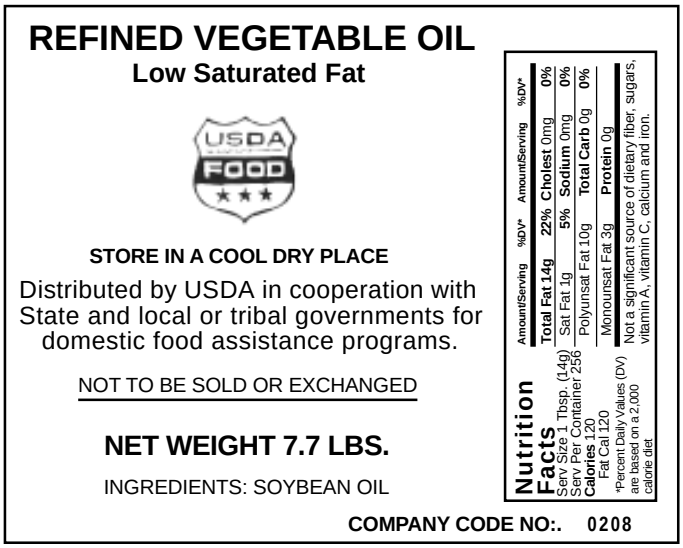
Cut the Fat – Keep the Flavor

Resource Unit About the Role of Agricultural Genetics in Reducing Saturated Fat in Food Oils



IOWA STATE UNIVERSITY
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Acknowledgements

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About This Resource Unit

Cut the Fat – Keep the Flavor will introduce advanced middle school or high school students to how advances in agricultural genetics are bringing new products that are lower in saturated fat to the marketplace. The unit is designed for use with students in grades 6-12 or other individuals in science, nutrition, agriculture, or family and consumer sciences. Extension specialists will find the unit's resources useful for their youth and adult audiences.

This resource unit is a collection of materials that educators may use to design their own curriculum about saturated fat in foods. The optional informational booklet titled *LoSatSoy™: The Story of A New Soybean Oil* is included on page 17 as an example of a product made lower in saturated fat by identifying and using certain plant genes. The booklet explains why a low-saturated-fat soybean oil was developed, the science behind its development, and possible uses for the new oil.

In addition to the optional booklet, this unit contains a collection of overhead transparency masters and several activities. A unique aspect of the Food Scientist activity included in the **Cut the Fat – Keep the Flavor** unit is that it provides students with the opportunity to evaluate a new product. If the teacher/leader wishes, the recipe modification activity can be used as a practical example of experimental design as applied to recipe modification. In this activity, students are encouraged to organize and "publish" the resulting data from their experiments as professional scientists do.

Low-saturated-fat soybean oil is available under the label LoSatSoy™ in some Midwestern grocery stores. After January 1999, the oil became available to all interested schools through the U.S. Department of Agriculture's National School Lunch Program as a commodity item under the label "Refined Vegetable Oil --- Low Saturated Fat."

The activities in this resource unit are based on the experiential learning model. Experiential learning means students do hands-on activities, then reflect on the meaning, and apply what they learned. This process helps ensure that the students learn actively and make knowledge a part of their world. It also helps students answer questions such as "Why should I learn this?" and "Now that I know this, what do I do next?" Each activity in the resource unit follows this experiential learning model. The sections titled "Procedures" and "Reflecting and Applying" relate to this model.

Educator Background Information

The field of biotechnology and foods is rapidly changing. Many new products are being researched for potential release to the public. Students need to be informed consumers. Developing the skills needed to look at an issue and make decisions for themselves is vital. A resource list of World Wide Web sites to assist you with this topic is included in the resource section of this unit.

Foods and Biotechnology

The first genetically modified organism (GMO) used as a food product was chymosin. Genetic modification is the process of transferring DNA from one organism into another. Chymosin is a natural enzyme used for the coagulation of milk in cheese-making. This enzyme can be obtained from the stomach of milk-fed calves. The use of biotechnology has greatly simplified the process of acquiring chymosin. Chymosin from fermentation is produced by the bacteria *E. coli* that was modified by transferring to it the gene of a calf that controls production of the enzyme. (For more information about chymosin, visit the web site at http://www.biotech.iastate.edu/publications/lab_protocols/Chymosin_Demonstration.html.)

The second GMO was the Flavr Savr Tomato™ in 1994. This tomato was developed by reversing the gene that controls ripening of the tomato. This enables the tomato to be picked red and shipped to market with a longer shelf life, thus enhancing the flavor. These tomatoes were produced and marketed but did not prove to be economically viable for the Calgene company and are no longer available.

Possible issues related to biotechnology and food include: regulation and testing of products, public health, food safety, labeling, effect on the environment, consumer information, animal rights, morals, and changes in the structure of our current agricultural system.

Federal Regulation

Patents protect the legal rights of an inventor of a new technology. The Food and Drug Administration (FDA) and the United States Department of Agriculture (USDA) require a company to conduct rigorous pre-market testing. Test results are submitted to both the FDA and USDA, from which they are available for public review and comment.

- USDA - evaluates whole foods and production processes, and regulates whether genetically engineered plants can be grown and under what conditions
- FDA - evaluates whole foods, food ingredients, and food additives
- Environmental Protection Agency (EPA) - evaluates production processes

Labeling

Food labels are regulated by the FDA, and, in some cases by the USDA. Regulatory agencies are concerned with ensuring that food labels are both true and not misleading. As a result, label information may be compulsory, permitted, or prohibited. Producers of food or food companies using biotechnology must provide evidence that no safety issues are raised. New products must

comply with existing portions of the Food, Drug, and Cosmetic Act. Decisions are made on a case-by-case basis. The general approach is that if the whole food is not materially different from the traditional counterpart, mandatory labeling designating it as a product of biotechnology is not required. In fact, such labeling might be misleading unless accompanied by a statement that clarifies that there is no difference in healthfulness between the two products.

Making Decisions about an Issue

The activity "Biotechnology and Foods: Is It an Issue?" is designed as an inquiry activity to initiate student thinking and discussion about biotechnology and foods. This activity is the first step in helping students make their own decisions about biotechnology food issues. Students can follow a simple four-step model when making a decision about an issue.

First, the students need to know what an issue is. An issue arises when one or more people disagree about a change or how to solve a problem. The people or players involved bring their values and beliefs to the discussion. For example, one player might be a company who has a food product to sell. They might value consumer safety and the economic viability of the company. Another player might be an environmentalist who values wise use of resources and the natural order of organisms.

Second, the students need to find out as much about the issue as possible. This might be accomplished through research, reading, and laboratory experiments.

Third, the students need to look at all sides of the issue and learn what others are saying. Some web sites that will help students learn what is being said about genetically engineered foods are listed in the resource section of this unit.

Fourth, the students need to make their own decisions about the issue and act accordingly.

Educator Background Information

FYI: FAT

FYI: FAT is from the Child and Adolescent Trial for Cardiovascular Health (CATCH) program materials. ©CATCH. Distributed by the National Heart, Lung, and Blood Institute of the National Institutes of Health. Used with permission. (Bolding has been added for emphasis.)

Heart disease is still the number one cause of death for both men and women in the United States. High blood cholesterol levels increase the risk of getting heart disease. In general, children whose blood cholesterol levels are high tend to have higher levels as adults and to be at greater risk for developing heart disease. We know that lowering blood cholesterol in adults slows fatty buildup in the walls of the arteries and reduces the risk of heart disease and heart attack. Lowering blood cholesterol levels in children is likely to also help reduce their risk of heart disease when they are adults.

What you eat may be a factor in lowering your blood cholesterol level. The most important dietary influences on your blood cholesterol levels are saturated fat, total fat, and dietary cholesterol.

There are two types of dietary fat – saturated and unsaturated. Unsaturated fat can be further classified as either polyunsaturated or monounsaturated. Together, saturated and unsaturated fats equal total fat.

Saturated fat raises your blood cholesterol level more than anything else in your diet. One of the goals of a blood cholesterol-lowering diet is to eat less total fat (which is one emphasis in the CATCH curriculum) because this is an effective way to eat less saturated fat. The best way to reduce your blood cholesterol level is to reduce the amount of saturated fat you eat.

Animal products are a major source of saturated fat in the average American diet. Butter, cheese, whole milk, ice cream, and cream all contain high amounts of saturated fat. Saturated fat is also concentrated in the fat that surrounds meat and in the white streaks of fat in the muscle of meat (marbling). Poultry, fish, and shellfish also contain saturated fat, although generally less than fatty meat.

A few vegetable oils – coconut, palm kernel, and palm – are high in saturated fat. These oils are found in many commercially baked goods and snack foods. Other vegetable oils can become saturated by "hydrogenation" – a process that solidifies them. They are called "hydrogenated vegetable oils." The type of oil used in commercially prepared products will be included in the ingredients listed on the label.

Unsaturated (polyunsaturated and monounsaturated) fats can actually help lower blood cholesterol levels when they are substituted for saturated fat. Polyunsaturated fats are found primarily in plant products including safflower, corn, soybean, cottonseed, sesame, and sunflower oils and nuts. Olive and canola oil are examples of oils that are high in monounsaturated fats.

(continued)

Although it is not the same as saturated fat, dietary cholesterol can also raise your blood cholesterol level. While cholesterol is needed for normal body function, your liver makes enough to meet your body's needs so that you do not need to eat any cholesterol at all. Dietary cholesterol is found in eggs, dairy products, meat, poultry, fish, and shellfish. Egg yolks and organ meats are particularly rich sources of cholesterol. Since cholesterol is not a fat, you can find it in both higher- and lower-fat foods. In other words, even if a food is lower in fat, it may be high in cholesterol (liver, for example). Cholesterol is not found in any food coming from plants, which means it is never found in peanut butter, bran products, or vegetable oils.

While diet plays an important role in raising or lowering your blood cholesterol level, genetic factors also affect this level and can determine how much you can lower it by diet alone. A small number of people have a genetic makeup that causes them to have a high blood cholesterol level even if they eat a cholesterol-lowering diet. On the other hand, a small percentage of people can eat a diet that is high in saturated fat and cholesterol and still maintain a low blood cholesterol level. For most of us, however, what we eat plays a role in our blood cholesterol level.

Currently, most American children get about 34% of their calories from fat. It is recommended, however, that healthy children's intake of fat average no more than 30% of calories. **Experts also suggest lowering children's saturated fat intake to less than 10% of calories. These recommendations are the same as those for adults.**

The following information can be used to decrease fat and cholesterol consumption:

- ☐ **Eat fewer foods high in total fat (especially those higher in saturated fat):**
  - choose the leanest meats, poultry without the skin, and fish more often
  - use less butter, cream or cheese sauces, and gravies
  - bake, broil, grill, or microwave instead of frying
  - switch to low-fat, skim, or non-fat dairy products

- ☐ **Replace part of your saturated fat with unsaturated fat:**
  - when you do use fats and oils, use those that contain primarily unsaturated fats whenever possible

- ☐ **Eat fewer higher cholesterol foods:**
  - limit egg yolks to up to four per week
  - eat fewer organ meats such as liver, brain, and kidney

- ☐ **Choose foods higher in complex carbohydrates (starch and fiber) as substitutes for foods higher in fat:**
  - eat more fruits, vegetables, and whole-grain products

Educator Background Information

Monitoring Blood Cholesterol

In addition to monitoring total blood cholesterol, doctors also watch the blood levels of LDL and HDL cholesterol. HDL stands for "high density lipoproteins." LDL is the abbreviation given to "low density lipoproteins." Because cholesterol does not mix with water, it needs help circulating through the blood, which is mostly water. Lipoproteins transport cholesterol throughout the body. LDLs carry cholesterol from the liver throughout the body and leave deposits on artery walls. HDLs carry cholesterol back to the liver for elimination.

If the ratio of LDLs to HDLs becomes too much in favor of the LDLs, it is likely that more cholesterol is being deposited in the arteries than is being removed. Some scientists use the LDL/HDL ratio to predict a person's chances of developing heart disease. A ratio greater than 3 to 1 can indicate above average risk.

Reading the Fat Grams from Nutrition Facts Labels

For some products, adding the grams of saturated, polyunsaturated, and monounsaturated fatty acids shown on the Nutrition Facts label does not equal the total fat grams listed. The sum of fatty acids listed individually on the label generally will be lower than the weight of total fat because the weights of fat components such as trans fatty acids and glycerol are not included. The way that food manufacturers are allowed to round the fat values on a label also is a factor. (Source: Mary-Margaret Richardson, Public Affairs Specialist, St. Louis Branch Office, Food and Drug Administration)

Educator Background Information

Understanding and Working with Youth: What are they like?

Certain characteristics are common to children at each age level. Although children differ in the rate at which they develop, the order of the stages does not vary. While it is extremely important to remember that every child is unique and special in his or her own right, some needs and interests are universal.

Ages 12-14, Early Adolescence

Characteristics of Age Group	Implications and Applications
• Change at different rates, according to highly individual "clocks." Can be painfully self-conscious and critical. Are vulnerable to bouts of low self-esteem.	• They need many varied opportunities to achieve and to have their competence recognized by others.
• Are self-conscious with many needing help to overcome inferiority complexes.	• Concentrate on developing individual skills.
• Experience emotions that are on a roller coaster ride. Change in hormones and changes in thinking contribute to the mood swings.	• Accept the feelings that they have. Remember that early adolescents are known for their drama, and their feelings may seem extreme at times.
• Are beginning to question authority and values of parents.	• Be willing to spend time to discuss values and morals.
• Are interested in activities involving boys and girls.	• Encourage learning experiences involving boys and girls.
• Are ready for in-depth, longer learning experiences.	• Encourage deeper exploration of leadership roles; encourage more detailed recordkeeping of leadership experiences.
• Can take responsibility in planning and evaluating their own work.	• Allow members to plan activities. Expect follow through. Help them evaluate the outcome. Let members have responsibility for group activity.
• May avoid difficult tasks.	• Help youth choose tasks at which they can succeed. Encourage them to participate in all tasks. Assist youth in eliminating their fears. Help them succeed in solving and participating in difficult tasks.

Ages 12-14, Early Adolescence (continued)

• Are getting over the age of fantasy. Beginning to think of what they will do when they grow up, but are often unclear of needs and values.	• Relate life skills to career choices.

Ages 15-18, Middle Adolescence

Characteristics of Age Group	Implications and Applications
• Want and need a strong voice in planning own programs.	• Provide suggestions and several alternatives rather than detailed instructions.
• Quite interested in coeducational activities.	• Plan coeducational and group-oriented projects or activities.
• Strong desire for status in peer group.	• Make sure youth are encouraged by peers. Help establish a climate that is conducive to encouragement.
• Are restricting areas of interest; patterns of interest becoming more definite.	• Projects can have considerably more depth. May need to suggest related areas to give youth a broader outlook.
• Reach high levels of abstract thinking and problem-solving. Can choose purposes, make plans, carry them out, and evaluate the results.	• Put youth into real life problem-solving situations. Allow them to fully discover ideas, make decisions, and evaluate the outcomes.
• Are developing a growing concern for the well-being and progress of other individuals and groups.	• Encourage interest in and discussion of community and world problems in which they express concern.

Excerpted from the publication *Understanding and Working with Youth: What are they like?* prepared by Sharon Query, state youth development specialist, and Melva L. Berkland, Extension communication specialist.

Biotechnology and Foods: Is It an Issue?

Objectives

To provide students with the opportunity to explore issues surrounding foods produced through biotechnology techniques. Students will participate in a simulation experience in which they will act as food science researchers. This activity could be done as an interdisciplinary activity involving the science and food and consumer science departments.

Skills

Life – decision making
Science – communicating, relating, applying

Time

One to two class sessions

Materials

Student handout 1 on pages 13-15
Student handout 2 on pages 17-25 (optional)
Overheads 1 and 2 on pages 77 and 79

Procedure

Optional: Have the students read student handout 2 "LoSatSoy: The Story of a New Soybean Oil" as a homework assignment prior to doing this activity.

1. Inform the students that today they will play the role of a team of research scientists who are using biotechnology techniques to produce a new food product. As research scientists, they must first ask themselves the following three questions:

   - What type of modified food would the consumer want?
   - Are the genes for the modification available? (in nature, by plant breeding, or by genetic engineering)
   - Is it possible to develop a product with this modification that will be economically feasible? (Will consumers buy the product? Can my company make money?)

2. Divide the students into groups of 3-5.

3. Using student handout 1, the groups should discuss and record their views/input on each of the questions. Optional: You can use the list of "real" current or proposed food products provided in overhead 1 or join with the students to determine their own future product lists. Their lists might include such things as "bubble-gum-flavored spinach" or other creative options they invent.

Reflecting and Applying

4. After the students complete their team discussions, lead a large group discussion using the following questions:

    - Which product would you produce? Why did you choose that product?
    - What are the concerns or issues that this product might bring up? Who are the players involved in this issue?
    - Who will do the testing for your product? What type of testing needs to be done?
    - Will you label your food product? Why or why not?
    - How will you promote your product to consumers?
    - As a consumer, how would you make a decision about whether to purchase this product?

Biotechnology and Foods: Is It an Issue?

1. You are a team of food science researchers that works for Future Foods, Inc. The company has asked your team to use biotechnology techniques to produce a new food product. Your team must consider the following three questions as you plan for the new food product.

   A) What type of modification or change would consumers want in their food?

   B) Are the genes for making that modification available? You might need to look in nature or use plant breeding techniques or genetic engineering.

   C) Would it be possible to make an economically feasible product with this modification? Will consumers buy the product? Will the changes make the food too expensive?

2. Read *LoSatSoy™: The Story of a New Soybean Oil* to see how one food product was created.

3. Attached is a list of possible new food products that your company could produce. Look over the list and decide which product your research team would like to produce. Write your choice below.

4. Now that you have selected your product, what issues or concerns in producing this product can your team foresee? List below.

5. Who will do the safety testing for your product? What type of testing will need to be done?

6. Will your product be labeled as a special biotechnology product? Why or why not?

7. How will you promote and advertise your product to consumers? Give a brief description of your marketing plan.

8. Would you as a consumer buy or use this product? Why or why not? How would you make this decision?

Enrichment

Search the Internet to discover views by different companies and consumer groups about biotechnology and foods. Your teacher can supply you with a list of sites to begin your search.

Possible New Food Products

Tomato Number One – This tomato has its flavor enhanced by a gene that makes it slow to ripen. Your tomatoes would not need to be picked green and could stay on the grocery shelf longer.

Tomato Number Two – The tomato resists insects so chemical insecticides would not need to be used. You could make this product by crossbreeding your plants with a poisonous wild tomato plant that is found in South America.

Corn – The corn is resistant to insects so that chemical insecticides would not need to be used.

Potato – This potato is higher in starch and absorbs less oil during frying.

Rice – The rice has more nutrients.

Soybean Number One – These soybeans produce cooking oil that is lower in saturated fat.

Soybean Number Two – These soybeans have a milder flavor and are easier to digest.

Nutriceuticals – Plants such as bananas would contain vaccines to prevent disease.

Vegetable Oil – The cooking oil adds no calories or fat.

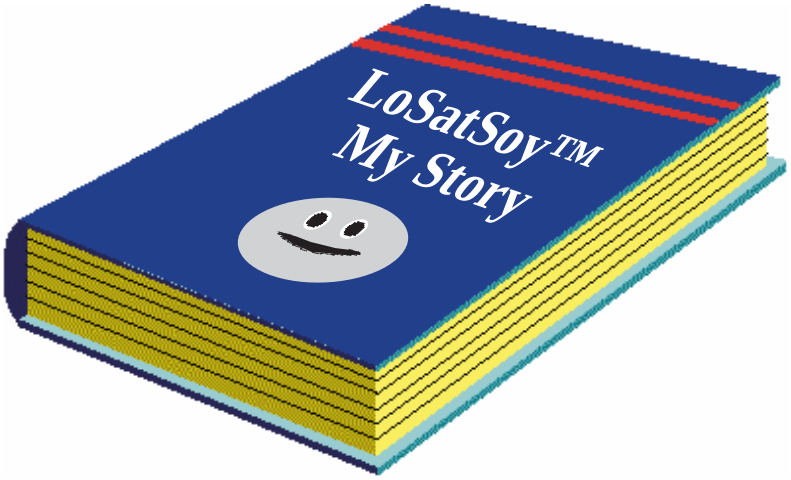
Sugar Substitutes – The product uses a microbe to produce amino acids for aspartame sweetener.

