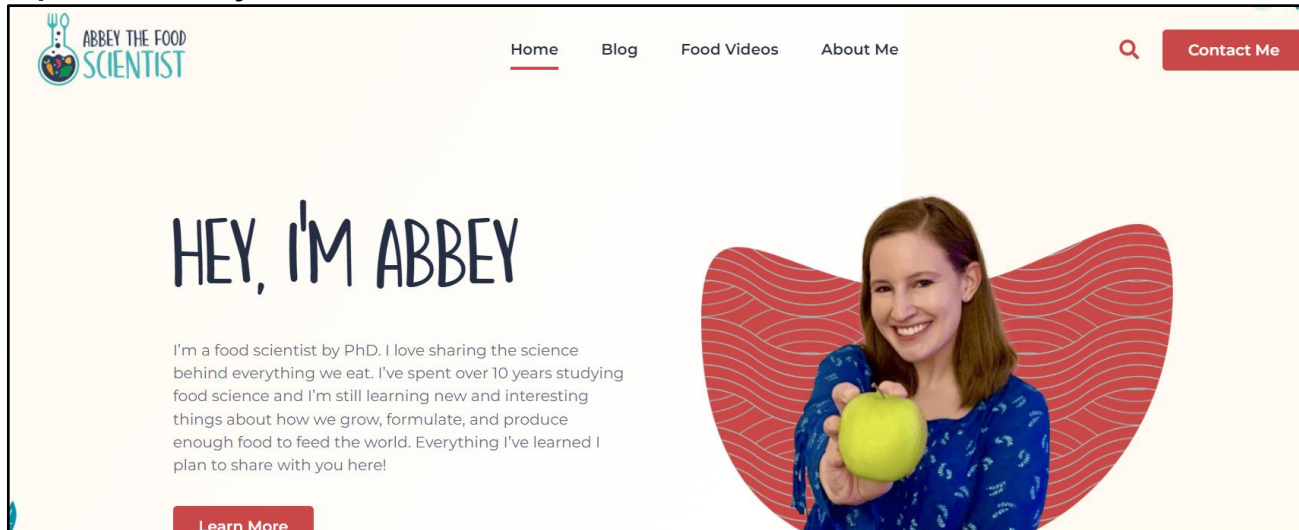
McCormick® Mayonesa >

Up Your Menu! >



# Abby the Food Scientist

<https://abbeythefoodscientist.com/>



- Abby is a food scientist & researcher. Abby 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

**CFSF** Chicagoland Food Science Foundation

HOME WHO WE ARE HOW YOU CAN HELP EVENTS WHAT WE DO OUR RECIPIENTS FRIENDS OF THE FOUNDATION

## Supporting The Next Generation Of Food & Beverage Professionals

Inspiring all ages to be engaged in the science of food

2023 SCHOLARSHIP APPLICATION

HOW YOU CAN HELP

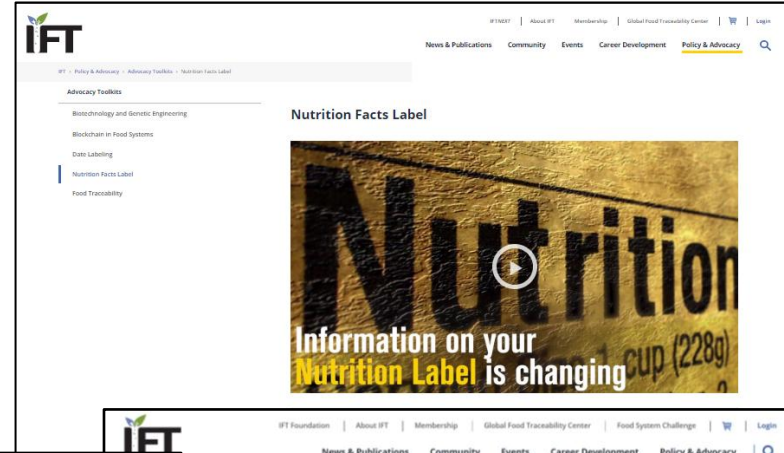
2023 SILENT AUCTION DONATIONS

# IFT: Institute of Food Technologist

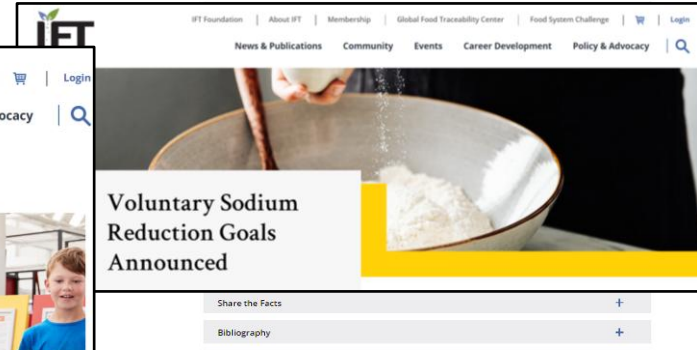
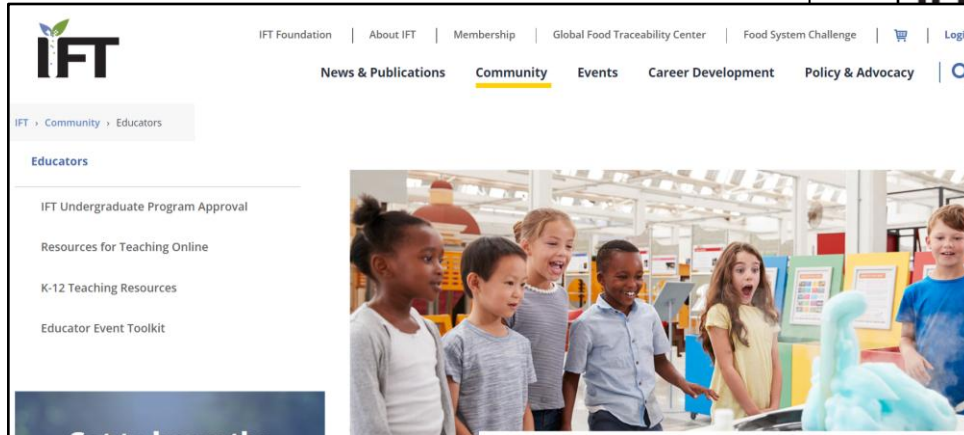


