

**Chemistry Supplement to
High School Food Technology**
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Overview

Cooking, coupled with explicit scientific explanation, is a growing area of interest in the scientific community. This paper seeks to give this dimension to the high school food technology students. Currently these students review and are able to recite by rote the six general classes of nutrients. They then usually study the specific nutrients within each general class. This curriculum supplement will enrich the existing course of study by discussing chemistry repeatedly. It will compare and illustrate major differences among the nutrients, including the molecular structures of carbohydrates, fats and proteins or between common ingredients, such as flour, sodium carbonate and sodium bicarbonate. It will cite instructions for testing the chemical differences of common ingredients. Simple experiments, with directions or explanations adapted from the chemistry lab, will stimulate students to bring scientific knowledge and explanations to their cooking experiences.

Rationale

Educators agree, that for learning to occur, students need to connect a new learning to one that has already been internalized. Students need to realize that courses do not exist in a vacuum. Courses should complement each other across the whole secondary school curricula. As a food technology teacher, I want to insert more science into its curriculum; I want my students to verbalize ideas gleaned in chemistry class to other class members in my class as well as take ideas from our class to chemistry. Students should understand that food technology is applied science, specifically applied chemistry. Food is made up of elements and compounds, many of which can be synthesized, precipitated out, denatured, emulsified, or fermented. These are not

the words students usually associate with a foods class. They expect such vocabulary as nutritionally balanced, empty calories, simple and complex carbohydrates etc. But let the students hear such reasoning as 'the properties of food can be explained because of chemistry,' or the double bonds in unsaturated fats cause greater reactivity and the more unsaturated the fat, the more prone it is to rancidity. (McGee, p.604) and a link is forged between chemistry and food technology. The foods course is more than just cooking and eating.

The curriculum in colleges for Family and Consumer Science teachers requires several chemistry courses. General chemistry, organic, and analytical chemistry formed an integral part of my college curriculum. Even the family and consumer science curriculum emphasized science with such courses as experimental foods and nutrition. Yet when the Family and Consumer Science teacher introduces and proceeds with the various levels of food technology courses in middle or high school, the bulk of the students expect to cook and eat. A dilemma exists. Students neither expect nor appreciate bookwork. Indeed, they are aghast when they are asked to get out a pen or use a text. Food technology should and does teach topics that are central to the course such as nutrition, diet, sanitation, safety, food selection, identity and proper uses of kitchen equipment and utensils, preparation skills, and principles of consumerism. But it would make more sense if students would see relationships among courses in school or with home and real life. After more than twenty years of teaching food and nutrition and seeing that students departmentalize their learning, I am convinced that students need to aggregate what they learn. The Pittsburgh Teachers Institute seminar, Kitchen Chemistry, taught by Chatham College professor Dr. John Hagen convinced me that food technology class is a perfect bridge for students to connect scientific principles with food. This curriculum unit will introduce sidebars of chemical facts and short, but effective laboratory experiments, which will reiterate scientific information for the food technology students. A glance at the text for food technology is the first step. Which topics or chapters naturally lend themselves to a discussion of chemistry or an inclusion of an experiment using what food technology students would call common ingredients but what chemistry students would call chemicals? What experiments can be easily demonstrated or adapted? Which experiments would the teacher feel competent to do? Every food technology teacher must address nutrition. This topic is boring at best to most students assigned to the class. Yet if it is augmented with some "hands on" chemistry, the topic could very well elicit more interest. It is a personal objective that all food technology students learn something everyday. If connections are made and stressed between food technology and the many different required courses, such as science, namely chemistry, math and language arts, the task is not insurmountable.

It might be interesting to the food technology students to make connections between what is taught in the foods class and the scientific facts, theory and phenomena taught in science class. A glance at the table of contents in the text, Food For Today, by Helen Kowtaluk shows that several chapters could benefit that this proposed curriculum supplement. But one needs to be selective and careful. This is still basically a semester long food preparation course. Food preparation is expected, desired and of course emphasized during the course. But the students should not only know what it is that they are preparing and eating, they should appreciate and understand some of the chemistry involved. They should also be able to verbalize the connections. So in addition to meeting Family and Consumer science standards, students will meet communications, mathematics and of course science and technology standards.