Hormones – These can be given to pigs to produce leaner meat or to cows to produce more milk.

Mystery Product – Use your imagination and determine your own potential food product. How does bubble-gum-flavored spinach sound?

LoSatSoy™

The Story of a New Soybean Oil



IOWA STATE UNIVERSITY

Introduction

You are about to become part of the continuing story of a new biotechnology product, LoSatSoy™ soybean oil. Developed in Iowa, LoSatSoy™ is the world's first low-saturated-fat soybean oil. In fact, that's what the "LoSat" part of LoSatSoy™ stands for.

Eating too much saturated fat has been associated with the development of heart disease, some cancers, and other health problems. You may have read articles from health-related organizations like the American Heart Association about the dangers of too much saturated fat. You'll learn more about that later.

LoSatSoy™ is so new that all the ways to use it in foods have yet to be discovered. Food scientists, nutritionists, school food service managers, and consumers like you are experimenting with how to use LoSatSoy™ in recipes to help them lower the saturated fat in their meals.

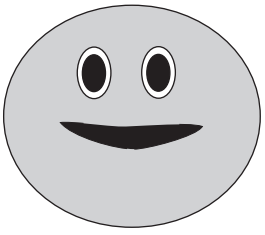
Even companies and the U.S. government are getting into the act. One Iowa company already has modified its recipes for spreadable salad dressing and mayonnaise to include LoSatSoy™ oil. If you live in Iowa, you may have heard their radio and television ads about their new lower-fat products.

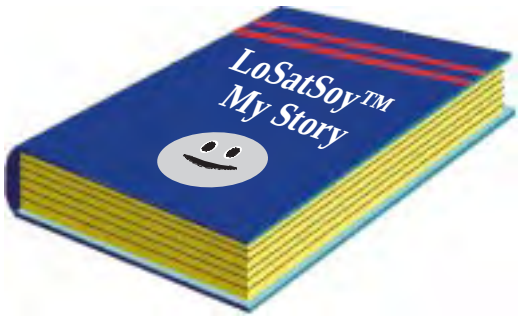
Schools in 10 states have tested the new low-saturated-fat soybean oil for use in the U.S. Department of Agriculture's National School Lunch Program. In fact, your school food service already may be serving meals made with the new low-saturated-fat soybean oil.

As part of this unit, you'll learn a lot about the science behind the development of LoSatSoy™. You'll also have the opportunity to design your own food science experiments using the new oil in your favorite recipes or new ones that you create.

But first, the story of LoSatSoy™ . . .

I'm a very special soybean!





What's All the Fuss About Soybeans?

During the past few years, you've probably heard about the health benefits attributed to soybeans. Doctors and scientists are working to sort out which health claims are true and which are not. There are, however, some basic facts about soybeans on which most people can agree:

Facts About Soybeans

Fact 1: Soybeans are an excellent source of protein.

Fact 2: Soy products such as tofu, soymilk, or soy flour are consumed by millions of people around the world, especially in Asia.

Fact 3: Soybean oil is the major vegetable oil produced and consumed in the United States.

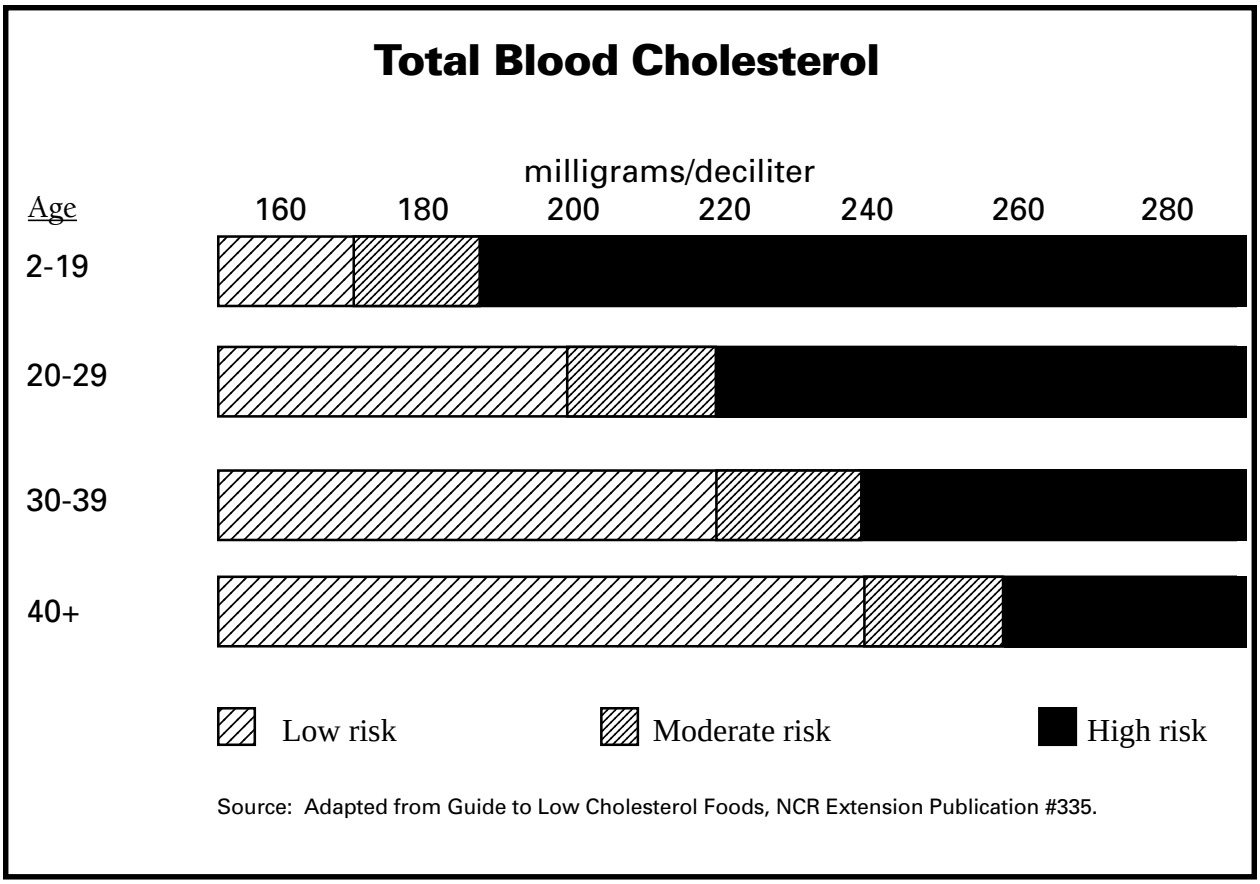
And that brings us to LoSatSoy™ oil. The scientists who developed LoSatSoy™ were looking for a soybean oil with less saturated fat. Eating too much saturated fat has been associated with high levels of blood cholesterol which, in turn, have been linked to heart disease. Because soybean oil is the major vegetable oil consumed in the United States, lowering its saturated fat could help reduce heart disease in this country.

Elevated Cholesterol and Heart Disease

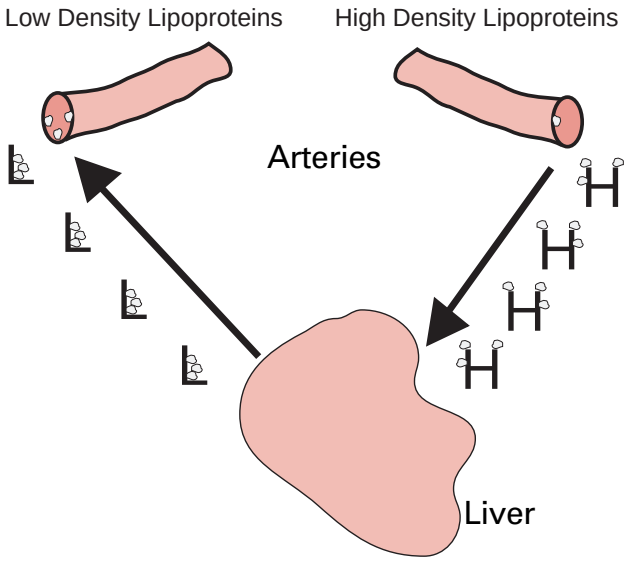
Heart disease is the number one cause of death for both men and women in the United States. Doctors measure serum (blood) cholesterol to determine a person's risk of developing heart disease.

Cholesterol is a waxy substance that circulates in the blood. Although some cholesterol is essential to make your body's cell membranes, hormones, and bile digestive acids, too much cholesterol is associated with heart disease. The fat you eat can raise your blood cholesterol level. The higher your blood cholesterol level, the greater your risk of developing heart disease.

The following chart will give you an idea of how blood cholesterol levels are associated with heart disease.



In addition to monitoring total blood cholesterol, doctors also watch the blood levels of LDL and HDL cholesterol. HDL stands for "high density lipoproteins." LDL is the abbreviation given to "low density lipoproteins." Because cholesterol does not mix with water, it needs help circulating through blood, which is mostly water. Lipoproteins transport cholesterol throughout the body. LDLs carry cholesterol from the liver to the body and leave deposits on artery walls. HDLs carry cholesterol back to the liver for elimination.

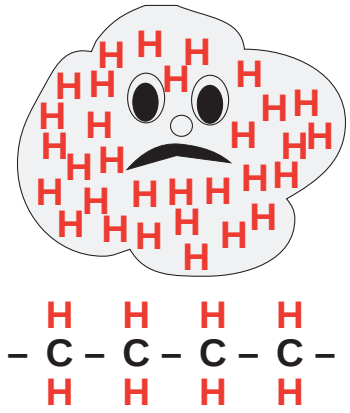


If the ratio of LDLs to HDLs becomes too much in favor of the LDLs, it is likely that more cholesterol is being deposited in the arteries than is being removed. Some scientists use the LDL/HDL ratio to predict a person's chances of developing heart disease. A ratio greater than 3 to 1 can indicate above average risk.

The Saturated Fat Connection

Saturated fat is one of two types of fat in your diet. The other type is unsaturated fat. There is strong evidence that saturated fat raises blood cholesterol. The reason why too much saturated fat elevates blood cholesterol is probably linked to the chemical structure of saturated fat.

Saturated Fat



If the carbon atoms (C's) in a fat have all the hydrogen atoms (H's) that they can hold, the fat is ***saturated.*** In the average American diet, animal products are a major source of saturated fat. These products include fatty meat, butter, cheese, cream, and whole milk.

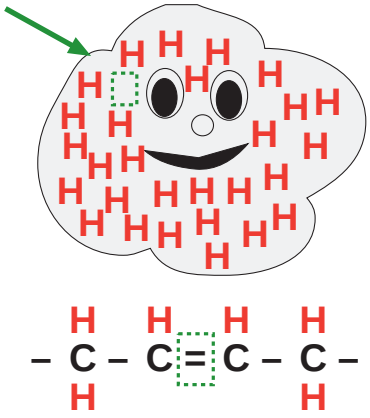
Some vegetable oils also are high in saturated fat. These oils include palm or palm kernel oil and coconut oil. These oils are listed as ingredients in many store-bought baked goods and snack foods, such as cookies, candy bars, and crackers.

Unsaturated fats are classified as either ***monounsaturated*** or ***polyunsaturated***. As you might guess from the prefix "mono-" meaning one, a monounsaturated fat has one site where hydrogen atoms can be added. A polyunsaturated fat has two or more sites where hydrogen atoms can be added. The prefix "poly-" means more than one.

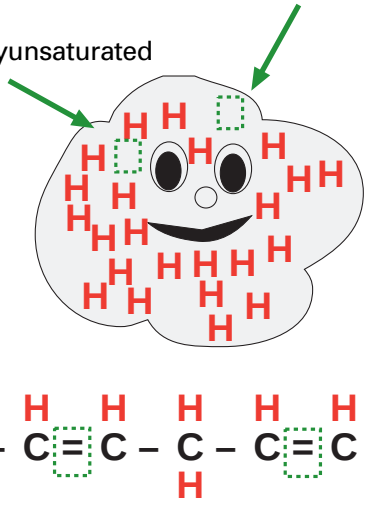
Unsaturated fats commonly are found in plant products. They can help lower the cholesterol levels in your blood when you substitute them for saturated fats. Sources of monounsaturated fat include nuts, olive oil, and canola oil. Sources of polyunsaturated fat include corn, safflower, sesame, soybean, and sunflower oils.

Unsaturated Fats

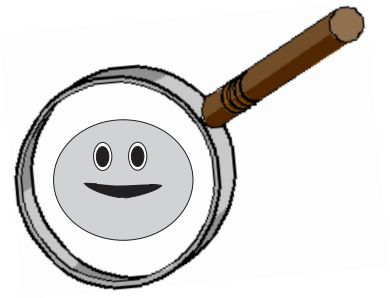
Monounsaturated



Polyunsaturated



Searching for Low-Saturated-Fat Soybeans



Now that you know about saturated fat and its role in increasing the risk of heart disease, you can understand why soybean scientists want to produce a soybean oil as low in saturated fat as possible. The seed of soybeans and other oilseed crops are crushed to obtain oil. The fatty acids in the seed determine the fat characteristics of the oil.

Soybeans contain two different saturated fatty acids, palmitic (rhymes with arthritic) and stearic (rhymes with derrick) acids. Palmitic acid is responsible for about 70 percent of the total saturated fat in soybean oil. That fact told the developers of LoSatSoy™ that palmitic acid was their target. They began the search for a soybean with genes that tell it to produce less palmitic acid.

The Right Genes

There are three ways that plant breeders obtain the genes they need to change crop plants.

1. Search the world's collection of the crop plant for an existing plant that has the desired gene.

2. Increase the natural mutation rate of the crop plant and hope the right gene appears.

3. Remove a gene from another organism and artificially put the gene into the crop plant through genetic engineering.

This soybean researcher is cross-pollinating soybean plants by hand.

A mutation is a genetic change in an organism. The organism's DNA is changed by any one of a number of factors that include ultraviolet radiation, exposure to some chemicals, and radioactivity. Mutations are a natural process that constantly produce variations in a species. A mutation can be helpful, harmful, or make no difference to an organism.

Strike One

The developers of LoSatSoy™ examined the different variations of soybeans throughout the world and did not find one whose genes produced the low amount of palmitic acid that they wanted.

Strike Two

Removing the DNA of a gene from another plant and placing it into a soybean was not possible in this case. No one had isolated the DNA of the gene(s) that regulate palmitic acid production in soybeans and other plants.

A Hit

That left the mutation method. The Iowa State University scientists who developed LoSatSoy™ treated soybean seeds with a chemical to increase the natural rate of mutations. They hoped that at least one of the genetically changed plants would produce less palmitic acid. It was a long process.

1. Seeds of an existing soybean variety were soaked for several hours in a chemical solution.

2. The seeds were planted, and seeds from the resulting plants were harvested and planted again. Then those seeds were harvested and analyzed for fatty acid content. The palmitic acid content had dropped considerably. But still the scientists weren't satisfied. Their goal was to lower the saturated fat in soybean oil to the same level as canola oil, a competing product.

3. The scientists decided to cross their new mutant soybean line with another mutant soybean line developed by the U.S. Department of Agriculture and Purdue University. The USDA/Purdue soybean line also had reduced palmitic acid content. When the genes from the two mutant lines came together, the scientists had what they wanted---a soybean that produced oil with half the saturated fat of conventional soybean oil.

Playing the Rest of the Innings

The LoSatSoy™ game was far from over. After the Iowa State University scientists had the new soybean line they wanted, someone had to make the new soybeans field-worthy. Growing in a carefully tended test plot is one thing, and growing in a real field is something else! The new low-saturate soybeans had to have the right agronomic characteristics to help them yield well when grown by farmers.

The new low-saturate soybean was crossed to other varieties of high-yielding soybeans already being grown by farmers. Some of the low-saturate offspring from those crosses yielded well enough under field conditions to be grown by farmers.

A company contracted with farmers to grow the new soybean seed from which LoSatSoy™ oil would be extracted. Because the LoSatSoy™ seed was different from all other seed, the farmers had to agree to keep the seed separate from regular soybean seed at all stages of planting and harvesting, a process called ***identity preservation***.

Farmers must remove any other type of soybeans from their combines before harvesting soybeans used for LoSatSoy™ oil.

Is This the End of the Story?

If you think that this is the end of the LoSatSoy™ story, you're wrong. In fact, it's just beginning and you can be a part of it. LoSatSoy™ soybean oil is so new that not all its uses in foods have been discovered yet. If you like to experiment with food, you can help develop new or modified recipes that contain LoSatSoy™ soybean oil.

And remember, using LoSatSoy™ oil is only one way of reducing the saturated fat in food. There are many ingredient substitutions that can be made to lower the fat in your favorite recipes. Your nutrition or family and consumer sciences teacher can tell you more.

Fats in Your Diet

Objective

To provide students with the experience of examining their own diets and calculating the amount of calories and total fat grams they consume in a typical day.

Skills

Science – comparing, inferring, applying
Life – healthy life style choices

Time

One-two class sessions

Materials

Overheads 3, 4, and 5 on pages 81, 83, and 85
"Getting In Gear" student handout 3 on pages 29-42 and student handouts 4 and 5 on pages 43 and 44
USDA Food Analysis Handbook (or similar food nutrient resource book that lists calorie and fat content of a variety of foods) or Nutritional Analysis Tool at http://www.ag.uiuc.edu/~food-lab/nat/
Optional: calculators

Procedure

1. Have the students read student handout "Getting in Gear." Discuss the handout using overheads 3, 4, and 5.

2. Ask the students to keep a food diary. Options for the diary include:

   - Check with your school's food services manager and obtain a listing of the lunch menus for a week. The food services manager may also be able to supply information on the calories and fat content of each meal. Use this information to complete the activity.
   - Record all foods consumed over the next 24 hours.
   - Record all foods consumed during the past 24 hours.

   Use the student handout "Food Diary" for students to record their food diary.

3. Use a food nutrient resource book or use the web site and have the students calculate an estimate of their total calorie intake for that 24-hour period/or week of lunches.

4. Have the students calculate their total fat grams and compare to the recommended levels on their student handout.

(continued)

5. Calculate the percent of total fat content of the foods.

Reflecting and Applying

6. How did your total calories and fat grams compare to the recommended levels?

7. What might these totals mean for your current and future health?

8. What are some things that you could do to change your total fat intake?

EAT LESS SATURATED FAT, TOTAL FAT, AND DIETARY CHOLES-TEROL

This is the crunch. This is the rule that probably makes the biggest change in your blood cholesterol.

A few timely definitions: **Fat** is one of three nutrients that supply calories to your body. The other two are **carbohydrates** and **proteins.**

The two main types of fat are **saturated** and **unsaturated.** Most foods have a mix of both. And together, the two are called **total fat.**

- **Saturated fat** occurs in greatest amounts in foods from animals, including meat and whole-milk dairy products, including cheese, cream, and butter. Some vegetable oils also have a lot of saturated fat: coconut, palm kernel, and palm oils, for instance. **Saturated fat raises blood cholesterol levels more than any other dietary source.**

- **Unsaturated fat** comes mostly from plants. Unsaturated fat stays a liquid when put in the refrigerator. The important subtypes are polyunsaturated and monounsaturated fats.

  - Monounsaturated fat is the main type in olive and canola oils.

  - Polyunsaturated fat is the main type in safflower, sunflower, corn, and soybean oils.

Source: National Heart, Lung, and Blood Institute. Used with permission by Iowa State University Extension and ISU Office of Biotechnology.

So, cut back on foods high in saturated fat and cholesterol. One way is by substituting unsaturated fat for saturated fat. Another is by eating foods high in complex carbohydrates and fiber (see box on page 32.