<https://www.ift.org/>

- 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! →



rsolutions



# IFT: Institute of Food Technologist

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

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## The FDA's New Healthy Rule

**IFT first**  
ANNUAL EVENT AND EXPO

**Save the Date**

**Innovation in a Time of Crisis: Can We Future-Proof the Food System?**  
This question is the basis for this year's theme at IFT FIRST. In July, the best and brightest academics, researchers, and innovators will be in Chicago to discuss bold ideas, cutting edge research and collaborate in ways that will connect our global food systems communities. Together, we can future proof the food system. Registration opens March 1.

**BLOG POST | BRAIN FOOD BLOG**

### A New Day at the FDA

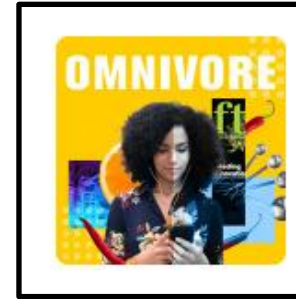
February 1, 2023

**BLOG POST | BRAIN FOOD BLOG**

### Tackling Food Waste in the Last Mile

December 1, 2022

### Outlook 2023: Consumer Trends



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

## FOOD TECHNOLOGY MAGAZINE:

**IFT**

**ft**  
Food Technology

### Careers in Food

Curated Conversations

November 2022, Volume 76, No. 10

**ft**  
Food Technology

### Growing in the Great Indoors

October 2022, Volume 76, No. 9

flavorsolutions

**CFSF** Chicagoland Food Science Foundation

# 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

AG EXPLORER  
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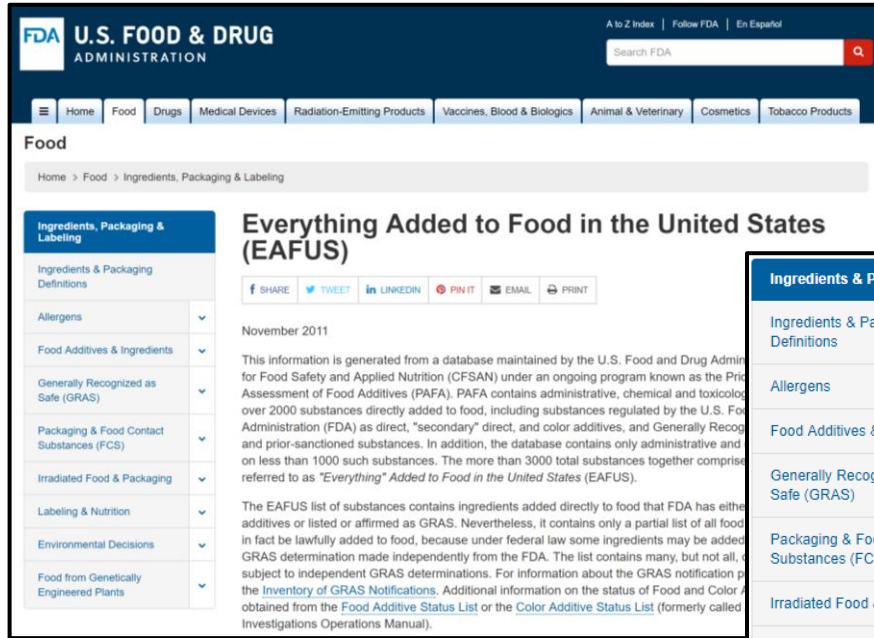
Start *exploring* career focus areas

- Agribusiness Systems
- Animal Systems
- Biotechnology Systems
- Environmental Service Systems
- Food Products & Processing Systems
- Natural Resources Systems
- Plant Systems
- Power, Structural & Technical Systems
- Agricultural Education  
Prepare students to be successful in their agricultural professions  
LEARN MORE >



