Food Science Activity Guide

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FOOD SCIENCE ACTIVITY GUIDE CONTENTS

Careers in Food Science

Ever wonder...

why M&M's® melt in your mouth but not in your hands? What makes microwave pizza crispy? How the fluffy center of a Twinkie® gets in there? Food scientists use science and engineering skills to address these and a whole host of food-related issues.

Want to Learn More?

The vision of the Institute of Food Technologists (IFT) is to ensure a safe and abundant food supply contributing to healthier people everywhere. IFT provides educational material about food science and careers in the food industry. Through a partnership with Discovery Education, IFT and the IFT Foundation provided multimedia kits and food science experiments to every public high school in the U.S. To learn more, visit http://school.discovery.com/foodscience or www.ift.org.

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INTRODUCTION

Thank you for your interest in IFT's Food Science Activity Guide. IFT created a Food Science Ambassador program to support food science career promotion. Teachers, counselors, and students can "find a food scientist" in their area by searching the database of Food Science Ambassadors on the IFT website, ift.org. If you are an Ambassador and have not been contacted by a school, but would like to share your expertise and experience with students, take a look at the Resources section for helpful hints on how to reach out to serve your local community.

The demonstrations in this guide are specifically designed to show how food science is applied on the job and in everyday life, and the National Science Education Standards addressed are identified. All of the demonstrations are intended to be presented in one class period or less with materials that can generally be found in your local grocery store. The targeted age group, estimated preparation time, and estimated activity time are indicated on the top of each activity. All of the activities are formatted to fit into a standard three-ring binder. The sections in the guide can be easily divided using 8-tab divider pages. Materials may be photocopied and distributed as needed. A handout is also included with the link to IFT's website if students are interested in learning more about careers in food science.

On the IFT website in the Teacher Resources and "find a food scientist" areas, you will also find PowerPoint® presentations which go hand-in-hand with each of the demonstrations in the activity guide and help to present the basic food science concepts illustrated in each activity. There are also basic presentations for elementary, middle, high school, and undergraduate/undecided students that describe what food science is and how to pursue a career in the field. All of these presentations can be adapted to include specific information about your company or university. Please visit the IFT website regularly, as new demonstrations and presentations will continue to be added. If you have a demonstration which has worked well in the past, please send it to *careerguidance@ift.org* so that we may include it in future updates.

If you have not already done so, visit *www.discoveryschool.com/foodscience* to view the content of two multimedia kits that were sent to 18,000 U.S. high schools in January 2006. These kits include six standards-based experiments. There you will also find videos about careers in food science which you may want to view and show to others. If you have any questions or comments about IFT's career guidance activities, please e-mail us at *careerguidance@ift.org*. We'd love to hear from you!

Thank you!

FOOD CHEMISTRY

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FOOD CHEMISTRY

I SECOND THAT EMULSION

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I SECOND THAT EMULSION
Background

This material was developed by Jeremy Peacock and Amy Rowley as part of The Science Behind our Food NSF Grade K-12 program at The University of Georgia in collaboration with the College of Agricultural and Environmental Sciences and the Department of Food Science and Technology. This material is based upon work supported by the National Science Foundation under Grant Award No. DGE0229577. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

Emulsions

Oil and water don't mix! You've heard it a thousand times. You've probably seen it for yourself. But the truth is that we are surrounded by foods that are made by mixing oil and water. Salad dressing, butter, ice cream, and milk are all oil-water mixtures that don't separate under normal conditions. So how can we explain this? All of these foods are emulsions. An emulsion is a colloid (a mixture of very tiny particles that are dispersed in another substance but do not settle out of that substance), in which liquids that do not normally mix are spread throughout each other. Emulsifying is done by slowly adding one ingredient to another while simultaneously mixing. This disperses and suspends tiny droplets of one liquid (known as the dispersed phase) through another (known as the continuous phase). To prevent the mixture from separating, an ingredient, known as an emulsifier, which is attracted to both oil and water, is added, thus allowing the two to mix.

Mayonnaise

Mayonnaise is an example of an oil-in-vinegar emulsion. Mayonnaise, like all emulsions, contains an emulsifier…in this case, the incredible, edible egg. Egg yolk contains the phospholipid lecithin. Each lecithin molecule contains a polar end that is attracted to water and a non-polar end that is attracted to oil. The result is that the lecithin dissolves half of itself in water and the other half in oil. Thus, droplets of oil can be dissolved in vinegar, creating mayonnaise.

Mayonnaise was invented in 1756 by the French chef of the Duc de Richelieu. After the Duc beat the British at Port Mahon, his chef created a victory feast that was to include a sauce made of cream and eggs. Realizing that there was no cream in the kitchen, the chef substituted olive oil for the cream and a new culinary creation was born. The chef named the new sauce "Mahonnaise" in honor of the Duc's victory.

I SECOND THAT EMULSION
Administrator's Guide

PLEASE NOTE: *The mayonnaise prepared in this demonstration is made with raw eggs and should not be consumed. Raw eggs may contain* Salmonella, *a bacterium which can cause foodborne illness.*

Grade levels: 3-12
Estimated Preparation Time: 15 minutes
Estimated Demonstration Time: 30 minutes
Standard Addressed: Content Standard B
(Structure and Property of Matter)

- Bonds between atoms are created when electrons are paired up by being transferred or shared. A substance composed of a single kind of atom is called an element. The atoms may be bonded together into molecules or crystalline solids. A compound is formed when two or more kinds of atoms bind together chemically.
- The physical properties of compounds reflect the nature of the interactions among its molecules. These interactions are determined by the structure of the molecule, including the constituent atoms and the distances and angles between them.

Reference:

The following demonstration is adapted from:

Peacock, J and Rowley, A. I Second That Emulsion. The Science Behind Our Food: A hands-on resource for science teachers. The University of Georgia College of Agricultural & Environmental Sciences. *http://www.uga.edu/discover/sbof*

Objectives:

- To introduce food science to students
- To introduce the importance of ingredient functionality and the function of an emulsifier

Materials:

- 2 mixing bowls
- 2 wire wisks
- 1 measuring cup
- Measuring spoons
- 1 egg yolk
- 6 teaspoon vinegar
- 2 cup vegetable oil

Set-up Instructions:

1. Assemble the ingredients and photocopy the student handout.
2. Pre-measure the oil in two 1-cup portions.

Demonstration Instructions:

1. Prepare the emulsion with and without the emulsifier (egg yolk):

   i. No emulsifier:
      1. Add 1 tsp. vinegar to a mixing bowl.
      2. Add oil, 1 tbsp. at a time, while continuously beating the mixture, until 1/3 cup has been added.
      3. Add 1 tsp. of vinegar and continue to beat mixture.
      4. Repeat steps 2 and 3 until all liquids have been added.

   ii. Emulsifier
      1. Add egg yolk and 1 tsp. vinegar to a mixing bowl.
      2. Beat vigorously until slightly thick.
      3. Add oil, 1 tbsp. at a time, while continuously beating the mixture, until 1/3 cup has been added.
      4. Add 1 tsp. of vinegar and continue to beat mixture.
      5. Repeat steps 2 and 3 until all liquids have been added.

NOTE: The emulsion will not form unless the oil is added VERY slowly. You will know you have formed an emulsion when the mixture turns white and thick.

2. Ask students what they think about the egg could have caused the oil and vinegar to mix.
3. Discuss that eggs contain lecithin which is an emulsifier (see background).

Extension: This demonstration can also be done using pasteurized egg yolks. If pasteurized egg yolks are used, the mayonnaise will be safe to consume. Pasteurized egg yolks have been rapidly heated and held at a minimum required temperature for a specified time. This process destroys *Salmonella*, but it does not cook the egg yolks or affect their color, flavor, nutritional value, or use. Lecithin is not affected by the heat treatment and remains an effective emulsifier. Be sure to buy only pasteurized egg products that bear the USDA inspection mark.

I SECOND THAT EMULSION
Student Handout

Background: Oil and water don't mix! You've heard it a thousand times. You've probably seen it for yourself. But the truth is that we are surrounded by foods that are made by mixing oil and water. Salad dressing, butter, ice cream, and milk are all oil-water mixtures that don't separate under normal conditions. So how can we explain this? All of these foods are emulsions. An emulsion is a colloid (a mixture of very tiny particles that are dispersed in another substance but do not settle out of that substance) in which liquids that do not normally mix are spread throughout each other. Emulsifying is done by slowly adding one ingredient to another while simultaneously mixing. This disperses and suspends tiny droplets of one liquid through another. To prevent the mixture from separating, an ingredient which is attracted to both oil and water, known as an emulsifier, is added, thus allowing the two to mix.

Conclusion Questions:

1. Observe the appearance, texture, and aroma of the mixtures.

_____

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2. Why do you think they are different?

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3. What common food emulsion was prepared?

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Objective:

- To prepare an emulsion of oil in water
- To learn about emulsions and the functions of an emulsifier

FOOD CHEMISTRY

BAFFLING BEATERS

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BAFFLING BEATERS Background

Egg White Foam

Egg white foam is a type of foam (a colloid in which a gas is dispersed or spread throughout a liquid) used in meringues, soufflés, and angel food cake to make them light and porous (airy). To prepare an egg white foam, egg whites are initially beaten (with a wire wisk or electric mixer) until they become frothy. Then an acid (such as cream of tartar) is added. Depending on the application, the beating of the egg white continues until soft (when the peaks stand straight and bend slightly at the tips) or stiff peaks (when the peaks stand straight without bending) are formed. Salt and sugar may also be added.

How It Works:

Egg whites are made up of water, protein, and small amounts of minerals and sugars. When the egg whites are beaten, air is added and the egg white protein, albumen, is denatured. Denaturation is the change of a protein's shape under stress (in this case, beating). The denatured protein coats the air bubbles and holds in the water, causing them to become stiff and stable. When an acid such as cream of tartar is added, the foam becomes even more stable and less likely to lose water (a process known as syneresis).

Several factors affect the formation and stability of egg white foams, including:

- Fat: The addition of even a small amount of fat will interfere with the formation of a foam. Fat is present in the egg yolk, so it is very important that all of the egg yolk is separated from the egg white.
- Salt: Salt is added to egg white foams for flavor.
- pH: Addition of an acid (such as cream of tartar) will decrease the pH of the egg white foam to near the isoelectric point of the proteins. At this point, the proteins are least stable and more sensitive to denaturation. Adding an acid also increases the beating time.
- Temperature: An egg white foam is formed and reaches greater volume more quickly when egg whites are at room temperature.
- Sugar: Sugar is added during foam preparation because it creates a smooth, stable foam – one that will not collapse and drain quickly.

References

Food Mysteries Case 4: Protein Puzzlers. 1992. Originally developed by 4-H Youth Development, Michigan State University Extension, East Lansing.

Himich Freeland-Graves, J and Peckham, GC. 1996. Foundations of Food Preparation. 6th ed. Englewood Cliffs: Prentice Hall. 750 pgs.

BAFFLING BEATERS
Administrator's Guide

Adapted with permission from Food Mysteries Case 4: Protein Puzzlers (1992), originally developed by 4-H Youth Development, Michigan State University Extension, East Lansing.

PLEASE NOTE: *The foams prepared in this demonstration are made with raw eggs and should not be consumed. Raw eggs may contain* Salmonella, *a bacterium which can cause foodborne illness.*

Grade levels: 3-12
*Estimated Preparation Time: 90 minutes *In order to demonstrate the syneresis to the class, part of this experiment must be prepared 1 hour before the demonstration.*
Estimated Demonstration Time: 30 minutes
Standard Addressed: Content Standard B
(Structure and Property of Matter)

- Bonds between atoms are created when electrons are paired up by being transferred or shared. A substance composed of a single kind of atom is called an element. The atoms may be bonded together into molecules or crystalline solids. A compound is formed when two or more kinds of atoms bind together chemically.

- The physical properties of compounds reflect the nature of the interactions among their molecules. These interactions are determined by the structure of the molecule, including the constituent atoms and the distances and angles between them.

Reference:

Food Mysteries Case 4: Protein Puzzlers. 1992. Originally developed by 4-H Youth Development, Michigan State University Extension, East Lansing.

Objectives:

- To introduce food science to students
- To introduce foams and investigate what affects their formation and stability

Materials:

- 4 egg whites from equal-size eggs at room temperature
- 1/2 teaspoon cream of tartar
- 2 mixing bowls of the same size
- Electric mixer
- 2 clear glasses (10 oz. or larger) of the same size
- Measuring cup
- Marker
- Measuring spoons

Set-up Procedure:

1. 1 HOUR before the demonstration

i. Beat one egg white with an electric mixer until stiff peaks form when the beaters are lifted out of the egg white. Pour the beaten egg white into a clear glass. Label the glass "without cream of tartar."

ii. Beat a second egg white with an electric mixer until foamy; then add 1/8 teaspoon cream of tartar. Start beating again at the same speed until stiff peaks form. Pour the beaten egg white into a clear glass labeled "with cream of tartar."

iii. Let the egg whites stand for one hour.

Experimental Procedure:

1. You will need to record the exact time you begin to beat each egg white. Have students record the time on the chart provided in their handout.

2. In a mixing bowl, beat one egg white with the electric mixer until stiff peaks form when the beaters are lifted out of the egg white. Have students record the minutes and seconds this took. Keep this egg white for comparison.

3. As you begin to beat the second egg white, have students record the time. Beat the second egg white in the remaining bowl until it is foamy. Add the cream of tartar and immediately start beating again at the same speed until stiff peaks form. Have students record the total beating time.

4. Pour off the accumulated liquid and measure the liquid in the measuring cup. Record the amount.

5. Ask the students to answer the following questions based on their observations:
   i. Did it take longer to beat to stiff peaks the egg white with cream of tartar or the egg white without cream of tartar?
   ii. Which egg white lost LESS liquid after one hour?
   iii. What can you conclude about how cream of tartar affects egg whites when beaten?
   iv. Why would you want egg whites to be stable after beating?

Extension: This experiment can also be done by preparing a third batch with 2 tablespoons of sugar added with the cream of tartar and/or by preparing another batch using powdered egg whites. The powdered egg whites will not foam because the drying process denatures the proteins in a different way than beating.

Note: Check the ingredient statement; some powdered egg white products (sometimes called meringue powder) contain gums and stabilizers so that the dried egg whites will foam.

BAFFLING BEATERS
Student Handout

Adapted with permission from *Food Mysteries Case 4: Protein Puzzlers* (1992), originally developed by 4-H Youth Development, Michigan State University Extension, East Lansing.

Background: Egg whites are made up of water, protein, and small amounts of minerals and sugars. When egg whites are beaten, air is added. The air bubbles are then surrounded by the egg white protein (albumen), causing the egg white foam to become stiff and stable. When an acid, such as cream of tartar, is added to an egg white foam, the foam becomes even more stable.