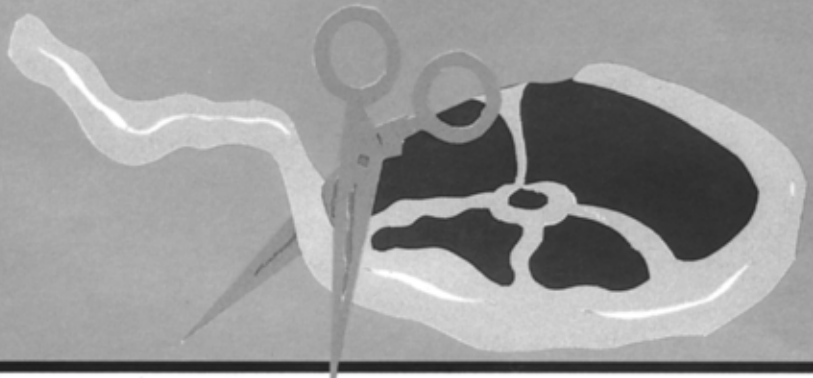
Dietary cholesterol is also part of the picture. Cholesterol is found only in animal products—meat, even lean meat, fish, and poultry, butterfat and egg yolk.

"Putting Heart Healthy Habits Into Play: Foods to Choose and Lose" lists foods low in saturated fat and cholesterol and high in complex carbohydrates and fiber.

YOUR RX FOR HEALTH

The Step-One Diet allows:

- Saturated fat—less than 10 percent of your daily calories.
- Total fat—an average of 30 percent of your daily calories.
- Cholesterol—less than 300 milligrams a day.



SO...HOW MANY CALORIES DO YOU NEED?

The recommended calorie intake for someone your age and average activity is about:

- 2,200 calories for girls
- 3,000 calories for guys

You may need more or less calories depending on your size, metabolism, and how active you are.

Source: National Heart, Lung, and Blood Institute. Used with permission by Iowa State University Extension and ISU Office of Biotechnology.

SO NOW...HOW MANY GRAMS OF SATURATED FAT AND TOTAL FAT DO THESE CALORIES TRANSLATE INTO?

How to figure saturated fat and total fat in grams for the Step-One Diet:

Calories	Maximum saturated fat in grams (no more than 10% of calories)	Maximum total fat in grams (an average of no more than 30% of calories)
2,200	24	73
3,000	33	100

To figure saturated fat in grams:

1. Multiply calorie intake by 10% to get saturated fat calories. (2,200 calories x 0.10 = 220 saturated fat calories)
2. Divide by 9 (fat has 9 calories per gram) to get saturated fat grams. (220 saturated fat calories ÷ 9 = 24 saturated fat grams)

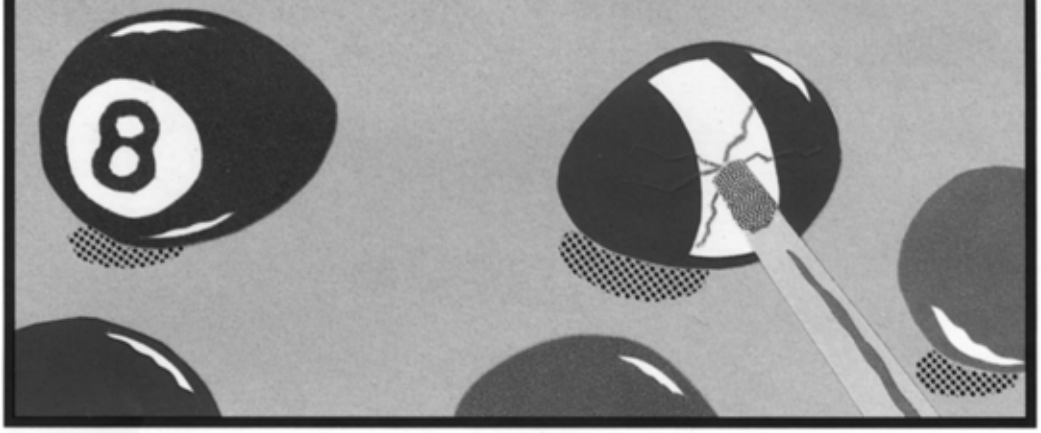
To figure total fat in grams:

1. Multiply calorie intake by 30% to get total fat calories. (2,200 x 0.30 = 660 total fat calories)
2. Divide by 9 (fat has 9 calories per gram) to get total fat grams. (660 total fat calories ÷ 9 = 73 total fat grams)

Source: National Heart, Lung, and Blood Institute. Used with permission by Iowa State University Extension and ISU Office of Biotechnology.

FREEZE FRAME

Hold it! What's a rule without an exception? Here's ours: Egg yolk and liver are not high in saturated fat. But they are high in dietary cholesterol and can pump up your blood cholesterol. So, you still should not eat too many egg yolks (egg whites are fine) or too much liver.



GET A CARBO COMPLEX

Carbohydrates, one of the body's three energy sources, come in two main types: simple carbohydrates (or sugars) and complex carbohydrates (starches and fiber). Both types come from plants. Starches are found in breads, cereals, pasta, corn, and peas; fiber is in whole grain breads, whole fruits, and dried beans.

Athletes favor complex carbohydrates as an energy source. Foods high in complex carbohydrates are excellent substitutes for foods high in saturated fat and cholesterol.

Source: National Heart, Lung, and Blood Institute. Used with permission by Iowa State University Extension and ISU Office of Biotechnology.

PUTTING HEART HEALTHY EATING HABITS INTO PLAY–

Foods to choose and foods to lose

This is a Who's Who of foods. Use it to learn about food groups and their nutrients. It lists foods in **choose** and **decrease** columns. It also gives recommended serving numbers and sizes, based on the Step-One Diet. Some serving numbers differ for guys and girls. That's because guys often need more calories. The amount of a single serving is given in parentheses beside the food.

Do:

- Choose foods from each food group every day.
- Select food group items more often from the **"choose"** column than the **"decrease"** column.
- Follow the Step-One Diet plan.

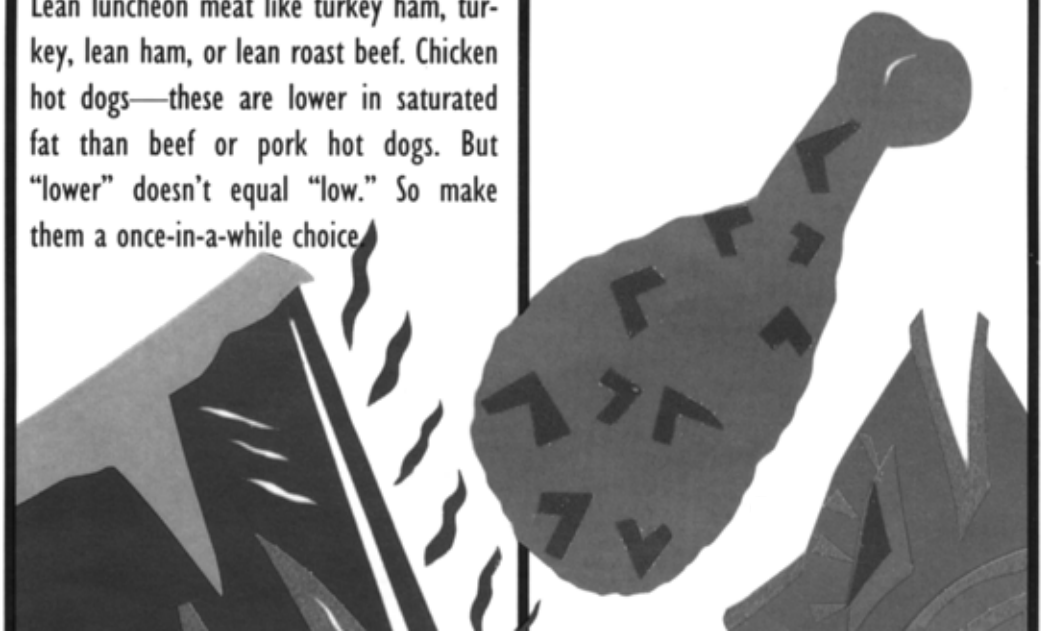
Source: National Heart, Lung, and Blood Institute. Used with permission by Iowa State University Extension and ISU Office of Biotechnology.

Nutrients: Protein, minerals (especially iron), vitamins, saturated fat, and cholesterol.

Servings/day:
Up to 6 ounces cooked (3 ounces of cooked meat is about the size of a deck of cards)

MEAT, *Poultry*, Fish, & Shellfish

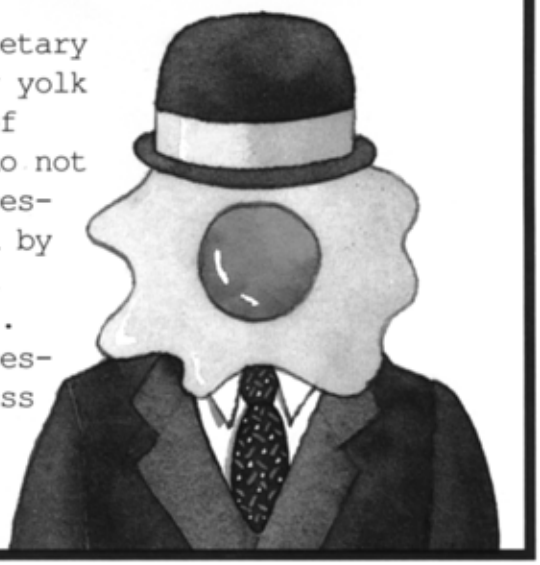
CHOOSE	DECREASE
Lean cuts of meat with fat trimmed, like: Beef—round, sirloin, chuck, loin, extra lean hamburger Lamb—leg, arm, loin, rib Pork—tenderloin, leg, shoulder (arm or picnic) Veal—all trimmed cuts except ground	**Cuts of meat, like:** Beef—regular hamburger, short ribs, corned beef brisket Pork—spareribs, blade roll
Poultry without skin	Bacon, sausage
Fish	Poultry with skin, fried chicken
Shellfish like crabs, clams, and scallops	Fried fish and fried shellfish
Lean luncheon meat like turkey ham, turkey, lean ham, or lean roast beef. Chicken hot dogs—these are lower in saturated fat than beef or pork hot dogs. But "lower" doesn't equal "low." So make them a once-in-a-while choice.	Organ meats like liver, kidney, sweetbread, brain Regular luncheon meat like bologna, salami, sausage, beef or pork hot dogs



Source: National Heart, Lung, and Blood Institute. Used with permission by Iowa State University Extension and ISU Office of Biotechnology.

EXTRA-EXTRA: MAN EGGED ON BY CHOLESTEROL HABIT

Egg yolks are rich in "dietary cholesterol." A large egg yolk contains 214 milligrams of cholesterol. Egg whites do not contain any. Dietary cholesterol is not manufactured by your body but is taken in through the foods you eat. Also it raises blood cholesterol levels, although less than does saturated fat.

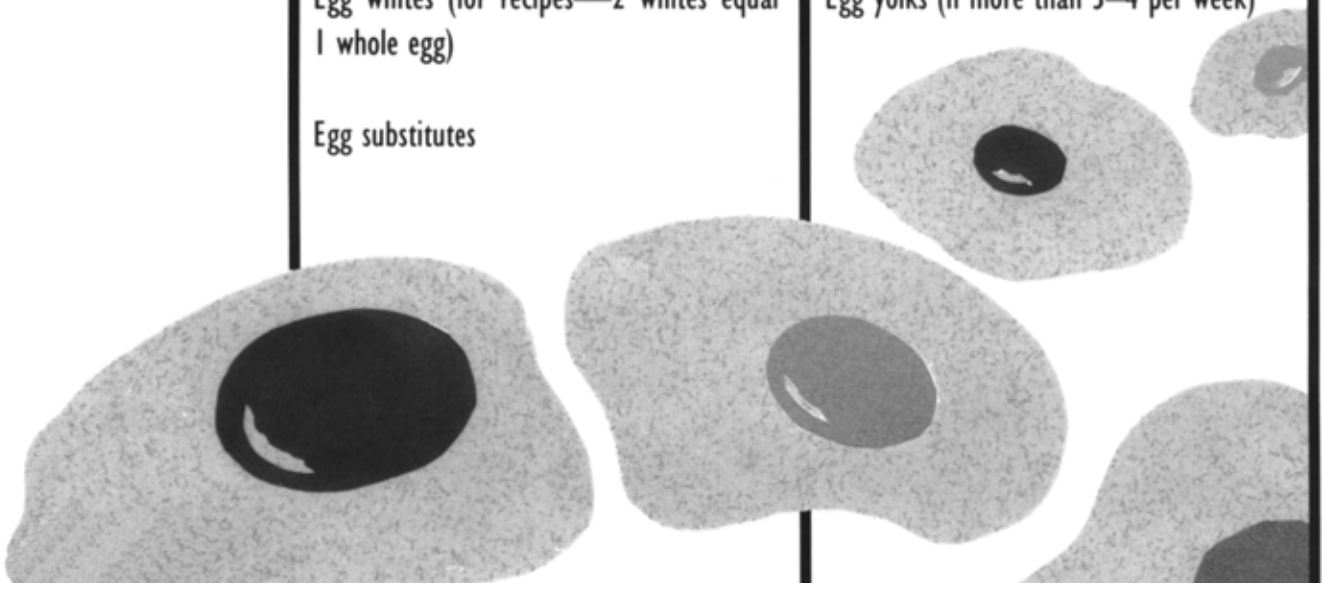


eggs

Nutrients: Yolks are high in cholesterol; whites are a good source of protein.

Servings/week: 3–4 whole eggs; count eggs used in recipes

CHOOSE	DECREASE
Egg whites (for recipes—2 whites equal 1 whole egg) Egg substitutes	Egg yolks (if more than 3–4 per week)



Source: National Heart, Lung, and Blood Institute. Used with permission by Iowa State University Extension and ISU Office of Biotechnology.

DON'T HAVE A COW

"One of the easiest things to change is drinking 1% milk instead of whole milk. And now there are lots of substitutes for ice cream."

MARIA, 15

Dairy foods are a great source of calcium and protein. Eating foods high in calcium helps bones grow and stay strong. As a teen, your bones are growing quickly. So now is the best time in your life to eat foods rich in calcium. Girls, especially, need to eat foods high in calcium. A very good choice is low-fat dairy products, which are not only rich in calcium but also low in saturated fat and cholesterol.

Source: National Heart, Lung, and Blood Institute. Used with permission by Iowa State University Extension and ISU Office of Biotechnology.

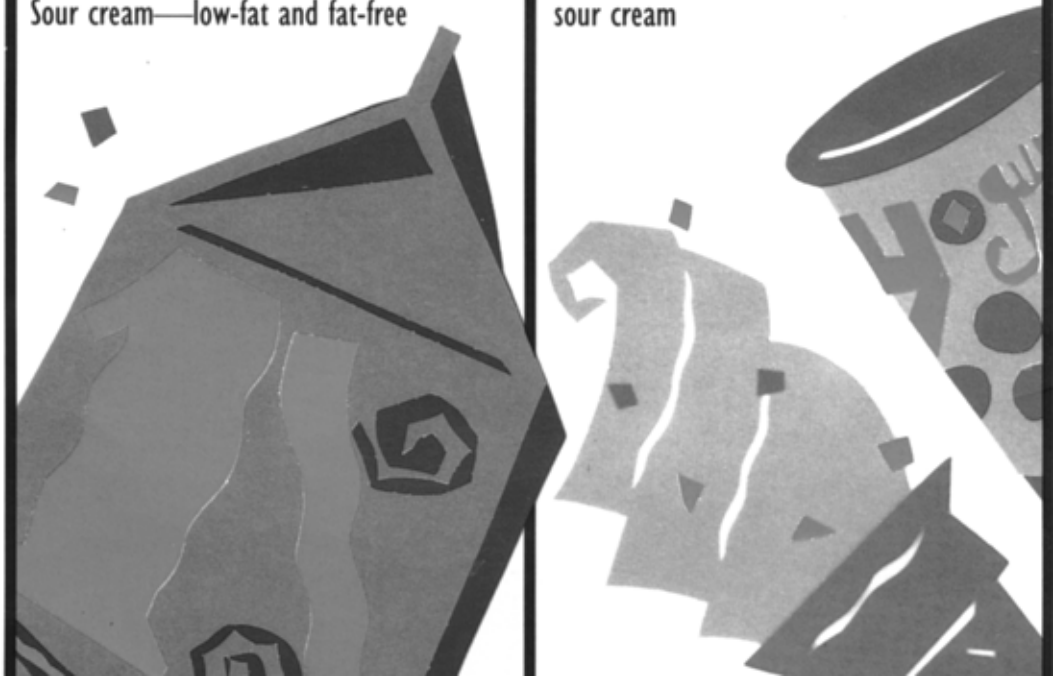
DAIRY PRODUCTS

Nutrients: Protein, vitamins, minerals (especially calcium), saturated fat, and cholesterol.

Servings/day: 4

Note: The numbers in parentheses below are equal to 1 serving.

CHOOSE	DECREASE
Milk (1 cup)—skim milk; 1% milk (fluid, powdered, evaporated) buttermilk	Whole milk (fluid, evaporated, condensed); 2% low-fat milk; imitation milk
Yogurt (1 cup)—nonfat or low-fat yogurt; yogurt beverages	Whole-milk yogurt; custard-style yogurt; whole-milk yogurt beverages
Cottage cheese (½ cup)—low-fat or nonfat	Cottage cheese (4% fat)
Cheese (1 oz.)—low-fat cheeses labeled no more than 3 grams of fat per ounce	High-fat cheese like American, blue, Brie, cheddar, Colby, Edam, Monterey Jack, Parmesan, Swiss; cream cheese
Frozen dairy dessert (½ cup)—ice milk, low-fat frozen yogurt	Ice cream
Sour cream—low-fat and fat-free	Cream like half and half, whipping cream, sour cream



Source: National Heart, Lung, and Blood Institute. Used with permission by Iowa State University Extension and ISU Office of Biotechnology.

Nutrients: Carbohydrates, protein, vitamins, minerals and fiber.
Servings/day: 12 for guys and 8 for girls
Note: The numbers in parentheses below are equal to 1 serving.