# FDA resource – Food Additives

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

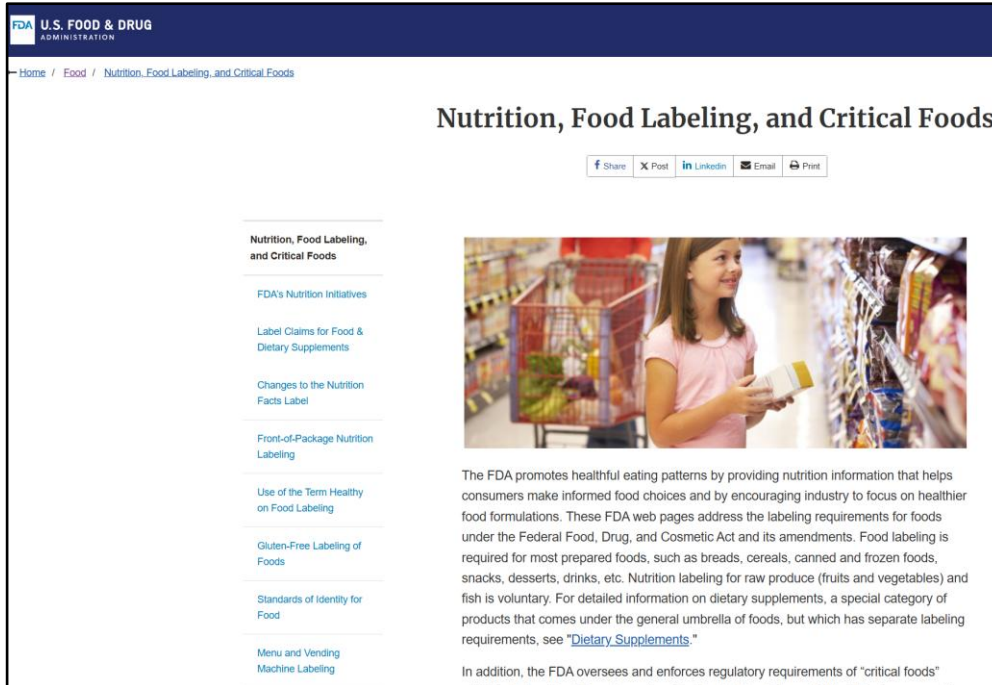


Ingredients & Packaging	
Ingredients & Packaging Definitions	
Allergens	▼
Food Additives & Ingredients	▼
Generally Recognized as Safe (GRAS)	▼
Packaging & Food Contact Substances (FCS)	▼
Irradiated Food & Packaging	▼
Environmental Decisions	▼
Food from Genetically Engineered Plants	▼

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>



The screenshot shows the FDA website page for 'Nutrition, Food Labeling, and Critical Foods'. The page header includes the FDA logo and the text 'U.S. FOOD & DRUG ADMINISTRATION'. Below the header is a navigation breadcrumb: 'Home / Food / Nutrition, Food Labeling, and Critical Foods'. The main title 'Nutrition, Food Labeling, and Critical Foods' is centered, with social media sharing options (Share, Post, LinkedIn, Email, Print) below it. On the left side, there is a vertical menu with links: 'Nutrition, Food Labeling, and Critical Foods', 'FDA's Nutrition Initiatives', 'Label Claims for Food & Dietary Supplements', 'Changes to the Nutrition Facts Label', 'Front-of-Package Nutrition Labeling', 'Use of the Term Healthy on Food Labeling', 'Gluten-Free Labeling of Foods', 'Standards of Identity for Food', and 'Menu and Vending Machine Labeling'. The main content area features a photograph of a young girl in a pink shirt looking at a product in a grocery store aisle. Below the photo, there is a paragraph of text: 'The FDA promotes healthful eating patterns by providing nutrition information that helps consumers make informed food choices and by encouraging industry to focus on healthier food formulations. These FDA web pages address the labeling requirements for foods under the Federal Food, Drug, and Cosmetic Act and its amendments. Food labeling is required for most prepared foods, such as breads, cereals, canned and frozen foods, snacks, desserts, drinks, etc. Nutrition labeling for raw produce (fruits and vegetables) and fish is voluntary. For detailed information on dietary supplements, a special category of products that comes under the general umbrella of foods, but which has separate labeling requirements, see "[Dietary Supplements](#)." In addition, the FDA oversees and enforces regulatory requirements of "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**

# National Science Teachers Assn.

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

The screenshot shows the NSTA website homepage. At the top left is the NSTA logo and a search bar. Navigation links for 'Bookstore', 'Log In', 'Join', and 'Menu' are on the right. Below are tabs for 'Discover', 'Learn', and 'Network'. A main heading reads 'Transform your teaching with NSTA's latest resources and more', followed by a sub-heading 'Get unlimited access today with your NSTA Membership'. Three large dark blue buttons with white icons represent 'Lesson Plans', 'Journals', and 'Free Resources'. A 'Popular Topics' section at the bottom features four categories: 'High School', 'Postsecondary', 'Middle School', and 'Elementary', each with a representative image of students.

This block shows a lesson plan preview. On the left is a photo of hands being washed with soap. To the right, the text reads 'Lesson Plan' and 'How does soap make dishes clean?'. Below this are several filter tags: 'Informal Education', 'Chemistry', 'Is Lesson Plan', 'NGSS', 'Phenomena', 'Physical Science', and 'Science and Engineering Practices'.

