

IFT Science of Food: June Educator Event

June 18, 2025

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 (9:00 - 9:05)
Introduction to Food Industry (Katie)	20 minutes (9:05 - 9:25)
The Science of Taste & Smell (Katie)	30 minutes (9:25 - 9:55)
The Science of Eggs (Linda)	20 minutes (9:55 – 10:15)
Break - gather ingredients	5 minutes (10:15 - 10:20)
Egg Experiments (Linda)	20 minutes (10:20 – 10:40)
Careers in the Food Industry (Linda)	10 minutes (10:40 – 10:50)
Close & Questions	10 minutes (10:50 - 11:00)





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.

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Overview



Feeding the minds that feed the world

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

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

Feeding Tomorrow 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.

11: Flavorsolutions

Flavor Company

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





Overview



M: Flavorsolutions



Next Generation Science Standards



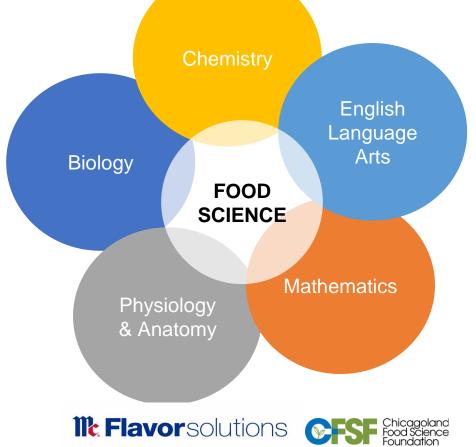
Practices

- Demonstrations
- Hands on Activities

Cross Cutting Concepts

Interdisciplinary connections

Disciplinary Core Ideas





Food System

The food we eat...











TRA CFSF Chicage Food Sc Food

poland







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.









Food Industry Facts

- Global food industry is ~ \$8.5 Trillion/year sales, with 3% growth
- US Food Industry is just shy of \$1 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.



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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









Top Food/Beverage Companies - USA

ABInBev



- 1. Nestle Nestle
- 2. PepsiCo, Inc



3. Anheuser – Busch InBev

The Coca-Cola Company

- 4. JBS
- 5. Tyson Foods



- 6. Archer Daniels Midland Company (ADM)
- 7. Mars MARS
- 8. Cargill

9.



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

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10. Danone

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.









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



The Science of Food & Flavor





Katie Sudler – McCormick



- uest Givaudan^e 23+ years in the Flavor Industry, supporting Food& Beverage Companies
 - **Current Role:** McCormick & Company, Flavor Division Responsible for partnerships in the communities we manufacture and in food/beverage industry, to build good name and reputation in both.
 - Past Roles: Food Regulations, Business Unit Marketing, Corporate Marketing
 - **Brands:** Have worked with 100's of companies to ideate and create products across Beverage, Alcohol, Confection, Dairy and Bakery segments.



- Education:
 - B.S. in Dietetics Purdue University
 - Business classes Northern Illinois University
 - M.S. in Child, Youth & Family Studies University of Nebraska-Lincoln
 - IL Teaching Certificate grades 6-12 to teach Health, Family & Consumer Sciences





Katie Sudler – McCormick







Let's level set!



Serving size 2/3 c	240
<u>Calories</u>	240
and the second s	Daily Value
Total Fat 14g	18%
Saturated Fat 9g	45%
Trans Fat Og	
Cholesterol 40mg	13%
Sodium 50mg	2%
Total Carbohydrate 25g	9%
Dietary Fiber 1g	4%
Total Sugars 24g	
Includes 19g Added Su	oars 38%
Protein 4g	
Vit. D 0.1mcg 0% • Calcium	120mg 10%
Iron 0.4mg 2% • Potassium	200ma 49

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

11: Flavor solutions



What's your flavor?

What is your favorite 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







- 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

https://www.mccormickfona.com/learn/discoverfona-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)



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



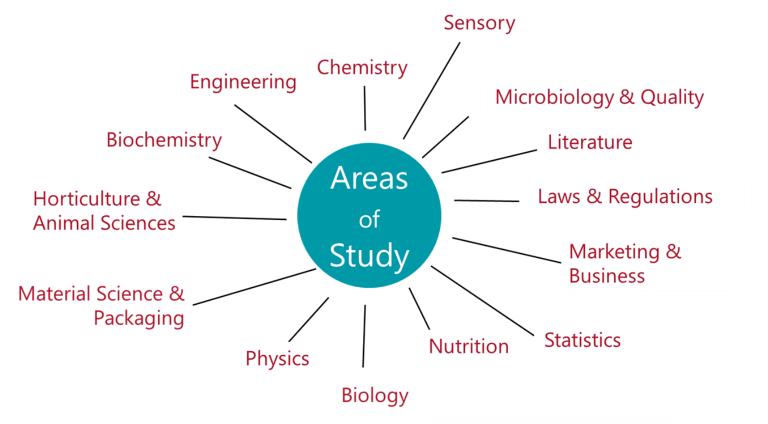
Career Exploration A career in the food industry goes well beyond the grocery store.



Science Bites Science news links & education-specific blog posts.