BREADS, Cereals, *pasta*, RICE, dry peas, & BEANS

CHOOSE	DECREASE
Bread (1 slice)—whole-grain bread; hamburger and hot-dog buns (½ a bun); bagels (½); tortilla (1)	Bread in which eggs are a major ingredient; croissants, butter rolls, cheese bread
Cereal (1 cup ready-to-eat, ⅓ cup bran or ½ cup cooked)—oat, wheat, corn, multigrain	Granola-type cereals
Pasta (½ cup cooked)—plain noodles, spaghetti, macaroni	Egg noodles and pasta containing egg yolk
Rice (½ cup cooked)	Pasta and rice prepared with cream, butter, or cheese sauces
Low-fat crackers—animal crackers (8); graham (3); saltine- type (6)	High-fat crackers—cheese crackers, butter crackers, or others made with saturated fats
Homemade baked goods using unsaturated oil, skim or 1% milk, and egg substitutes—quick bread (1 slice); 2" biscuit (1); cornbread muffin (1); bran muffin (1); 4" pancake (1); 9" diameter waffle (¼)	Commercial baked pastries, muffins, biscuits, doughnuts, sweet rolls, Danish pastry using high saturated fat and cholesterol ingredients
Dry beans, peas and legumes (½ cup cooked)—split peas, black-eyed peas, chick peas, kidney beans, navy beans, lentils, soybeans, soybean curd (tofu)	Dry beans, peas and legumes prepared with butter, cheese, or cream sauce
Soup like chicken or beef noodle, tomato, vegetable	Potato or corn chips
	Soups made with cream or whole milk

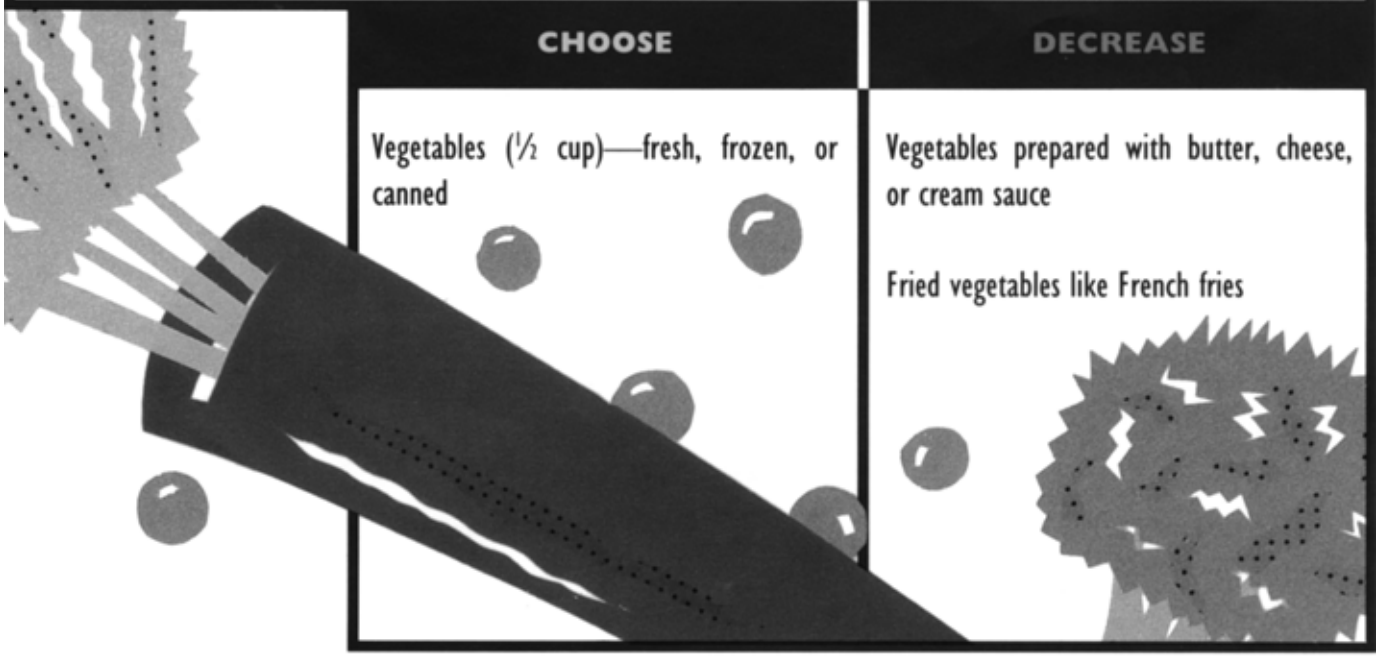
Vegetables

Nutrients: Carbohydrates, fiber, vitamins, and minerals.

Servings/day: 4 for guys and 3 for girls

Note: The numbers in parentheses below are equal to 1 serving.

CHOOSE	DECREASE
Vegetables (½ cup)—fresh, frozen, or canned	Vegetables prepared with butter, cheese, or cream sauce Fried vegetables like French fries



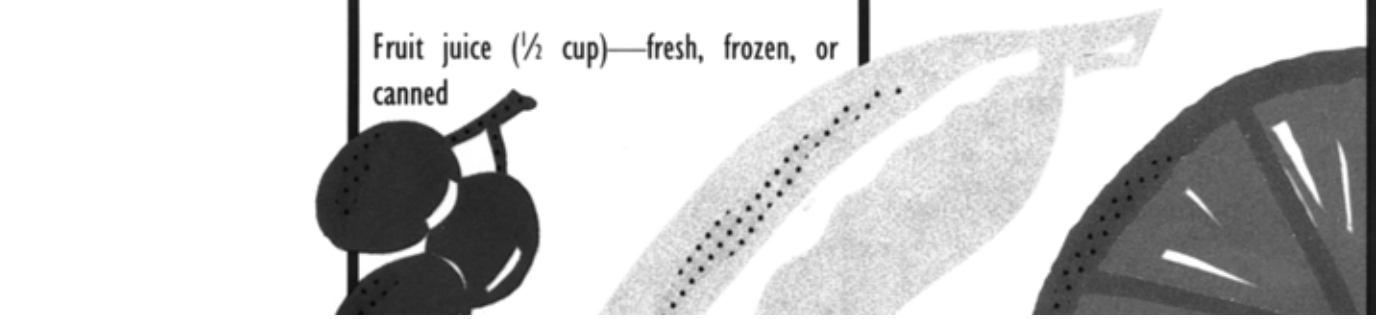
FRUITS

Nutrients: Carbohydrates, fiber, and vitamins.

Servings/day: 5 for guys and 3 for girls

Note: The numbers in parentheses below are equal to 1 serving.

CHOOSE	DECREASE
Fruit (½ cup or medium-size piece)—fresh, frozen, canned, or dried Fruit juice (½ cup)—fresh, frozen, or canned	Fried fruit like banana chips or fruit served with butter, cream sauce, or ice cream



Source: National Heart, Lung, and Blood Institute. Used with permission by Iowa State University Extension and ISU Office of Biotechnology.

FATS & Oils

Nutrients: Saturated and unsaturated fats, cholesterol, and very small amounts of vitamins and minerals.

Servings/day: 10 for guys and 5 for girls

Note: The numbers in parentheses below are equal to 1 serving.

CHOOSE

Unsaturated oils (1 tsp.)— sunflower, safflower, sesame, soybean, corn, olive, canola oil

Margarine or shortening (1 tsp.)— made from unsaturated oils listed above; light or diet margarine (2 tsp.)

Salad dressings (1 tbsp.)—dressings made with unsaturated oils listed above; low-fat or oil-free dressings (serving size depends on amount of oil)

Seeds and nuts (1 tbsp.)—peanut butter, other nut butters*

Cocoa powder (as desired)

Olives (5 small) and avocado (⅛ of whole)*

*These are listed because they are high in unsaturated fat.

DECREASE

Saturated oils—Coconut oil, palm kernel oil, palm oil

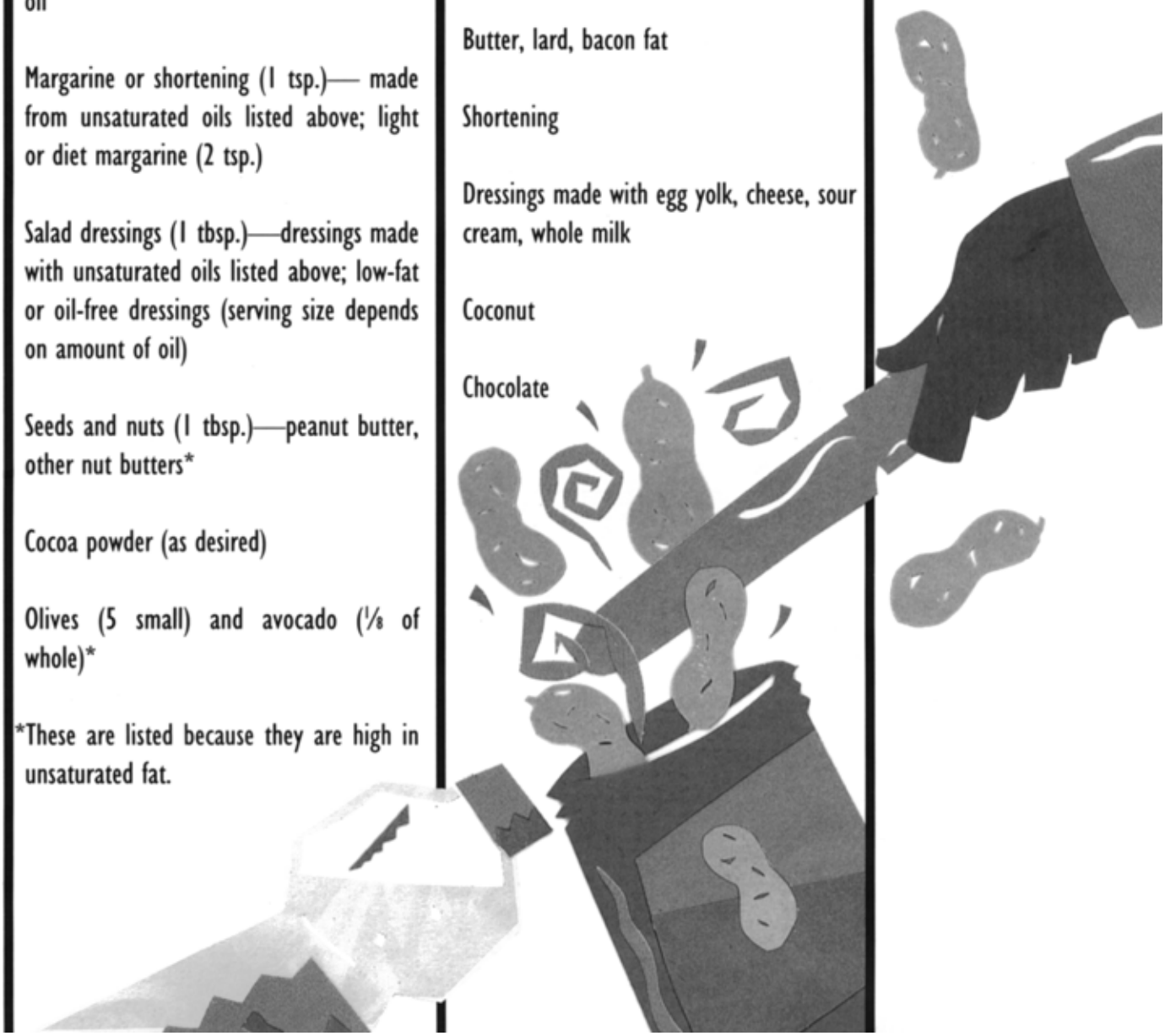
Butter, lard, bacon fat

Shortening

Dressings made with egg yolk, cheese, sour cream, whole milk

Coconut

Chocolate



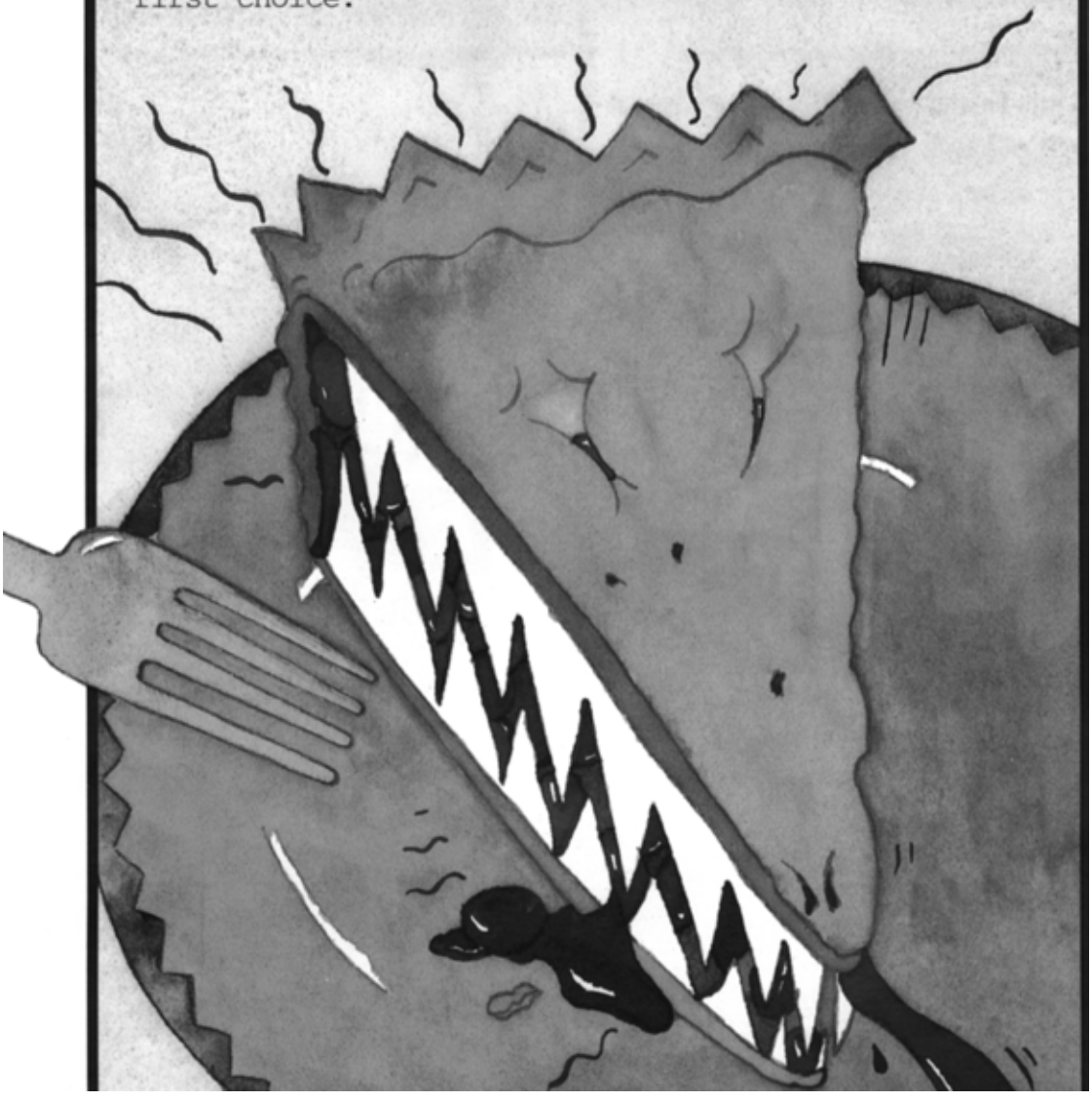
Source: National Heart, Lung, and Blood Institute. Used with permission by Iowa State University Extension and ISU Office of Biotechnology.

HAVE YOUR CAKE— AND EAT IT...SOMETIMES

Sweets and snacks. Can't live with them but don't want to live without them? Some are demons typically low in vitamins, minerals, and fiber—and sky-high in fat, especially saturated fat, and calories.

But, surprise, some are low in saturated fat and cholesterol. So enjoy! Choose sweets and snacks lower in saturated fat and cholesterol.

Also remember, a snack does not have to only be made up of sweets. Snacks can also come from the other food groups that provide more nutrients. In fact, snacks from the other food groups should be your first choice.



Source: National Heart, Lung, and Blood Institute. Used with permission by Iowa State University Extension and ISU Office of Biotechnology.

Nutrients: Saturated fat, cholesterol, and carbohydrates.

Servings/day: 4 for guys and 3 for girls

Note: The numbers in parentheses below are equal to 1 serving.

Sweets & SNACKS

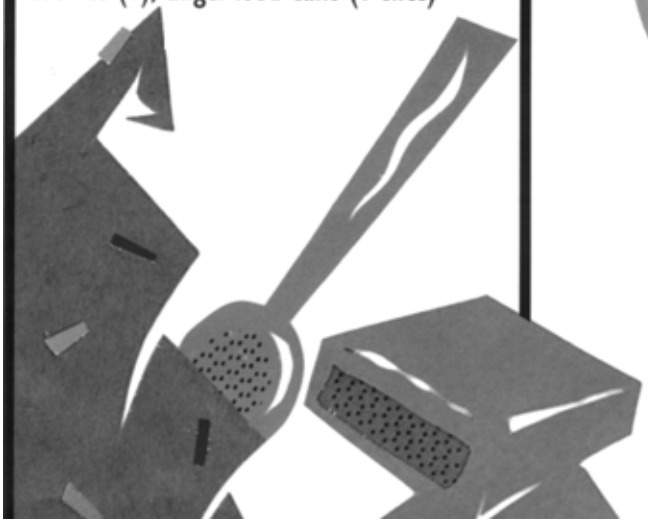
CHOOSE

Beverages (6 fl. oz.)—fruit-flavored drinks; lemonade, fruit punch

Sweets (1-½ tbsp.)—sugar, syrup, honey, jam, preserves; candy (¾ oz.) made primarily with sugar (candy corn, gumdrops, hard candy); fruit-flavored gelatin (½ cup)

Low-fat frozen desserts (⅓ cup)—sherbet, sorbet, fruit ice, popsicles, low-fat frozen yogurt

Cookies (2), cake (1 slice), pie (1 slice), pudding (½ cup)—all prepared with egg whites, egg substitute, skim or 1% milk, and unsaturated oil or margarine; plain popcorn (3 cups); gingersnaps (2); fig bar cookies (1); angel food cake (1 slice)

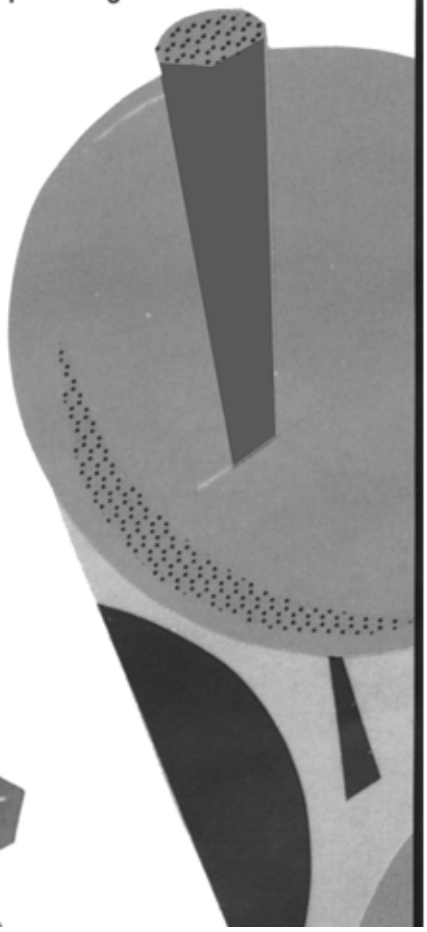


DECREASE

Candy made with chocolate, butter, cream, coconut oil, palm oil, palm kernel oil, coconut oil

Ice cream and frozen treats made with ice cream or whole milk

Commercial baked high-fat cookies, cakes, cream pies, doughnuts



Source: National Heart, Lung, and Blood Institute. Used with permission by Iowa State University Extension and ISU Office of Biotechnology.

Fat in Your Diet

Currently most American youth get about 34% of their calories from fat. It is recommended, that healthy youth and adults get no more than 30% of their calories from fats.

1. Keep a food diary using the form on the next page. Your teacher will give you more specific instructions on what information to collect.

2. Use the Internet or information resources that your teacher supplies to estimate the amount of calories, saturated fat, and total fat in each of the foods. Determine totals for all the foods.

3. You may need more or less calories depending on your size, metabolic rate, and how active you are.

Reflecting and Applying

4. Are fats an important component of your diet?

5. What are the types of fats and how are they different from each other?

6. How did your total calories and fat grams compare to the recommended levels?

7. How do the foods on your food diary compare to the usual type or amounts of foods that you have over a day/week?

8. What might these totals mean for your current and future health?

9. What are some things that you could do to change your total fat intake if it isn't within the recommended levels?

Food Diary

Name _____

Date/Meal	Food	Serving Size	Calories	Saturated Fat	Total Fat
TOTALS:					

Fats in Fast Foods

Objective
To make students aware of the amount of fats they consume when eating fast foods.

Skills
Life – healthy lifestyle choices
Science – comparing, inferring, applying

Time
One class session

Materials
Nutritional contents of foods handouts from popular fast food restaurants or http://www.olen.com/food
Scales to measure grams
Shortening to represent the fat
Containers, such as test tubes, for holding the fat

Procedure
1. Give each team of four students the nutrition information for a different fast food restaurant. Have the students identify the grams of fat in a basic hamburger, a medium chocolate shake, and a medium french fries.

2. Weigh/measure an equivalent amount of shortening to represent the grams of fat in each of these foods. Place in containers so students can see the amount of fats in those foods.

3. Have students find out how many calories in their meal come from fat. To find the total number of calories from fat, multiply the number of fat calories by nine. (Students may go a step further to find the percentage of calories from fat by dividing the number of calories from fat by the total number of calories in the meal.)