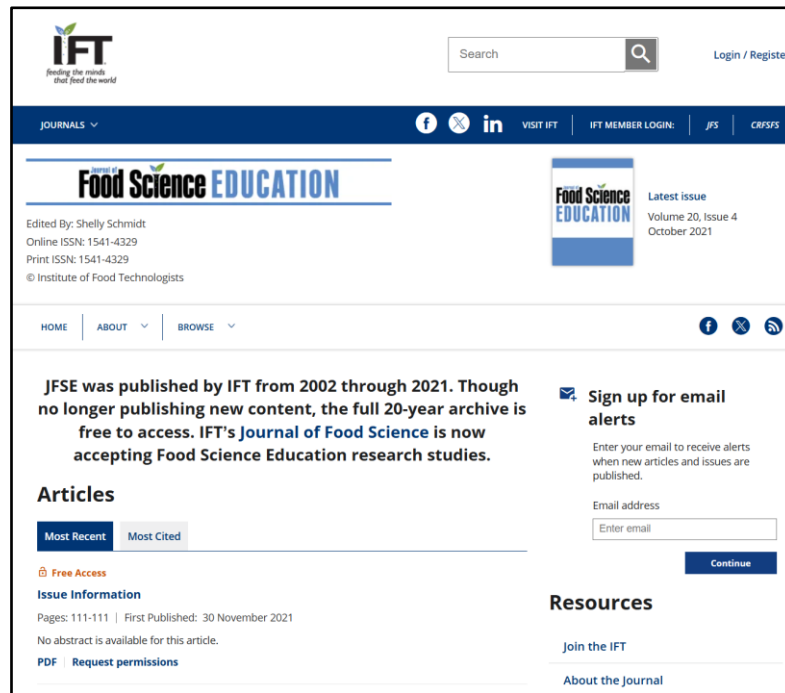
This block displays a grid of lesson plan cards. At the top are filters for 'Elementary', 'Middle', 'High', and 'For Families'. The 'High' filter is selected. The grid contains eight cards, each with a topic image, a title, and a 'Lesson Plan' label. The topics are: 'What makes muscle proteins so different from other proteins in our body? (Playlist Version)', 'How do cells know which amino acids go together to make certain proteins? (Playlist Version)', 'What exactly are proteins and how are the proteins we make different from those we eat? (Playlist Version)', 'How do people build muscles if they are not eating muscle proteins? (Playlist Version)', 'How can ecosystems survive without sunlight?', 'What Causes the Disproportionate Impact of COVID-19 on Racial and Ethnic Minority Groups?', 'What Do Cardboard Boxes Have to Do With Carbon Emissions?', and 'Why Is a Covered Planet a Healthy Planet?'.

# Journals for Food Science Education

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



The screenshot shows the IFT website homepage. At the top left is the IFT logo with the tagline "feeding the minds that feed the world". To the right is a search bar and a "Login / Register" link. Below the header is a navigation bar with "JOURNALS" and social media icons for Facebook, Twitter, and LinkedIn. A main banner features the text "Publish in IFT's Journals" and "Highly respected In-depth coverage Advancing the science of food", with buttons for "Submit to JFS" and "Submit to CRFSFS". The "Our Journals" section displays three journal covers: "Journal of Food Science", "Comprehensive REVIEWS in Food Science and Food Safety", and "Journal of Food Science EDUCATION". A sidebar titled "Institute of Food Technologists" lists activities like "Food Technology Magazine" and "IFT Annual Event". An "Article Preview" section highlights a recent article about recombinant technology in the food industry.



The screenshot shows the IFT Journal of Food Science EDUCATION page. The header includes the IFT logo, a search bar, and a "Login / Register" link. The main title "Journal of Food Science EDUCATION" is prominently displayed. Below the title, it states "Edited By: Shelly Schmidt", "Online ISSN: 1541-4329", and "Print ISSN: 1541-4329". A "Latest issue" box indicates "Volume 20, Issue 4" published in "October 2021". The page features a navigation bar with "HOME", "ABOUT", and "BROWSE" options. A central announcement states: "JFSE was published by IFT from 2002 through 2021. Though no longer publishing new content, the full 20-year archive is free to access. IFT's Journal of Food Science is now accepting Food Science Education research studies." There is a "Sign up for email alerts" section with an email input field and a "Continue" button. An "Articles" section includes "Most Recent" and "Most Cited" filters. A "Free Access" icon is visible, along with "Issue Information" and "Resources" sections. The "Resources" section includes a "Join the IFT" link and "About the Journal" information.

# 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**

Research in Food Science Education

**The Science of Pizza: The Molecular Origins of Cheese, Bread, and Digestion Using Interactive Activities for the General Public**

Amy C. Rowat, Daniel Rosenberg, Kathryn A. Hollar and Howard A. Stone

Article first published online: 24 SEP 2010  
 DOI: 10.1111/j.1541-4329.2010.00101.x  
 © 2010 Institute of Food Technologists®

Journal of Food Science Education  
 Volume 9, Issue 4, pages 106–112, October 2010

**SEARCH**  
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**ARTICLE TOOLS**

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- Save to My Profile
- E-mail Link to this Article
- Export Citation for this Article
- Get Citation Alerts
- Request Permissions
- Share | Facebook | Twitter

**Abstract** | Article | References

**Abstract:** We describe a presentation of pizza, which is designed for the general public including children ages 6 and older. The presentation focuses on the science of making and digesting cheese and bread. We highlight 4 major scientific themes: (1) how macromolecules such as carbohydrates and proteins are composed of atoms and small molecules; (2) how macromolecules interact to form networks in bread and cheese; (3) how microbes contribute to the texture of bread; and (4) how enzymes break down macromolecules during digestion. Using live demonstrations and interactive exercises with children in the audience, we provide simple explanations of the scientific principles related to these themes that are essential for understanding how to make pizza, and what happens when we eat it. This

**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:
<b>A: Understanding scientific inquiry</b>	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>B: Physical science standards</b>	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.
<b>E: Science and technology</b>	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.
<b>G: History and nature of science</b>	Profile food scientists, explore	Discuss science as a human endeavor; history of science.	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!