This experiment will help you understand this baffling mystery!

Objectives:

To study foams and investigate what affects their formation and stability

Conclusion Questions:

1. Did it take longer to beat to stiff peaks the egg white with cream of tartar or the egg white without cream of tartar?

_____

_____

2. Which egg white lost LESS liquid after one hour?

_____

_____

3. What can you conclude about how cream of tartar affects egg whites when beaten?

_____

_____

4. Why would you want egg whites to be stable after beating?

_____

_____

Data Sheet:

	Egg White without Cream of Tartar	*Egg White with Cream of Tartar*
Starting Time		
Total Amount of Beating Time		
Amount of Accumulated Liquid		

FOOD CHEMISTRY

ALGINATE GUMMIES

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ALGINATE GUMMIES
Background

Alginate is a type of polysaccharide that occurs naturally in all brown algae as a skeletal component of their cell walls. Alginate is used in food because it is a powerful thickening, stabilizing, and gel-forming agent. Some foods that may include alginate are ice cream, fruit-filled snacks, salad dressings, pudding, onion rings, and even the pimento strips that are stuffed into green olives.

Most alginate used in foods is in the form of sodium alginate. In order to form a gel, sodium alginate needs to come into contact with divalent ions such as calcium (Ca^{2+}). As soon as sodium alginate (Figure 1) is added to a solution of calcium chloride, a gel forms as the sodium ions (Na^{+}) are exchanged with calcium ions (Ca^{2+}) and the polymers become crosslinked (Figure 2).

The calcium ions are able to crosslink the alginate polymers because they can form two bonds, as opposed to monovalent ions such as sodium, which can only form one bond. The longer the alginate is in contact with the calcium chloride solution, the more rigid the gel will become, as more crosslinks are formed. Also, depending on the concentration of calcium ions, the gels are either thermoreversible (low concentrations) or not (high concentrations).

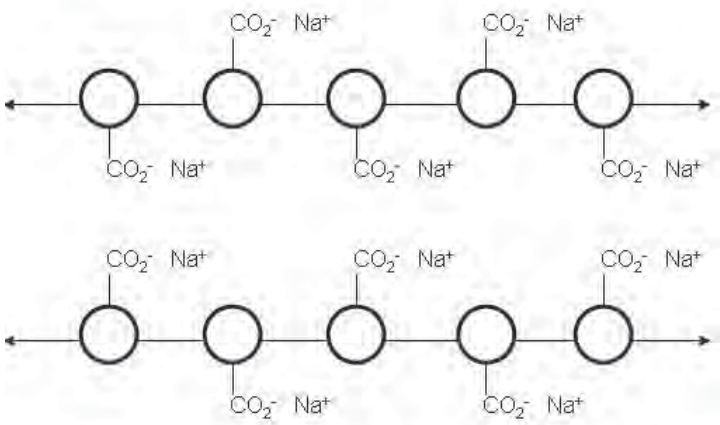

Figure 1. Alginate polymer in NaCl solution (no crosslinking) (Waldman et al. 1998)

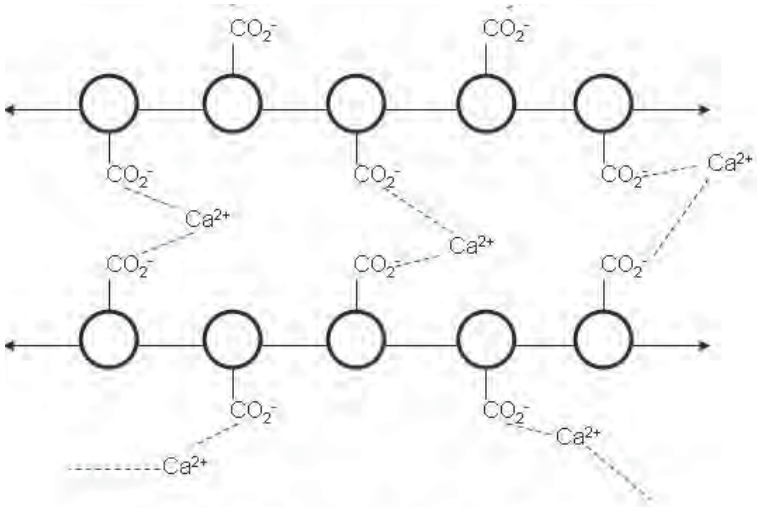

Figure 2. Alginate polymer in $CaCl_2$ solution (crosslinking) (Waldman et al. 1998)

References

Waldman, AS, Schechinger, L, Govindarajoo, G, Nowick, JS, Pignolet, LH. 1998. The alginate demonstration: polymers, food science, and ion exchange. Journal of Chemical Education 75(11): 1430-1431.

Belitz, HD and Grosch, W. 1999. Food Chemistry. Berlin: Springer. 992 pgs.

ALGINATE GUMMIES
Administrator's Guide

Grade levels: 3 - 12
Estimated Preparation Time: 30 minutes
Estimated Demonstration Time: 30 minutes
Standard Addressed: Content Standard C (Chemical Reactions)

Chemical reactions occur all around us; for example, in healthcare, cooking, cosmetics, and automobiles. Complex chemical reactions involving carbon-based molecules take place constantly in every cell in our bodies.

Reference:

Waldman, AS, Schechinger, L, Govindarajoo, G, Nowick, JS, Pignolet, LH. 1998. The Alginate Demonstration: Polymers, Food Science, and Ion Exchange. Journal of Chemical Education. 75(11): 1430-1431.

Objectives:

- To introduce food science to students
- To demonstrate the formation of an alginate gel

Materials:

- Distilled water (the demonstration will not work properly unless distilled or deionized water is used)
- 2 grams of alginic acid sodium salt (call TIC Gums at 1.800.899.3953 and request the free University Kit)
- 2 grams of sodium chloride (NaCl)
- 2 grams of calcium chloride ($CaCl_2$)
- Food coloring
- Pipette
- Two beakers (larger than 100mL)
- Optional: Also bring in a product which contains an alginate gel. For example, green olives with pimentos.

Set-up Procedures:

1. Add 2 grams of alginic acid sodium salt to 100 mL of distilled water. Stir the suspension vigorously for several minutes. Add several drops of food coloring to the suspension. For best results, prepare the suspension the day before.

2. Add 2 grams of sodium chloride to 100 mL of distilled water. Stir vigorously. Label the jar Na^+.

3. Add 2 grams of calcium chloride to 100 mL of distilled water. Stir vigorously. Label the jar Ca^{2+}.

Procedures:

1. Using the pipette, pour a thin stream of the alginate solution into the calcium chloride. This should form worm-like gels.

2. Using the pipette, pour a thin stream of the alginate into the sodium chloride. This should not form a gel.

3. Ask students to describe what they see. Allow students to touch the alginate worms.

4. Explain why the alginate formed a gel in the presence of calcium chloride and not in the presence of sodium chloride. Waldman et al (1998) recommend:

   For 3rd through 6th-grade students: Have students line up in two rows representing the alginate chains (polymers). Have a few "volunteer ions" who represent Na^+ stand in between the rows and hold onto any student with one hand. To model the crosslinked calcium alginate, have the volunteer ions (now magically converted to Ca^{2+}) touch two students each in a different row. Explain that the Na^+ ions can only form one bond while the Ca^{2+} ions can form two.

   For 7th through 12th-grade students: Draw a cartoon on the board of the sodium alginate (see background Figure 1). Describe what happens during the ion exchange by replacing the sodium ions with calcium ions (see background Figure 2). Explain that the process is reversible at low calcium concentrations.

5. Optional: Pass around the jar of olives containing pimentos, and have students look at the label. It should read: Olives, Water, Minced Pimento (Sodium Alginate, Guar Gum, Calcium Chloride), Salt, Lactic Acid.

Photos courtesy of Peter Machado, University of Maryland

Extension: Milk can also be used as a source of calcium. Using a pipette, pour a thin stream of the alginate solution into milk. The gel formed will be very weak.

ALGINATE GUMMIES
Student Handout

Background: Alginate is a type of polysaccharide that occurs naturally in all brown algae as a skeletal component of their cell walls. Alginate is used in food because it is a powerful thickening, stabilizing, and gel-forming agent. Some foods that may include alginate are ice cream, fruit-filled snacks, salad dressings, pudding, onion rings, and even the pimento strips that are stuffed into green olives.

Objectives: To investigate how an alginate gel is formed

Observations:

1. What happened when a thin stream of 2% sodium alginate was poured into the calcium chloride (Ca^{2+})?

2. What happened when a thin stream of 2% sodium alginate was poured into the sodium chloride (Na^{+})?

Conclusion Questions:

1. What needs to be present for an alginate gel to form?

2. Why does it need to be present?

NUTRITION, LABELING, AND FOOD ANALYSIS

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NUTRITION, LABELING, AND FOOD ANALYSIS

THERE'S IRON IN BREAKFAST CEREAL?

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THERE'S IRON IN BREAKFAST CEREAL?
Background

It's true! Breakfast cereals may be fortified with a variety of vitamins and minerals to ensure a completely balanced nutritional meal. In general, a **fortified food** contains ingredient(s) that are not normally found in that food in order to achieve a particular dietary purpose. For example, salt is fortified with iodine (or iodized) in order to prevent goiter. Foods are fortified with iron because it is considered an essential ingredient of the daily diet which must be present for the body to function properly. Approximately 60-70% of the human body's iron is found in hemoglobin, a protein in the blood that transports oxygen. Iron is also present in muscle tissue and some enzymes.

Breakfast cereals are an important source of iron in our diet; in fact, in 1999, Americans consumed an average of 23.6 mg of iron per day, with 53% coming from grains and breakfast cereals. The recommended daily allowance (RDAs) of iron depends on the age and sex of an individual because certain populations require higher amounts of iron, such as children, women before menopause, and pregnant or nursing women. For example, the RDA is 15 mg/day for females age 14-18 and 11 mg/day for males age 14-18. The Daily Value for iron (the value listed on the cereal box) is 18 mg per day. This number is a reference number developed by the Food and Drug Administration (FDA) to help consumers determine if a food contains a lot or a little of a specific nutrient.

Iron can be added to breakfast cereals in several food-grade forms. Some cereal manufacturers prefer to add particles of pure iron metal (called elemental iron or reduced iron) because elemental iron is stable in storage and does not affect the cereal's flavor. Not all cereals contain the same amount of iron, and this information can be found on the Nutrition Facts panel. To fortify a breakfast cereal, the iron, along with other vitamins and minerals, is first mixed in with the grains, salt, water and, if applicable, other flavoring agents and/or sweeteners. This mixture is then cooked. To create flakes, the cooked grains are flattened between rollers under tons of pressure. Once the flakes are made, the iron is well incorporated into the product and cannot be seen by the consumer.

References

Federal Studies. 2002. Family Economics & Nutrition Review. 41(2): 90.

Belitz, HD and Grosch, W. 1999. Food Chemistry. Berlin: Springer. 992 pgs.

Himich Feeland-Graves, J and Peckham, GC. 1996. Foundations of Food Preparation. 6th ed. Englewood Cliffs: Prentice Hall. 750 pgs.

JCE Editorial Staff. 2004. A Magnetic Meal. Journal of Chemical Education. 81: 1584A.

THERE'S IRON IN BREAKFAST CEREAL?
Administrator's Guide

PLEASE NOTE: The cereal slurry should not be consumed.

Grade levels: 3-12
Estimated Preparation Time: 30 minutes
Estimated Demonstration Time: 30 minutes
Standard Addressed: Content Standard C (The Cell)

Most cell functions involve chemical reactions. Food molecules taken into cells react to provide the chemical constituents needed to synthesize other molecules. Both breakdown and synthesis are made possible by a large set of protein catalysts, called enzymes. The breakdown of some of the food molecules enables the cell to store energy in specific chemicals that are used to carry out the many functions of the cell.

Reference:
JCE Editorial Staff. 2004. A Magnetic Meal. Journal of Chemical Education. 81: 1584A.

Objective:

- To demonstrate iron fortification of breakfast cereals

Materials:

- 1 box iron fortified cereal (Total® cereal, which contains 100% of the daily value per serving, works best)
- Plastic bags
- Water (warm, if possible)
- Strong magnet
  - Large white stir bar (70 mm) and stir bar retriever rod OR
  - Large neodymium magnet (can be purchased individually from www.stevespanglerscience.com)

Procedures:

1. Pour 1 cup of cereal into a plastic bag and crush the cereal using your hands or a mallet. The cereal can also be crushed using a mortar and pestle, if available.
2. Pour the crushed cereal into a second plastic bag. Fill the bag at least half full with water (warm water will speed up the process). Carefully seal the bag, leaving an air pocket inside.
3. Mix the cereal and the water by gently shaking the bag until the contents become a brown, soupy mixture.
4. If time allows, let the bag sit for 30 minutes to an hour.
5. Open the plastic bag and drop in the large white stir bar. Allow the stir bar to sit in the bag for 2 minutes. Remove the stir bar using the stir bar retriever rod. The iron should be attached to the stir bar.

   OR

6. Place the large neodymium magnet on the outside of the plastic bag. Look closely at the edge of the magnet; you should see tiny black specks on the inside of the bag around the edges of the magnet.

THERE'S IRON IN BREAKFAST CEREAL?
Student Handout

Background: It's true! Breakfast cereals may be fortified with a variety of vitamins and minerals to ensure a completely balanced nutritional meal. In general, a fortified food contains ingredient(s) that are not normally found in that food in order to achieve a particular dietary purpose. For example, salt is fortified with iodine (or iodized) in order to prevent goiter. Foods are fortified with iron because it is considered an essential ingredient of the daily diet which must be present for the body to function properly. Approximately 60-70% of the human body's iron is found in hemoglobin, a protein in the blood that transports oxygen. Breakfast cereals are an important source of iron in our diet; in fact, in 1999, Americans consumed an average of 23.6 mg of iron per day, with 53% coming from grains and breakfast cereals.

Objective: To demonstrate iron fortification of breakfast cereals

Procedures:

1. Pour 1 cup of cereal into a plastic bag and crush the cereal using your hands or a mallet. The cereal can also be crushed using a mortar and pestle, if available.

2. Pour the crushed cereal into a second plastic bag. Fill the bag at least half full with water (warm water will speed up the process). Carefully seal the bag, leaving an air pocket inside.

3. Mix the cereal and the water by gently shaking the bag until the contents become a brown, soupy mixture.

4. If time allows, let the bag sit for 30 minutes to an hour.

5. Open the plastic bag and drop in the large white stir bar. Allow the stir bar to sit in the bag for 2 minutes. Remove the stir bar using the stir bar retriever rod. The iron should be attached to the stir bar.