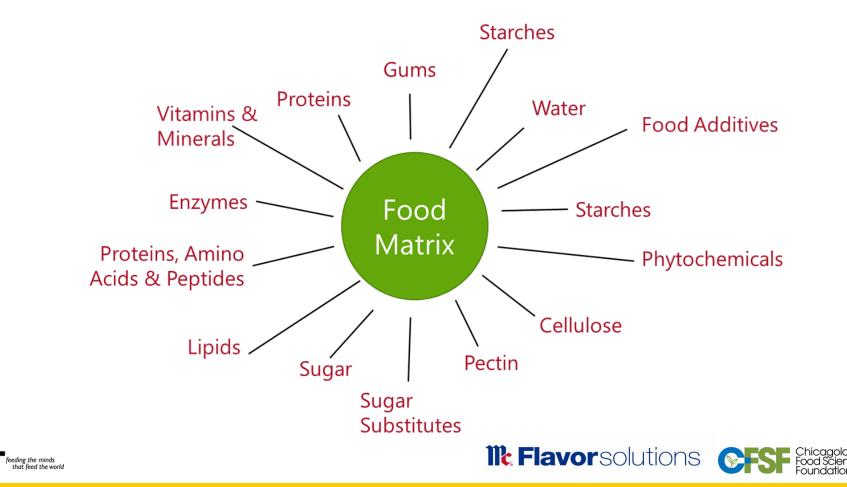
What do Food Scientists study?



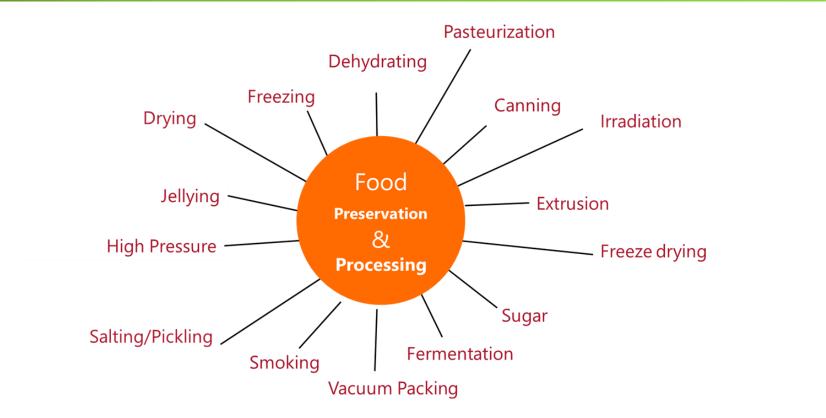


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What do Food Scientists study?



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.

"Poverty

- 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







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







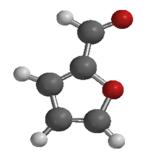
What is a CHEMICAL?







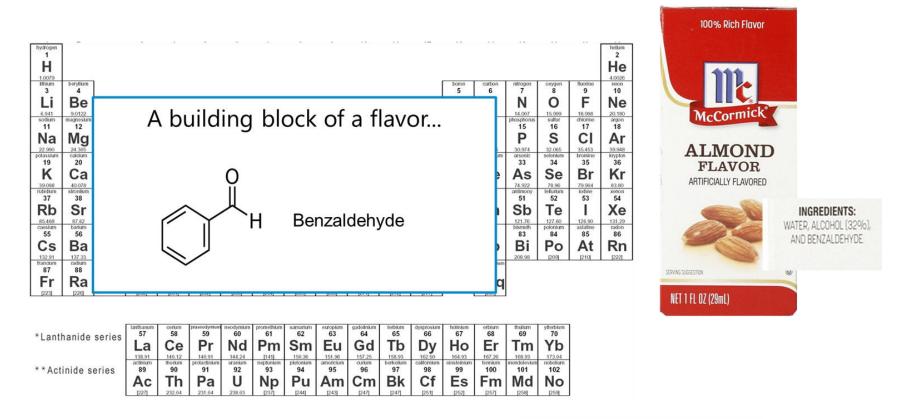
- Chemicals are the backbone of everything we see, smell, touch and experience.
- Chemicals can be organic, natural or artificial.
- Chemicals can be toxic, neutral or healthy for us.
- Chemicals can be acids, neutral pH or bases.
- Chemicals are everywhere!
- A chemical is made of elements.







Chemicals in Our Food







Chemicals in Our Food







What do you smell?









Ingredients in All-Natural Produce

ALL-NATURAL CHERRIES



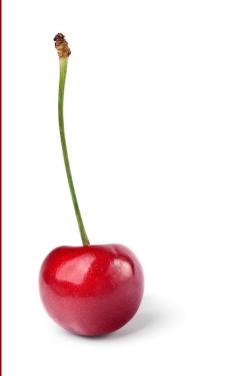
INGREDIENTS: AQUA (82.2%), SUGARS (12.8%) (GLUCOSE (52%), FRUCTOSE (42%), GALACTOSE (5%), MALTOSE (<1%), SUCROSE (<1%)), FIBRE E460 (2.1%), ASH, FATTY ACIDS (1.6%) (OCTADECAENOIC ACID (24%), OMEGA-6 FATTY ACID: OCTADECADIENOIC ACID (24%), OMEGA-3 OCTADECATRIENOIC ACID FATTY ACID: (23%).HEXADECANOIC ACID (14%), OCTADECANOIC ACID (<1%), HEXADECAENOIC ACID (<1%), TETRADECANOIC ACID (<1%)) **AMINO ACIDS** (<1%) (ASPARTIC ACID (57%), GLUTAMIC ACID (9%), PROLINE (4%), SERENE (3%), LEUCINE ALANINE (3%), (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)-B-HEXENOL. 2-HEPTANONE. CINNAMIC ALCOHOL. CINNAMIC ALDEHYDE, (E)-2,6-NONANEDIENAL, (E)-2-HEXENAL, HEXANAL. EUGENOL. LINALOOL. BENZALDEHYDE, PHENYLACETALDEHYDE).