# 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 -

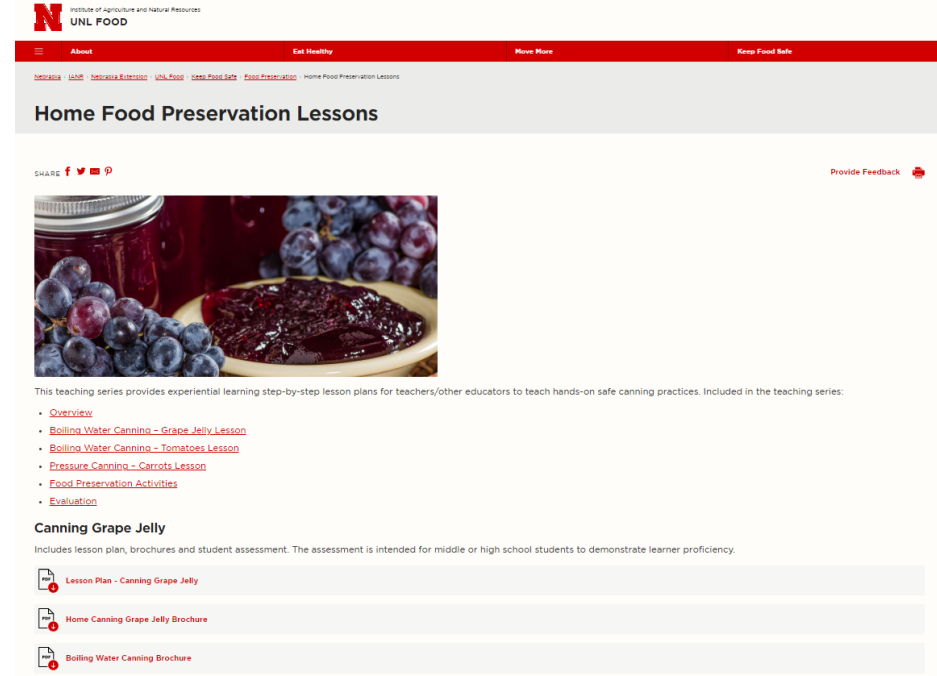
<https://nemep.unl.edu/food-safety-lunch-hour>

## 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>



The screenshot shows the UNL Food website interface. At the top, there is a red navigation bar with the UNL logo and the text "INSTITUTE of Agriculture and Natural Resources UNL FOOD". Below the navigation bar, there are several menu items: "About", "Eat Healthy", "More More", and "Keep Food Safe". A secondary navigation bar contains links for "Home Food Preservation Lessons". The main content area is titled "Home Food Preservation Lessons" and features a large image of a jar of grape jelly and a plate of grape jelly. Below the image, there is a list of lesson plans and an evaluation section. The text below the image reads: "This teaching series provides experiential learning step-by-step lesson plans for teachers/other educators to teach hands-on safe canning practices. Included in the teaching series:"

- [Overview](#)
- [Boiling Water Canning – Grape Jelly Lesson](#)
- [Boiling Water Canning – Tomatoes Lesson](#)
- [Pressure Canning – Carrots Lesson](#)
- [Food Preservation Activities](#)
- [Evaluation](#)

**Canning Grape Jelly**

Includes lesson plan, brochures and student assessment. The assessment is intended for middle or high school students to demonstrate learner proficiency.

- [Lesson Plan - Canning Grape Jelly](#)
- [Home Canning Grape Jelly Brochure](#)
- [Boiling Water Canning Brochure](#)

# University of Illinois – Food related Labs

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

The screenshot shows the Illinois Extension website. At the top left is the Illinois Extension logo. To its right is a navigation menu with links for HOME, TOPICS (underlined), WORKSHOPS, FOOD DONATIONS, NEWS AND BLOGS, and SCHOOL NUTRITION PROFESSIONALS. A search icon is located to the right of the navigation menu. In the top right corner, there is a 'Make a Gift' button. Below the navigation menu, the word 'Topics' is displayed. A large orange headline reads 'It's more than just what's for dinner.' Below this headline is a paragraph of text: 'Food brings families, friends, and communities together. When it comes to making food choices for you and your household, the possibilities seem endless, but not everything is safe, healthy, affordable, or accessible. Whether buying produce at a farmers market, starting a cottage food operation, or wanting to provide your family safe, nutritional foods preserved at home, count on Illinois Extension experts for the trusted solution.' Below the paragraph is a search prompt: 'Find what you're looking for at Illinois Extension.' At the bottom of the main content area, there are four colored boxes with images and text: 'preserving FOOD' (red), 'preparing FOOD' (green), 'safety with FOOD' (orange), and 'healthy FOOD' (blue). On the right side of the page, there is a dark blue 'TOPICS' header followed by a list of topics with right-pointing chevrons: Buying Food, Food Preparation, Food Preservation, Food Safety, Food Waste, Local Food Purchasing Assistance, Nutrition, Seasonal Food Favorites, and Selling Food.

Illinois Extension

HOME TOPICS WORKSHOPS FOOD DONATIONS NEWS AND BLOGS SCHOOL NUTRITION PROFESSIONALS

Topics

**It's more than just what's for dinner.**

Food brings families, friends, and communities together. When it comes to making food choices for you and your household, the possibilities seem endless, but not everything is safe, healthy, affordable, or accessible. Whether buying produce at a farmers market, starting a cottage food operation, or wanting to provide your family safe, nutritional foods preserved at home, count on Illinois Extension experts for the trusted solution.