This course will address the first of the four Family and Consumer Science standards: "All students will demonstrate their knowledge of principles of

consumer behavior as a foundation for managing available resources to provide for personal and family needs."

(FCS 1)

It will focus on selected Science and Technology standards. "All students explain how scientific principles of chemical, physical and biological phenomena have developed and relate them to real world situation." "All students demonstrate knowledge of basic concepts and principles of physical, chemical, biological and earth sciences." (ST1, 2, and 4)

Students will also "analyze and make critical judgments about all forms of communication, separating fact from opinion..." " They will exchange information orally, including understanding and giving spoken instructions..."(CO 5,6 and10)

The mathematics standards, which will be integrated with this food technology this unit include using numbers, equivalent forms, algebraic expressions and geometry. Students will also be required to compute, evaluate and draw appropriate conclusion. (MA 1,2,5, and 6)

Objectives

This supplementary curriculum unit has one general objective and several specific objectives. But it must be remembered that this is first and foremost a food preparation class. These science insertions are meant to enhance the course and are introduced when appropriate. The general objective is that students will appreciate the chemistry found in food and food preparation and make connections between science class and food technology. This is a lofty, maybe even nebulous goal. To accomplish this, several specific objectives and lesson plan procedures are listed in the **Strategies** section of this paper. Students will construct molecular models of nutrients, as well as use simple, familiar ingredients in experiments to determine their chemical composition and what conditions affect their ability to do what they are supposed to do in a recipe. Since the students will be expected to relate their findings, they will meet selected communication standards. They will use their science background to explain with scientific fact and vocabulary the composition of nutrients in food and attempt to explain the chemical reactions going on when single ingredients are being tested or when food is being prepared and evaluated. Students will be expected to relate results in terms of science rather than food appeal or appearance. When students realize that food is composed of chemicals and that simple food preparations are either simple or even sophisticated chemical reactions, food technology students should stop to think and evaluate what it is that they are buying to prepare to eat. When they do

this they will "demonstrate their knowledge of principles of consumer behavior by better managing their available resources" (FCS 1)

Strategies

This supplementary curriculum has three specific objectives. To complete each, a teacher needs to plan different time allowances. Each specific objective will naturally lend itself to different classroom teaching techniques, but a strong emphasis will be placed on demonstration and laboratory work. Students will be expected to summarize orally and in writing the significant science connections that explain the results achieved in class, thereby meeting selected communication as well as science and technology standards.

First specific objective

The first specific objective is that food technology students, in reviewing nutrition, will discuss the similarities and differences in the chemical composition of three of the general classes of nutrients, namely, carbohydrates, fats and proteins.

The teacher must assess the nutrition background that the students bring to class, from middle school or other courses. After the six general classes of nutrients are verbalized, the teacher will then initiate a discussion of their chemical composition. Those students who have had or who are currently enrolled in chemistry will assume leadership roles. If possible, they will use molecular models to construct and view the structural differences between carbohydrates and fats since each of these nutrients are comprised of carbon, hydrogen and oxygen molecules. Proteins have additional nitrogen atoms.

Molecular model kits will be used to construct a three-dimensional model of a simple sugar (a carbohydrate), a fat and a protein. Team teaching with a chemistry teacher would be very valuable. It would be a novel experience for the students to see that teacher in the foods room complementing another classroom setting. Students would be encouraged to draw from their science experiences. Seeing their science teacher there could very well trigger more recall and scientific jargon. If students are able to picture with their mind's eye a model of the different nutrients, their interest in science as well as appreciating that food is made up of chemicals could result. Students could also be given the assignment of searching the Internet for a sketch or diagram of specific nutrient molecular structures. These same students would share with the class explanations of the sketches.

Second specific objective

The second specific objective lends itself to a demonstration or lab. Students will test for gluten. Gluten is the protein found in flour that gives baked products its structure. The experiment will test for the amount of gluten in at least three kinds of wheat flour. But nowhere on the bag of flour is the exact amount of gluten content noted. Three different kinds of wheat flour will be compared and their gluten content will be determined. Students will see a common ingredient tested, but not eaten. They will conduct the experiment as they would any other science experiment--with accuracy of measurement, time, and temperature. They will note their

observations. They will set up and perform the chemical experiment in the foods room. They will compare and verbalize results. They will see and touch dough balls, rinse away the starch component of flour, measure the mass and volume of dough before and after baking. They will generalize when gluten is desirable in a food product.