   OR

6. Place the large neodymium magnet on the outside of the plastic bag. Look closely at the edge of the magnet; you should see tiny black specks on the inside of the bag around the edges of the magnet.

Discussion Questions:

1. What happened when the magnet came in contact with the cereal?

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2. If iron was present, why don't you normally see it when you eat cereal?

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NUTRITION, LABELING, AND FOOD ANALYSIS

COUNTING CALORIES

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COUNTING CALORIES
Background

All foods contain energy, although the amount of potential energy stored will vary greatly depending on the type of food. When we eat food, our bodies convert the stored energy to chemical energy, allowing us to do work. The energy values of food are measured by the Calorie, with a capital C. A Calorie is equal to 1,000 calories or 1 kilocalorie (kcal). A calorie is the amount of heat (energy) required to raise the temperature of 1 gram (g) of water 1 degree Celsius (°C). You can find information about the amount of Calories in a food on the Nutrition Facts panel. For example, the Nutrition Facts panel below shows that this food contains 250 Calories. The label also shows how many grams of fat, carbohydrates, and protein it contains. These components contribute different amounts of Calories to the overall food product. Here is how many Calories are in a gram of each:

- 1 g fat = 9 Calories
- 1 g carbohydrate = 4 Calories
- 1 g protein = 4 Calories

To determine the amount of Calories in a food, nutrition and food scientists can use an instrument that is called a calorimeter. A calorimeter (from the Latin word *calor*, meaning heat) is a device that measures the heat generated by a chemical reaction or change of state.

Reference

Sizer, F and Whitney, E. 1997. Nutrition Concepts and Controversies. 7th ed. Wadsworth: CA.

Nutrition Facts

Serving Size 1 cup (228g)
Servings Per Container 2

Amount Per Serving	
Calories 250	Calories from Fat 110
	% Daily Value*
Total Fat 12g	18%
Saturated Fat 3g	15%
Trans Fat 3g	
Cholesterol 30mg	10%
Sodium 470mg	20%
Total Carbohydrate 31g	10%
Dietary Fiber 0g	0%
Sugars 5g	
Protein 5g	
Vitamin A	4%
Vitamin C	2%
Calcium	20%
Iron	4%

* Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs.

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

www.cfsan.fda.gov

COUNTING CALORIES
Administrator's Guide

Grade levels: 9-12
Estimated Preparation Time: 30 minutes
Estimated Demonstration Time: 30 minutes
Standard Addressed: Content Standard C (Matter, Energy, and Organization in Living Systems)

- The chemical bonds of food molecules contain energy. Energy is released when the bonds of food molecules are broken and new compounds with lower energy bonds are formed. Cells usually store this energy temporarily in phosphate bonds of a small high-energy compound called adenosine triphosphate (ATP).

- As matter and energy flows through different levels of organization of living systems—cells, organs, organisms, communities—and between living systems and the physical environment, chemical elements are recombined in different ways. Each recombination results in storage and dissipation of energy into the environment as heat. Matter and energy are conserved in each change.

Objectives:

- To introduce food science to students
- To introduce a method of food analysis

Reference:

Sizer, F and Whitney, E. 1997. Nutrition Concepts and Controversies. 7th ed. Wadsworth: CA.

Materials:

- Cashew (save the Nutrition Facts panel)
- Popcorn (save the Nutrition Facts panel)
- Measuring cup
- Water (at room temperature)
- Ring stand
- Two paper clips
- Celsius thermometer
- Matches
- Two shallow glass dishes (Pyrex® 10 oz. custard cups work well)
- Safety goggles

Procedures:

1. Unravel one paperclip. Stick the popcorn on one end. Bend the other end of the paper clip so that it forms a support base. Place the paper clip support holding the popcorn on the base of the ring stand.

2. Pour 100 mL (0.1 kg) of water into the glass dish and place the dish in the ring on the ring stand approximately 3-4 cm above the popcorn. The amount of water added must be exactly 0.1 kg.

3. Measure and record the temperature of the water (it should be at room temperature).

4. Remember to secure loose clothing and long hair before lighting a match. Wearing safety goggles, light the popcorn with a match. The burning popcorn will release energy to heat the water.

5. As soon as the popcorn stops burning check the temperature of the water again. Do not let it cool down. Note: the temperature will only increase a few degrees.

6. Repeat steps 1-6 with one piece of cashew. Note: The cashew may be more difficult to light on fire. The temperature should increase 30° or more.

7. Have students calculate the Calories in each type of nut.

Sample calculation for the cashew (in a trial $\Delta T = 30°$):

Calorie Calculation: $Qw=(m)(c)(\Delta T)$

Qw=Heat gained by the water in calories (cal)
C=Specific heat capacity of water (1 calorie/g°C)
m=Mass of the water (grams)
ΔT=Change in water temperature (°C)
1 Kg = 1,000 g
1 Calorie = 1,000 calories

$Qw=(m)(c)(\Delta T)$
Qw=100g * 1 calorie/g°C * 30°C
Qw =3000 calories
Qw=3000 calories * 1 Calorie/1000 calories
Qw =3 Calories

Sample Nutrition Facts panel for cashews. According to the manufacturer, 28g=23 servings. Therefore, each cashew contains approximately 7 Calories.

NUTRITION FACTS

Serving Size 28g

Servings per Container about 10

Amount Per Serving

Calories 170 Calories from Fat 120

To improve the accuracy, you can also enclose the system in a coffee can. See this experiment for more detail: http://bioweb.usc.edu/courses/2004-fall/documents/bisc150-lab_burningcal.pdf.

COUNTING CALORIES
Student Handout

Background: All foods contain energy, although the amount of potential energy stored will vary greatly depending on the type of food. When we eat food, our bodies convert the stored energy to chemical energy, allowing us to do work. The energy values of food are measured by the Calorie, with a capital C. A Calorie is equal to 1,000 calories or 1 kilocalorie (kcal). A calorie is the amount of heat (energy) required to raise the temperature of 1 gram (g) of water 1 degree Celsius (°C).

To determine the amount of Calories in a food, nutrition and food scientists use an instrument that is called a calorimeter. A calorimeter (from the Latin word *calor*, meaning heat) is a device that measures the heat generated by a chemical reaction or change of state. There are many different types of calorimeters. This demonstration uses a homemade calorimeter in which a food is ignited; the water above the food absorbs the heat of the burning food, thereby causing the temperature (T) of the water to increase. By measuring the change in temperature (ΔT) of a known volume of water (in this case, 0.1 kg), you will be able to calculate the amount of energy in the food because the heat gained by the water is equal to the heat lost by the food.

Objective: To measure the amount of Calories in certain foods.

Calorie Calculation: $Qw=(m)(c)(\Delta T)$

Qw=Heat gained by the water in calories (cal)
C=Specific heat capacity of water (1 calorie/g°C)
m=Mass of the water (grams)
ΔT=Change in water temperature (°C)

Note:
1 Kg = 1,000 g
1 Calorie = 1,000 calories

Conclusion Questions:

1. How many Calories are in 1 piece of popcorn? What about in 1 cashew?

2. Was there a difference in Calories between the two products? If so, which contains more Calories?

3. Some heat is lost into the air and into the metal ring stand and dish. Does this mean the food contained more or less Calories than you observed?

4. How would you improve this experiment so that it is more accurate?

5. What is the source of energy in the foods tested?

Record Data Here:

	Water Temperature (°C)		
Food Item	*Initial Temperature*	*Final Temperature*	*Change in Temperature (ΔT)*
Cashew			
Popcorn			

FOOD PROCESSING

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FOOD PROCESSING

GOT MILK?

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GOT MILK?
Background

Food Processing and Preservation

Food processing is the set of methods and techniques used to transform raw ingredients into food for consumption. Food processing occurs from the farm to the table. Several food processing methods are used to preserve foods. Over the years, these methods have been improved to increase the shelf-life of foods while minimizing changes to the quality and nutritional content. Some methods to preserve food include:

- Refrigeration and freezing
- Canning
- Irradiation
- Dehydration
- Freeze-drying
- Salting
- Pickling
- Pasteurizing
- Fermentation

All of these processes work by slowing down the activity and growth of disease-causing bacteria, or by killing the bacteria all together. They also slow down or stop the action of enzymes which can degrade the quality of the food. How a food is processed can affect its appearance, odor, flavor, and texture.

Milk Processing and Preservation

Most milk sold in grocery stores and markets in the United States undergoes some sort of processing, mainly pasteurization and homogenization. These processes greatly increase the safety and the shelf-life of milk. In fact, in the U.S. it is illegal to sell raw (unpasteurized) milk because of the high risk of foodborne illness.

Pasteurization: Pasteurization is the process of heating liquids to destroy disease-producing bacteria as well as yeasts, molds, viruses, and less harmful bacteria.

High Temperature, Short Time

The most common method used to pasteurize milk is high temperature, short time (HTST) pasteurization. In this process, milk is heated to 161°F for 15 seconds or 145°F for 30 minutes. The pasteurized milk is then immediately cooled to 45°F to minimize the growth of surviving organisms. Milk that is HTST pasteurized must still be refrigerated and has a shelf-life of about 2 to 3 weeks.

Ultra High Temperature

Another method used to pasteurize milk is called ultrapasteurization or ultrahigh temperature (UHT). In this process, milk is heated to 275-300°F for 2-4 seconds. The high temperature kills off more bacteria and gives the product a longer shelf life. The milk is also immediately cooled after ultrapasteurization. If the ultrapasteurized milk is packaged in a sterile environment in aseptic packages, the product can last on the shelf (unrefrigerated) for over 6 months.

Homogenization: Homogenization is the process by which whole pasteurized milk is treated so that the fat globules are decreased in size to the extent that there is no separation of fat from the milk serum (the portion of the milk that contains water, carbohydrates, proteins, and minerals). Most milk purchased in the United States is homogenized; otherwise, the fat portion of the milk would separate from the serum portion.

Whole Milk: Whole milk must contain a minimum of 3.25% milk fat and contain 8.25% milk solids, not fat (mainly carbohydrates, protein, and minerals). Both milkfat and milk solids, not fat, may be added or removed during processing to meet these criteria.

Skim Milk: Skim milk is milk that has had as much of the fat drawn off as possible. It must contain less than 0.5% fat, a minimum of 8.25% milk solids, not fat, and must be fortified with 2,000 IU (International Units) of vitamin A per quart.

Lactose-Free Milk: Lactose-free milk is pasteurized, ultrapasteurized, or UHT-processed milk that has been treated with lactase to reduce the lactose content by 100%. Lactase is an enzyme that converts milk sugar, or lactose, into glucose and galactose. People who are lactose intolerant don't make enough lactase to fully digest lactose themselves. As a result, people who are lactose intolerant may experience mild to severe side effects within 30 minutes to 2 hours of eating dairy; however, the effects are not life threatening. Lactose intolerance should not be confused with cow's milk allergy, in which people experience an allergic reaction to the protein in milk that can be life threatening. Lactose-free milk is sweeter than untreated milk because the sugars glucose and galactose are sweeter than lactose.

Nonfat Dry Milk: Nonfat dry milk is made from pasteurized skim milk that has had the water removed. It contains less than 5% moisture and 1.5% milkfat, unless otherwise labeled. To manufacture nonfat dry milk, first two-thirds of the water is removed under pressure to form concentrated milk. Then the concentrated milk is dried by spraying the concentrated milk into a heated vacuum. This process is called spray-drying. The result is a fine powder that can be dissolved in warm water upon stirring. Nonfat dry milk is most commonly used in areas where there is no access to refrigeration.

Evaporated Milk: Evaporated milk is manufactured by removing about 60% of the water from homogenized whole milk by heating it under a vacuum. The evaporated milk must be sealed in a container and sterilized at 240-245°F for 15 minutes to prevent bacterial spoilage. Evaporated milk is usually light brown in color due to a reaction between the sugar in milk (lactose) and the protein in milk. This reaction is called the Maillard reaction. It also results in changes to the flavor of the milk. According to the United States Food and Drug Administration (FDA), evaporated milk must contain at least 6.5% by weight of milkfat and 23% total milk solids. If evaporated milk is packaged in a can, it may have a metallic flavor.

Sweetened Condensed Milk: Sweetened condensed milk is obtained by evaporating fresh milk sweetened with sucrose or dextrose (or both) to a point where the finished product contains no less than 28% milk solids and 8% milkfat. Sweetened condensed milk does not need to be sterilized like evaporated milk because of the high sugar content, which is sufficient to prevent spoilage. Sweetened condensed milk is often used to make sweetened desserts. If sweetened condensed milk is packaged in a can, it may have a metallic flavor.

References

Himich Freeland-Graves, J and Peckham, GC. 1996. Foundations of Food Preparation. 6th ed. Englewood Cliffs: Prentice Hall. 750 pgs.

GOT MILK?
Administrator's Guide

Grade levels: 8-12
Estimated Preparation Time: 30 minutes
Estimated Demonstration Time: 30 minutes
Standard Addressed: Content Standard F (Science and Technology in Local, National and Global Challenges)

Individuals and society must decide on proposals involving new research and the introduction of new technologies into society. Decisions involve assessment of alternatives, risks, costs, and benefits, and consideration of who benefits and who suffers, who pays and who gains, and what the risks are and who bears them. Students should understand the appropriateness and value of basic questions—"What can happen?"—"What are the odds?"—and "How do scientists and engineers know what will happen?"

Reference:

Himich Freeland-Graves, J and Peckham, GC. 1996. Foundations of Food Preparation. 6th ed. Englewood Cliffs: Prentice Hall. 750 pgs.

Objectives:

- To introduce food processing and food science to students
- To demonstrate the effects different processing methods have on the sensory properties of food products

Materials:

- Whole milk
- Skim milk
- Lactose-free milk
- Nonfat dry milk
- Sweetened condensed milk
- Shelf-stable ultra high temperature milk
- Water
- Crackers
- Cups (enough for each member of the class to try each sample)
- Trays (enough for each member of the class)

Be aware that some students may have food allergies or sensitivities. Alternatives: This demonstration can also be done with orange juice (from concentrate, not from concentrate, fresh squeezed, canned, orange juice drink, and Tang orange drink mix).

Set-up Procedures:

1. Hydrate powdered milk according to package directions.
2. Label cups with random three-digit codes.
   - For example: Whole milk (753), Skim milk (026).
   - Record the number used for each sample.
3. Pour each type of milk into appropriately labeled cups.
4. Assemble the trays. Put one of each sample (in random order) on a tray along with crackers and a cup of water.
5. Bring samples to room temperature prior to serving.