Find what you're looking for at Illinois Extension.

preserving FOOD

preparing FOOD

safety with FOOD

healthy FOOD

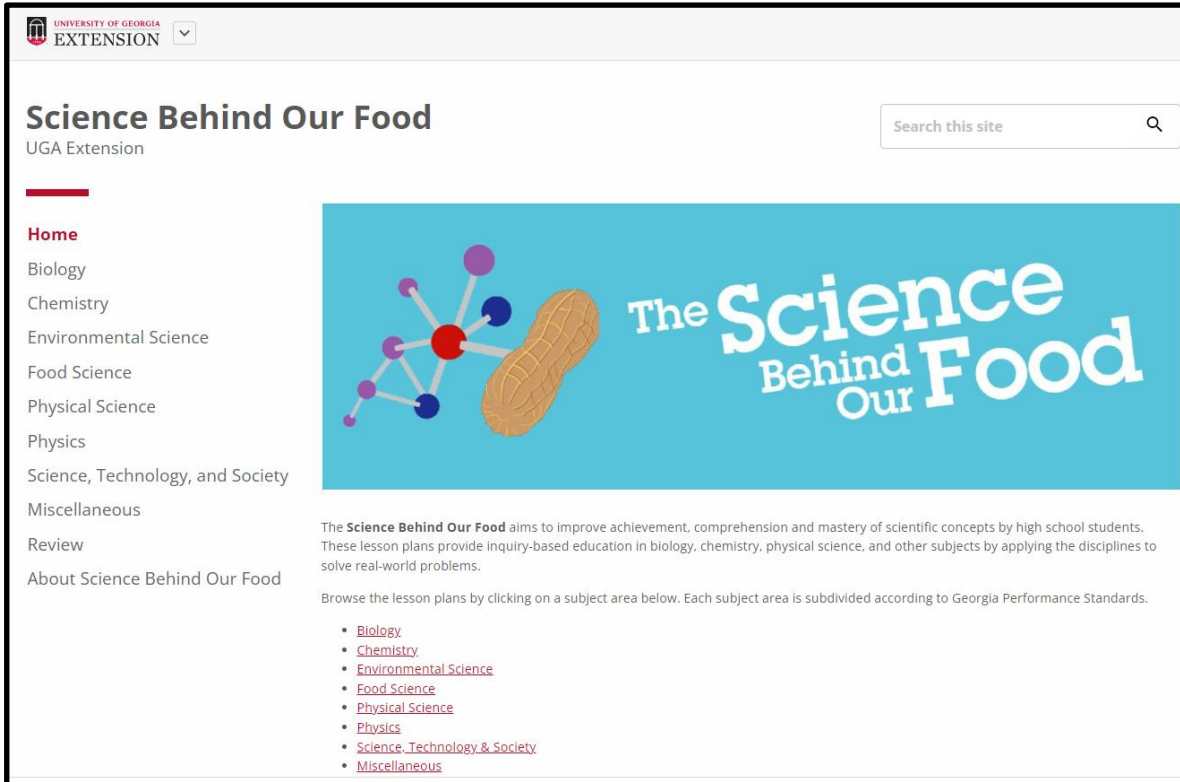
Food Preservation Food Preparation Food Safety Healthy Food

**TOPICS**

- Buying Food >
- Food Preparation >
- Food Preservation >
- Food Safety >
- Food Waste
- Local Food Purchasing Assistance
- Nutrition
- Seasonal Food Favorites
- Selling Food

# University of Georgia – Science of Food

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



The screenshot shows the website's header with the University of Georgia Extension logo and a search bar. The main title is "Science Behind Our Food" with the subtitle "UGA Extension". A navigation menu on the left lists various science topics. The central banner features a molecular diagram and a peanut with the text "The Science Behind Our Food". Below the banner, there is a paragraph describing the program's goal and a list of subject areas with links.

UNIVERSITY OF GEORGIA  
EXTENSION

## Science Behind Our Food

UGA Extension

Search this site

### Home

- Biology
- Chemistry
- Environmental Science
- Food Science
- Physical Science
- Physics
- Science, Technology, and Society
- Miscellaneous

Review

About Science Behind Our Food

# The Science Behind Our Food

The **Science Behind Our Food** aims to improve achievement, comprehension and mastery of scientific concepts by high school students. These lesson plans provide inquiry-based education in biology, chemistry, physical science, and other subjects by applying the disciplines to solve real-world problems.

Browse the lesson plans by clicking on a subject area below. Each subject area is subdivided according to Georgia Performance Standards.

- [Biology](#)
- [Chemistry](#)
- [Environmental Science](#)
- [Food Science](#)
- [Physical Science](#)
- [Physics](#)
- [Science, Technology & Society](#)
- [Miscellaneous](#)



avor solutions

**CFSF** Chicagoland Food Science Foundation

# American Chemical Society-ChemMatters

**ChemMatters** Online  
Demystifying Everyday Chemistry



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

February 2025

[More In This Issue >](#)

## 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

**S**teven Munger loves the sour smell of a butane lighter. The hydrocarbon, butane, is colorless and odorless, but sulfurous additives give it a punch 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 responses 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, the first student chemical detector 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. —Alex C. Levy

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 spit its prey. Well, they weren't working that project anymore, but they were studying the sense of smell in crayfish.