4. Have the students calculate the fat in a typical meal they would order at their favorite fast food restaurant.

5. Have the students plan a low-fat meal that they could order at their favorite restaurants or compare restaurants to see which has the most low fat options.

Reflecting and Applying
6. What foods from fast food restaurants have a high number of fat grams? A low number of fat grams? How do you determine if something is high fat?

7. How much fat is found in a typical meal that you would order at your favorite restaurant?

8. Which restaurants have the most low-fat options?

9. What could you eat at a fast food restaurant if you want a low-fat meal? Plan a menu for your next visit to your favorite fast food restaurant.

10. Compare your meal plan to the food guide pyramid. Do you meet most of the daily requirements? What would you need to eat during the remainder of the day to fit into the food pyramid ranges?

Adapted from an activity submitted by
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Fats in Milk and Dairy Products

Objective
Compare the fat content of various milk and dairy products

Skills
Life – healthy lifestyle, planning and organizing, decision making
Science – observing, comparing, categorizing, inferring

Time
One class session

Materials
Student handout 6 on pages 49-51
Cups, napkins, and plates for taste-testing
Calculators

Possible items to be tested may include: skim milk, 2% milk, whole milk, reduced-fat cheddar cheese, regular cheddar cheese, processed food cheese slices, 1/3 less fat cream cheese, regular cream cheese, frozen yogurt, lite ice cream, and regular ice cream.

Lactose intolerant students may test Lactaid® brand dairy products such as lowfat milk, reduced fat milk, fat free milk, or lowfat yogurt. Lactose intolerant students may also test regular and light soy beverages.

Procedure
1. Distribute student handout 6, "Fats in Milk and Dairy Products," and start recording information from the labels on the chart.

2. Have the students participate in taste testing. Compare flavors, textures, and fats in the products. Ask the students to write down vivid descriptions of their observations (creamy, salty, gummy, sticks to the roof of your mouth, etc.)

   Having students do a blind taste test may give more accurate results. To conduct a blind taste test, have the dairy products set out ahead of time and labeled with letters or numbers. Make sure to keep a master list of the product that goes with each letter/number. Have the students write the letters/numbers in the milk products chart under the food column. Another interesting option would be to have half of the students do a blind taste test and the other students taste the products while knowing which product they are tasting. Compare their findings.

3. Use the information from the chart to complete a math problem that looks at long-term effects of using high fat milk products.

Sample Math Problem

Part 1:
Person A drinks 2 cups of 2% milk per day.
Person B drinks 2 cups of skim milk per day.
In one year (365 days), how many more calories (just from milk) will person A consume?

Answer: 29,200 calories

A: 130 calories x 2 cups = 260 milk calories/day
B: 90 calories x 2 cups = 180 milk calories/day
80 x 365 days = 29,200 extra calories

Part 2:
There are 3,500 calories in 1 pound of body fat. How many pounds of body fat would those extra calories equal?

Answer: 8.34 pounds 29,200 divided by 3,500 = 8.34 pounds

Reflecting and Applying

4. What effect did the total fat in each product have on the flavor and texture of the food?

5. How do the total fat amounts relate to the saturated fats and cholesterol that is found in each product?

6. What trade-offs, if any, were made when lowering the fat content in the food? (Did they have to add anything to the food to keep the flavor? Did the food lose flavor or did the texture change when the fat content was lowered?)

7. How could you use the information on your chart to help you make a decision about what type of milk, cheese, or ice cream you would choose to eat?

8. Using the information from your math problem, what effect could those decisions have on your future health?

9. Under what circumstances would you use the lower-fat versions of the dairy products? Could you get used to any of the lower-fat items?

Adapted from an activity submitted by
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Fats in Milk and Dairy Products

You go to the supermarket to pick up some milk, cheese, and ice cream. The dairy case is filled with products labeled as reduced fat, lite, regular, and skim. How do you make the decision about which product to buy?

1. Use the food labels to complete the chart on page 51.

2. Do a comparison taste test for each of the products. Record your comments about flavor and texture in the Taste Testing Comments section of the chart.

3. Complete the following math problem to see what effect your choice of products might have on your health.

   A) Person A drinks 2 cups of 2% milk per day.
   Person B drinks 2 cups of skim milk per day.

   In one day, how many calories will person A consume from milk?

   In one day, how many calories will person B consume from milk?

   How many more calories will person A consume from milk each day?

   In one year (365 days), how many more calories (just from milk) will person A consume than person B?

(continued)

B) There are 3,500 calories in 1 pound of body fat. How many pounds of body fat would those extra calories equal?

Reflecting and Applying

4. What effect did the total fat in each product have on the flavor and texture of the food?

5. How do the total fat amounts relate to the saturated fat and cholesterol that are found in each product?

6. What trade-offs, if any, were made when lowering the fat content in the food? (Did they have to add anything to the food to keep the flavor? Did the food lose flavor or did the texture change when the fat content was lowered?)

7. How could you use the information on your chart to help you make a decision about what type of milk, cheese or ice cream you would choose to eat/buy?

8. Using the information from your math problem, what effect could those decisions have on your future health?

9. Under what circumstances would you use the lower-fat versions of the dairy products? Could you get used to any of the lower-fat items?

Milk Products Chart

Name _____

Food	Ranking	Serving Size	Calories	Total Fat g	Saturated Fat g	Cholesterol mg	Sodium mg	Protein g	Calcium (% DV)	Taste Testing Comments*

*Be sure to give specific observations when commenting on the products. Use descriptive words such as creamy, sticks to the top of my mouth, gummy, watery, sweet, salty, etc.

HDL / LDL Demonstration

Objective
To illustrate the difference between the way "good" HDL cholesterol and "bad" LDL cholesterol travel through the bloodstream.

Skills
Life – healthy lifestyle choices
Science – observing, comparing, relating, inferring

Time
15-20 minutes

Materials
1/2 inch inside diameter clear, flexible tubing (amount depends on whether you do this as a demonstration or have teams of students do the activity)
Plastic bowls or containers
Miniature marshmallows and cinnamon red-hot candies
Overheads 3, 4, 5, and 6 on pages 81, 83, 85, and 87
Alternative activity materials:
Cornstarch
Sugar
Clear plastic straws
Scrap paper to make paper funnels

Background Information
Please look on page 8 to find background information on HDL and LDL.

Procedure
1. Introduce the activity with overheads 3-6. Show the students a miniature marshmallow and ask them what they think would happen if the marshmallow was inserted into the tubing. It would move very slowly, if at all.

2. Suggest to the students that the marshmallow is like LDL cholesterol. The marshmallow would leave some powdered sugar residue in the tube. Compare this to the cholesterol that LDLs deposit on artery walls.

3. The tubing represents the arteries and veins that carry blood through our bodies.

4. Drop a few candies into the tube. They easily slide through. Asks the students to examine the tube for anything left behind by the candies. There should be no visible residue.

5. Show overhead 6 to more thoroughly explain the role of LDLs and HDLs. Suggest to the

students that the red-hots are like HDLs that travel through the blood vessels very quickly, carrying excess cholesterol to the liver where it is disposed of as a waste product. The HDL reduces the cholesterol on artery walls.

Alternative Activity

Go through the same procedure as above. Use a straw instead of the tubing, cornstarch to represent the LDL cholesterol, and table sugar to represent the HDL cholesterol. Funnels made out of scrap paper will help to get the cornstarch and sugar into the straw with minimal mess.

Reflecting and Applying

6. What do the plastic tubing, marshmallows, and cinnamon candies (or clear straws, cornstarch, and table sugar) represent?

7. What is the role of HDL and LDL in the body?

8. Doctors check your levels of HDL and LDL when doing a cholesterol test. What do you think a reading of high LDL might mean?

9. Why would it be important for you to have a cholesterol test? What would the readings tell you?

10. What type of foods contain cholesterol? What does it mean if something is low in cholesterol or is cholesterol-free?

11. What factors other than diet affect how much cholesterol a person has in the bloodstream? Do only overweight people have high cholesterol levels? What role does genetics play in the amount of LDL and HDL cholesterol found in different people?

Adapted from an activity submitted by
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Sample Demonstration/Classroom Activity for Teaching Relationship of Fats and Oils in the Diet

Objective
To emulate the process of how fat affects arteries and encourage the reading and understanding of food labels.

Skills
Life – healthy lifestyle choices
Science – observing, comparing, relating, inferring

Time
20 minutes to one class session

Supplies
Clear, flexible plastic tubing
Plastic bowls or basins
Funnel
Solid vegetable shortening
Cotton swabs
Red food coloring
Water
Overheads 5 and 7-10 on pages 85, 89, 91, 93, and 95
Food labels or completed fats chart from "Fats in Milk and Dairy Products" activity

Procedure
1. Fill the bowl or basin with water. Add red food coloring. This will act as the blood.

2. Using the funnel, pour the "blood" through the tubing. The tubing acts as the arteries.

3. Using the cotton swab, place a dab of shortening on the inside of the tube. Again pour the "blood" through the tube.

4. Continue to add shortening to the tube and pour the "blood" through the tube. Ask the students to observe and compare what is happening.

5. The shortening is representative of the cholesterol that can build up in the arteries over many years. What will happen when the tubing is actually blocked by cholesterol?

6. Using overheads, discuss the relationship between cholesterol and the types of fats that you eat. Discuss that saturated fats tend to come from animal sources, with the exception of coconut oil and palm kernel oil, and that unsaturated fats generally are from plant sources and contain no cholesterol.

7. Transfer the learning activity to making food choices by looking at food labels or using the completed Fats Chart from the "Fats in Milk and Dairy Products" activity. Identify the fats used. Compare saturated fat and unsaturated fat content. Look at labels that state the food contains no cholesterol. What is the source of the fat?

Reflecting and Applying

8. What is the difference between saturated and unsaturated fats?

9. What are the sources for these fats?

10. How do these type of fats affect your health?

11. How can reading food labels help you make wise choices about the foods that you eat?

Adapted from an activity submitted by
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Reading Labels for Fat Types

Objective
To read labels and compare the differences among saturated fat, polyunsaturated fat, and monounsaturated fat in various cooking fats.

Skills
Life – healthy lifestyle choices, decision making
Science – comparing, categorizing, inferring

Materials
Labels from different types of cooking fats such as olive oil, sunflower oil, shortening, lard, etc.
Graphing paper
Overheads 3-16 on pages 81, 83, 85, 87, 89, 91, 93, 95, 97, 99, 101, 103, 105, and 107
Optional: student handout 7 on page 58
Two different colors of modeling clay
Toothpicks

Procedure
1. Optional: Have students read student handout 7 titled "Dietary Fat Reconsidered."

2. Using the overheads 7-16, discuss the differences in saturated fat, polyunsaturated fat, and monounsaturated fat. You may want to use clay color #1 (carbon atoms), clay color #2 (hydrogen atoms), and toothpicks (bonds) to actually make models of the molecules. This can be done as a demonstration or have teams of students make each type of fat molecule as you display and discuss the overhead.

3. Working in teams, the students should have a chance to observe each type of fat and look at the labels. Students are to design a graph to represent the amount of total saturated, polyunsaturated, monounsaturated, and total fats in each type of fat. (See overhead 17 on p. 109 for an example of how these graphs might appear.)

4. Discuss hydrogenation of fats and the effect of trans fatty acids. You may want to demonstrate the molecule with the clay and toothpicks. Show the students an example of a hydrogenated fat such as shortening.

Reflecting and Applying
5. Compare saturated and unsaturated fats. How are they alike? How are they different?

6. How do the different types of cooking fats that you observed compare in saturated, polyunsaturated, and monounsaturated fats?

7. What are the benefits of hydrogenated fats? What are the problems associated with

hydrogenated fats?

8. What types of cooking fats do you think would be best to use?

9. How can you use labels and graphs to help you decide what cooking fats to use?

Enrichment

Choose other food products besides cooking fats. Read labels and determine the amounts of polyunsaturated fat, saturated fat, and monounsaturated fat in those products.

Adapted from an activity submitted by
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Dietary Fat Reconsidered

Excerpted from the March 1998 issue of the *Harvard Women's Health Watch*, ©1998, Presidents and Fellows of Harvard College.

Individual and bulk subscriptions available; contact the Harvard Health Publications Group at 164 Longwood Avenue, Boston, MA, 02115; (617) 432-1485.

In the last two decades, dietary fat has been given a bad name. It has been pegged as the most concentrated source of calories (9 / gram compared to 4 / gram for proteins and carbohydrates). It has also been linked with an increased risk of heart disease and colon cancer. The National Research Council has advised us to restrict fat intake to 30% of total calories, and many of us have aimed to keep fat consumption far below that mark.

However, a recent spate of reports seems to be telling us that, in many respects, fat's reputation is undeserved. There is now evidence that increasing one's intake of certain fats may in fact protect against heart disease and breast cancer. What to believe?

The answer is in the phrase "certain fats." Fat isn't one entity, but several. The word applies to a number of chemically different molecules with varying degrees of flexibility. As a result, each has a different influence on the body. In a sense, there are good fats, bad fats, and ugly fats.

THE GOOD

• *Polyunsaturated fats*. These are the most flexible of fats because they have several hydrogen-free sites along their chemical backbones. Many plant oils, including those from corn, safflower, soybeans, and sesame seeds, are in this category. So are fish oils – a good source of linoleic and linolenic fatty acids, which the body needs but cannot manufacture.
• *Monounsaturated fats*. These fatty acids contain one "empty" site, giving the molecules some flexibility. In the American diet, sources of these fats tend to be foods that also contain some saturated, trans unsaturated, or polyunsaturated fats – dairy fats, beef, and partially hydrogenated vegetable oils.

THE BAD

• *Saturated fats*. This term applies to a molecule in which all the available sites on both sides of the chemical backbone are occupied by hydrogen atoms. This hydrogen saturation imparts a fixed, rigid structure that renders them solid at room temperature. Natural components of animal fat, they are found in lard, meat, and dairy foods. They are also present in palm and coconut oils.

THE UGLY

• *Trans unsaturated fats (trans fats)*. These are unsaturated fats that have picked up hydrogen atoms and, as a result, have taken on a structural shape similar to that of saturated fats. Some trans fats occur naturally in meat and dairy products and particular plants. However, most are created by food manufacturers when they add hydrogen to unsaturated fats like corn oil, to make vegetable shortenings and margarine. In this hydrogenation process, certain chemical bonds in the oil are changed to create a solid fat that has a longer shelf life. Trans fats are the most sinister, because they are bad fats that for years have gotten away with their masquerade as good (unsaturated) fats.

THE EVIDENCE

• *Saturated fats*. Observational studies have repeatedly indicated that saturated fats raise cholesterol levels and increase the risk of heart disease. In a recent report of 80,000 women in the Nurses' Health Study, women who increased saturated-fat calories by 5% elevated their risk of coronary disease by 17%. Similar studies link saturated fats to an increased risk of colon cancer, but not of breast cancer.
• *Trans fats*. Evidence against trans fats continues to mount. In the Nurses' Health Study, an increase of only 2% of calories from trans fats was associated with a 93% increase in the risk of coronary heart disease. Like saturated fats, trans fats appear to reduce blood levels of HDL (the good) cholesterol and increase levels of LDL (the bad) cholesterol.
• *Monounsaturated fats*. The Nurses' Health Study has indicated that monounsaturated fats may reduce breast cancer risk. In that study, a 5% increase in monounsaturated-fat calories also yielded a 19% reduction in heart-disease risk.
• *Polyunsaturated fats*. These fats may have no link to colon cancer, although some animal studies have associated them with breast cancer. Research has shown a strong association between polyunsaturated fats and heart-disease prevention. In the Nurses' Health Study, a 5% increase in polyunsaturated-fat calories was tied to a 38% drop in heart-disease risk.

WHAT TO DO

It's still a good idea to limit fat calories to 30% of your daily total, trying to get as many of those calories as possible from monounsaturated or polyunsaturated fats. Package labels are the most reliable guide to the types of fats a food contains. Although the "Nutrition Facts" box doesn't include information on trans fats, the Food and Drug Administration is considering adding it. For the meantime, the best approach is to scan the ingredients for the word "hydrogenated" – a giveaway that trans fats are present, albeit in unknown quantities. These tend to show up in snack foods and packaged bakery goods.

One good rule when choosing fats is "the softer, the better" because liquids are less likely to contain saturated or trans fats. Look for margarines labeled "trans-fat free." Among oils, olive and canola, which are high in monounsaturated fats, are preferable to corn and safflower oils.

If your fat intake regularly exceeds 30% of calories, consider replacing extra fat calories with those derived from fruits, vegetables, legumes, soy-based foods like tofu, and whole grains. However, it isn't a good idea to turn to fat-free snacks that are high in simple carbohydrates, especially if you have diabetes or reduced glucose tolerance. A high-carbohydrate diet may raise the blood concentration of triglycerides (a compound made of fatty acids and glycerol) while lowering the level of HDLs. Once again, following the Food Guide Pyramid (*HWHW,* February 1996) or the DASH diet (*HWHW*, July 1997) can't lead you too far astray.

Taste Tests of Baked Goods Made with Low-Saturated-Fat Soybean Oil

Objective

To provide students with the opportunity to compare baked goods that were made using low-saturated-fat soybean oil (available on the USDA school commodities list as low-saturated-fat soybean oil or sold under the trademark name LoSatSoy™) to baked goods made with traditional cooking fats.

Skills

Life – critical thinking
Science – observing, communicating, comparing

Time

One to three class sessions (dependent on whether students or teachers/leaders make the baked goods)

Materials

Overhead 17 on page 109
Optional: student handout 2, "The Story of LoSatSoy™," on pages 17-25
Supplies for making selected baked goods – keep labels from the supplies to use for calculations in step #2
Student handout 8, "Taste Tests of Baked Goods Made with Low-Saturated-Fat Soybean Oil" on pages 63-65. (The oil may be available from your school's food service manager or can be purchased in some grocery stores under the trademark name LoSatSoy™.)

Procedure

1. Introduce students to recipe modification for lowering the fat content of recipes by making different variations of one or more of the following three recipes. (Overhead 17 and "The Story of LoSatSoy" may be useful in your discussion.) Teachers/leaders may prepare the recipes for taste tests by students, or students may prepare the recipes as practice for the Student Food Scientist Activity.

Rhubarb Muffins

Try making this recipe using various types of vegetable oils, including low-saturated-fat soybean oil.

- 3/4 cup brown sugar
- 1/3 cup vegetable oil
- 1 tsp. vanilla
- 1 egg
- 1/2 cup buttermilk
- 1 1/2 cups all-purpose flour
- 1/2 tsp. salt
- 1/2 tsp. soda
- 1 cup rhubarb

Topping: 1/2 tsp. cinnamon, 1/4 cup brown sugar, 1/4 cup chopped nuts

Preheat oven to 325 degrees. Grease bottom of 12-cup muffin pan (or use paper baking cups). Combine brown sugar, oil, vanilla, egg, and buttermilk. Mix well. Stir in dry ingredients. Divide batter evenly among 12 muffin cups. Sprinkle topping over each cup of batter. Bake for 25-30 minutes or until done.

Saturated fat grams in recipe using low-saturated-fat soybean oil:

5 1/3 tablespoons (1/3 cup) of oil =	5.30 grams
1 large egg =	1.60 grams*
1/2 cup buttermilk =	0.65 gram*
1 1/2 cups flour =	0.30 gram*
2 oz. (1/4 cup) chopped black walnuts =	2.00 grams*
TOTAL	9.85 saturated fat grams

Saturated fat grams per muffin: 9.85 divided by 12 = 0.82 gram

Chocolate Chip Bars

Try making this recipe at least two ways, with 1 cup margarine or substituting 2/3 cup of low-saturated-fat soybean oil. To reduce the fat to 1/4 cup, a substitute ingredient must be added to make up for the fat that was removed. For example, try 1/4 cup oil plus 3/4 cup applesauce. Another alternative is 1/4 cup oil plus 3/4 cup canned pumpkin.