IR Flavorsolutions **Chicagoland** Food Science Foundation

37 Aroma Chemicals in Cherry

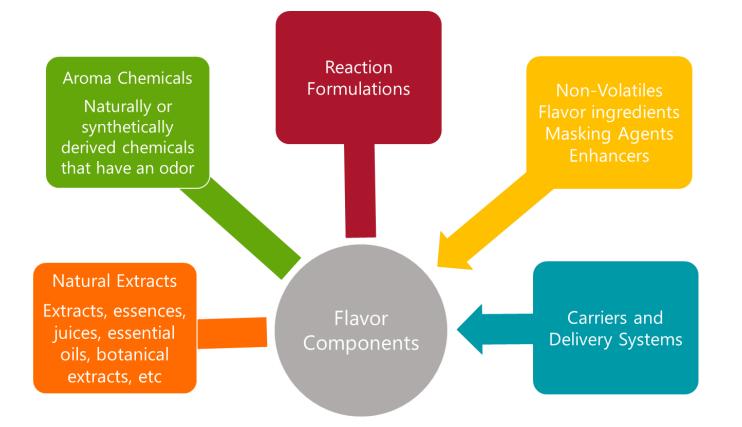
Acetaldehyde, 2-methylpropanal, 3-methylbutanal, hexanal, (E)-2-hexenal, octanal, nonanal, decanal, **benzaldehyde**, (E,Z)-2,6-nonadienal, β -phenylacetaldehyde, ethyl acetate, ethyl butanoate, ethyl hexanoate, methyl salicylate, ethyl hexadecanoate, acetic acid, 3methylbutanoic acid, pentanoic acid,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







Flavor Chemistry - Ingredients/Raw Materials





The Flavor solutions **Chicagoland**

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 5year (Apprentice)
- Certification exam at 7 years

*Chef vs Flavor Chemist - both create flavors by understanding how food/chemicals work synergistically together.





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.





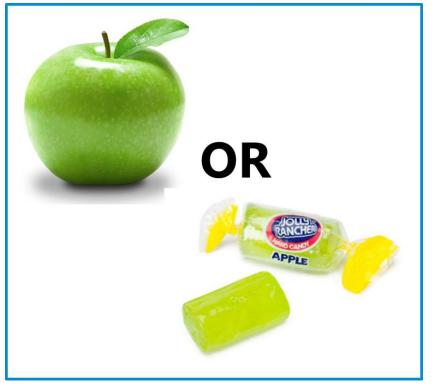
iHeartCraftyThings.com







Chemicals in Our Food



Espino-Díaz, Miguel et al. "Biochemistry of Apple Aroma: A Review." *Food Technology and Biotechnology* 54.4 (2016): 375–397. *PMC*. Web. 19 Feb. 2018.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5253989/





Using our senses when we eat







Why are flavors important in food?



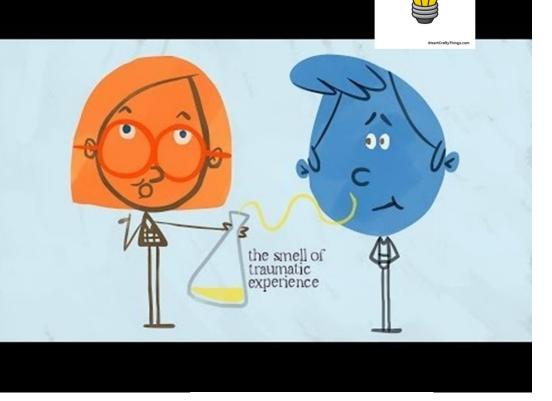






80-90% of what you experience as "flavor" is aroma.









Aroma - Two ways we perceive aroma

Orthonasal Pathway



Fig. 8. Cross sectional depiction of naso-oral cavity Slide content © 2014, FONA. All rights reserved.

feeding the minds that feed the world

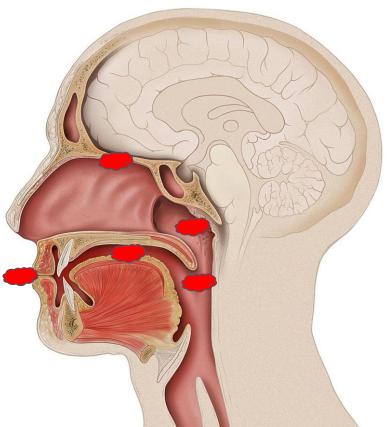


Aroma - Two ways we perceive aroma

Retronasal Pathway



Fig. 8. Cross sectional depiction of naso-oral cavity Slide content © 2014, FONA. All rights reserved.

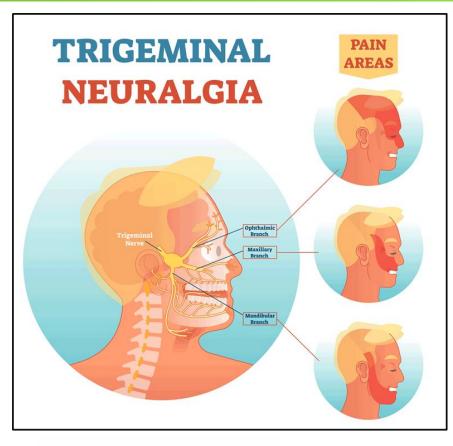






Trigeminal Nerve - Sensations

- Sensations serve and intensify the eating experience.
- 3 branches
- Each provides sensation to different areas of the face:
 - o 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.



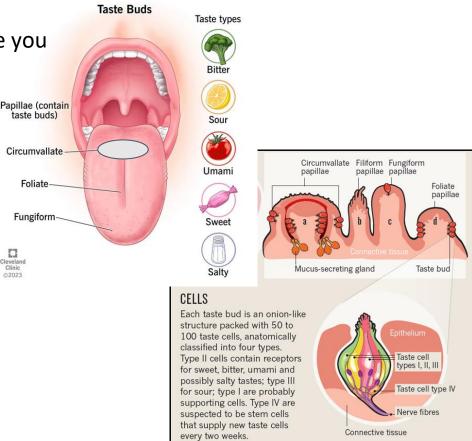
M: Flavorsolutions



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





Using our senses when we eat

Are you a super taster?