Demonstration Procedures:

1. Students can voluntarily participate, but should not be forced to participate because all sensory tests that include human subjects must be conducted on a voluntary basis. Be aware that some students may have food allergies or sensitivities.
2. Give each student a tray.
3. Review the tasting guidelines on the student handout:
   i. Smell the sample by wafting the odor to your nose. Take an open hand with the palm towards your body and move your arm in a rapid clockwise circular manner over the sample so as to lift vapors of the substance towards the nose. Record any odor that you smell.
   ii. Take a small sip, and with the mouth closed, not swallowing any of the milk, move your tongue moderately five or six times to assure that the rear of the tongue also comes into contact with the sample. At the same time, inhale and exhale slowly through the nose. This forces the aroma through the back of the nose, making it possible to note the aroma. Record any flavors that you perceive.
   iii. Spit out the sample quickly and notice the aftertaste. Hold the sample in your mouth no longer than about ten seconds. Holding it longer will dull your senses of taste and smell.
   iv. If necessary, repeat the procedures as a further check on your findings. Sometimes it may be necessary to go on to the next sample, and come back later for a recheck. However, in order to avoid confusion and develop more confidence in your decision, do not recheck a sample any more than is necessary.
   v. It is advisable to allow a short interval of time between tasting samples. Also, in between samples, take a sip of water and eat a bite of cracker.
4. Ask students to taste products from left to right and record their observations about color, taste, smell, and mouth-feel on the ballot provided.
5. Remind students to take a sip of water and eat a bite of cracker between samples.
6. Ask students to share some of their observations
7. Discuss how each type of milk is processed and why the processing would affect the flavor (see background).

Extension: Discuss standards of identity and labeling. Some information is included in the background. For more detailed information, visit: www.gpo.gov/nara/cfr/waisidx_02/21cfr131_02.html.

Data Sheet:

Sample #						
Attribute						
Appearance						
Odor						
Flavor						
Mouth-feel						

Data Sheet:

Sample #						
Attribute						
Appearance						
Odor						
Flavor						
Mouth-feel						

GOT MILK?
Student Handout

Background: Food processing is the set of methods and techniques used to transform raw ingredients into food for consumption. Several food processing methods are used to preserve foods. Over the years, these methods have been improved to increase the shelf-life of foods while minimizing changes to the quality and nutritional content. Some methods to preserve food include:

- Refrigeration and freezing
- Canning
- Irradiation
- Dehydration
- Freeze-drying
- Salting
- Pickling
- Pasteurizing
- Fermentation

All of these processes work by slowing down the activity and growth of disease-causing bacteria, or by killing the bacteria all together. They also slow down or stop the action of enzymes which can degrade the quality of the food. How a food is processed can affect its appearance, odor, flavor, and texture.

Objectives: To investigate the effects of processing techniques on the sensory properties of food

Instructions: To taste each sample of milk, follow these procedures:

1. Taste samples one at a time from left to right.

2. Look at the first sample and record the sample number and the color of the milk sample on your data sheet.

3. Smell the sample by wafting the odor to your nose. Take an open hand with the palm towards your body and move your arm in a rapid clockwise circular manner over the sample so as to lift vapors of the substance towards the nose. Record any odor that you smell.

4. Take a small sip, and with the mouth closed, not swallowing any of the milk, move your tongue moderately five or six times to assure that the rear of the tongue also comes into contact with the sample. At the same time, inhale and exhale slowly through the nose. This forces the aroma through the back of the nose, making it possible to note the aroma. Record any flavors that you perceive.

5. Spit out the sample quickly and notice the aftertaste. Hold the sample in your mouth no longer than about ten seconds. Holding it longer will dull your senses of taste and smell.

6. If necessary, repeat the procedures as a further check on your findings. Sometimes it may be necessary to go on to the next sample, and come back later for a recheck. However, in order to avoid confusion and develop more confidence in your decision, do not recheck samples any more than is necessary.

7. It is advisable to allow a short interval of time between tasting samples. Also, in between samples, take a sip of water and eat a bite of cracker.

Some Potential Dairy Terms:			
Appearance	*Odor*	*Flavor*	*Mouth-feel*
Transparent (can see through it)	Buttery	Buttery	Watery
Opaque (can't see through it)	Feed (grassy)	Feed (grassy)	Thick
Glossy/shiny	Metallic	Metallic	Slick/Smooth
White	Cooked	Cooked	
Blue	Musty	Musty	
Yellow	Rancid (like it's gone bad)	Rancid (like it's gone bad)	
		Bitter	
		Salty	
		Sweet	
		Acidic (sour)	

Conclusion Questions:

1. Did the milk samples taste different?

2. If so, which attributes (appearance, odor, flavor, and/or mouth-feel) were most different?

3. What about the way in which the samples were processed might have influenced these sensory properties?

FOOD PROCESSING

FREEZING FOAMS

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FREEZING FOAMS
Background

The origins of ice cream manufacturing can be traced back to at least the 4th century B.C. Early references include the Roman emperor Nero (A.D. 37-68), who ordered ice to be brought from the mountains and combined with fruit toppings. This was one of the early techniques used for refrigeration. In fact, much of the history of ice cream is closely associated with developments in refrigeration and freezing, including:

1. Cooling food and drink by mixing it with snow or ice
2. The discovery that dissolving salts in water produces cooling
3. The discovery that mixing salts and snow or ice cools even further
4. The invention of the ice cream maker in the mid-19th century
5. The development of mechanical refrigeration in the later 19th and early 20th centuries—which led to the development of the modern ice cream manufacturing industry

Commercial Ice Cream Manufacturing

Commercial ice cream manufacturing has many steps to ensure that a uniform product is made, and that it is stable and safe to eat over a long period of time. To produce ice cream commercially:

- First, the **milk products, stabilizers** (such as gums and/or gelatin), and **emulsifiers** are mixed together and *homogenized* to form a stable emulsion.
  - An emulsion is a colloid (a mixture of very tiny particles that are dispersed in another substance, but do not settle out of that substance), in which liquids that do not normally mix are spread throughout each other. To prevent the mixture from separating, an ingredient, known as an emulsifier, which is attracted to both oil and water, is added, thus allowing the two to mix. In ice cream, an emulsion is formed as the milkfat is dispersed in the water. Milk naturally contains the emulsifier, lecithin; however emulsifiers and stabilizers (such as gums or gelatin) may be added to improve the stability.
- Homogenization occurs in two stages:
  - In the first stage of homogenization, the mixture is subjected to high pressure (2,000-3,000 psi) to reduce (or squish) the fat globules to 1/10 their original size. This process stabilizes the fat globules in the emulsion and improves the mouthfeel of the ice cream.
  - In the second stage, the mixture is placed under pressure again (500-700 psi) to prevent the fat globules from coalescing (sticking together).
- Next the homogenized mixture is *pasteurized* at either 150°F for 30 minutes or at 166°F for 15 seconds. Then the mixture is cooled.
  - The pasteurization process kills pathogenic organisms, improves the flavor and shelf life, and enhances uniformity.
- The next step is *aging*, in which the mixture is usually stirred overnight.
  - This process increases the viscosity (or thickness) of the mixture, allows time for complete hydration of the stabilizers (gelatin and/or gums) and crystallization (solidification) of the fat, and improves the whippability (ability to add air).
- After the mixture has matured or aged, the **flavors** and **colors** are added just before freezing.

- The final stage, *freezing*, is typically a two stage-process.
  - First, in the *soft serve stage*, the mixture is frozen in a continuous freezer where it is also whipped so that small bubbles of air become trapped in the aqueous solution, forming a foam.
    - A foam is a type of colloidal dispersion in which very tiny particles of gas are dispersed (scattered) in a liquid or solid substance and do not settle out of that substance.
  - As large amounts of air are incorporated into the mixture, the volume increases. The percent increase in volume is known as overrun. The expected overrun is much greater in commercial preparations of ice cream (80-100%) than for homemade ice cream (30-50%) because of the mechanical whipping.
  - After the soft serve stage, the ice cream is then extruded between 21-27°F into the desired food packaging (tubs, cups). Variegates (such as caramel sauce) and inclusions (such as fruit, nuts, chocolate chips) can be added at this point.
  - In the next phase, *hardening*, the ice cream is hardened without agitation as it passes through a ventilated tunnel at about -24°F to the point where about 90% of the water is frozen.
  - To create a smooth texture, it is important that both stages of freezing occur quickly so that small ice crystals are formed. If the ice cream is frozen too slowly, large ice crystals will form, which give a coarse, grainy texture.
- Now the ice cream is ready to be distributed to grocery stores, convenience stores, and foodservice establishments (like restaurants)!
- Ice cream may also be manufactured commercially using liquid nitrogen. Dippin' Dots® is an example of an ice cream snack that is created by flash freezing ice cream mix in liquid nitrogen. Because the product is frozen so quickly, small ice crystals form, resulting in a smooth mouth-feel (texture). Even though there is no whipping, the ice cream is aerated as the liquid nitrogen evaporates.

How It Works:

As the liquid nitrogen is poured onto the ice cream mix, it changes state from a liquid into a gas, a phase change known as evaporation. This process requires heat, so as the liquid evaporates it essentially absorbs heat from the ice cream, which in turn cools the ice cream down. Other liquids, like water, will not work because they evaporate at much higher temperatures than liquid nitrogen, which evaporates at temperatures above -196°C!

Homemade Ice Cream Manufacturing

Most household freezers for ice cream are designed so that an ice-and-salt mixture can be packed around a metal container into which the ice cream mixture is poured.

How It Works:

When a salt solution touches the surface of ice, it lowers the vapor pressure of the ice and causes it to melt. As the ice melts, it absorbs heat from the surrounding brine and the ice cream mixture. As the heat is withdrawn, the freezing point is lowered.

While the mixture is freezing, it is also stirred to incorporate air into the ice cream. As previously discussed, the amount of air incorporated, also called overrun, is much less for homemade ice cream.

References

Himich Freeland-Graves, J and Peckham, GC. 1996. Foundations of Food Preparation. 6th ed. Englewood Cliffs: Prentice Hall. 750 pgs.

Goff, D. Ice Cream. Dairy Science and Technology Education Series: http://www.foodsci.uoguelph.ca/dairyedu/icecream.html. Accessed on August 8, 2007.

FREEZING FOAMS
Administrator's Guide

The following experiment was adapted from The Science of Ice Cream by Jason Bolton. The Science of Ice Cream was developed as part of the University of Maine's NSF GK-12 Sensors Fellowship.

Grade levels: 3-12
Estimated Preparation Time: 30 minutes
Estimated Activity Time: 1 hour
Standard Addressed: Content Standard E (Understandings about Science and Technology)

- Science often advances with the introduction of new technologies. Solving technological problems often results in new scientific knowledge. New technologies often extend the current levels of scientific understanding and introduce new areas of research.

- Creativity, imagination, and a good knowledge-base are all required in the work of science and engineering.

Reference:

Himich Freeland-Graves, J and Peckham, GC. 1996. Foundations of Food Preparation. 6th ed. Englewood Cliffs: Prentice Hall. 750 pgs.

Objectives:

- To introduce food processing and food science to students
- To demonstrate the effects different processing methods have on the sensory properties of food products

Materials:

- 5 - 1 lb. Coffee Cans[1]
- 5 - 3 lb. Coffee Cans
- 10 – 1 ½ cup servings (1 gallon) half and half
- 10 – 1 ½ cup servings (1 gallon) heavy cream
- 1 bottle vanilla extract
- 10 – ½ cup servings (2 lb. bag) sugar
- Rock salt, kosher salt, or table salt
- Ice
- Newspaper
- 5 measuring cups (liquid and dry measure)
- 3 teaspoon measuring spoons
- 100 small cups (6-8 oz.)
- Plastic spoons
- Store-bought vanilla ice cream
- Duct tape

(Note: Be aware that some students may have food allergies or sensitivities)

If also preparing ice cream using liquid nitrogen, you will need:

- Approximately 5 liters liquid nitrogen and special container to hold the liquid nitrogen in (to purchase, try contacting your local university or ask if the school's science department has some available; the cost should be about $1.50 to $2.00 per liter).
- Non-porous rubber gloves (elbow-length if possible)
- Safety goggles
- 1 wooden spoon
- 1 large metal bowl

Set-up Instructions:

1. Cover a table at the front of the classroom with newspapers.
2. Set up stations for each ingredient with measuring cups and spoons.

Procedure:

Students can voluntarily participate, but should not be forced to participate because all sensory tests that include human subjects must be conducted on a voluntary basis.

Coffee Can Ice Cream

1. Divide students into 5 groups.
2. Have one student from each group measure 1 ½ cups half and half,

[1] If coffee cans are not available, quart size Ziploc® and gallon size Ziploc® freezer bags can be used. See Alternatives at the end of the Administrator's Guide for further instructions.

1 ½ cups heavy cream, 1 tsp. vanilla, and ½ cup sugar into the one pound coffee can. Instruct students to mix the ingredients and place the lid on securely. You may want to have students duct tape the can.

3. Have students set the 1 lb. can inside the 3 lb. can.
4. Have another student from each group add ice, and alternate layers of ice and salt outside the small can and inside the large can. When totally full, secure the lid on the large can. Have students take turns rolling the can back and forth for at least 15 minutes. Have each student put some ice cream into a cup and taste. Have students record their perceptions in the data table provided.

Liquid Nitrogen Ice Cream

1. Put on safety gear: rubber gloves and goggles.
2. Mix 3 cups cream, 3 cups half and half, 2 tsp. vanilla, and 1 cup sugar together in a bowl (adjust recipe according to class size).
3. Pour 1 to 2 liters of liquid nitrogen into the bowl slowly and mix with the wooden spoon constantly until the ice cream is completely frozen.
4. Continue to stir until the nitrogen has evaporated (the fog has disappeared).
5. Serve each student a sample of the ice cream made with liquid nitrogen. Have students taste the ice cream and record their perceptions in the data table provided.

Commercial Ice Cream

1. Serve each student a sample of store-bought vanilla ice cream. Have students record their perceptions in the data table provided. Discuss with students the effects of the different processing methods on the appearance, odor, flavor, and mouthfeel (texture) of the ice cream. Two major factors are:

    - Overrun – Commercial ice cream tends to have higher overrun (which would make it less dense and more airy).
    - Crystal size – Products which are frozen faster (like the liquid nitrogen ice cream) will have smaller crystals which results in a smoother texture.

Mention to students that typically during sensory evaluation experiments, samples are blind coded with three-digit codes so that the subjects are not biased by knowing how the products were prepared.

Alternatives: If coffee cans are not available, quart size Ziploc® and gallon size Ziploc® freezer bags can be used. Purchase enough so that they can be doubled to prevent leaking. If using Ziploc® bags, divide the recipe for each group in half. If time and materials allow, each student can prepare their own ice cream. Follow the directions as indicated for the coffee can ice cream. Be sure the bags are sealed tightly and have students shake the bags, holding onto the edge. If available, have students wear gloves because the bags might be cold.