2 1/4 cups all-purpose flour
1 tsp. baking soda
1 tsp. salt
2/3 cup low-saturated-fat soybean oil or 1 cup margarine, softened)
3/4 cup sugar
3/4 cup brown sugar
1 tsp. vanilla
2 eggs
One 12 oz. package chocolate chips
1 cup chopped nuts (optional)

Preheat oven to 350 degrees. Grease a 15 x 10 inch baking pan. Mix oil (or cream margarine) with sugars. Add eggs and vanilla and stir well. Add flour, baking soda, and salt. Mix well. Stir in chocolate chips and nuts. Spread in baking pan and bake for 18 minutes or until done.

Saturated fat per recipe using low-saturated-fat soybean oil (no nuts):

2 1/4 cups all-purpose flour =	0.45 gram*
10 2/3 tablespoons (2/3 cup) oil =	10.70 grams
2 large eggs =	3.20 grams*
12 oz. semi-sweet chocolate chips =	59.60 grams*
TOTAL	73.95 saturated fat grams

Saturated fat per 2 1/2 x 2 inch bar = 73.95 divided by 35 = 2.11 grams

*Saturated fat of ingredients will vary by brand-name product. These calculations are based on figures from *Bowes and Church's Food Values of Portions Commonly Used*, Sixteenth Edition, 1994.

Snickerdoodles

Try making this recipe with shortening and then lower the fat by substituting 2/3 cup of low-saturated-fat soybean oil.

1 cup shortening (or 2/3 cup low-saturated-fat soybean oil)	2 3/4 cups all-purpose flour
1 1/2 cups granulated sugar	2 tsp. cream of tartar
2 eggs	1 tsp. soda
	1/4 tsp. salt

Rolling mixture: 2 tablespoons sugar plus 2 teaspoons cinnamon

Preheat oven to 400 degrees. Cream shortening (or mix oil) with sugar. If using oil, stir only until blended – do not overmix. Add eggs. Mix only until blended. Add remaining ingredients and stir only until well blended. Roll dough into balls the size of a small walnut and roll each ball in sugar/cinnamon mixture. Place on ungreased cookie sheets and bake until lightly browned for 8 to 10 minutes. Yields about 50 three-inch cookies.

Saturated fat in recipe using low-saturated fat soybean oil:

10.56 tablespoons (2/3 cup) oil = ...	10.56 grams
2 large eggs = ...	3.20 grams*
2 3/4 cups all-purpose flour = ...	0.55 gram*
TOTAL	14.31 saturated fat grams

Saturated fat per three-inch cookie: 0.29 gram

2. Teachers/leaders may ask students to calculate the saturated fat content per recipe and per serving. Saturated fat content per recipe is determined by reading the saturated fat content per serving from the ingredient labels, determining how the serving size compares proportionately to the amount used in the recipe, and multiplying the saturated fat grams per serving by the same proportion. For example, suppose an ingredient label lists the serving size as 2 tablespoons that has 8 grams of saturated fat. If 6 tablespoons of the ingredient are used in the recipe, that is three times the serving amount so the ingredient would add three times the saturated fat, 24 grams, to the recipe.

   Add the saturated fat amounts contributed by each ingredient in the recipe to arrive at the total saturated fat per recipe.

   Divide the total saturated fat amount in the recipe by the number of servings to determine the saturated fat grams per serving.

*Saturated fat of ingredients will vary by brand-name product. These calculations are based on figures from *Bowes and Church's Food Values of Portions Commonly Used*, Sixteenth Edition, 1994.

3. Working in teams, ask the students to compare the baked goods made with low-saturated-fat soybean oil and traditional cooking oils.

4. Ask the students to design a chart on which to record information or other comparisons. Include such characteristics as texture, flavor, aroma, and total fat contained.

5. Ask the food services manager to visit your class. Have the students share their taste test results. Ask the food services manager to share: what type of oils are being used in your food service and how that decision was made; how they develop menus that are low in fat; and what type of requirements they must meet in terms of fats and calories for student lunches.

Reflecting and Applying

6. How does the low-saturated-fat soybean oil (LoSatSoy™) compare to other types of cooking fats in terms of saturated and unsaturated fats present? (Use overhead 17.)

7. How do the baked goods made with low-saturated-fat soybean oil and traditional fats compare in terms of fat content, taste, texture, aroma, etc.?

8. How would you make a decision whether to use low-saturated-fat soybean oil in your baking? What would you need to consider? Are there any trade-offs? What are the benefits of using low-saturated-fat soybean oil?

9. What other ways could you reduce fats in baked goods?

Taste Tests of Baked Goods Made with Low-Saturated-Fat Soybean Oil

You will have the opportunity to compare baked goods that were made using low-saturated-fat soybean oil (possibly available from your school's food service manager or sold under the trademark name LoSatSoy™) to baked goods made with traditional cooking fats.

Recipes

Rhubarb Muffins

Try making this recipe using various types of vegetable oils, including low-saturated-fat soybean oil.

3/4 cup brown sugar
1/3 cup vegetable oil
1 tsp. vanilla
1 egg
1/2 cup buttermilk
1 1/2 cups all-purpose flour
1/2 tsp. salt
1/2 tsp. soda
1 cup rhubarb

Topping: 1/2 tsp. cinnamon, 1/4 cup brown sugar, 1/4 cup chopped nuts

Preheat oven to 325 degrees. Grease bottom of 12-cup muffin pan (or use paper baking cups). Combine brown sugar, oil, vanilla, egg, and buttermilk. Mix well. Stir in dry ingredients. Divide batter evenly among 12 muffin cups. Sprinkle topping over each cup of batter. Bake for 25-30 minutes or until done.

Chocolate Chip Bars

Try making this recipe at least two ways, with 1 cup margarine or substituting 2/3 cup of low-saturated-fat soybean oil. To reduce the fat to 1/4 cup, a substitute ingredient must be added to make up for the fat that was removed. For example, try 1/4 cup oil plus 3/4 cup applesauce. Another alternative is 1/4 cup oil plus 3/4 cup canned pumpkin.

2 1/4 cups all-purpose flour
1 tsp. baking soda
1 tsp. salt
2/3 cup low-saturated-fat soybean oil or 1 cup margarine (softened)
3/4 cup sugar
3/4 cup brown sugar
1 tsp. vanilla
2 eggs
One 12 oz. package chocolate chips
1 cup chopped nuts (optional)

Preheat oven to 350 degrees. Grease a 15 x 10 inch baking pan. Mix oil (or cream margarine) with sugars. Add eggs and vanilla and stir well. Add flour, baking soda, and salt. Mix well. Stir in chocolate chips and nuts. Spread in baking pan and bake for 18 minutes or until done.

Snickerdoodles

Try making this recipe with shortening and then lower the fat by substituting 2/3 cup of low-saturated-fat soybean oil.

1 cup shortening (or 2/3 cup low-saturated-fat soybean oil)	2 3/4 cups all-purpose flour
1 1/2 cups granulated sugar	2 tsp. cream of tartar
2 eggs	1 tsp. soda
	1/4 tsp. salt

Rolling mixture: 2 tablespoons sugar plus 2 teaspoons cinnamon

Preheat oven to 400 degrees. Cream shortening (or mix oil) with sugar. If using oil, stir only until blended – do not overmix. Add eggs. Mix only until blended. Add remaining ingredients and stir only until well blended. Roll dough into balls the size of a small walnut and roll each ball in sugar/cinnamon mixture. Place on ungreased cookie sheets and bake until lightly browned for 8 to 10 minutes. Yields about 50 three-inch cookies.

1. Work with your team to compare the baked goods.

2. Calculate the saturated fat content for the recipe that was used.
   - Read the saturated fat content per serving from the ingredient labels.
   - Determine how the serving size compares proportionately to the amount used in the recipe.
   - Multiply the saturated fat grams per serving by the same proportion. For example: The label lists the serving size as 2 tablespoons that has 8 grams of saturated fat. If 6 tablespoons of the ingredient are used in the recipe, that is three times the serving amount. So the ingredient would add three times the saturated fat, 24 grams, to the recipe.
   - Add the saturated fat amounts contributed by each ingredient in the recipe to arrive at the total saturated fat per recipe
   - Divide the total saturated fat amount in the recipe by the number of servings to determine the saturated fat grams per serving.

3. Design a chart for recording information about your comparisions. Some of the things you might want to include are texture, flavor, aroma, and fat content.

4. Prepare to share your taste test results with the rest of the class and your school food services manager.

Reflecting and Applying

5. How does the low-saturated-fat soybean oil (LoSatSoy™) compare to other types of cooking fats in terms of saturated and unsaturated fats present?

6. How do the baked goods made with low-saturated-fat soybean oil and traditional fats compare in terms of fat content, taste, texture, aroma, etc.?

7. How would you make a decision whether to use low-saturated-fat soybean oil in your baking? What would you need to consider? What are the benefits? the trade-offs?

8. What other ways could you reduce fats in baked goods?

Food Scientist Activity

Objectives

To provide students with experience in planning, conducting, and writing about a food modification experiment that they design. Students will learn how real-life researchers use the scientific method to formulate hypotheses, design experiments that test one variable, keep complete records, and report their findings. This activity could be done as an interdisciplinary activity involving the science, food and consumer science, and language arts departments.

Skills

Life – planning and organizing, problem solving
Science – observing, communicating, comparing, relating, inferring, applying

Materials

Cookbooks or recipes from students' families
Ingredients for recipes selected by students, including low-saturated-fat soybean oil (available on the school commodities list as low-saturated-fat soybean oil or sold under the trademark name LoSatSoy™)
Cooking/baking pans, utensils, and oven/stove for baked or top-of-stove recipes
Student handout 9 on pages 68-69
Student handout 10 on page 70

Procedure

1. Discuss handout 9, "Food Scientist Activity," with the students, and answer any questions.

2. Divide students into groups or pairs, whichever suits the class size. Groups/pairs meet to determine what type of food they wish to modify to be lower in saturated fat by using low-saturated-fat soybean oil. The only restriction is that the original recipe must call for margarine, shortening, butter, or vegetable oil as an ingredient or in the method of preparation (frying, for example). Baked goods, salad dressings, cooked sauces such as spaghetti sauce, or pan-fried foods such as hashbrown potatoes are some possibilities. Students locate an existing recipe(s) for the food they select, or some students may wish to create an original recipe.

3. Students form a hypothesis about what will happen to the taste, texture, aroma, or appearance of the food when the recipe is modified by using low-saturated-fat soybean oil. While planning their food modification experiment, students should keep careful records of the equipment and ingredients that they will need and the procedures that they will follow. Emphasize to students that keeping detailed records will be important when they write their final experiment report.

4. Students submit their ingredient lists and experimental plans to the teacher/leader for approval and ingredients/equipment are readied for the experiment.

5. Students prepare original and modified versions of the same recipe and evaluate the results. Remind the students to make only one modification at a time and compare the modifications to the original recipe that will act as the "control." They may enlist other class members to help evaluate the modified recipe for taste, texture, and other characteristics. Depending on the length of class periods, some foods could be prepared one day and evaluated the next.

6. Student groups/pairs "publish" their research findings by writing their final report as described in the student handout. The final report is evaluated by the teacher/leader. Student groups could also share their research findings with their classmates.

7. Ask the food services manager to visit your class. Have the students share their taste test results. Ask the food services manager to share: what type of oils are being used in your food service and how that decision was made; how they develop menus that are low in fat; and what type of requirements they must meet in terms of fats and calories for student lunches.

Reflecting and Applying

8. How did it feel to be a scientist on a research team? Is this a type of career that you might be interested in for the future?

9. Why are planning and organizing important in doing research?

10. Why is it important for research scientist to share and publish their results?

11. How would you change your research plan if you could do this activity again?

Student Food Scientist Activity
Evaluation of Foods Prepared with Low-Saturated-Fat Soy Oil

Thank you for helping evaluate the performance of low-saturated-fat soybean oil. The new oil is available on the USDA school commodities list as low-saturated-fat soybean oil or is sold in some grocery stores under the trademark name LoSatSoy™.

You as a Food Scientist

As you evaluate the foods you prepare with low-saturated-fat soybean oil, you will practice many of the same procedures for scientific investigation that professional food scientists use. As a student food scientist, you will be expected to:

1. **Plan your food experiment carefully.**
   Pay attention to the details of your experiment. You don't want to be halfway through your experiment and realize that you're missing a key ingredient.

2. **Conduct your food experiment precisely**.
   You should use exact measurements, cooking temperatures, and times. You should conduct your experiment in such a way that other student food scientists could repeat it and achieve the same results that you did.

3. **Keep complete records.**
   A scientist's lab notes are very important. They help a scientist plan a new experiment or repeat a previous experiment exactly the same way as before. Lab notes may be used as evidence to prove which scientist should be given credit for a discovery. As you do your food experiments, you should make notes about the exact ingredients, ingredient substitutions, procedures, temperatures, and times that you used and the results.

4. **Be objective and keep an open mind.**
   Although scientific experiments start with a hypothesis, or educated guess, about what the results will be, true scientists do not try to manipulate the experiment to obain results to fit their hypothesis. Careful scientists make a hypothesis, design an experiment to test their hypothesis, and wait for the actual results before drawing any conclusions.

Planning Your Experiment

1. **Form one or more hypotheses.**
   Possible hypotheses could involve what will happen to the taste, texture, smell, or appearance of food when the new oil is substituted for shortening, melted margarine or butter, or another type of cooking oil in the same, greater, or lesser amounts called for in an existing recipe. You may want to try creating your own lower-saturated-fat recipe using the new oil and other ingredients. You may want to calculate how much saturated fat is in one serving of your modified or newly created recipe.

2. **Design an experiment to test your hypotheses.**
   Select the recipe(s) you will modify to be lower in saturated fat or create your own low-saturated-fat recipe using low-saturated-fat soybean oil. Decide what modifications you will make to test your hypothesis. Your modifications should be made one at a time and compared to the original recipe that will act as your "control." If you make more than one modification at a time, you will not know which change affected your final food product.

   For example, in a cookie recipe, your first modification may be to change a recipe by substituting 2/3 cup of low-saturated-fat soybean oil for each cup of margarine, butter, or shortening called for in the original (control) recipe. A second modification might be to substitute 1/4 cup of low-saturated-fat soybean oil plus 3/4 cup applesauce for each cup of margarine, butter, or shortening called for in the original recipe. A third modification could be to substitute 1/4 cup of low-saturated-fat soybean oil plus 3/4 cup canned pumpkin for each cup of margarine or oil called for in the original recipe. Other modifications that you can make to lower fat in a recipe include using egg substitutes or egg whites for eggs or reducing the amount of fatty ingredients like chocolate chips.

   Be sure you know what ingredients, utensils, and other supplies you will need well in advance of the class period in which you will conduct your experiment. If you are working in a group, mutually agree on what each person will do during the experiment.

Conducting Your Experiment

1. **Conduct your experiment**. Follow the experiment plans that you designed in the previous step as closely as possible. If you have to make changes, be sure to record them in your lab notes.

2. **Evaluate the resulting food product.** Rate the taste, appearance, texture, aroma, saturated fat content, or any other characteristics that your teacher wants you to include. Record your findings in your lab notes.

"Publishing" Your Research Findings

1. **Write about your research findings.** Writing is very important in science. Professional food scientists write about their research findings and submit them for publication to professional journals.

   You will use your lab notes to write your final report. In your final report, be sure to include your hypothesis, how you tested your hypothesis, the results, and your recommendations. If you modified a recipe, be sure to include the original recipe and your modifications.

2. **Submit your final report.** Attach the cover sheet on the next page to your experiment report and give the report to your teacher for his/her evaluation.

Cover Sheet for Experiment Final Report

Date _____

Teacher name: _____

Class (Example: Foods III)_____

Name(s) of student food scientist(s) in your group:

_____

_____

_____

_____

_____

_____

_____

Attach your final experiment report and give to your teacher for evaluation.

For More Information About Dietary Fats and Oils

American Academy of Family Physicians

Booklets, Brochures, and Pamphlets
Cholesterol: What You Can Do to Lower Your Level

Order from the American Academy of Family Physicians, 8880 Ward Parkway, Kansas City, MO 64114, phone 1-800-944-0000, e-mail fp@aafp.org. The AAFP also provides health information online at http://www.aafp.org and http://www.healthanswers.com.

American Dietetic Association

Books
Cut the Fat!
Skim the Fat: A Practical and Up-To-Date Food Guide

Curriculum Resource Packages
Project LEAN (Low-fat Eating for Americans Now)
Quick and Easy Low-Fat Cooking

Booklets, Brochures, and Pamphlets
Growing Up Healthy: Fat, Cholesterol, and More
Heart-Healthy Eating for Children
The New Cholesterol Countdown
Pocket Supermarket Guide
Understanding Food Labels

Fact Sheets
The ABC's of Fats Oils, and Cholesterol
Reducing the Fat in Baked Goods
What Are Triglycerides?

Slides
Learning the New Food Labels: An Educator's Slide Kit

For a catalog and complete ordering information, contact the American Dietetic Association, 216 W. Jackson Boulevard, Chicago, IL 60606-6995, phone 1-800-877-1600 ext. 5000. The ADA web site is located at http://www.eatright.org.

American Heart Association

Booklets, Brochures, and Pamphlets

An Eating Plan for Healthy Americans
Cholesterol and Your Heart
Step by Step: Eating to Lower Your High Blood Cholesterol (Produced in cooperation with the National Heart, Lung, and Blood Institute.)

Call 1-800-MYHEART (694-3278) for free brochures about women's risks of heart disease.
Take Charge! A Woman's Guide to Fighting Heart Disease
Take Charge! A Woman's Guide to Fighting Stroke

Medical/Scientific Statements

Trans Fatty Acids, Plasma Lipid Levels, and Risk of Developing Cardiovascular Disease
Publications are available from the American Heart Association, Public Information, 7272 Greenville Avenue, Dallas, TX 75231-4596 or by phoning 1-800-242-8721. The AHA web site is located at http://www.amhrt.org.

The American Society for Clinical Nutrition

Publications

Fats and Oil Consumption in Health and Disease: Current Concepts and Controversies. Proceedings of a symposium held at The Rockefeller University, New York, April 24-25, 1995, and published as a supplement to *The American Journal of Clinical Nutrition*. Order from *The American Journal of Clinical Nutrition*, 9650 Rockville Pike, Bethesda, MD 20814-3998, telephone (301) 530-7038, fax 301-571-8303.

Harvard Medical School

Articles

"Dietary Fat Reconsidered," (no author). *Harvard Women's Health Watch*, March 1998, p. 6.

Iowa State University Extension

Publications

Biotechnology Information Series NCR 483, 487, 488, 492, 529, 550, 551, 552, 553, 554, 557
Cholesterol Guidelines for Children NCR 431
Cholesterol in Your Body NCR 332
Do you want to...feel better? lose weight? stay healthy? NCR 560
Foods and Your Cholesterol NCR 334
Guide to Low Cholesterol Foods NCR 335
How to Eat Less Fat NCR 336
How to Eat Out without Raising Your Cholesterol NCR 337
What You Should Know About Triglycerides and Fatty Acids NCR 333

Order from ISU Extension Distribution Center, 119 Kooser Drive, Iowa State University, Ames, IA 50011, phone 515-294-5247, fax 515-294-2945, or e-mail pubdist@exnet.iastate.edu.

Krames Communications

Booklets, Brochures, and Pamphlets
Low-Fat Eating

Order from Krames Communications, 1100 Grundy Lane, San Bruno, CA 94066-3030, phone 1-800-333-3032.