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





HeartCraftyThings.co

<u>TRY THIS!</u>

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

<u>TRY THIS!</u>

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





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/cantaste-color/



Influence of Color



Crystal Pepsi Launched in 1992



EZ Squirt Ketchup, Launched in 2000





Influence of Sound

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.)







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.

It Flavorsolutions

- Meltability
- Flowability
- Breakability
- Spreadability



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)".

- <u>Study of:</u>
 - Food Science
 - Psychology
 - Statistics
 - Trends





Wrap it up

Your students do not realize most of the careers you are learning about today, even 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











- 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

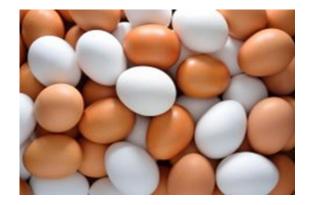






- Eggs can make your blood cholesterol level high and should be avoided
- Brown Eggs are healthier than White Eggs
- Blood spots in an egg are bad
- Free-Range vs Cage- Free
- You will get Salmonella if you eat raw eggs









Nutrition of an Egg

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



Egg Nutrition Yolk White Fat 4.5 q Fat 0 q Sat. Fat 1.6 g Sat. Fat 0 q Cholesterol 184 mg Cholesterol 0 mg Carbohydrates 0.5 g Carbohydrates 0 g 2.5 g Protein 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%), 8%), LYSINE (7%), SERINE (7%), PHENYLALANINE (6%), ALANINE SOLEUCINE (5%), PROLINE (4%), TYROSINE (3%), GLYCINE (3%), HISTIDINE (2%), METHIONINE (3%). TRYPTOPHAN (1%)); FATTY ACIDS (9.9%) (OCTADECENOIC ACID HEXADECANOIC ACID (32%). OCTADECANOIC EICOSATETRAENOIC ACID (3%), EICOSANOIC ACID (2%) ACID (1%), TETRACOSANOIC ACID (1%), OCTANOIC DECANOIC ACID (<1%), DODECANOIC ACID (<1%) ACID (<1%), PENTADECANOIC ACID (<1%), HEPTADECANOIC ACID (<1%) TETRADECENOIC ACID (<1%), HEXADECENOIC EICOSENOIC ACID (<1%), DOCOSENOIC ACID (<1%), OMEGA ACID: OCTADECADIENOIC ACID (12%) OCTADECATRIENOIC ACID (<1%), EICOSAPENTAENOIC ACID (<1%), OMEGA-3 FATTY ACID: DOCOSAHEXAENOIC ACID (DHA) SUGARS (0.8%) (GLUCOSE (30%), SUCROSE LACTOSE (15%), MALTOSE (15%), GALACTOSE (15%)) E160a), E306, E101; FLAVOURS (PHENYLACETALDEHYDE, DODECA-2 ENAL, HEPTA-2-ENAL, HEXADECANAL, OCTADECANAL, BUTAN-2-ONE, ACETALDEHYDE, FORMALDEHYDE, ACETONE); SHELI E170) ALSO CONTAINS BENZENE & BENZENE DERIVATIVES. ESTERS. FURANS, SULFUR-CONTAINING COMPOUNDS AND TERPENES



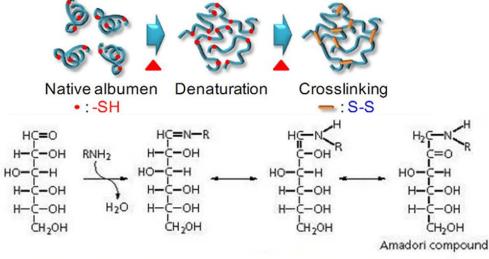


Chemistry & Eggs





(b) Protein Thermal Irreversible Denaturation



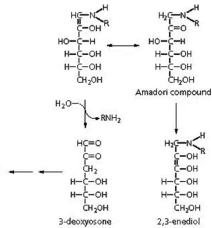
Hard-Cooked Eggs



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

Hydroxy methyl furfural (HMF)

Me Flavor solutions

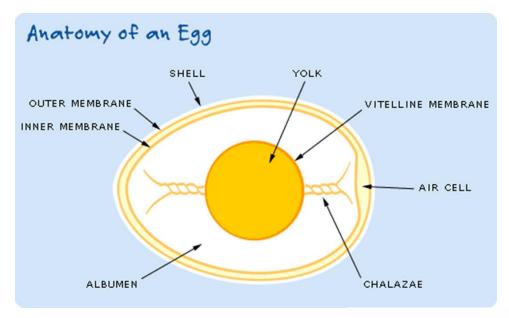


Chicagoland Food Science Foundation



Biology & Eggs

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







Food Science & Eggs

- Eggs role in Cooking and Baking
- •Binding Agent
- •Coat or Seal Food
- •Add color or shine
- •Leavening Agent
- •An Emulsifier
- •A Thickener



11: Flavor solutions





Foods we love because of Eggs



eeding the minds that feed the world















Reminder to Change to Speaker View

Change your view to "Speaker" in the top right hand corner where it says "View"





Eggs Experiments





Hard Boiled Eggs

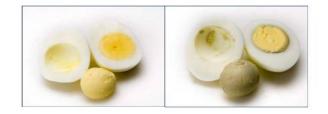
A greenish-gray ring around a hard-boiled egg yolk is caused by a chemical reaction between sulfur from the egg white and iron from the yolk

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.
- 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).



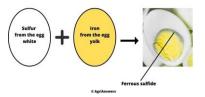


Hard Boiled Eggs

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 graygreen compound. The longer the proteins are cooked, the more iron sulfide green ring.
- While the green ring may look unappealing, it is safe to eat.