Data Sheet:

Sample			
Attribute	*Coffee Can Ice Cream*	*Liquid Nitrogen Ice Cream*	*Commercial Ice Cream*
Appearance			
Odor			
Flavor			
Mouthfeel			

Data Sheet:

Sample			
Attribute	*Coffee Can Ice Cream*	*Liquid Nitrogen Ice Cream*	*Commercial Ice Cream*
Appearance			
Odor			
Flavor			
Mouthfeel			

Data Sheet:

Sample			
Attribute	*Coffee Can Ice Cream*	*Liquid Nitrogen Ice Cream*	*Commercial Ice Cream*
Appearance			
Odor			
Flavor			
Mouthfeel			

FREEZING FOAMS
Student Handout

Background: Commercial ice cream manufacturing has many steps to ensure that a uniform product is made, and that it is stable and safe to eat over a long period of time. These steps include: homogenization, pasteurization, aging, and freezing. Commercial ice cream is usually frozen in two stages:

- First, in the soft serve stage, the mixture is frozen in a continuous freezer where it is also whipped so that small bubbles of air become entrapped in the aqueous solution, forming a foam. As large amounts of air are incorporated into the mixture, the volume increases. The percent increase in volume is known as **overrun**. The expected overrun is much greater in commercial preparations of ice cream (80-100%) than for homemade ice cream (30-50%) because of the mechanical whipping.

- In the second stage, called hardening, the ice cream is hardened without agitation as it passes through a ventilated tunnel at about -24°F, to the point where about 90% of the water is frozen.

To create a smooth texture, it is important that both of these processes occur quickly so that small ice crystals are formed. If the ice cream is frozen too slowly, large ice crystals will form, which give a coarse, grainy texture.

Objectives: To investigate the effects of different processing on the sensory properties of food products

Instructions:

Coffee Can Ice Cream

1. Have one student from your group measure 1 ½ cups half and half, 1 ½ cups heavy cream, 1 tsp. vanilla, and ½ cup sugar into the one pound coffee can. Mix the ingredients and place the lid on securely. You may want to duct tape the lid to the can.
2. Set the 1 lb. can inside the 3 lb. can.
3. Have another student from your group add ice, and alternate layers of ice and salt outside the small can and inside the large can. When totally full, secure the lid on the large can.
4. Take turns rolling the can back and forth for at least 15 minutes.
5. Put some ice cream into a cup and taste.
6. Record your perceptions in the data table provided.

Liquid Nitrogen Ice Cream

1. Watch as your instructor mixes cream, half and half, vanilla, and sugar together in a bowl.
2. The instructor will then pour liquid nitrogen slowly into the mixture while mixing with a wooden spoon until the ice cream is completely frozen.
3. Taste the sample of the ice cream made with liquid nitrogen.
4. Record your perceptions in the data table provided.

Commercial Ice Cream

1. Taste the sample of the commercial ice cream.
2. Record your perceptions in the data table provided.

Conclusion Questions:

1. Did the ice cream samples taste different?

_____

_____

_____

2. If so, which attributes (appearance, odor, flavor, and/or mouthfeel) were most different?

_____

_____

_____

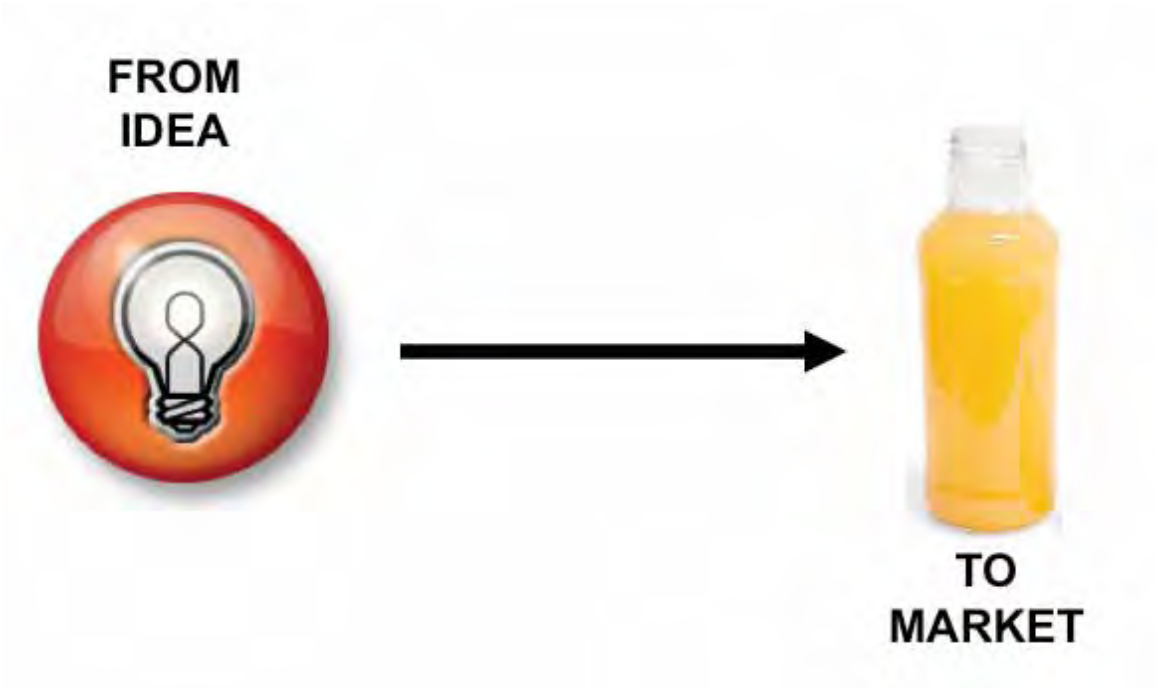
3. What about the way in which the samples were processed might have influenced these sensory properties?

_____

_____

_____

PRODUCT DEVELOPMENT



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PRODUCT DEVELOPMENT

TOP 10 TRENDS

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TOP 10 TRENDS
Background

In 2006, almost 105,000 new food and drink products were launched globally (Rowan 2007). That's around 300 for every day of the year! It is estimated, however, that only 5%, or about 5,250, will succeed.

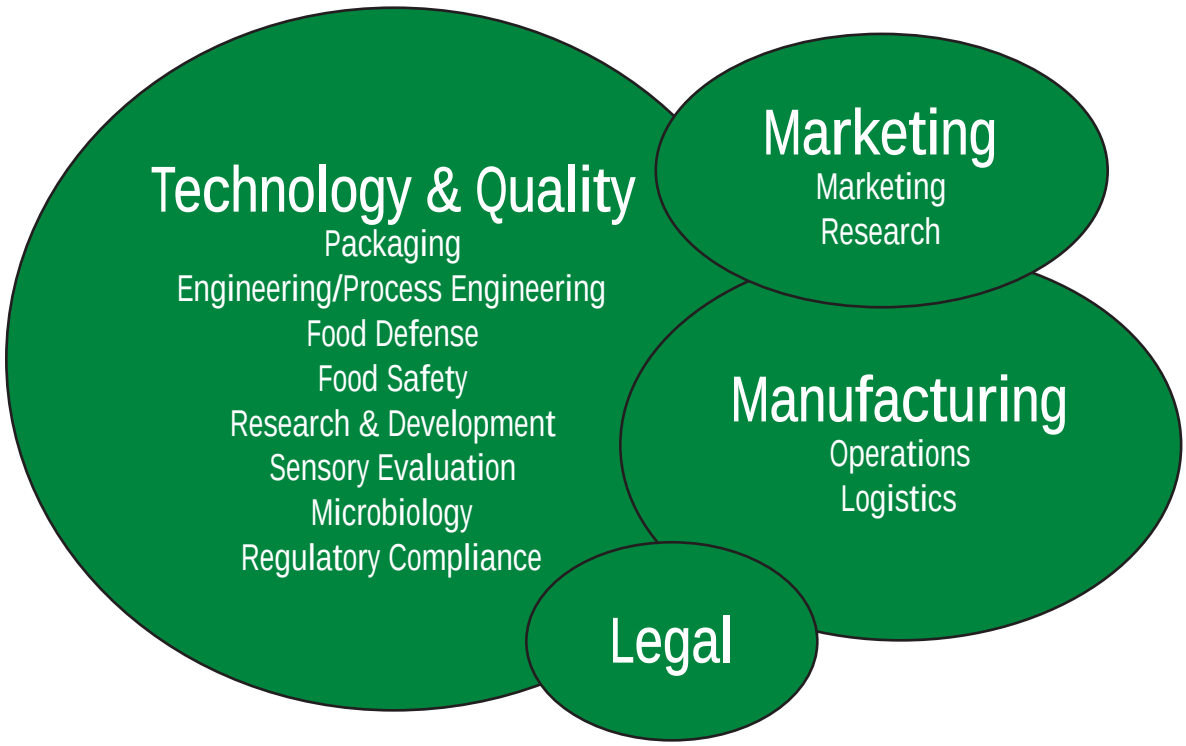
There are several general categories of new products:

- Completely new (a.k.a. Blue Sky beverages)
- Line extensions of current products
- Same product, but repositioned for a new target market
- Improvements of current products

So, how does a successful new product get created? It takes a **product development team** and several **key steps** to create a successful new product.

Product Development Team

The product development team is comprised of specialists in all areas of the food business (see the figure below). All of the team members are involved throughout the project, but the level of activity varies depending on the function and the development phase (Rudolph 1995).



Product Development Process

In general, there are three phases of product development (Brody and Lord 2000):

- Phase I: Product definition
- Phase II: Product implementation
- Phase III: Product introduction

To be successful, the product definition should meet a true consumer need/want, the formula implemented should be well liked by the consumer and of high quality, and the product should be introduced with a marketing plan that ties together the product concept with the lifestyle and needs/wants of the target consumer. See the figure below for some key milestones of the process.

Developing a successful new product can take months to years, and the process does not end once the product is launched. Depending on the feedback from customers and the manufacturing facility, the formula of a new product may need to be modified to improve the quality or the productivity (cost and yield). The marketing strategy may also need to be modified depending on how the product is received in the marketplace. If a completely new product is launched and it is successful, line extensions (e.g., different flavors) may be added to the product portfolio. Either way, developing a new product is fun and exciting, and certainly never boring!

The product development team must keep up with changing consumer needs/wants, competitors, and new ingredient technology.

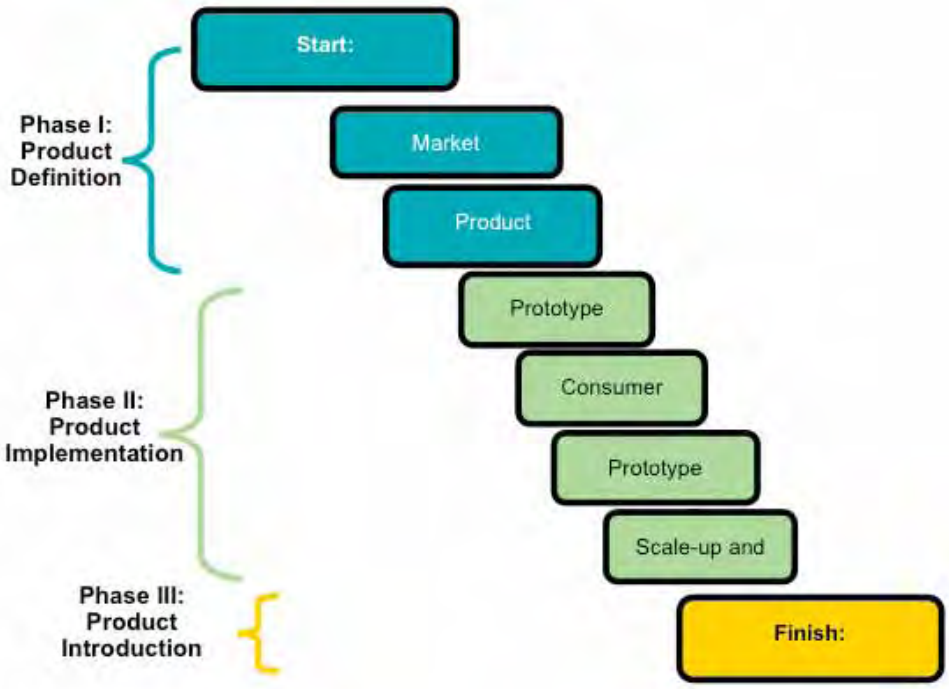
References

Brody, AL and Lord, JB. 2000. Developing new food products for a changing marketplace. Lancaster: Technomic Publishing Co., Inc. 496 pgs.

Rowan, C. 2007. Record-Breaking Number of New Products Flood Global CPG Shelves. Mintel International Group Ltd. [Accessed on June 11, 2007; Published on January 23, 2007] http://www.mintel.com/press_release.php?id=254053

Rudolph, J. 1995. The food product development process. British Food Journal 97(3): 3-11.

Sloan, AE. 2007. Top 10 food trends. Food Technology 61(4): 23-35.



TOP 10 TRENDS
Administrator's Guide

Grade levels: 8-12
Estimated Preparation Time: None
Estimated Activity Time: 1 class period (45 minutes to 1 hour)
Standard Addressed: Content Standard E (Understandings about Science and Technology)

- Creativity, imagination, and a good knowledge base are all required in the work of science and engineering.

- Science and technology are pursued for different purposes. Scientific inquiry is driven by the desire to understand the natural world, and technological design is driven by the need to meet human needs and solve human problems. Technology, by its nature, has a more direct effect on society than science because its purpose is to solve human problems, help humans adapt, and fulfill human aspirations. Technological solutions may create new problems. Science, by its nature, answers questions that may or may not directly influence humans. Sometimes scientific advances challenge people's beliefs and practical explanations concerning various aspects of the world.

Reference:

Sloan, AE. 2007. Top 10 food trends. Food Technology 61(4): 23-35.

Objectives:

- To introduce product development to students

Materials:

- Large paper (approx. 23" X 20" preferably, with a sticky back to display on the walls)
- Markers in a variety of colors

Procedures:

1. Discuss the meaning of the Top 10 Food Trends of 2007:
   - Eating in (prepared meals, meal kits)
   - Premium, gourmet, and exotic food
   - Single-serve pre-made meals
   - Food with texture, crispness, and crunch
   - Food for kids
   - Low-calorie, lactose-free, gluten-free, and/or low-fat
   - Locally grown/organic/fair trade produce
   - Functional foods (with added health benefits, e.g., with Omega-3 fatty acids, etc.)
   - Beverages
   - Snacks
2. Ask students to create a new product that meets one of the Top 10 Food Trends.
3. Have them create a poster with the following information:
   - Product name
   - Product picture
   - Target market
   - Description of the product, including package type (e.g., can, glass bottle, pouch) and serving size (e.g., single or multi-serve)
   - Ingredients
   - Shelf-life
4. Have each team present their concept to the class.
5. Score each poster (optional: have students rate purchase intent).