Third specific objective

The third specific objective is very similar to the second objective. The lesson will be a lab experiment and again it will use common ingredients. This time, students will test chemical leavening agents. They will determine that chemical leavening agents are not interchangeable and are only effective when certain conditions are met. To do this, students will select a recipe and bake different versions of it. They will prepare and bake a product, such as applesauce cake but vary one of the listed ingredients. They will use the called for chemical leavening agent in one cake and the other common chemical leavening agent in the other. They will determine the effectiveness of the two different chemical leavening agents under one set of conditions—the recipe. The students will read, interpret, measure and follow the recipe's directions accurately. Before baking the products, students should try to determine the pH of the two mixtures. Perhaps cooked red cabbage water could be used to test the pH of both mixtures. (Shakhashiri, Vol.3, p. 162-166.) They should see and taste different baked results and make conclusions. Are the two leavening agents interchangeable? What are the optimum conditions for baking soda, (sodium bicarbonate) or for baking powder, (sodium carbonate) to produce carbon dioxide? They should list the differences and similarities in the final products. Did both products rise the same? Students will learn the scientific names and formulas for the chemical leavening agents and list the conditions that promote optimum CO₂ production. (This experiment does not preclude testing of other variables. Other ingredients could be selected and tested, such as sugar. Does the type of sugar or sweetener change the pH of the mixture? Can the type of milk—evaporated, sour or whole milk affect pH? Does the type of fat make a difference in the end product? If so, how? There are many ways a recipe's chemistry can be tested and still have the students be able to cook, taste and evaluate.)

Classroom Activities

This classroom activities section includes specific lesson plans that are written in detailed form so that teachers are given step-by-step directions. This curricular unit is to add more science than is currently available in the text assigned to this course, *Food for Today* by Helen Kowtaluk and Alice O. Kopan. Teachers using this supplementary curricular unit can use it in its entirety or choose selected parts to meet the specific needs or talents of their own classes. Remember that the general objective for this entire unit is that the students will appreciate that the course called food technology is applied chemistry, not just cooking and eating, and that they will integrate

and make connections with their study of nutrition as well as food preparation to science, particularly chemistry.

Specific Objective 1: Molecular models of nutrients

The specific objective of this lesson is that the students will be able to discuss the similarities and differences in the chemical composition and structure of three of the six general classes of nutrients, specifically, that of carbohydrates, fats and protein. The procedure for achieving this goal is:

1. Teacher will review with the students the six general classes of nutrients.

These should include carbohydrates, fats, protein, vitamins, minerals and water.

2. The word 'carbohydrates' is written on the backboard and the teacher initiates discussion about its chemical composition. Segment the word. 'Carbo' probably refers to which element on the periodic table? 'Hydr' probably refers to another element. Which one? 'Ates' is a suffix referring to what chemical in compounds such as nitrate, sulfate etc?

3. The students should list carbon, hydrogen and oxygen.

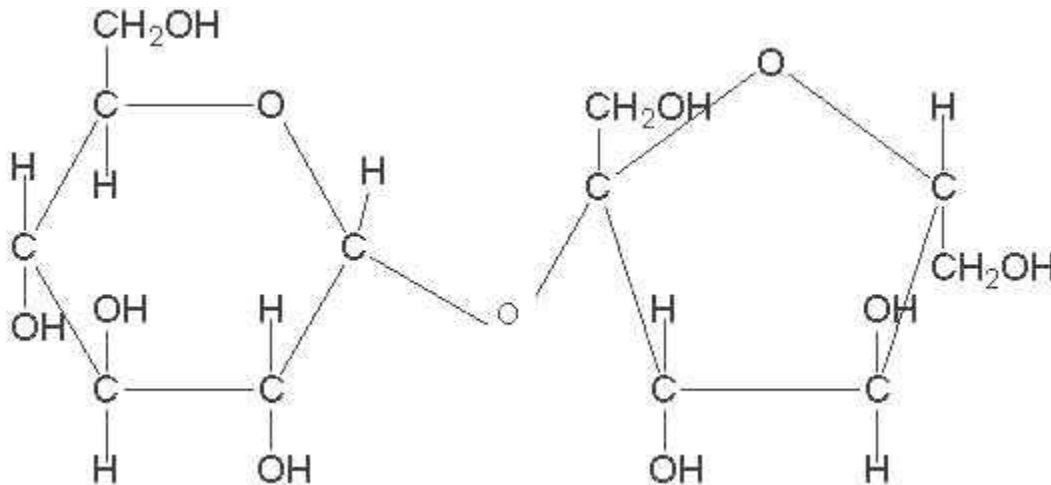


Figure 1 Sucrose made up of glucose on left and fructose on right. (McGee, p.586)