Maillard Browning Reaction

Eggs as a coating agent to add color and flavor

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

Experiment

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

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





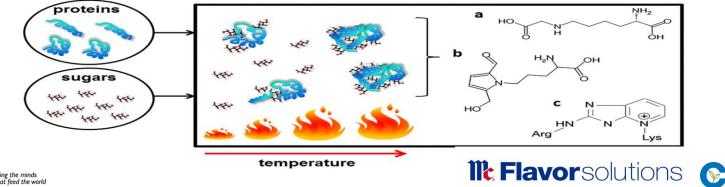


Eggs as a coating agent to add color and flavor

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.



Formation of Maillard reaction products

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

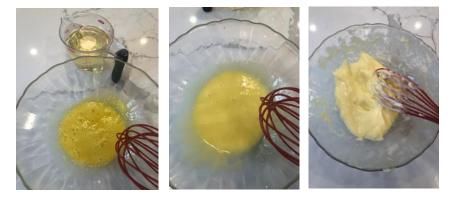
- 1 large egg yolk (room temp)
- 1 Tablespoon Lemon Juice
- 1 cup Oil (You can use the oil of your choice)
- ¼ teaspoon salt
- 1 bowl large enough to mix your mayonnaise

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







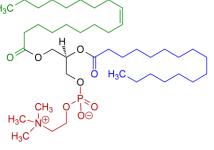
An Edible Oil in Water Emulsion

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

It Flavorsolution



Egg Foam

Egg Foam

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

Experiment

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



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

Variations on the experiment

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





Egg Foam

Egg Foam

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

What is happening?

- Beating egg whites forces air into the liquid, stretching and unfolding the protein molecules. This process, known as denaturation, changes the protein's shape, breaking its internal bonds.
- The unfolded proteins which have both hydrophillic (water-attracting) and hydrophobic (water-repelling) regions, arrange themselves around the air bubbles. The hydrophillic parts interact with the water in the egg white, while the hydrophobic parts are attracted to the air with the bubbles. This network provides the structural support needed to create a stable foam.
- Cream of tartar and sugar both help make the foam more stable. However, cream of tartar is considered better. While the sugar stabilizes egg whites by binding water and adding viscosity, cream of tartar acts as an acid, lowering the pH and further stabilizing the foam structure. Cream of tartar also speeds up the whipping process and prevents overbeating.
- Even a small amount of fat (part of the egg yolk) can interfere with foam formation by coating the proteins and preventing them from interacting with each other. It will reduce the foam volume.
- An egg foam can release water due to syneresis, a process where the foam collapses and liquid separates out. Over-beating your egg foam will make syneresis worse.





Marshmallows

The science behind marshmallows involves creating a foam, trapping air within a network of protein strands (gelatin and eggs) and utilizing the properties of sugar and corn syrup to create the desired texture and sweetness.

Experiment

2 eggs whites (use fresh egg white and not pasteurized) 2 packets (2 Tablespoons) unflavored gelatin

1 cup water

1 ½ cup sugar

¹/₂ cup corn syrup

¼ teaspoon salt

1 tablespoon vanilla extract

Powder sugar and corn starch equal amounts for dusting

Greased 8 X 8 pan Parchment paper Small Pot Candy thermometer Mixer with whisk attachment Spatula



1. Butter/oil 8 x 8 pan and then line with parchment paper. Dust the top of parchment paper with powder sugar/corn starch mixture.

2. Place ½ cup cold water in mixing bowl with gelatin and mix with whisk attachment. Stop mixing and let sit for 15 minutes.

3. In small pot combine ½ cup water, sugar, and corn syrup. Cook over medium-low heat. Stir only until sugar is dissolved then stop mixing.

4. Heat sugar solution until candy thermometer registers 240F.

5. Just before the sugar solution reaches 240F, add egg whites to gelatine in the electric mixer and whip in high speed until stiff peaks.

9. Reduce the speed to low and slowly pour the hot sugar syrup into the mixing bowl.

Add salt.

8. After the hot sugar syrup is added, increase the speed to high and whip until the mixture has at least doubled becoming thick and fluffy about 12-15 minutes.

Add Vanilla

Q. Pour the mixture into the pan and spread out evening using spatula.

L. Dust the top with powder sugar and let it sit 3-4 hours or overnight is best, uncovered, to dry.

12.Cut into squares and enjoy.





Marshmallows

The science behind marshmallows involves creating a foam, trapping air within a network of protein strands (gelatin and eggs) and utilizing the properties of sugar and corn syrup to create the desired texture and sweetness.

What is happening?

- Regular sugar is made from sugarcane. It is made up of just sucrose molecules. It dissolves very well in water, but the slightest disturbance can cause it to crystallize.
- Corn syrup is make from corn and is a mixture of different sizes of sugars. It contains glucose and fructose, but also larger polysaccharides. Corn syrup helps prevent the crystallization of regular sugar. However, too much make your marshmallows sticky.
- The sugar is dissolved in water first to melt the sugar crystals into a syrup.
- Boiling the sugar evaporates the water making for a more concentration and viscous solution.
- Egg whites proteins are an exceptionally good at foaming. The proteins in the egg white can easily stabilize the air bubbles that you can incorporate by whisking the egg white. This whisking unfolds the protein and allow them to surround the air bubbles in a way that stabilizes them within the foam.
- The hot sugar syrup cooks the egg whites causing the proteins to uncurl and stabilizes the marshmallow.
- Gelatin is also made up of proteins that when cooled down form a gel. It holds on to the surrounding water, firming up the marshmallow. The elasticity of gelatin allows marshmallows to be bouncy and stretchable.