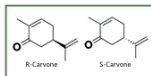
Just became really fascinated with sensory biology in general—how we understand the world around us.

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.

### Steven Munger

EDUCATION  
Ph.D. Biology, University of Virginia  
Ph.D., University of Florida

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



### What do you mean?

Taste is simpler. There are dedicated receptor proteins in taste buds used 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 there's about it.

There's also an innate "hedonic valence."  
Basically, do you like 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 sour 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—and learning is more about pattern recognition. If you get the aroma of pizza, which has a bunch of different chemicals, you have to understand it 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.



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

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 mirror images of each other, but the 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 innately 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 a bag 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!!**

Flavor solutions

**CFSF** Chicago and Food Science Foundation

# ACS: Food & Cooking Chemistry

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



American Chemical Society » Education » Students » High School » ACS ChemClub » Activities » Food and Cooking Chemistry

**ACS CHEMCLUB**  
CONNECTING CHEMISTRY TO YOUR WORLD

Start A Club   Periodic Table   Activities   Resources   Directory   Blog

## Food and Cooking Chemistry

Want to learn some chemistry? Look no further than your kitchen! Discover the science of making food items such as cheese, strawberries, grilled meat, and more.



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

# James Kennedy Blog

<https://jameskennedymonash.wordpress.com/>

## Chemistry Teacher Australia

### AN ALL-NATURAL BANANA



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

**INGREDIENTS:** WATER (75%), SUGARS (12%) (GLUCOSE (48%), FRUCTOSE (40%), SUCROSE (2%), MALTOSE (<1%), STARCH (5%), FIBRE E460 (3%), **AMINO ACIDS** (<1%) (GLUTAMIC ACID (19%), ASPARTIC ACID (16%), HISTIDINE (11%), LEUCINE (7%), LYSINE (5%), PHENYLALANINE (4%), ARGININE (4%), VALINE (4%), ALANINE (4%), SERINE (4%), GLYCINE (3%), THREONINE (3%), ISOLEUCINE (3%), PROLINE (3%), TRYPTOPHAN (1%), CYSTINE (1%), TYROSINE (1%), METHIONINE (1%)), **FATTY ACIDS** (1%) (PALMITIC ACID (30%), OMEGA-6 FATTY ACID: LINOLEIC ACID (14%), OMEGA-3 FATTY ACID: LINOLENIC ACID (8%), OLEIC ACID (7%), PALMITOLEIC ACID (3%), STEARIC ACID (2%), LAURIC ACID (1%), MYRISTIC ACID (1%), CAPRIC ACID (<1%)), ASH (<1%), PHYTOSTEROLS, E515, OXALIC ACID, E300, E306 (TOCOPHEROL), PHYLLOQUINONE, THIAMIN, **COLOURS** (YELLOW-ORANGE E101 (RIBOFLAVIN), YELLOW-BROWN E160a), **FLAVOURS** (3-METHYLBUT-1-YL ETHANOATE, 2-METHYLBUTYL ETHANOATE, 2-METHYLPROPAN-1-OL, 3-METHYLBUTYL-1-OL, 2-HYDROXY-3-METHYLETHYL BUTANOATE, 3-METHYLBUTANAL, ETHYL HEXANOATE, ETHYL BUTANOATE, PENTYL ACETATE), 1510, NATURAL RIPENING AGENT (ETHENE GAS).

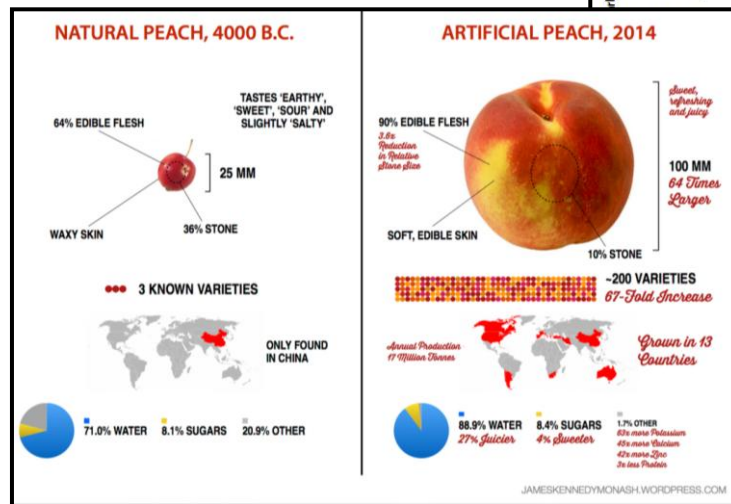


Table of esters and their smells

	from the alcohol (first word)										
	methyl 1 carbon	ethyl 2 carbons	propyl 3 carbons	2-methyl propyl- 4 carbons	butyl 4 carbons	pentyl 5 carbons	hexyl 6 carbons	benzyl benzene ring	heptyl 7 carbons	octyl 8 carbons	nonyl 9 carbons
methanoate 1 carbon	ETHEREAL	BAKED	APPLE	ETHEREAL	RASPBERRY	"GREEN"	ORANGE	AVOCADO	ORANGE	?	?
ethanoate 2 carbons	PEPPERMINT	PEAR	CHERRY	APPLE	BANANA	JASMINE	ORANGE	MUSHROOM	?	?	?
propanoate 3 carbons	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT
2-methyl propanoate 4 carbons, branched	ETHEREAL	BAKED	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT
butanoate 4 carbons	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT
pentanoate 5 carbons	FRUIT	FRUIT	FRUIT	ETHEREAL	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT
hexanoate 6 carbons	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT
benzoate benzene ring	YLANG-YLANG	YLANG-YLANG	NUTS	BALSAMIC	BALSAMIC	BALSAMIC	BALSAMIC	BALSAMIC	BALSAMIC	BALSAMIC	BALSAMIC
	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT
	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT	FRUIT