4. Teacher will continue the discussion on the compounds making up the nutrients. Teacher says that fats are composed of the same elements but that fatty acid compounds are denser and it takes the human body a longer time to digest an equal weight of fats than it does that of carbohydrates.

5. Teacher assigns a chemistry student to write the compounds that she gives orally such as glucose, $C_6H_{12}O_6$, a fatty acid such as $C_{10}H_{20}O_2$, and an amino acid, a small portion of the protein chain molecule $RC(H)(NH_2)C(O)OH$

6. Students who have had chemistry will volunteer or be assigned to construct a three dimensional molecular model using these formulas. They will explain their structure to the class.

7. Teacher explains that starches are polysaccharides, which are sugar molecules composed of many thousands of individual sugar units. (McGee, p.587)

8. Teacher explains that fats are a combination of three fatty acids with one molecule of glycerol. One example of a fatty acid is oleic acid. It is eighteen carbon atoms long. Many fatty acids are much longer than oleic acid. Included in the next figures are simplified drawings of a saturated and unsaturated portion of a fat. What students should notice is the presence of all single bonds and the presence of a double bond. (See Figure 2 and 3, McGee, p.603) For practicality, this nutrient proves to be very difficult to construct using the molecular models. Even oleic acid is too large and its three dimensional model is too unwieldy.

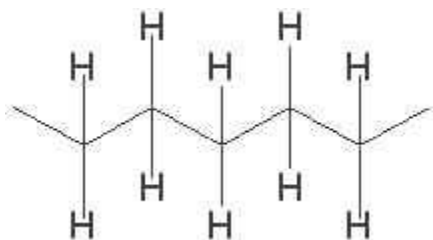


Figure 2 Saturated portion of fat molecule (McGee, p.603)

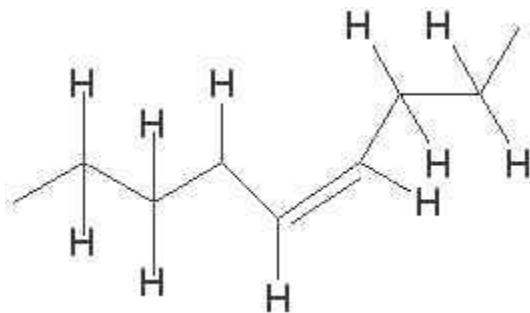


Figure 3 Unsaturated portion of fat molecule (McGee, p. 603)

9. Teacher explains that proteins are similar to fats in that they can be very large molecules made up of much smaller molecular units. In proteins, these units are called amino acids. It is not unusual for a protein to contain hundreds of amino acids. (See Figure 4, McGee, p.590) Most amino acids have one thing in common-the presence of nitrogen in the NH_3 or amine group in one corner of its structure. This is what distinguishes proteins from carbohydrates and fats.

(McGee, p. 590-591) Students or teacher could construct an amino acid using a different colored bead is represent the remaining part of the organic molecule.

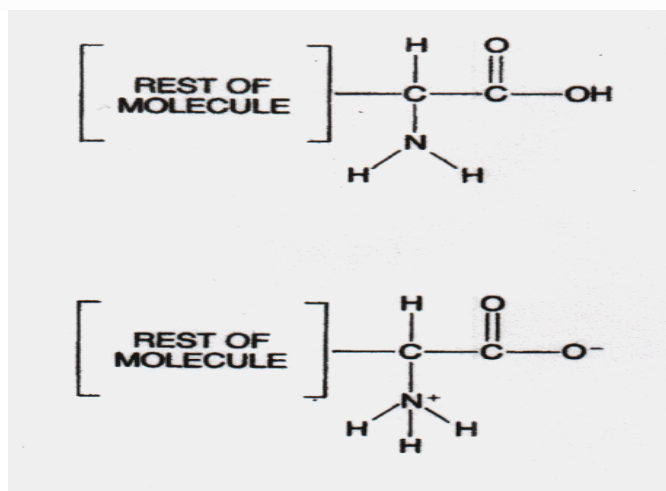


Figure 4: Portion of protein molecule (McGee, p.590)

10. Or the project could be given to students for them to come up with a way to better envision these organic compounds.

11. Students should be encouraged to form and verbalize generalizations. Remember that this is just a small addition to the discussion of nutrients. This is to stimulate those students interested in chemistry as well as prove that nutrients found in food are chemicals. With the heterogeneous mix of students in most food technology classes, this brief sidebar will suffice.