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 $3 \frac{1}{2}$ 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 $-3 \frac{1}{2}$ 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.







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



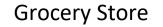




Career: Consumer and Sensory Testing

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









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









Career: Research Scientist or Ingredient Scientist

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

Common Degree: Chemistry, Biochemistry or Food Science

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

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

Grocery Store







Career: Marketing

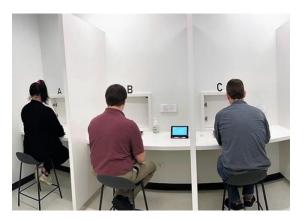
How will the company talk to the consumers about the product and get them to try it? Will there be TV ads, magazine ads, coupons, social media? What makes the product stand out against all other competition? What will the price be and where will it be found in the grocery store? How much is projected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

Common Degree: Marketing

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









Career: Product Development

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

Common Degree: Food Science









Career: Flavor Chemist

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

Common Degree: Chemistry, Biology, Food Science

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









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

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







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

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

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

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







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

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

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

Grocery Store







Career: Grocery Store Merchant

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







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 incomeglobally, 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 food?

Why use food to teach your content?

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

Food will always impact your students lives!





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





Questions





- Learn more about where you can get a Food Science Degree!
- <u>https://www.ift.org/community/st</u> <u>udents/undergraduate-programs</u>







Food Science Textbooks

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





Thank You!

Sign Out for Illinois PD Hours!



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

Recipients will be notified via email next week

Reach out to Christina Ginardi at <u>cginardi@ift.org</u> 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/discoverfona-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**!



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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



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





VANILLA: NAVIGATING THE PERFECT STORM

Vanilla. Access to the beloved ingredient is facing some objectes. A combination of factors has created the perfect stor comes to sourcing vanilla—knocking supply-Trend therefore, natural vanilla—march How can product develor their label requires to the their label requires the table of table o

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Voice of the Expert: Crafting

Cocktail Flavors

Fruit, Aji Amarillo

February 14, 2025

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Trend Bite: Tropical Vibes

Trend Bite: 2025 Food &

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Consumer Insight: Purchase Power of Today's Teens

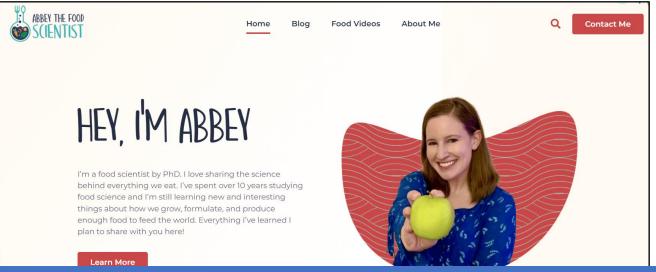
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https://abbeythefoodscientist.com/



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





Chicagoland Food Science Foundation https://chicagofoodscience.org/

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







IFT: Institute of Food Technologist

- 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!

IFT Foundation

Educators

FT > Community > Educators

IFT Undergraduate Program Approval

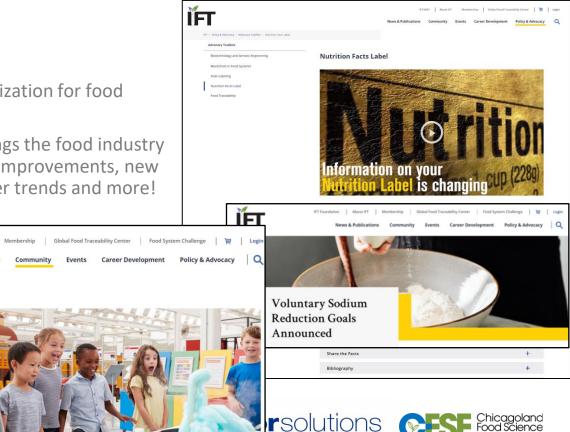
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K-12 Teaching Resources

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IFT: Institute of Food Technologist

https://www.ift.org/news-and-publications/podcasts/omnivore ĬFT About 171 | Membership | Global Food Traceability Center | Food System Challenge | 🙀 | Legin **PODCAST**: News & Publications Community Events Career Development Policy & Advocacy Salary/Career Trends, Sandwiches on the menu, Food Waste, Sensory, Pet The FDA's New food, etc Healthy Rule **FOOD TECHNOLOGY MAGAZINE:** Innovation in a Time of Crisis: Can We Future-Proof the Food System? innovators will be in Chicago to discuss bold ideas, cutting-edge research and collaborate in ways that will connect our global food system communities. Together, we can future-proof the food system. Registration opens March 1. reers ĬFT November 2022. October 2022, Volume A New Day at the FDA Volume 76, No. 10 76, No. 9

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December 1, 2022

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Ag Explorer

https://www.agexplorer.com/

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

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Plant Systems	Power, Structural & Technical Systems	Agricultural Education Propersistudents to be successful in their agricultural professions LEARNIMORES





Science Meets Food-Blog

http://sciencemeetsfood.org/

Institute Food Technology Student Association









FDA resource – Food Additives

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



Types of Ingredients	What They Do	Examples of Uses	Names Found on Product Labels
Emulsifiers	Allow smooth mixing of ingredients, prevent separation Keep emulafied 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 lecthin, 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