# The Kitchen as a Physics Lab!

[https://legacy.ibp.ucla.edu/research/rowat/Publications\\_files/Rowat.Phys.Edu.2014.pdf](https://legacy.ibp.ucla.edu/research/rowat/Publications_files/Rowat.Phys.Edu.2014.pdf)

**PAPER**  
<https://doi.org/10.1021/acs.jchemeduc.5b00100>

## The kitchen as a physics classroom

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Olger Campàs<sup>3</sup>, Pere Castells<sup>4</sup>, Daniel Rosenberg<sup>5</sup>,  
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<sup>4</sup> UB-Bullipedia Unit/Food and Nutrition Torribera Campus, University of Barcelona, Santa Coloma de Gramenet, 08921, Barcelona, SPAIN  
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**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 fulfill 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>



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

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**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<sup>1</sup>, with roughly two-thirds of all calories being store-bought and consumed at home depending on income<sup>2,3</sup>. Reported home cooking occurs at higher rates among those of low income<sup>1,3</sup>. Despite this the U.S. Bureau of Labor Statistics reported in 2015 that the average household spends \$3,008 per year on eating out<sup>4</sup>. With a U.S. adult obesity rate of 42.4% in 2017-2018<sup>5</sup>, 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<sup>6</sup>. 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<sup>7</sup>. 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 11<sup>th</sup> and 12<sup>th</sup> 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

Curriculum Unit 20.02.02 1 of 16



**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.



Watch on  YouTube

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. ; Sørensen, 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>

# Food Loss & Food Waste

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



SAVE FOOD: Global Initiative on Food Loss and Waste Reduction

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Publications

## 35% FISH & SEAFOOD FOOD LOSSES

8% of fish caught globally is thrown back into the sea. In most cases they are dead, dying or badly damaged.

This is equal to almost 3 billion Atlantic salmon.

Region	Fisheries	Post-catch	Processing	Distribution	Consumption
Europe	~10%	~10%	~10%	~10%	~10%
North America and Oceania	~10%	~10%	~10%	~10%	~10%
Industrialized Asia	~10%	~10%	~10%	~10%	~10%
Sub-saharan Africa	~10%	~10%	~10%	~10%	~10%
North Africa, West and Central Asia	~10%	~10%	~10%	~10%	~10%
South and Southeast Asia	~10%	~10%	~10%	~10%	~10%
Latin America	~10%	~10%	~10%	~10%	~10%

■ Fisheries    ■ Distribution  
■ Post-catch    ■ Consumption  
■ Processing

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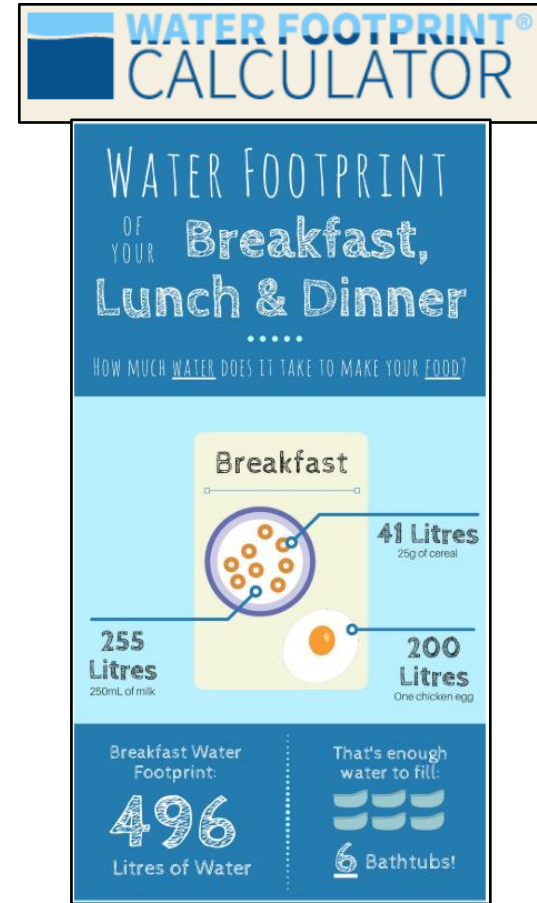
Infographics

Click on images to enlarge

- 30% CEREALS FOOD LOSSES**  
In developed countries, losses are high. In developing countries, losses are high.
- 20% DAIRY FOOD LOSSES**  
In Europe alone, 10 million tonnes of milk are lost each year.
- 35% FISH & SEAFOOD FOOD LOSSES**  
8% of fish caught globally is thrown back into the sea. In most cases they are dead, dying or badly damaged.
- 45% FRUIT & VEGETABLES FOOD LOSSES**  
In the EU, 10 million tonnes of fruit and vegetables are lost each year.
- 20% MEAT FOOD LOSSES**  
In the EU, 10 million tonnes of meat are lost each year.
- 20% OLIVEES & PULSES FOOD LOSSES**  
Each year, 10% of the global production of olive and pulses is lost or wasted.

# 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](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/>

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# 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](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/>