Score the posters using the following sheet:

Team Name:			
Judging Criteria	*Points Possible*	*Points Earned*	*Comments*
Product Name: Is it descriptive? Is it new?	10		
Product Picture: Is it descriptive? Is it new?	10		
Target Market: Is the target market well defined? (e.g., Did the team give an age range and gender?)	20		
Product Description: Is it appealing? Is it new? Does it include the package type and serving size? Do the package type and serving size match the target group?	20		
Ingredients: Does the ingredient list match the product description?	20		
Shelf-Life: Is the shelf-life realistic?	10		
Questions: Did they answer the questions completely?	10		
Total Score	*100*		

Product Name: _____

Indicate with an "X" the likelihood that you would purchase this product.

☐ ☐ ☐ ☐ ☐

Very unlikely to purchase — Very likely to purchase

— CUT

Product Name: _____

Indicate with an "X" the likelihood that you would purchase this product.

☐ ☐ ☐ ☐ ☐

Very unlikely to purchase — Very likely to purchase

TOP 10 TRENDS
Student Handout

Background:

In 2006, almost 105,000 new food and drink products were launched globally. Only about 5% of these products will succeed. To develop a successful product, it is important to think about:

- What are some trends in consumer behavior and product purchasing?
- What is already on the market and what isn't?
- What is your target market?
- What is their gender?
- What is their age?
- What does the target market like and dislike?
- What are some trends in flavor?

Objective: To learn how ideas for new products are generated

Procedures:

1. Your task is to develop a new food product that meets one of the Top 10 Food Trends from 2007. They are:

   - Eating in (prepared meals, meal kits)
   - Premium, gourmet, and exotic food
   - Single-serve pre-made meals
   - Food with texture, crispness, and crunch
   - Food for kids
   - Low-calorie, lactose-free, gluten-free, and/or low-fat
   - Locally grown/organic/fair trade produce
   - Functional foods (with added health benefits, e.g., with Omega-3 fatty acids, etc.)
   - Beverages
   - Snacks

2. Once your team has thought of a new product idea, create a poster with the following information:
   - Product name
   - Product picture
   - Target market
   - Description of the product, including package type (e.g., can, glass bottle, pouch in box) and serving size (e.g., single or multi-serve)
   - Ingredients
   - Shelf-life

SENSORY EVALUATION

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SENSORY EVALUATION

IS SEEING BELIEVING?

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SENSORY EVALUATION

IS SEEING BELIEVING?

Background

Sensory Evaluation is defined as "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)."

All of the senses are important when eating. Think about eating a potato chip – first you see the chip (maybe you notice if it has any dark/burnt spots?). Next you touch it (maybe you notice if it's greasy, or if it's thick?). Then as you bring the chip to your mouth you smell it (maybe you smell the seasoning? Or the oil it was fried or baked in?), then you eat it and hear the crunch of the chip, and you probably also taste the saltiness (maybe you also experience some additional flavor?). Imagine if any one of these experiences was missing – would a chip be the same if you didn't hear it crunch in your mouth?

References

Lawless, HT and Heymann, H. 1998. Sensory Evaluation of Food: Principles and Practices. New York: Chapman & Hall.

Stone, H and Sidel, JL. 1993. Sensory Evaluation Practices. 2nd ed. Academic Press: San Diego.

IS SEEING BELIEVING? Administrator's Guide

The following experiment was prepared by Sarah Smith-Simpson.

Grade levels: 9-12
Estimated Preparation Time: 30 minutes
Estimated Activity Time: 30 minutes
Standard Addressed: Content Standard C (Behavior of Organisms)

Multicellular animals have nervous systems that generate behavior. Nervous systems are formed from specialized cells that conduct signals rapidly through the long cell extensions that make up nerves. The nerve cells communicate with each other by secreting specific excitatory and inhibitory molecules. In sense organs, specialized cells detect light, sound, and specific chemicals, and enable animals to monitor what is going on in the world around them.

Objectives:

- To introduce sensory science to students
- To have students voluntarily participate in a sensory test
- To demonstrate the effects of sight on your ability to identify and distinguish the taste of beverages
  (Note: Be aware that some students may have food allergies or sensitivities)

Materials:

- 2 – 2 liters of lemon lime soda (ex., Sprite or Sierra Mist)
- Red and blue food coloring
- 6-8 oz. plastic cups (total should equal 2 times the number of students)
- Marker
- Ballots
- Calculators

Set-up Procedures:

1. Before class, color one 2-liter bottle of soda purple by adding approximately 20 drops of red food coloring and 20 drops of blue food coloring into the bottle. Gently shake the bottle to disperse the color.
2. Before class, color the other 2-liter bottle of soda red by adding approximately 20 drops of red food coloring into the bottle. Gently shake the bottle to disperse the color.
3. Label half the cups with a random three-digit code (for example, 209), label the other half of the cups with a different random three-digit code (for example, 047). There should be enough labeled cups so that each student receives one of each sample.
   Example: If there are 12 students in the class, there should be 12 cups labeled 209 and 12 cups labeled 047.
4. Immediately before the test, pour one of the beverages into one set of labeled cups, and pour the other beverage into the remaining cups.
   Example: Pour the purple beverage into the cups labeled 209 and the red beverage into the cups labeled 047.
5. Prepare the order of presentation for each student—half the students should receive the purple beverage (209) first, half the students should receive the red beverage (047) first.
   Example:
   Balanced Random Code Presentations:
   Student #1 receives sample order: 209, 047
   Student #2 receives sample order: 047, 209
   Student #3 receives sample order: 047, 209
   Student #4 receives sample order: 047, 209
   Student #5 receives sample order: 209, 047
   Student #6 receives sample order: 047, 209
   Student #7 receives sample order: 209, 047
   Student #8 receives sample order: 209, 047
   Student #9 receives sample order: 047, 209
   Student #10 receives sample order: 209, 047
   Student #11 receives sample order: 047, 209
   Student #12 receives sample order: 209, 047
   Student #13 receives sample order the same as Student #1, and so on…
6. Prepare the ballots (Total should equal 2 times the number of students; see next page for photocopies).
7. Prepare the data sheets.

Extension: This demonstration can also be done using colorless flavored water. For example, purchase two 1-liter bottles of flavored water (such as Fruit^{2}O® raspberry) and color one bottle red with red food coloring and one bottle purple with red and blue food coloring. Follow the directions above for preparation and serving. Source: Jason Bolton, So There are Five Basic Senses, prepared as part of the NSF GK-12 Sensors Fellowship, University of Maine.

Photocopy enough ballots for each student and write in the sample numbers.

Taste sample _____ and circle the box that represents the intensity of that attribute.

How sweet is sample?

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Not sweet at all — Extremely sweet

How sour is sample?

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Not sour at all — Extremely sour

How intense is the fruit flavor of sample?

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Not intense at all — Extremely intense

Comments:

Taste sample _____ and circle the box that represents the intensity of that attribute.

How sweet is sample?

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Not sweet at all — Extremely sweet

How sour is sample?

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Not sour at all — Extremely sour

How intense is the fruit flavor of sample?

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Not intense at all — Extremely intense

Comments:

Data Sheet:

Attribute #

Student	*Red Beverage*	*Purple Beverage*
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
Mean (x)		
Standard Deviation		

Sensory Test Procedures:

1. Students can voluntarily participate, but should not be forced to participate because all sensory tests that include human subjects must be conducted on a voluntary basis.
2. Present the two drinks to students one at a time. Remember – half of the students should receive the purple beverage first, and half of the students should receive the red beverage first. Each student should also have a cup of water. Direct the students to have a sip of water in between samples.
3. Give students the ballot and ask them to rate the intensity of each attribute on the 9-point scale.
4. Have each student fill in the data sheets in the front of the class with their scores for each attribute (1=Not sweet at all, 9=Extremely sweet).
5. If time allows, calculate averages (means) and standard deviations.

Example Data Sheet: Attribute #1: Sweetness		
Student	*Red Beverage (X1)*	*Purple Beverage*
1	7	5
2	8	4
3	7	6
4	7	5
5	6	5
6	7	5
Mean (x)	7	5
Standard Deviation	*0.577*	

Standard Deviation = $\sqrt{(1/N * ((X1-X)^2 + (X2-X)^2 + (X3-X)^2 + (X4-X)^2 + (X5-X)^2 + (X6-X)^2)}$

N= total number of students

X1= rating for student #1

X= Mean

Example Standard Deviation Calculation: Red Beverage

Standard Deviation = $\sqrt{((1/6)*(7-7)^2 + (8-7)^2 + (7-7)^2 + (7-7)^2 + (6-7)^2 + (7-7)^2}$

Standard Deviation = $\sqrt{((1/6)*((0)^2 + (1)^2 + (0)^2 + (0)^2 + (-1)^2 + (0)^2)}$

Standard Deviation = $\sqrt{((1/6)*(2))} = 0.577$

Ask the students:

1. Did you rate the sweetness levels of the two beverages differently?
2. Did other members of the class rate the sweetness about the same?
3. What about the sour or fruit flavor?
4. What flavors do you think the two samples are?
5. What affected your rating?
6. What other changes could be made to the beverages that would affect the ratings?

IS SEEING BELIEVING?
Student Handout

Background: Humans have five senses: taste, smell, touch, sight, and sound. All of the senses are important when eating. Think about eating a potato chip — first you see the chip (maybe you notice if it has any dark/burnt spots?). Next you touch it (maybe you notice if it's greasy?) or if it's thick?). Then, as you bring the chip to your mouth, you smell it (maybe you smell the seasoning?) or the oil it was fried or baked in?). Then you eat it and hear the crunch of the chip, and you probably also taste the saltiness (maybe you also experience some additional flavor?). Imagine if any one of these experiences was missing — would a chip be the same if you didn't hear it crunch in your mouth?

Objective: To experience the effects of sight and smell on your ability to identify and distinguish the taste of foods and beverages.

Procedures:

1. You have just tasted two beverage samples and rated the intensity of each attribute on the 9-point scale.
2. Fill in the data sheets in the front of the class with your scores for each attribute (1=Not sweet at all, 9=Extremely sweet).
3. If time allows, calculate averages (means) and standard deviations.

Conclusion Questions:

1. Did you rate the sweetness levels of the two beverages differently?

2. Did other members of the class rate the sweetness about the same?

3. What about the sour or fruit flavor?

4. What affected your rating?

5. What other changes could be made to the beverages that would affect the ratings?

SENSORY EVALUATION

OH MY — PAPILLAE!

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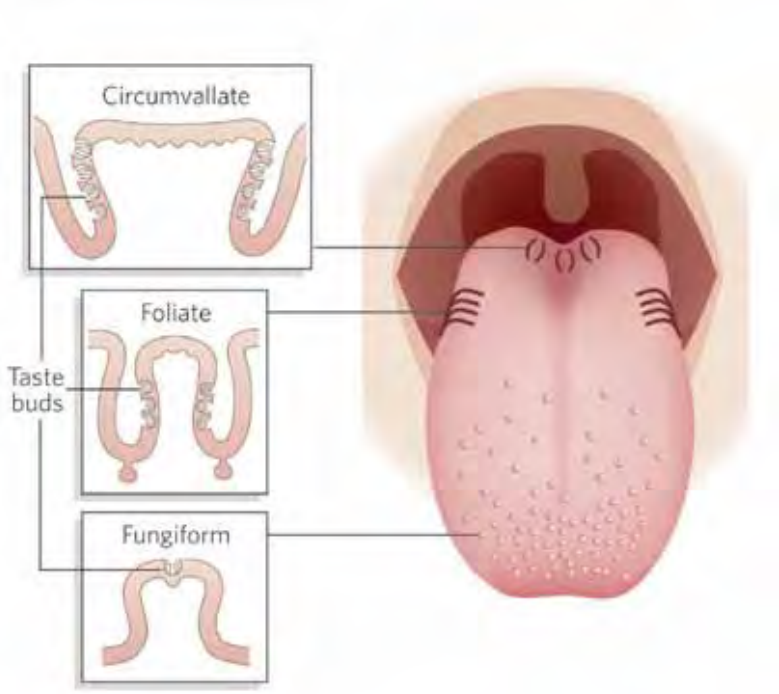
OH MY — PAPILLAE!
Background

Taste

There are five basic tastes. They are: sweet, sour, salty, bitter, and umami. The Japanese word "umami" translates as "pleasant to the taste, agreeable, good, mild, savory, delicious." Umami is also described as "meaty." Sources of the taste include monosodium glutamate (MSG), broth, and shiitake mushrooms.

Taste begins when taste molecules in food enter a pore at the top of the taste bud. Taste buds are located throughout the mouth, including on the soft palates and larynx. Contrary to what is published in many textbooks, all taste buds respond to all five basic tastes. Taste buds can't be seen without a microscope. Those "bumps" that you can see on the tongue are called papillae. Three out of the four types of papillae contain taste buds. The locations of the papillae that contain taste buds are shown in the figure on the right.

Once in the taste pore, taste molecules bind to hair-like cilia that project from the top of taste cells that are located in the taste bud. Each taste bud contains 30-50 taste receptor cells (TRCs). After the tastants bind to the cell, the next step, taste transduction, is somewhat different for each of the basic tastes. The chemicals that produce salty and sour tastes act directly through ion channels, whereas those responsible for sweet, umami, and bitter tastes bind to surface receptors that trigger a series of signals to the cells' interiors that ultimately results in the opening and closing of ion channels. The opening of the ion channels increases the concentration of positive ions inside taste cells. This depolarization causes the taste cells to release tiny packets of chemical signals called neurotransmitters, which prompt neurons connected to the taste cells to relay electrical messages to the brain.



(Chandrashekar et al. 2006)

References

Chandrashekar, J, Hoon, MA, Ryba, NJ, Zuker, CS. 2006. The receptors and cells for mammalian taste. Nature 444: 288-294.

Lawless, HT and Heymann, H. 1998. Sensory Evaluation of Food: Principles and Practices. New York: Chapman & Hall.

OH MY — PAPILLAE!
Administrator's Guide

The following demonstration was prepared by Sarah Smith-Simpson.

Grade levels: 3-8
Estimated Preparation Time: 5 minutes
Estimated Activity Time: 10 minutes
Standard Addressed: Content Standard C (Behavior of Organisms)

Multicellular animals have nervous systems that generate behavior. Nervous systems are formed from specialized cells that conduct signals rapidly through the long cell extensions that make up nerves. The nerve cells communicate with each other by secreting specific excitatory and inhibitory molecules. In sense organs, specialized cells detect light, sound, and specific chemicals, and enable animals to monitor what is going on in the world around them.

References:

Chandrashekar, J, Hoon, MA, Ryba, NJ, Zuker, CS. 2006. The receptors and cells for mammalian taste. Nature 444: 288-294.