Flavorsolutions

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Engineered Plants



FDA resource – Food Additives

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



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

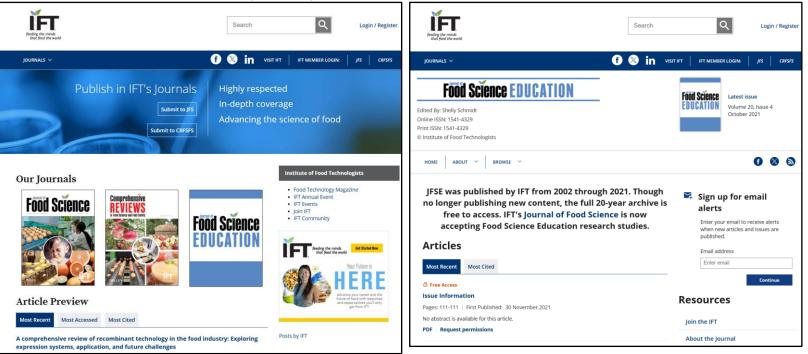


National Science Teachers Assn.

http://www.nsta.org/conference	<u>s/fda.aspx</u>		Lesson Plan How does soap	make dishes clean?	
Search for anything	Bookstore Log In Join 🕅 Menu 😑		Informal Education Phenomena	n an	ce and Engineering Practices
Discover Learn Ne	twork	Flowant	tarv Middle	High Fo	na Familian
Transform your teaching with NSTA's latest resource	es and more	Element	ary Middle	nign ru	or Families
Get unlimited access today with your NSTA Members	ship	Lesson Plan What makes muscle proteins so different from other proteins in	Lesson Plan How do cells know which amino acids go together to make certain	Lesson Plan What exactly are proteins and how are the proteins we make different	Leson Plan How do people build muscles if they are not eating muscle
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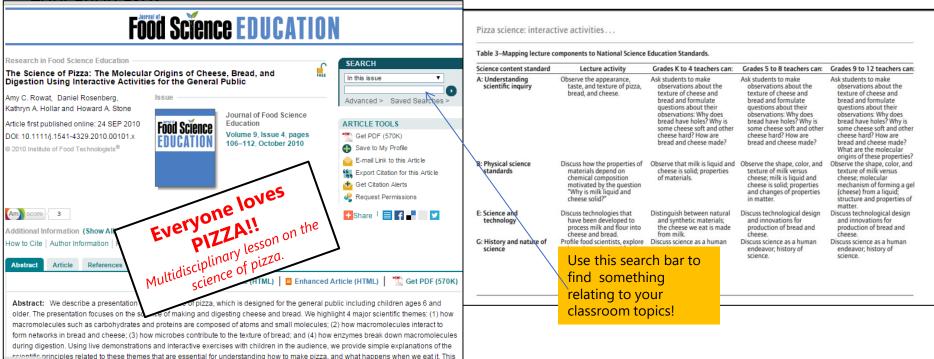




IFT: Journal of Food Science Education

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

<u>aducation asnv</u>



Ilt Flavorsolutions



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

	Institute of Apriculture and National Resources						
		Eat Healthy	Move More	Keep Food Safe			
	Mezzara - MAR - Menzara Edensian - VAL Food - Hear Food Bet - Food Presmation - Home Food Presmation Lessons						
	Home Food Preservation Lessons						
	smare f ¥ = P			Provide Feed			
<u>-hour</u>							



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 Lesso
- Boiling Water Canning Tomatoes Lesson
- Pressure Canning Carrots Lesson
- Eood 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.

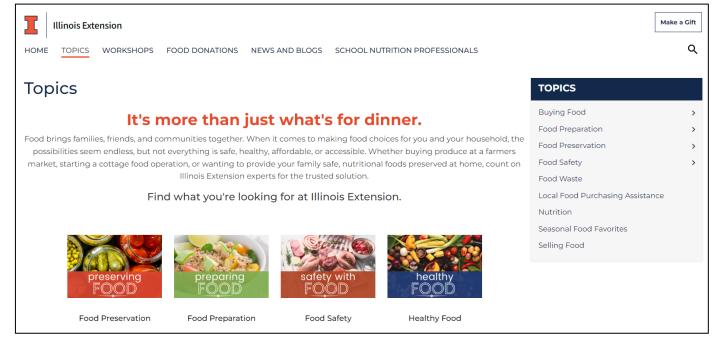
Lesson Pian - Canning Grape Jelly
Home Canning Grape Jelly Brochure





University of Illinois – Food related Labs

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

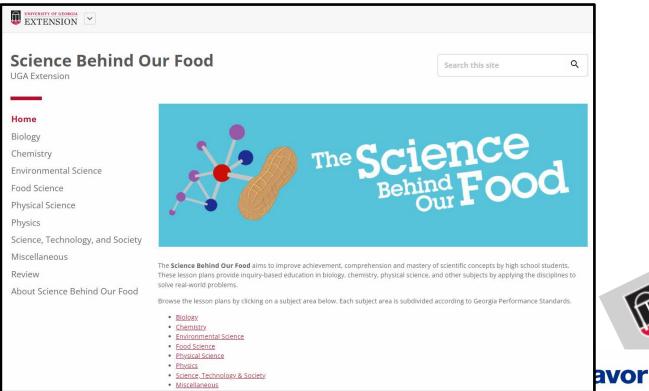






University of Georgia – Science of Food

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





American Chemical Society-ChemMatters



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

February 2025

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Free Articles

FEATURE

Can Plants Fuel Champions?