Materials needed for the lesson:

LAB-AIDS 125 Student Molecular Structure Model Set

Organic Chemistry Molecular Models Kit by Redco Science

Molecular Visions: The **flexible** molecular model kit by Darling Models

Specific Objective 2: Testing for gluten

The second specific objective sets up an experiment, which tests for gluten, a particular protein. In their text, *Food for Today*, students read: "Flour makes up the structure of a baked product. When the liquid is added, the flour particles absorb it, swell, and stick together. The substance that gives flour these qualities is gluten." (Kowtaluk p. 423) But there are different kinds of wheat flour and the students will test three. The distinguishing factor is the flour's "hardness." This "hardness" is a measure of the content of protein. It is known that the higher the protein content, the fewer the starch granules. (McGee, p. 284-285.) Hard wheat flour is preferred for making bread, while soft wheat flour, with its higher starch, lower gluten content is preferred for making

cakes. All-purpose flour is a blend of hard and soft flours. The included table allows students to compare the protein and carbohydrate composition of these three different flours that they will be testing. The McGee reference includes more data.

Flour Compositions

Percentages

Flour Protein Carbohydrate

Bread (Straight Hard) 11.8 74.5

All purpose 10.5 76.1

Cake 7.5 79.4

(McGee, p. 285)

Dough must be kneaded to develop the gluten. McGee asserts that gluten is both plastic and elastic. He further says that gluten is the gumlike residue that remains in your mouth after you have chewed on raw dough. Under pressure, it can change its shape and then if the pressure is released, the protein can reassume its original shape. This balance is seen when bread dough is kneaded. McGee also makes another observation. Gluten proteins are not water-soluble. (McGee, p.291) This is the characteristic that makes this experiment possible. Jan Scholl has published a lengthy gluten experiment, as have others. But the following experiment is short, effective and makes its point. The following directions will provide a teacher with enough instruction and confidence to amaze the students with discovering gluten.

1. Students will accurately measure $\frac{1}{2}$ cup of three samples of different kinds of bleached wheat flour—cake flour, all purpose flour and bread flour. Place each kind of flour in a separate bowl.
2. To each bowl, add 4 T. water. Stir each. The mixtures should be of a consistency. (Add additional flour if necessary, but note the addition.)
2. Knead dough mixtures for five minutes.
3. Immerse each dough ball into cool water.
4. Wait 10 minutes. Massage each dough ball. Drain white starchy water and replace with fresh water. Do this repeatedly in 10-minute intervals.
5. Compare results after 1 hour. Note color and elasticity.

6. Refrigerate overnight.
7. Massage dough again and change water.
8. If water contains little or no white starchy residue, preheat oven to 325.
9. Bake dough balls for 20 minutes.
10. Compare appearance, size and weight of dough balls.

Materials/equipment needed for the lesson:

½ c. all purpose flour
½ c. cake flour
½ c. bread flour
water
½ c dry measuring cup
liquid measuring cup
small spatula
mixing spoon
3 medium mixing bowls
3 8x8 inch baking pan
measuring devices such as a tape measure, small food scale
sink
oven

Gluten lab report sheet (See appendix)

Specific Objective 3: Testing chemical leavening agents-**NaHCO₃** and **NaHCO₃**

The third specific objective involves the testing of one selected ingredient in a recipe. In a scientific experiment, this ingredient would be designated as the variable. So the chemical leavening agent is the ingredient and the variable that the food technology students will test. If the students are to make consumer decisions as to how best manage their resources, they need to know important or distinguishing differences between frequently called for ingredients. Informed consumers would use the correct ingredients so that the product would turn out as expected and desired. The science student would explain basic concepts and chemical relationships. This lesson will make the connection between the two. The students will generalize that chemical leavening agents are not interchangeable and are only effective when certain conditions are met. They will determine these conditions by preparing two variations of the same cake using the same ingredients and directions except for the type of leavening agent. The procedure for this lesson follows.