Objectives:

- To introduce sensory science to students
- To have students voluntarily participate in a sensory test

Materials:

- Food coloring
- Mirrors

Procedures:

1. Students can voluntarily participate, but should not be forced to participate because all sensory tests that include human subjects must be conducted on a voluntary basis.

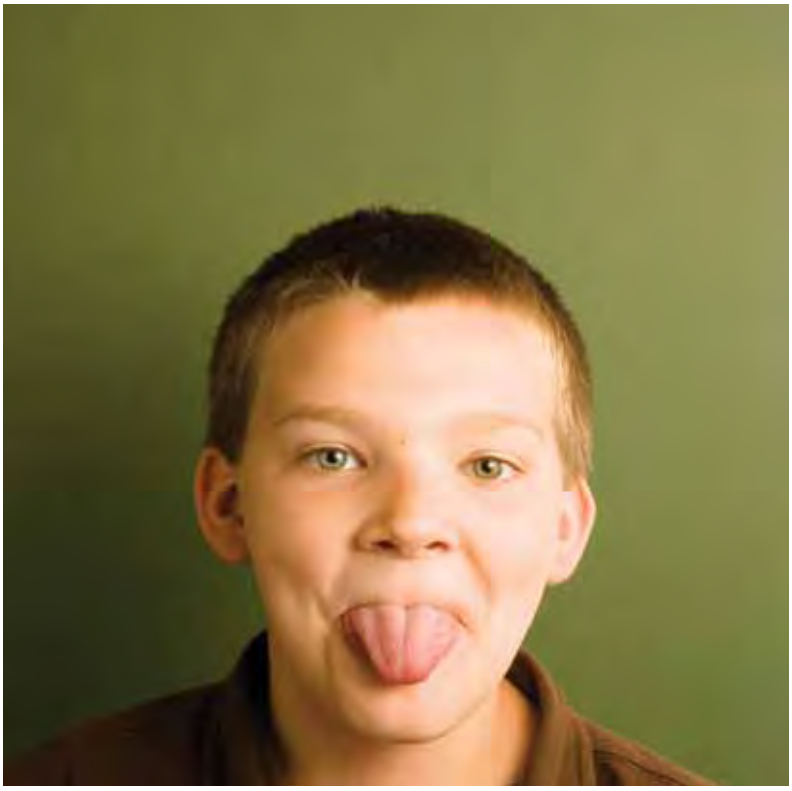
2. To make the papillae visible, have students put a few drops of blue food coloring on their tongue, and they will see that a bunch of little pale bumps—mostly fungiform papillae—stand out on a blue background.

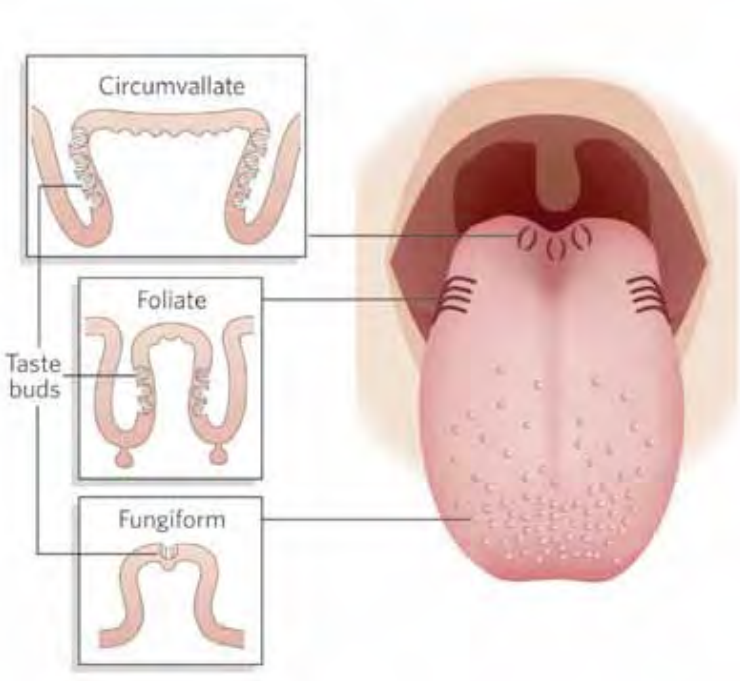
OH MY — PAPILLAE!
Student Handout

Background: Taste buds can't be seen without a microscope. Those "bumps" that you can see on the tongue are called papillae. Three out of the four types of papillae contain taste buds. The four types of papillae are:

- Filliform (no taste buds)
- Fungiform
- Foliate
- Circumvallate

Objectives: To investigate the anatomy of taste





Chandrashekar, J, Hoon, MA, Ryba, NJ, Zuker, CS. 2006. The receptors and cells for mammalian taste. Nature 444: 288-294.

Procedures:

1. To make the papillae visible, put a few drops of blue food coloring on your tongue and you'll see that a bunch of little pale bumps—mostly fungiform papillae—stand out on a blue background.

Conclusion Questions:

1. How many kinds of papillae can you see?

SENSORY EVALUATION

CAN YOU TASTE WITHOUT YOUR NOSE?

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CAN YOU TASTE WITHOUT YOUR NOSE?
Background

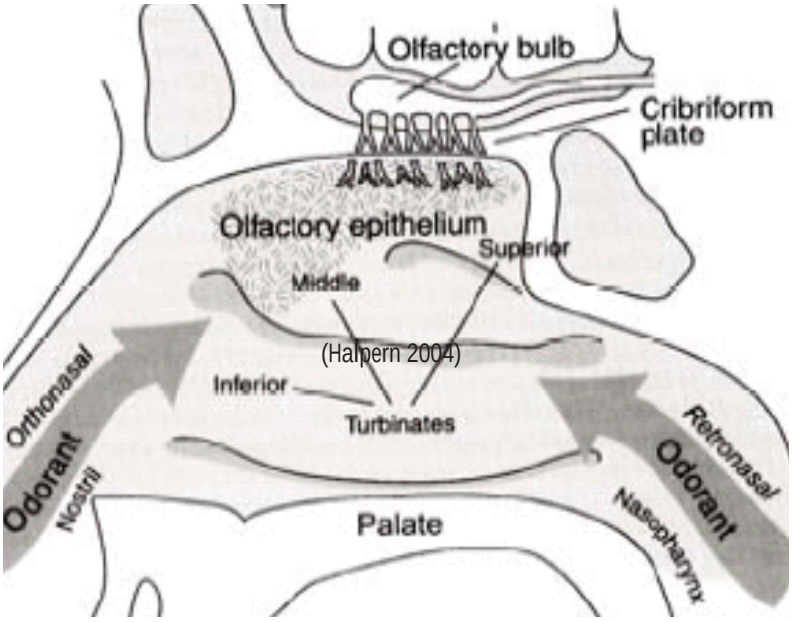
Smell

Think about the last time you had a cold and your nose was blocked. Do you remember eating and thinking that your food had less flavor? That's because most of what we "taste" is actually being sensed by our olfactory system. The word *olfaction* is actually based on the Latin word *olfacere*, which means to smell. In contrast to taste, where humans can only perceive five qualities (sour, bitter, sweet, salty, and umami), humans can smell thousands of odorants.

Odorants can reach the olfactory epithelium by two routes. The first route, **orthonasal olfaction**, is the detection of an odor through the nostrils by sniffing or inhalation. The second route, **retronasal olfaction**, is the detection of an odorant when it is released from food in your mouth during chewing, exhalation, or swallowing. During this process, the odorant passes through the posterior nares of the nasopharynx (or the back of the nose; retro-means backward).

Once in the olfactory epithelium, odor molecules bind to olfactory receptors which are expressed in olfactory sensory neurons in the nose. Once an odorant binds to the receptor, the olfactory receptors trigger a series of signals to the cells' interiors that ultimately results in the opening and closing of ion channels. The opening of the ion channels increases the concentration of positive ions inside olfactory cells. This depolarization causes the olfactory cells to release tiny packets of chemical signals called neurotransmitters, which initiate a nerve impulse. Odor information is then relayed to many regions throughout the brain. Each odorant binds to a unique combination of olfactory receptors which means that a unique signal is sent to the brain for each odorant. In fact, there are at least 400 functioning olfactory receptors, which is why we can smell hundreds of smells!

Some interesting things happen during olfaction. Think about the last time you went into a restaurant and smelled a really strong smell. After a while, did you realize you didn't smell it anymore? This process is called adaptation, and it is a decrease in response under conditions of constant stimulation. Adaptation also occurs with taste. Adaptation is an important process because otherwise you would smell all odorants all of the time, and your sensory system would go into overload!



(Halpern 2004)

Another interesting thing about smell is that some people just can't smell certain odorants. This is called a **specific anosmia**. Differences also exist in how sensitive people are to different odorants. Some people are more sensitive to some odorants than others. Individual genetic differences in the expression of the hundreds of olfactory receptors may explain the variation.

Flavor

The sensory experience of eating is really a combination of taste and smell. If you still don't believe it, try eating a food while holding your nose shut. You will see how important smell is to the sensory experience. Don't forget there are also other sensations from trigeminal irritants such as the "heat" from spicy foods and the "tingling" from soda. Flavor is the word used to describe the perception of taste and smell together, along with any other perceptions experienced while eating.

References

Chandrashekar, J, Hoon, MA, Ryba, NJ, Zuker, CS. 2006. The receptors and cells for mammalian taste. Nature 444: 288-294.

Halpern, BP. 2004. Retronasal and orthonasal smelling. ChemoSense 6(3). 1-7.

Lawless, HT and Heymann, H. 1998. Sensory Evaluation of Food: Principles and Practices. New York: Chapman & Hall.

CAN YOU TASTE WITHOUT YOUR NOSE?
Administrator's Guide

The following experiment was prepared by Sarah Smith-Simpson.

Grade levels: 5-12
Estimated Preparation Time: 10 minutes
Estimated Activity Time: 30 minutes
Standard Addressed: Content Standard C (Behavior of Organisms)

Multicellular animals have nervous systems that generate behavior. Nervous systems are formed from specialized cells that conduct signals rapidly through the long cell extensions that make up nerves. The nerve cells communicate with each other by secreting specific excitatory and inhibitory molecules. In sense organs, specialized cells detect light, sound, and specific chemicals, and enable animals to monitor what is going on in the world around them.

Objectives:

- To introduce sensory science to students

Materials:

- Set of individually wrapped candies with four or five different flavors
- Blind folds (handkerchiefs can be used)
- Scorecards
- Saltine crackers
- Water

Sensory Test Procedures:

1. Students can voluntarily participate, but should not be forced to participate because all sensory tests that include human subjects must be conducted on a voluntary basis.
2. Pair students with a classmate.
3. Pass out a handful of candies to each pair of students. Be sure each pair receives at least 2 pieces of every flavor, and that they receive at least 8 pieces in total.
4. Instruct one student to put the blindfold on.
5. Instruct the other student to hand their partner a different flavor of food one at a time and record the actual flavor of the food AND what flavor the student tastes. Between samples, the blindfolded student should clear their palate with cracker and water.
6. Students should trade places and repeat Steps 4 and 5.
7. Next, the students should each repeat Step 5 while blindfolded AND holding their nose. Be sure the students record the actual flavor and the flavor tasted by the student who is taste testing.
8. When students are finished tasting with the blindfold and plugged nose, have them compile the data on the data sheet provided.
9. Calculate the percentage of correct answers received during Steps 5 and 8 for conclusions.

Flavor of Food While Blindfolded		*Correct or Wrong?*
Actual Flavor	*Flavor Tasted*	
Flavor of Food While Blindfolded and Plugging Nose		*Correct or Wrong?*
Actual Flavor	*Flavor Tasted*	

Record your partner's response on this chart:

Flavor of Food While Blindfolded		*Correct or Wrong?*
Actual Flavor	*Flavor Tasted*	
Flavor of Food While Blindfolded and Plugging Nose		*Correct or Wrong?*
Actual Flavor	*Flavor Tasted*	

Record your partner's response on this chart:

Flavor of Food While Blindfolded		*Correct or Wrong?*
Actual Flavor	*Flavor Tasted*	
Flavor of Food While Blindfolded and Plugging Nose		*Correct or Wrong?*
Actual Flavor	*Flavor Tasted*	

Record your partner's response on this chart:

Flavor of Food While Blindfolded		*Correct or Wrong?*
Actual Flavor	*Flavor Tasted*	
Flavor of Food While Blindfolded and Plugging Nose		*Correct or Wrong?*
Actual Flavor	*Flavor Tasted*	

CAN YOU TASTE WITHOUT YOUR NOSE?
Student Handout

Background: Believe it or not, most of what we "taste" is actually being sensed by our olfactory system. The word olfaction refers to the sense of smell and is based on the Latin word *olfacere*, which means "to smell." In contrast to taste, where humans can only perceive five qualities (sour, bitter, sweet, salty, and umami), humans can smell thousands of odors.

Objective: To investigate the importance of olfaction (smell) when eating

Record your partner's response on this chart:

Flavor of Food While Blindfolded		*Correct or Wrong?*
Actual Flavor	*Flavor Tasted*	
Flavor of Food While Blindfolded and Plugging Nose		*Correct or Wrong?*
Actual Flavor	*Flavor Tasted*	

Conclusion Questions:

1. Did you correctly identify all flavors while blindfolded?

2. Did you correctly identify all flavors while blindfolded and plugging your nose?

3. Why do you think the percentage of correct answers decreased when your nose was plugged?

4. Were your answers affected by orthonasal olfaction, retronasal olfaction, or both?

SENSORY EVALUATION

TRIANGLE SENSORY TEST WITH OREO COOKIES

IFT
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TRIANGLE SENSORY TEST WITH OREO COOKIES

Background

The following experiment was prepared as part of the University of Maine's NSF GK-12 project by NSF Fellow Beth Calder, Mary Ellen Camire, and Susan Brawley.

Sensory science is a scientific method used to "measure, analyze, and interpret human responses to products as perceived through their senses of touch, taste, sight, smell, or sound." Sensory science is often used to improve existing products or to test people's views on new products, such as the softness of tissues, the crunchiness of an apple variety, or the aroma of air fresheners. It is also used to test the taste and color acceptance of new products, such as purple ketchup, or the sound characteristics of products, as in the crunch of snack foods.

There are many different types of sensory tests. Attribute Difference tests ask: How does a certain quality or trait differ between samples? Affective sensory tests ask: What is the consumer acceptance of a product(s)? Overall Difference tests ask: Does a sensory difference exist between samples? A Triangle test is a type of Difference test to determine if there is a sensory difference between two products. For example, a researcher may want to see if changing one ingredient in a recipe to make a certain food product will affect the taste of the final product. Three coded samples are presented to each panelist, and each panelist is asked to pick out which sample they feel is different from the other two. There are also sensory tests which panelists have to be trained to detect taste thresholds (such as determining the concentration of a flavor which can be identified by the panelist when introduced into a food product) or to have trained panelists describe certain characteristics that researchers are interested in studying.