OPEN FOR DISCUSSION

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

CHEMISTRY IN PERSON

Why Your Sense of Smells Is Basically Infinite

Downloads

Teacher's Guide (DOC)

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



CHEM IN PERSON

Why Your Sense of Smells Is Basically Infinite

Steven Munger loves the sour smell of a butane lighter. The hydrocarbon, butane, is colorless and odorless, but sulfurous additives rive it a sterich that's almost chiertively foul Intost. To Mutder 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 tripper deeply buried memories. "A ish smell might be unappealing." Munper says. But if you grew up spending time on boats around family members who fish, you might respond more positively. The same chemical smell can elicit different meanings for different people, and in different contexts Unlike sight, sound, and touch, the smells and tastes we sense are all chemicals. The associations we peg to chemicals have long captivated Munger. He first studied chemical sensing in crustaceans as a college student before moving on to lab mammals such as mice. He is now a professor at the University of Virginia in Charlottesville, Virginia, studying the mysteries of our chamical senses In this interview. Munger discusses his roundabout journey into chemistry and the mysteries of smell and taste that have kept him fascinated those chemicals mean. There's a receptor that throughout his career. -Max G. Levy Did you always expect to study chemical senses or chemistry in general? was not a great chemistry student. It didn't eally click for me. I ended up approaching it from the biological side ow did biology lure you into chemistry By pure chance. When I was an undergraduate, was interested in neuroscience and marine biology and looking to work in a lab. One professor had been working on the reflex of mantis shrimp, which can [punch] the water and stun its bitter-tasting compounds are poisonous. prey. Well, they weren't working on that project anymore, but they were studying the sense of smell in cravfish Liust became really fascinated with sensory hiology in general-how we understand the world around up What fascinated you about the chemical With smell and taste you get this complexity receptors to different degrees. That elicits a where your nervous system has to tease apart different chemicals and then put them back pattern that your brain had previously learned

together in some way



pizz, which has a bunch of different chemicals. Do you have advice for students for executors of different degrees. That elicits a pattern that you be a fraid of . Chemistry is statement that gover have a straid of . Chemistry is something to be a fraid of . Chemistry is something

ChemMatters | www.acs.org/chemmatters 19

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

Flavorsolutions **FS**

ACS: Food & Cooking Chemistry

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



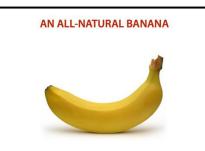




James Kennedy Blog

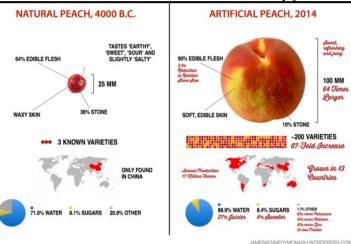
https://jameskennedymonash.wordpress.com/

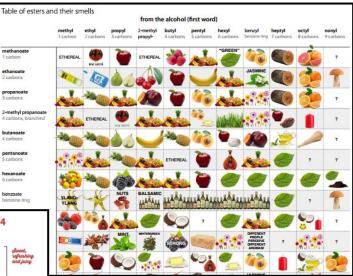
Chemistry Teacher Australia



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 ETHÁNOATE, 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).

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

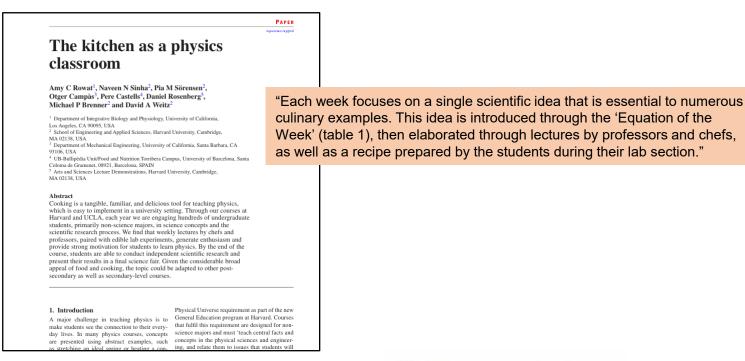




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The Kitchen as a Physics Lab!

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



It Flavorsolutions



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

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

Curriculum Unit 20.02.02 by Nicholas Farrell

Introduction and Rationale

Introduction

Food is near and dear to every one of us. We rely on it for sustenance and health, yet the understanding of food, the energy contained within it, and how it compares to our energy requirements, is likely limited. The number of Americans cooking at home increased from 2003 to 2016, especially among men⁻¹, with roughly two-thirds of all calories being store-bought and consumed at home depending on income21. Reported home cooking occurs at higher rates among those of low income21. Despite this the U.S. Bureau of Labor Statistics reported in 2015 that the average household spends \$3,000 per year on eating out⁴. With a U.S. adult obesity rate of 42.4% in 2017-2018³, 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 concern⁴. 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 2016⁷. Physics is incredible in its ability to transform the way students look upon the world. Applying a little bit of physics can help us to better understand not only energy balance in our bodies, but also heat transfer in cooking. A few simple equations and experiments can help us to think more rationally and quantitatively about food and cooking. This unit aims to help students learn about the physics of food and cooking and apply the knowledge to act more responsibly and prevent some of the cases of obesity and food poisoning.

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



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



Food Loss & Food Waste

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



Food and Agriculture Organization of the United Nations



SAVE FOOD: Global Initiative on Food Loss and Waste Reduction

Background News and multimedia Members Projects and activities Regional Resources Login Register

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Global Water Issues

Water Calculator

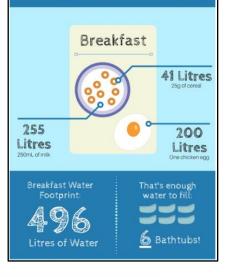
https://www.watercalculator.org/

- Cape Town, South Africa will turn off it's Taps! <u>https://news.nationalgeographic.com/2018/02/cape-town-running-out-of-water-drought-taps-shutoff-other-cities/</u>
- Water Footprint, National Geographic: <u>https://www.youtube.com/watch?v=2T_n0oi9YdY</u>
 - 13 gal water=1 gal fuel, 30 gal water=1 glass of wine
 - Agriculture consumes about 80% water consumed.





WATER FOOTPRINT your Breakfast, Lunch & Dinner







Monell Taste & Smell Institute

https://monell.org/smellandtasteforlife/







Additional Resources



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





Additional Resources

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