National Institutes of Health—National Heart, Lung, and Blood Institute

Booklets, Brochures, and Pamphlets
Check Your Cholesterol and Heart Disease I.Q.
Eat Right to Lower Your High Blood Cholesterol
Eating with Your Heart in Mind (7 to 10 Year Olds)
The Healthy Heart Handbook for Women
Heart Health...Your Choice (11 to 14 Year Olds)
Hearty Habits: Don't Eat Your Heart Out (15 to 18 Year Olds)
Live Healthier, Live Longer: Lowering Cholesterol for the Person with Heart Disease
Parents' Guide: Cholesterol in Children Is a Family Affair
So You Have High Blood Cholesterol
Step by Step: Eating to Lower Your High Blood Cholesterol

Curriculum Resource Packages
Child and Adolescent Trial for Cardiovascular Health (CATCH) curriculum for grades 3-5

Fact Sheets
Facts About Blood Cholesterol

Facts About Heart Disease and Women: Self-Help Strategies for a Healthy Heart – Reducing High Blood Cholesterol

Order from NHLBI Information Center, P.O. Box 30105, Bethesda, MD 20824-0105, phone 301-251-1222, fax 301-251-1223.

National Science Teachers Association

Articles
"Food for Thought: A Comparison of Dietary Fat in Western and Inuit Diets," by Brian Murfin. *The Science Teacher*, March 1998, p. 42-45.

Society for Nutrition Education

Articles
The Society for Nutrition Education publishes the *Journal of Nutrition Education* that regularly features teaching activities called Great Educational Materials (GEMS). Some of these GEMS deal with dietary fats and oils. For example:

"Heart Smart Nutrition Education" by Lou Kupka-Schutt, Ph.D., R. D. *Journal of Nutrition Education*, 24:94A, 1992. An example of a community-wide nutrition education program in one Washington state county where about half the deaths resulted from cardiovascular disease.

"New Food Product Workshop" by Judith Eaton, M.S., et al. *Journal of Nutrition Education*, 24:50C, 1992. How to present sessions about new reduced-fat or fat-free products that can be used as substitutions or replacements for traditional fattier versions.

Books

The Nutrition Idea Book, Patricia Britten, editor, is a collection of 188 Great Educational Materials (GEMS) that appeared in the *Journal of Nutrition Education* from 1988-1992. To order, contact Guen Brown, GEMS, WVU Extension Service, P.O. Box 6031, Morgantown, West Virginia 26506-6031, phone 304-293-2694, e-mail gbrown2@wvu.edu.

Computer Resources

Visit the Iowa State University Office of Biotechnology homepage at http://www.biotech.iastate.edu for an up-to-date Internet listing of sites related to nutrition and biotechnology and foods. In the list below, "S" designates sites primarily for students, "T" designates sites primarily for teachers, and "S/T" notes sites for both.

S/T American Dietetics Association
http://www.eatright.org
Excellent site for information on biotechnology and foods, along with nutrition.

S/T Pub Med
http://www.nlm.nih.gov/
Click on "Search MEDLINE" to arrive at a site for advanced student research.

S/T American Heart Association National Center
http://www.americanheart.org
Search for information on fats, fat substitutes, and trans fatty acids.

S/T Fast Food Facts Interactive Food Finder
http://www.olen.com/food/
Nutrition information from a variety of restaurants.

T Education and Nutrition Web Sites for Early Childhood and K-12
http://www.sfu.ca/~jfremont/educationsites.html
Information on resources and activities.

T Minnesota LunchPower
http://www.nal.usda.gov/fnic/schoolmeals/Recipes/minnesota.html

T Dining on DNA
http://www.gene.com/ae/AB/IWT/DODpub/index.html

T Tufts University Nutrition Navigator
http://navigator.tufts.edu/index.html
Rates a variety of nutrition sites.

S Kids Food CyberClub Home Page
http://www.kidsfood.org/
Interactive page for students.

S/T International Food Information Council Foundation (IFIC)
http://ificinfo.health.org/
Keyword search using biotechnology and fats will provide direct contacts to research articles.

T The American School Food Service Association (ASFSA)
http://www.asfsa.org/
Information on resources available to food services managers.

S/T Food and Nutrition Information Center
http://www.nal.usda.gov/fnic/

S/T Agbiotech Newsletter
http://www.bowditchgroup.com
Brief weekly updates on current events in biotechnology.

S/T Citizen's Guide to Biotechnology
http://www.bio.org/whatis/guidecit.html
Information on current and developing biotechnology products and the state of the industry.

S/T Center for Science in the Public Interest
http://www.cspinet.org
Information on issues and biotechnology.

S/T Natural Foods Merchandiser Online
http://www.nfm-online.com
Key word search on biotechnology will provide biotechnology issues information.

S/T Monsanto – Food Biotechnology is a Matter of Opinions
http://www.monsanto.co.uk
Information on food and biotechnology with a connection to a variety of sites from both sides of the issue.

S/T Fat Free Pringles
http://fatfree.Pringles.com
Information on the Olean® cooking oil and snack products.

Possible New Food Products for Future Foods, Inc.

Tomato Number One – This tomato has its flavor enhanced by a gene that makes it slow to ripen. Your tomatoes would not need to be picked green and could stay on the grocery shelf longer.

Tomato Number Two – The tomato resists insects so chemical insecticides would not need to be used. You could make this product by cross-breeding your plants with a poisonous wild tomato plant that is found in South America.

Corn – The corn is resistant to insects so that chemical insecticides would not need to be used.

Potato – This potato is higher in starch and absorbs less oil during frying.

Rice – The rice has more nutrients.

Soybean Number One – These soybeans produce cooking oil that is lower in saturated fat.

Soybean Number Two – These soybeans have a milder flavor and are easier to digest.

Nutriceuticals – Plants such as bananas would contain vaccines to prevent disease.

Vegetable Oil – The cooking oil adds no calories or fat.

Sugar Substitutes – The product uses a microbe to produce amino acids for aspartame sweetener.

Hormones – These can be given to pigs to produce leaner meat or to cows to produce more milk.

Mystery Product – Use your imagination and determine your own potential food product.

Research Team Questions for Future Foods, Inc.

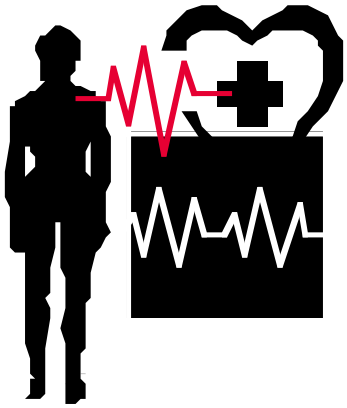
1. What type of modification or change would consumers want in their food?

2. Are the genes for making the modification available?

3. Will consumers buy the product? Will the changes make the food too expensive?

Overhead Master #2

Why should I care about the fat I eat?



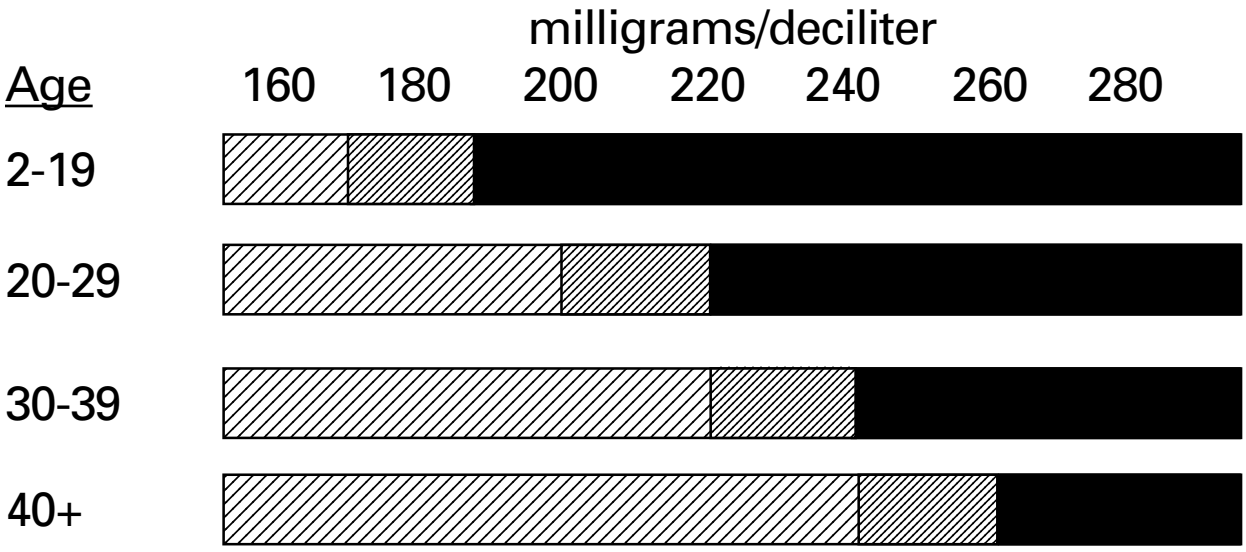
Heart disease is the number one cause of death for both men and women in the United States.

- The higher your blood cholesterol level, the greater your risk of developing heart disease.
- Cholesterol is a waxy substance that circulates in your blood.
- The fat you eat can raise your blood cholesterol level.

Overhead Master #3

Total Blood Cholesterol Levels

Doctors measure blood cholesterol to determine your risk for heart disease.



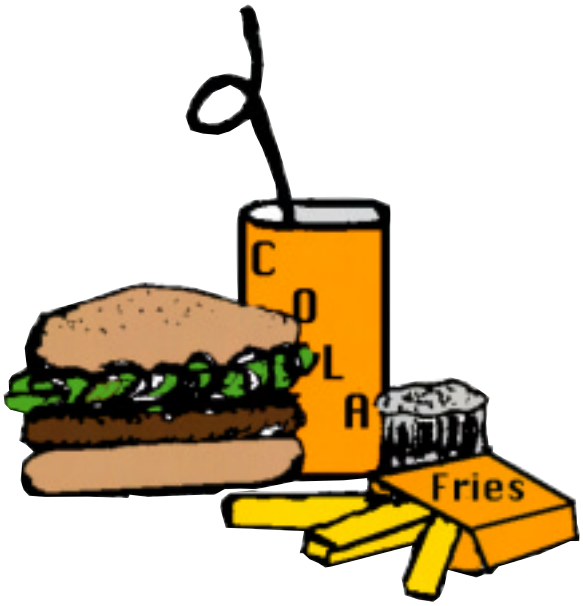
Source: Adapted from Guide to Low Cholesterol Foods, NCR Extension Publication 335.

- Low risk
- Moderate risk
- High risk

Overhead Master #4

What does cholesterol have to do with what I eat?

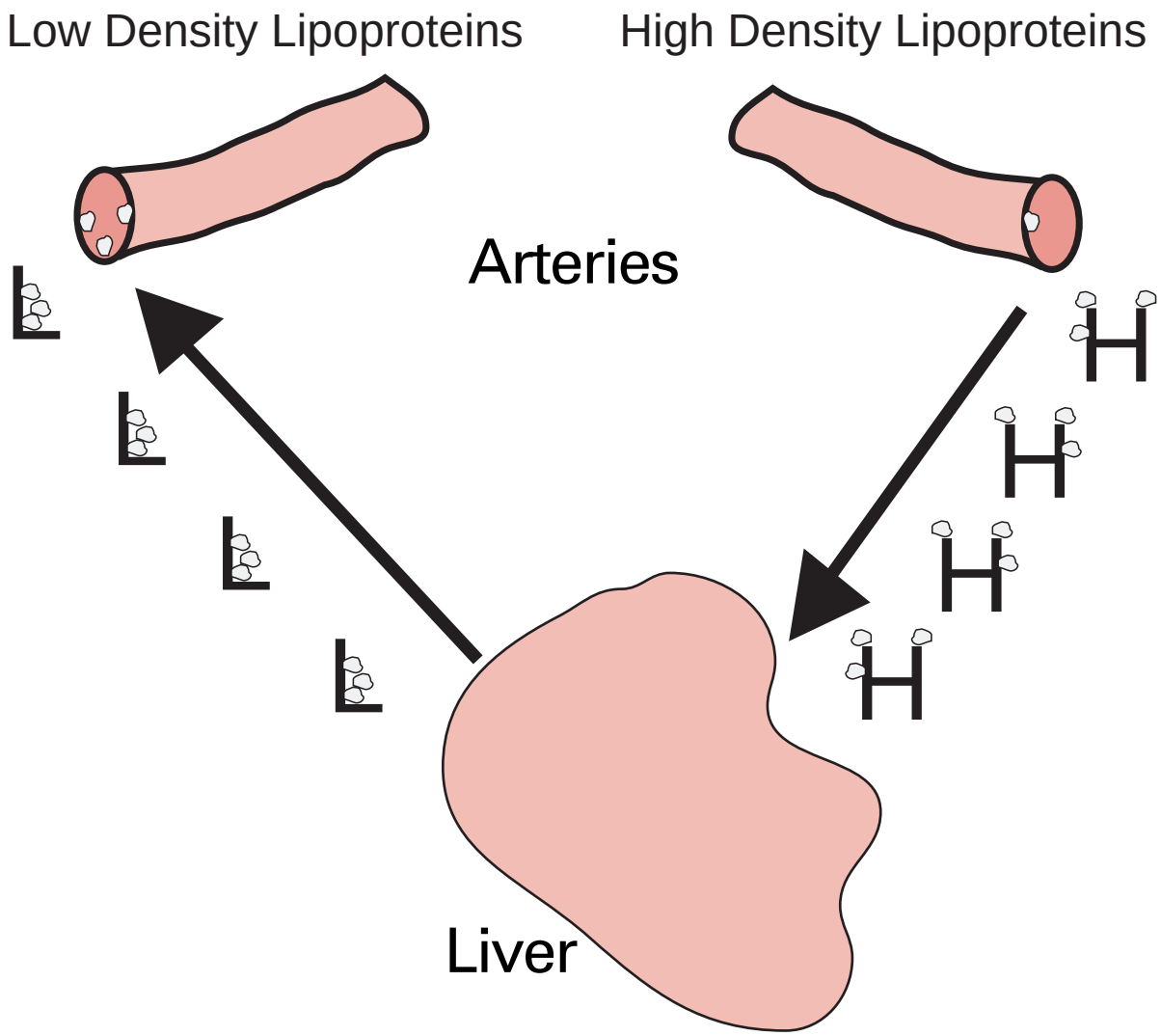
- Your body already makes all the cholesterol that you need. You don't need any cholesterol from your food.
- The saturated fat that you eat raises your blood cholesterol.



Overhead Master #5

HDLs and LDLs

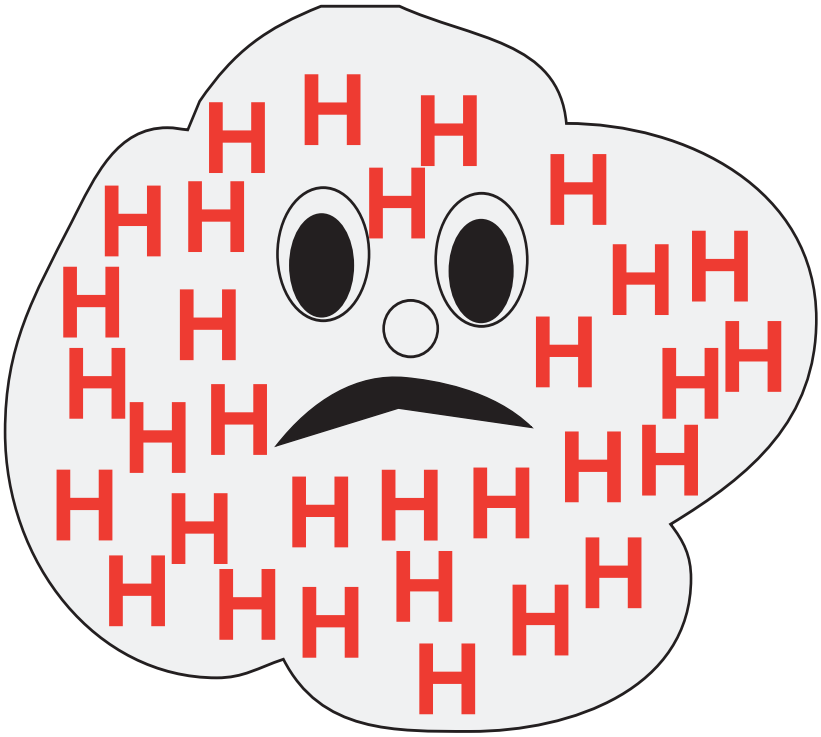
- LDLs carry cholesterol from the liver to the body and leave deposits on blood vessel walls.
- HDLs carry cholesterol back to the liver for elimination.

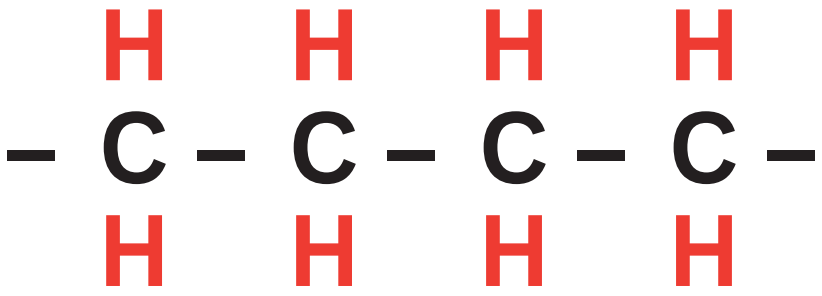


Overhead Master #6

What are the facts about saturated fat?

- If the carbon atoms (C's) in a fat have all the hydrogen atoms (H's) that they can hold, the fat is saturated.

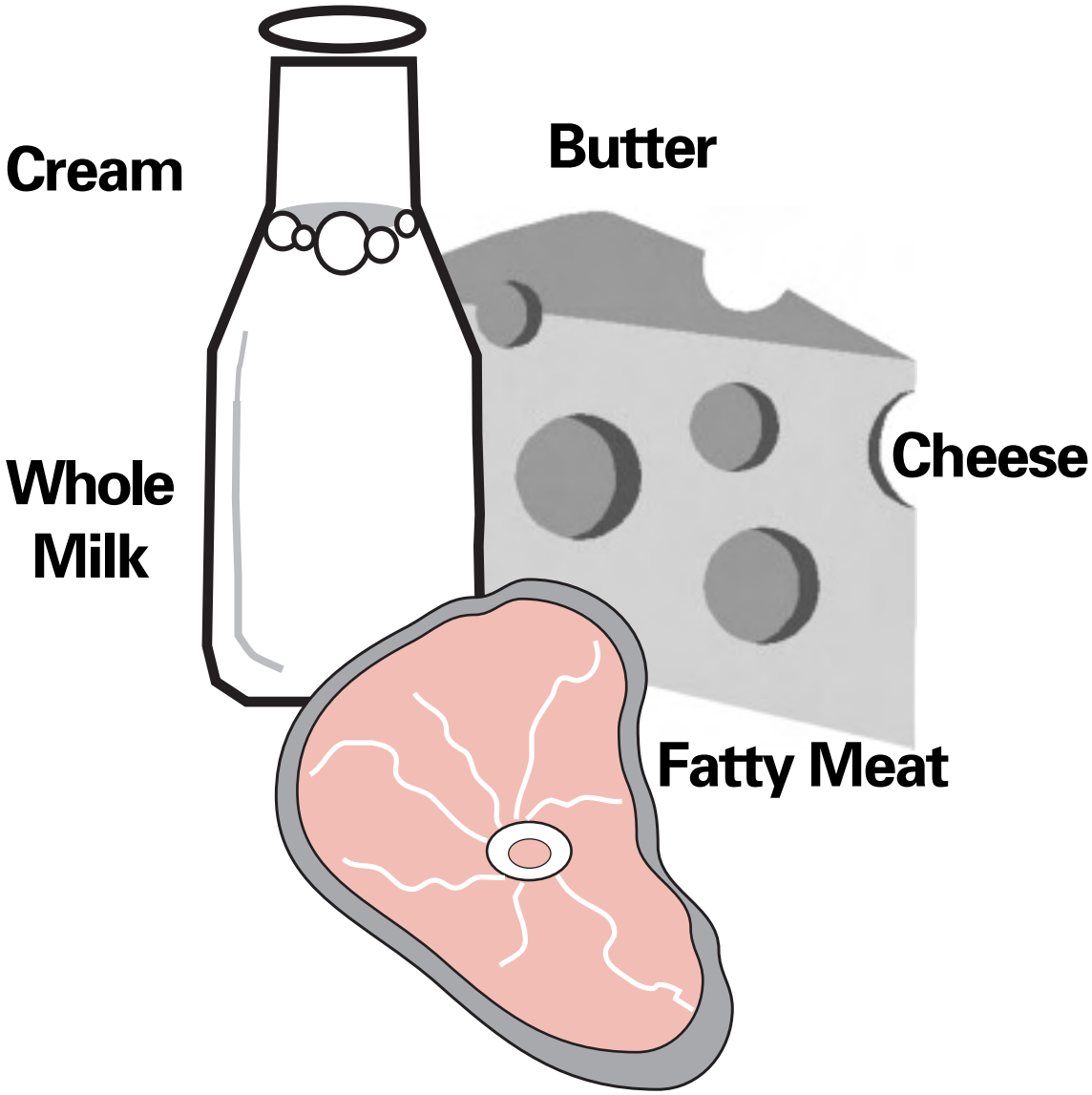




Overhead Master #7

Animal Sources of Saturated Fat

In the average American diet, animal products are a major source of saturated fat.