Sensory tests have to be conducted under controlled conditions to reduce bias (prejudice or influence) on how panelists view the product(s). The sensory room has to be free from distractions (sound, odors) to not influence people's decisions of the product. Sensory testing laboratories are able to adjust the lighting, air regulation, and individual booths according to the needs of each sensory test that is conducted. Samples also have to be presented in a random order and assigned product codes, such as three-digit sample numbers, to keep food products anonymous to further reduce influencing the panelists' decision. The sensory test measures if any differences detected are truly significant by analyzing the sensory data for statistical significance. After statistical analysis, the researchers can make a meaningful interpretation from the results of the sensory data.

References

Meilgaard, M, Civille, GV, Carr, BT. 1999. Sensory Evaluation Techniques. 3rd ed. Boca Raton: CRC Press LLC.

TRIANGLE SENSORY TEST WITH OREO COOKIES
Administrator's Guide

The following experiment was prepared as part of the University of Maine's NSF GK-12 project by NSF Fellow Beth Calder, Mary Ellen Camire, and Susan Brawley.

Grade levels: 2-10
Estimated Preparation Time: 30 minutes
Estimated Activity Time: 1 class period (45 minutes to 1 hour)
Standard Addressed: Content Standard A (Science as Inquiry)

Mathematics is essential in scientific inquiry. Mathematical tools and models guide and improve the posing of questions, gathering data, constructing explanations, and communicating results.

Reference:

Lawless, HT and Heymann, H. 1998. Sensory Evaluation of Food: Principles and Practices. New York: Chapman & Hall.

Meilgaard, M, Civille, GV, Carr, BT. 1999. Sensory Evaluation Techniques. 3rd ed. Boca Raton: CRC Press LLC.

Objectives:

- To introduce sensory science to students
- To have students voluntarily participate in a sensory test
- To learn more about hypothesis testing and statistical significance

Materials:

- Low-fat Oreo cookies with normal cream filling (total should equal 1.5 times the number of students)
- Original Oreo cookies with normal cream filling (total should be 1.5 times the number of students)

Example: If there are 12 students in the class you will need at least 18 Low-fat Oreo cookies and 18 regular Oreo cookies

- Small white paper plates
- Marker
- Sensory ballots (samples are provided)
- 6-8 oz. plastic cups (one for each student)
- Water

(Other products that could be used include regular and low-fat cheese or regular and low-fat graham crackers. Be aware that some students may have food allergies, sensitivities, or dietary restrictions.)

Set-up Procedures:

1. Using the marker, label the small white plates with random three-digit codes (the number of plates for each code should be equal to half of the number of cookies needed).

   Example: Random three-digit sample codes:
   767 - Original Oreo cookie sample
   189 - Original Oreo cookie sample
   312 - Low-fat Oreo cookie sample
   570 - Low-fat Oreo cookie sample

   12 students need at least:
   - 18 Low-fat Oreo cookies – therefore, 9 plates should be labeled 767 and 9 plates should be labeled 189
   - 18 regular Oreo cookies – therefore, 9 plates should be labeled 312 and 9 plates should be labeled 570
2. Prepare the order of presentation for each student — half the students should receive two low-fat Oreos and one regular, and the other half of the students should receive two regular Oreos and one low-fat Oreo.

Example: Suggested balanced random code presentations:

Student #1 receives sample order: 767,312,189

Student #2 receives sample order: 767,312, 570

Student #3 receives sample order: 767,189,570

Student #4 receives sample order: 312,189,570

Student #5 receives sample order: 312,189,767

Student #6 receives sample order: 570,312,189

Student #7 receives sample order: 189,570,767

Student #8 receives sample order: 189, 570,312

Student #9 receives sample order: 189,767,312

Student #10 receives sample order:570,767,312

Student #11 receives sample order:570,767,189

Student #12 receives sample order:312,570,767

Student #13 receives sample order the same as Student #1

and so on…

3. Prepare a sensory ballot for each student.

Photocopy enough ballots for each student and write the order for each student on the blank lines as shown in the example on the previous page.

CUT

Triangle Sensory Test on Cookies

Please take a drink of water before tasting cookie samples. Eat cookie samples from left to right, and please take a sip of water between samples.

Place an "X" under the cookie which is different than the others.

_____ _____ _____

Comments:

Sensory Test Procedures:

1. Introduce the topic of sensory science to familiarize students.
   a. Try not to bias students with the introduction. Just mention to students that they will be participating in a Triangle sensory test.
   b. Students can voluntarily participate, but should not be forced to participate because all sensory tests that include human subjects must be conducted on a voluntary basis. Explain to students, if they participate, that sensory panelists have to remain silent during the taste test and cannot share answers with their neighbors. Explain that there will be a discussion after the test to share answers.

2. Introduce the experiment to the students.
   a. Mention to students that they will be given three cookies, and that they should taste the cookies from left to right. They should take a sip of water between each sample.
   b. The object of the test is to mark which of the cookies is different from the other two. Only one cookie out of the three should be marked as being different. If students have difficulty deciding, mention to them that it is acceptable if they want to go back and forth and re-taste samples to determine the different cookie.
   c. They may have to re-taste samples, so explain to students that they may not want to eat the whole cookie all at once, but wait until the test is over before eating the entire cookie sample.
   d. If they cannot tell which cookie is different, tell them to guess.
   e. Use the provided sensory ballot as a guide, if needed.

3. Begin the experiment.
   a. Pass out sensory ballots, cookies on labeled plates with random codes, and water.
   b. Allow the students to begin the sensory test. Enforce the quiet rule during the sensory test.

4. Collect the ballots.
   a. Optional: After the ballots are collected, explain the hypothesis of the sensory test.
   b. The stated scientific question is:
      i. Can the class detect a difference between low-fat and regular fat (original) Oreo cookies?
      ii. Hypothesis testing and introducing the scientific method could be used in this lesson.
      Hypothesis Testing Basics: The null hypothesis (H_0) is presumed true until statistical evidence in the form of a hypothesis test indicates otherwise – then you can reject the null hypothesis in support of the alternative hypothesis (H_a).

      For example:

      H_0: Students of the class cannot tell a difference between low-fat and original Oreo cookies.

      H_a: Students of the class can tell a difference between low-fat and original Oreo cookies.

5. Tally sensory ballots to determine the number of correct and incorrect responses.
   a. Optional: There is a statistical table (T8, pg. 369 of Meilgaard et al., 1999 or T4.1, pg. 130 of Lawless and Heymann, 1998) that can be used to determine if the class was able to detect a difference between the low-fat and original Oreo cookies that was statistically significant. To use: the table should be set at 0.05 and n=to the total number of participating students.
      i. In this case since the level will be set at 0.05, the results will be statistically significant if the difference between the two products would have occurred by chance alone in less than 1 time in 20 times.
      ii. Statistically significant means that the likelihood is low that the difference found between the two products occurred by chance alone.

b. After determining final results, interpret the findings back to the students. For example: The class was able (or not able) to detect a statistically significant difference between low-fat and original Oreo cookies.

6. Have a class discussion with students and get their input.
   a. The company that makes Oreo cookies may find the results interesting that this particular grade level was able to detect (or not detect) a significant difference between the two kinds of cookies.
   b. Sensory tests can provide companies with valuable information such as the acceptability of a new cookie.
      i. If the sensory test results are promising, the company may find it worthwhile to produce the cookies.
      ii. If a company produced cookies and then sold them without conducting sensory tests, they could potentially be taking a large risk and lose a lot of money producing a food product that will not sell.
   c. If they were able to detect a difference, what sort of sensory differences were they able to perceive between the two cookies? Any texture, flavor, or color differences? (In previous sensory tests, students have mentioned that low-fat Oreo cookies have a slight coffee flavor, are slightly lighter in color, and are crunchier than the original.)
      i. Another discussion can be introduced as to what properties fat can add to cookies, for example, more flavor or softer textural qualities.
      ii. A good final question to ask the students is: How well did the food and sensory scientists meet the challenge to make the cookie lower in fat, but try to retain good flavor qualities of the original Oreos?

TRIANGLE SENSORY TEST WITH OREO COOKIES
Student Handout

Background: When a food company is offering a new product, changing ingredients, or researching potential products, it's important for them to know what the consumer reaction is likely to be and the impact of the key characteristics of the product on their reaction. Sensory science is the discipline in which food scientists develop and execute testing to evaluate attributes of food products. There are three basic types of sensory tests that are routinely used in practice:

1. *Discrimination or difference tests* are used to answer whether there are any differences between two types of products. For example, when a food company finds an alternate ingredient to include in a food product, they want to confirm that consumers cannot tell the difference between the original product and the newly formulated product. One type of discrimination test is the Triangle test, in which three coded samples are presented to each panelist, and each panelist is asked to pick out which sample they feel is different from the other two.

2. *Descriptive analyses* are methods used to quantify the perceived intensities of a product's sensory characteristics. This technique is used to assess how food products are similar or different from one another. Using the example above, if it is determined that the two products are different, descriptive analysis identifies which characteristic of the food products cause them to be different.

3. *Affective or hedonic tests* are used to quantify the degree of preference for a product. These tests measure how well products are liked or which products are preferred. Returning to our example, affective tests will assess whether the new product is liked more or less when compared to the original product. Thus, all three sensory testing methods can be used to provide different information during the development of food products.

Objective: To learn about sensory science

Procedures:

1. Please take a drink of water before tasting the cookie samples.
2. Taste the cookie samples from left to right, and please take a sip of water between samples.
3. On your ballot, place an "X" under the cookie which is different than the others. It is okay to re-taste samples. If you cannot tell which cookie is different, it is okay to guess.
4. After you choose which sample you think is different, use the table provided to describe all three of the samples.

Discussion Questions:

1. Were you able to tell a difference between the samples? If so, which sample did you choose as the different sample?

_____

_____

2. Were you correct?

_____

_____

3. If you were able to detect a difference, what sort of sensory differences were you able to perceive between the two cookies?

_____

_____

4. Which sample did the majority of the class choose as the different sample?

_____

_____

5. Were they correct? Was this statistically significant?

_____

_____

6. Do you think a food company would find these results interesting?

_____

_____

RESOURCES

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FAST FACTS:

The USDA reports that between 2005 and 2010, U.S. universities will not graduate enough people with food, agriculture, and natural resource degrees to meet demand.

The food manufacturing industry employs over 1.5 million people at 29,000 locations.

In 2005:

- The median starting salary for a food scientist was $48,000
- The median salary was $78,000
- The median salary by degree was:
    - BS: $70,000
    - MS: $76,000
    - Ph.D.: $92,500

Source: *Food Technology* magazine, February 2006

Several scholarships are awarded annually to scholastically outstanding high school graduates or seniors expecting to graduate from high school entering college for the first time in an approved program in food science/technology.

There are over 45 universities in the U.S. that offer approved food science/technology degree programs.

For more information, visit www.ift.org.

WANT TO REACH OUT DIRECTLY? HERE'S WHO TO CONTACT:

Your local elementary, middle, and high school. Contact the science coordinator and/or guidance counselor. See the sample letter provided.

Your local food science department. Many universities already work with local high schools and may want your help or can connect you with the right contact.

The National Science Teachers Association: http://www.nsta.org.

The American School Counselor Association: http://www.schoolcounselor.org.

Contact your local Boy or Girl Scouts troops. Some Girl Scout patches are directly related to food science.

A local museum or science center. See if they have a "science day" or other type of event where these demonstrations could be used.

SAMPLE LETTER

Food Science Ambassador Address
Date

Recipient's Address

Dear ,

Everyone eats food. But have you ever stopped to consider all of the science that went into creating what you eat? Food is an excellent tool to teach basic science concepts. I am writing to let you know that the Institute of Food Technologists (IFT) has developed a new program called the Food Science Ambassador Program. By searching the database of Food Science Ambassadors on the IFT website (www.ift.org) teachers, parents, counselors, and students can connect with a food scientist in their area who can help explain and show the science behind food.

The Institute of Food Technologists is the premier scientific and educational society serving the food science and technology field. IFT is a not-for-profit organization whose mission is to advance the science and technology of food through the exchange of knowledge. IFT currently has 22,000 members who represent the food industry, academia, and government in over 111 countries.

As an IFT Food Science Ambassador in your area, I am writing to let you know that I am available to talk about food science and about career opportunities in that field, using hands-on activities. I also would like to increase awareness that there are several scholarship opportunities available for graduating high school seniors who apply to approved food science/ technology programs. I would encourage you to utilize this great program that connects food scientists with local schools to promote the science behind food.

I will be in touch to provide some more details. Please don't hesitate to contact me at (email) or (phone) if you have any questions, or would like to arrange a time to meet.

Sincerely,

Your name
IFT Food Science Ambassador

SURVEYS

Your feedback is important to us! Please fill out the following survey(s) regarding the Food Science Activity Guide and send it to careerguidance@ift.org or mail them to:

Institute of Food Technologists
ATTN: Career Guidance
1025 Connecticut Avenue, NW, Suite 503
Washington, DC 20036

If you are an Ambassador:

On a scale of 1 to 5, how would rate the overall helpfulness of the activity guide?

1	2	3	4	5
Not Helpful		Neutral		Very Helpful

Have you had an opportunity to use the guide and/or presentations yet?

If so, which ones?

And if so, where did you use them and what was the feedback?

What comments do you have to make the activity guide and/or presentations more useful?

SURVEYS

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Institute of Food Technologists
ATTN: Career Guidance
1025 Connecticut Avenue, NW, Suite 503
Washington, DC 20036

For organizers/teachers/troop leaders, etc.:

Name: _____

Contact Information:

_____

_____

What subject(s) do you teach? _____

How did you find out about the Food Science Ambassador Program?

_____

_____

How useful was the information on food science that was presented to you?

_____

_____

What did you like the most/least about the experiment(s) shown to you?

_____

_____

What comments do you have to make the activity guide and/or presentations more useful?

_____

_____

Do you plan to contact a Food Science Ambassador from IFT for further assistance?

❑ Yes ❑ No ❑ Maybe

SURVEYS

Your feedback is important to us! Please fill out the following survey(s) regarding the Food Science Activity Guide and send it to careerguidance@ift.org or mail them to:

Institute of Food Technologists
ATTN: Career Guidance
1025 Connecticut Avenue, NW, Suite 503
Washington, DC 20036

For students:

How useful was the information on food science that was presented to you?

What did you like the most/least about the experiment(s) shown to you?

What comments do you have to make the activity guide and/or presentations more useful?

Do you plan to learn more about careers in food science?

❑ Yes ❑ No ❑ Maybe

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