1. Students will discuss purpose, kinds and names of leavening agents.
2. Students will focus on two chemical ones: sodium carbonate or baking powder and sodium bicarbonate or baking soda. They will touch, smell and taste the two and record differences.
3. Students will prepare a recipe that requires baking soda. (The selected recipe is applesauce cake. (Better Homes and Garden, p.70) Its recipe is included in the appendix. But some students will be asked to use baking powder instead.
4. Students are cautioned to follow recipes as accurately as possible since this is a chemical experiment.
5. Before the product is baked, students will remove a small sample of the product and test its pH. Students will record data.
6. The cake is to be baked as directed.
7. Cakes made with baking powder will be compared to those made with baking soda.
8. Results are to be recorded. (See Leavening Agent Comparison Form in appendix)
9. Students are to report their comparisons orally to class.
10. They are to work collectively to make at least two generalizations.
11. Generalizations could include that baking soda needs more acidic conditions to produce carbon dioxide. Applesauce is slightly acidic. The leavening agent affects the resultant height and lightness of the baked product. The chemicals within the product affect color and taste of the finished product.
12. Students should know the chemical names and formulas for the two chemical leavening agents.

If this experiment generates enthusiasm with the students, then they and the teacher can devise more edible experiments.

Materials/equipment needed for lesson:

Recipe and ingredients for applesauce cake (Better Homes and Gardens New Cook Book, p. 70)

dry measure cups
liquid measuring cup
small spatula
measuring spoons
2 mixing spoons
2 mixing bowls

2 8x8 inch baking pans
oven

Leavening evaluation lab report (See appendix)

It is hoped that the inclusion of these three lessons will encourage students to apply more chemistry and chemical principles both in practice during actual food preparation and in theory when troubleshooting cooking failures. Hopefully learning connections will be realized between chemistry class and food technology and students will automatically assume that more connections are possible.

Works Cited

Better Homes and Gardens, New Cook Book. New York: Meredith Press, 1968. A popular cook book that is a favorite old standby for finding basic recipes.

Hillman, Howard., Kitchen Science: A Guide to Knowing the Hows and Whys for Fun and Success in the Kitchen, Boston: Houghton Mifflin, 1989 This McGee text is easy reading and contains a lot of interesting trivia that makes someone quoting from it appear to be very knowledgeable about scientific as well as mundane topics.

Kowtaluk, Helen., Kopan, Alice O., Food for Today. California: Glencoe Publishing, 1986. This textbook is currently the text that we use, despite its old date. It is a basic, student friendly text that should be supplemented with current information.

McGee, Harold., On Food and Cooking: The Science and Lore of the Kitchen. New York: A Fireside Book, 1984. This scholarly text provides valuable background, academic and practical information for the teacher. Its appendix contains molecular structures, concise information on nutrients, plus much more.

Scholl, Jan. "Creative Bread: Lesson 4." <http://agexted.cas.psu.edu/docs/29503577.html>. This was the paper that is referenced in the gluten experiment. Jan's paper tests many more kinds of flour besides wheat flour.

Shakhashiri, B. Z., Chemical Demonstrations, A Handbook for Teachers of Chemistry., Vol. 3, Madison: The University of Wisconsin Press, 1989. This book makes interesting reading for both teachers and students. He couples chemical theory with procedures for chemistry demonstrations.

Annotated Reading List for Students

Better Homes and Gardens, New Cook Book. New York: Meredith Press, 1968. A popular cook book that is a favorite old standby for finding basic recipes.

Kowtaluk, Helen., Kopan, Alice O., Food for Today. California: Glencoe Publishing, 1986. This textbook is currently the text that we use, despite its old date. It is a basic, student friendly text that should be supplemented with current information.

Newton's Apple: Teacher's Guides, "Bread Chemistry," show #1205, <http://www.pbs.org/ktca/newt.../bread.htm>. This is a lesson in bread chemistry. It includes technical vocabulary, resources and activities.