Overhead Master #8

Vegetable Sources of Saturated Fat

Some vegetable oils are high in saturated fat. These oils are found in many store-bought baked goods and snack foods.

Palm

Coconut

Palm kernel

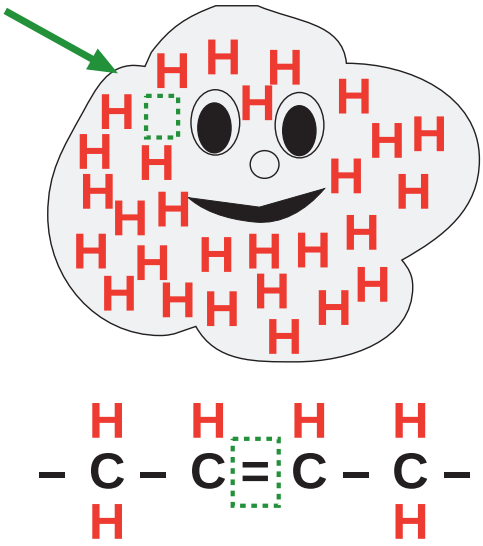
Overhead Master #9

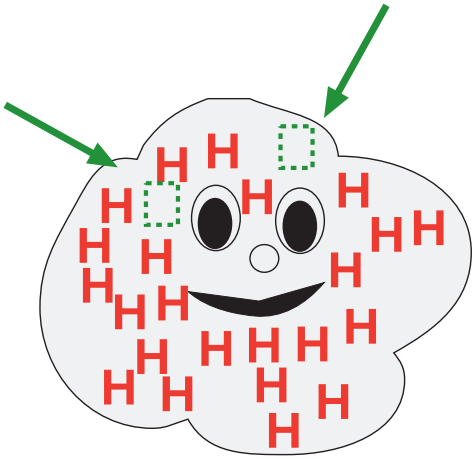
What are unsaturated fats?

- Unsaturated fats are classified as either:

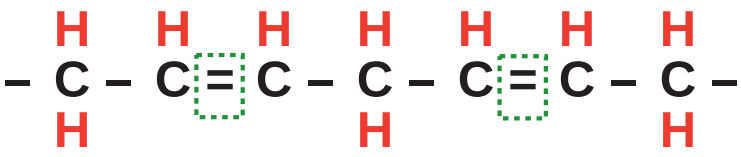
  a. **Monounsaturated**
  b. **Polyunsaturated**

- A **monounsaturated** fat has one site where hydrogen atoms can be added.



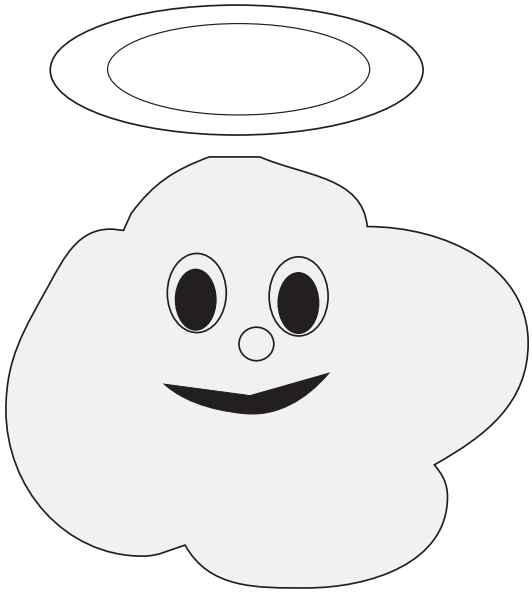


- A **polyunsaturated** fat has two or more sites where hydrogen atoms can be added.



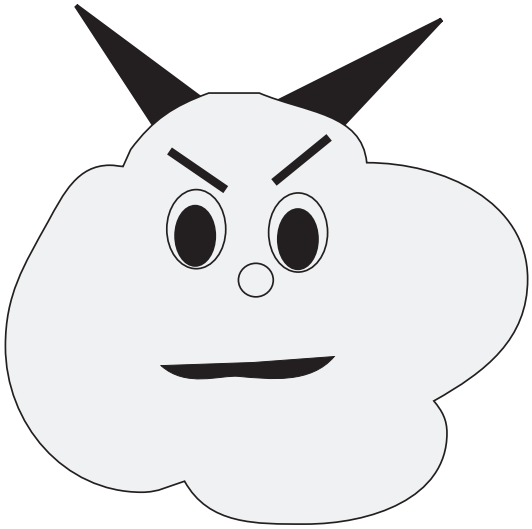
Overhead Master #10

Dietary Fat



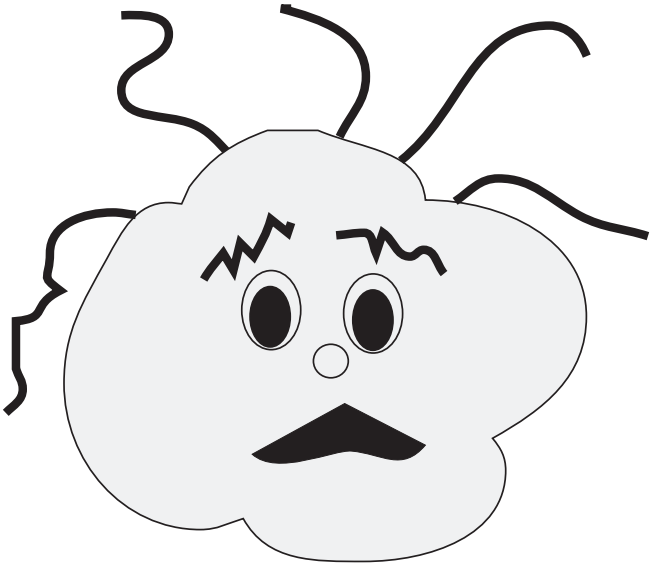
THE GOOD

Polyunsaturated fats
Monounsaturated fats



THE BAD

Saturated fats

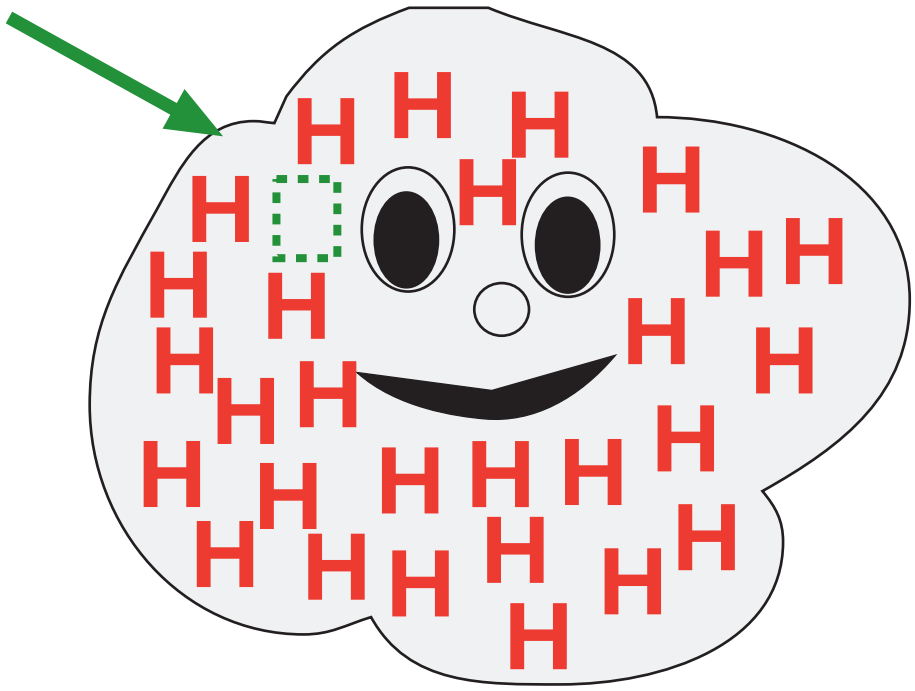


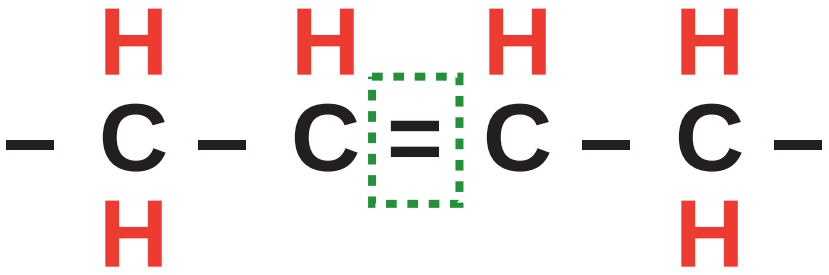
THE UGLY

Trans unsaturated fats

Overhead Master #11

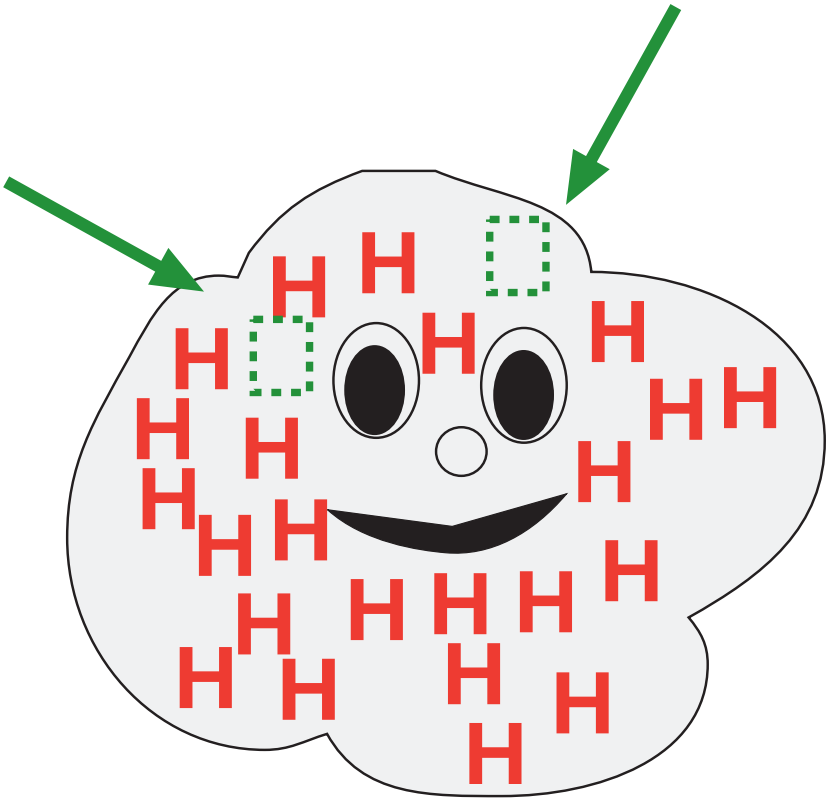
Monounsaturated Fat

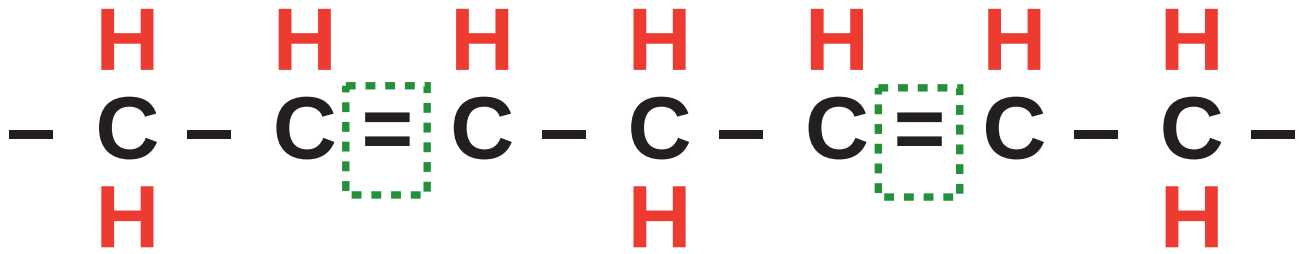




Overhead Master #12

Polyunsaturated Fat





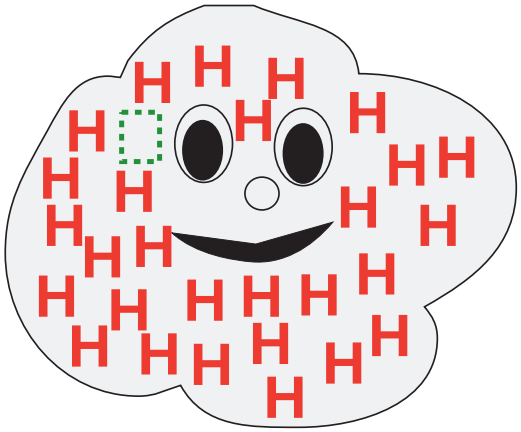
Overhead Master #13

Sources of Unsaturated Fats

- Unsaturated fats commonly are found in plant products.

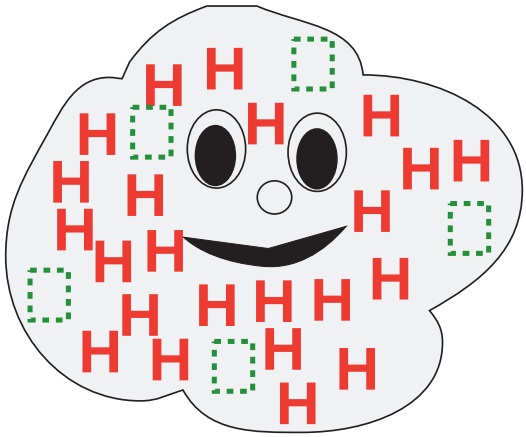
- They can help lower the cholesterol levels in your blood when you substitute them for saturated fats.

Sources of Monounsaturated Fat



Canola oil
Nuts
Olive oil

Sources of Polyunsaturated Fat



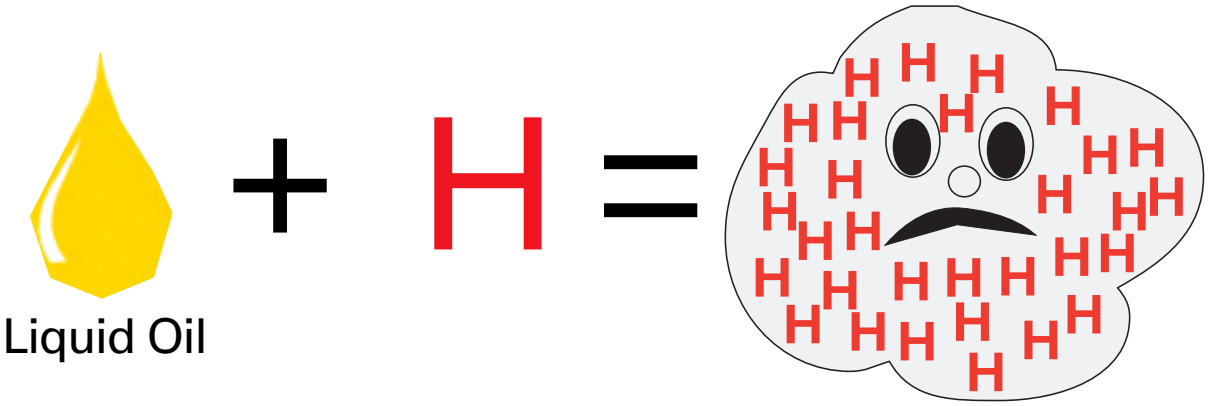
Corn oil
Safflower oil
Sesame oil
Soybean oil
Sunflower oil

Overhead Master #14

What is hydrogenation?

- Vegetable oils that are not naturally saturated may become saturated through a manufacturing process called hydrogenation.

- Hydrogenation adds hydrogen atoms to fats to make them solid, like shortening or butter, at room temperature and extend their shelf life.



Liquid Oil

Saturated Fat

Overhead Master #15

What are trans fatty acids?

- The process of hydrogenation creates trans fatty acids, also called trans fats.
- The natural "cis" structure of a fatty acid may be twisted at the site where hydrogen is added into a distorted "trans"structure.
- Scientific evidence is mounting that eating large amounts of trans fats may cause blood cholesterol levels to rise.
- The American Heart Association recommends using unhydrogenated oils when possible.

\+ H =

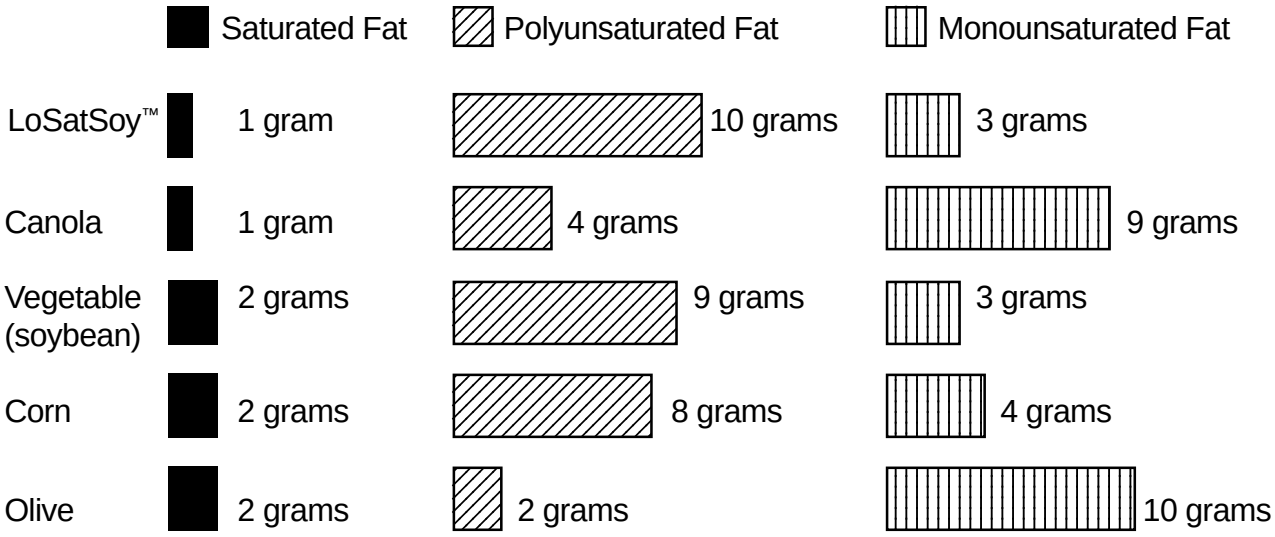
Liquid Oil

TRANS

Overhead Master #16

Comparing the Types of Fat in Vegetable Oils

Here is how low-saturated-fat soybean oil (LoSatSoy™) compares with other vegetable oils.



Note: Average values for national brands. 14 grams total fat per tablespoon. Grams per tablespoon are rounded.

Overhead Master #17

Cooperative Extension Service, Iowa State University of Science and Technology, and the United States Department of Agriculture cooperating. Stanley R. Johnson, director, Ames, Iowa. Distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914.