Scholl, Jan. "Creative Bread Lesson 4." <http://agexted.cas.psu.edu/docs/29503577.html>. This was the paper that is referenced in the gluten experiment. Jan's paper tests many more kinds of flour besides wheat flour.

Shakhashiri, B. Z., Chemical Demonstrations, A Handbook for Teachers of Chemistry., Vol. 3, Madison: The University of Wisconsin Press, 1989. This book makes interesting reading for both teachers and students. He couples chemical theory with procedures for chemistry demonstrations.

Appendix 1-Content Standards:

Family and Consumer Science

1. All students will demonstrate their knowledge of principles of consumer behavior as a foundation for managing available resources to provide for personal and family needs.

Communications

5. All students analyze and make critical judgments about all forms of communication, separating fact from opinion, recognizing propaganda, stereotypes and statements of bias, recognizing inconsistencies and judging the validity of evidence.

6. All students exchange information orally, including understanding and giving spoken instructions, asking and answering questions appropriately, and promoting effective group communications.

10. All students communicate appropriately in business, work, and other applied situations.

Science and Technology

1. All students explain how scientific principles of chemical, physical and biological phenomena have developed and relate them to real-world situations.

2. All students demonstrate knowledge of basic concepts and principles of physical, chemical, biological and earth sciences.

4. All students explain the relationships among science, technology and society.

Mathematics

1. All students use numbers, number systems, and equivalent forms (including numbers, words, objects and graphics) to represent theoretical and practical situations.

2. All students compute, measure, and estimate to solve theoretical and practical problems, using appropriate tools, including modern technology such as calculators and computers.

5. All students understand and apply basic concepts of algebra, geometry, probability and statistics to solve theoretical and practical problems.

6. All students evaluate, infer, and draw appropriate conclusions from charts, tables and graphs showing the relationships between data and real-world situations.

Appendix 2: Recipe

Applesauce Cake (Better Homes and Gardens, 1968 Edition, p 70)

1/4 c. margarine	1/2 tsp. ground cinnamon
1 c. sugar	1/4 tsp. ground nutmeg
1 egg	1/8 tsp. ground allspice
1 1/4 c. flour	3/4 c. canned applesauce
3/4 tsp. baking soda	1/4 c. raisins
1/2 tsp. salt	1/4 c. chopped pecans

Directions:

1. Cream margarine.
2. Gradually add sugar. Beat until fluffy.
3. Add egg.
4. In another bowl, blend together all dry ingredients.
5. Add alternatively to creamed mixture with applesauce.
6. Stir in raisins and nuts.
7. Grease and lightly flour 8 x 8 inch pan.
8. Pour batter into prepared pan.

9. Bake approximately 35 min. at 350°
10. Cool on pan.

Appendix 3:

List of Materials for Classroom Use for entire Curriculum Unit

LAB-AIDS 125 Student Molecular Structure Model Set

Organic Chemistry Molecular Models Kit by Redco Science

Molecular Visions: The **flexible** molecular model kit by Darling Models

½ c. all purpose flour

½ c. cake flour

½ c. bread flour

water

½ c dry measuring cup

liquid measuring cup

small spatula

mixing spoon

3 medium mixing bowls

3 8x8 inch baking pan

measuring devices such as a tape measure, small food scale

sink

oven

Gluten lab report sheet (See appendix)

Recipe and ingredients for applesauce cake(Better Homes and Gardens New Cook Book, p. 70)

dry measure cups

liquid measuring cup

small spatula

measuring spoons

2 mixing spoons|

2 mixing bowls

2 8x8 inch baking pans

oven

Leavening evaluation lab report (See appendix)

Appendix 4:

Leavening Agents Comparison Form

Name of Leavening Agent pH of 1 tsp. leavening agent pH of batter Height of cake Texture of crust Color of cake Appeal of cake

Used dissolved in 1/4 c. H₂O baked cake baked cake of crust cake

Comments about Cake 1:

Comments about Cake 2:

List 2 generalizations regarding chemical leavening agents.

Appendix 5:

Gluten Work Sheet

Kind of Flour: All Purpose Bread Cake

Amount used

Total amount of water used to make dough ball

Time used to knead dough ball

Number of times water is changed until clear

Size or weight of ball before baking

Size of gluten ball after baking

Appearance of gluten ball after baking

Appearance of interior of gluten ball

Generalizations concerning flour:

Generalizations concerning gluten: