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Data Back Ban of Artificial Trans Fats

SOCIETY FOR SCIENCE & THE PUBLIC

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About this Issue

The article "Data back ban of artificial trans fats" (10.8 readability score) summarizes new research showing that banning artificial trans fats in foods could reduce the risk of heart attacks and strokes. Students can focus on details reported in the article, follow connections to earlier articles about trans fats research, engage in a classroom discussion of related scientific and government policy questions and make connections between the science of food and their health. Students can also conduct their own experiments to analyze foods for fats and then research the types of fats within different foods to make recommendations about dietary consumption.

Want to read more about trans fats? Check out "Why trans fats became a food villain" (7.1 readability score) in *Science News for Students*. Power Words are defined at the end of the *Science News for Students* article.

Connections to Curricula:

- Polar vs. nonpolar solvents
- Biochemistry of lipids
- Trans vs. cis isomers
- Cardiovascular system
- Cardiovascular diseases
- Food and Drug Administration
- Government policy and restrictions
- Physiology
- Health

Looking for a STEM-related career that will let you influence the food supply? Check out Cool Jobs: Finding food for the future by *Science News for Students*.

What's in this Guide?

- Article-Based Observation: These questions focus on reading and content comprehension by drawing on information found in the article "Data back ban of artificial trans fats." Questions focus on the data collected and analyzed in the study, and the potential health implications of eliminating artificial trans fats from the human diet.
- Quest Through the Archives: With Internet access and your school's digital access to *Science News*, your students can use this short section to explore other articles about trans fats and their effects on human health as reported by *Science News* since 1924.
- Cross-Curricular Discussion: These questions and extension prompts relate to the article "Data back ban of artificial trans fats" and encourage students to think in more detail about lipids, their hydrogenation and related scientific areas. The section is divided roughly by science discipline for educators who would like to focus on one particular topic. Some of the extension prompts are topic-specific, and others are more conceptually advanced. **Chemical and Physical Sciences** questions involve the structures and related properties of different types of fats and other types of lipids. **Biological Sciences** questions concern the mechanisms by which trans fats can cause cardiovascular

disease. **Experimental Design and Public Policy** questions allow students to conduct research or develop their own opinions regarding what should be done about foods containing trans fats or potentially harmful levels of other substances. An interactive discussion and writing activity are also suggested.

- Activity: Students can conduct their own experiments to analyze a variety of foods for the presence of fats. Students can also research the types of fats that foods contain and relate their findings to human health.

Standards Alignment

Next Generation Science	Common Core
Matter and Its Interactions: HS-PS1-2, HS-PS1-4	ELA Standards: Reading Informational Text (RI): 1, 2, 4, 5, 7
From Molecules to Organisms: Structures and Processes: HS-LS1-2, HS-LS1-3, HS-LS1-6, HS-LS1-7	ELA Standards: Writing (W): 1, 2, 4, 7
Engineering Design: HS-ETS1-1, HS-ETS1-2, HS-ETS1-3	ELA Standards: Speaking and Listening (SL): 1, 2, 3, 4, 6, 9
	ELA Standards: Reading for Literacy in Science and Technical Subjects (RST): 1, 2, 3, 4, 5, 7, 8, 9
	ELA Standards: Writing Literacy in History/Social Studies and Science and Technical Subjects (WHST): 1, 2, 4, 6, 7, 9

SN IN HIGH SCHOOLS

May 13, 2017

Data Back Ban of Artificial Trans Fats

Article-Based Observation

Directions: Read the article "Data back ban of artificial trans fats" and then answer these questions:

1. **What is the overall significance of the recent *JAMA Cardiology* report on hospital admission data for counties in New York state that did and did not restrict trans fat use?**

2. **What has past research found are some health-related effects of consuming foods that contain trans fats, or trans-fatty acids, as mentioned in the article?**

3. **According to the article, what are typical foods that contain trans-fatty acids, and what is the source of the trans fats in these foods?**

4. **New York City, followed by a number of New York counties, began restricting artificial trans fats in 2007. Eric Brandt and his colleagues examined changes in cardiovascular health that followed these restrictions. Describe the design of their study and what they found.**

5. **Cardiologist Dariush Mozaffarian outlines the U.S. Food and Drug Administration's determination about partially hydrogenated oils and the upcoming actions. What does he say that the FDA ordered, and why is this study important to that future policy?**

6. **Does Brandt's study find that the New York trans fats restriction policy *caused* a decrease in cardiovascular events in counties with restrictions? Explain.**

7. **Pick your favorite social media platform, and design a post to inform others about the study described in the article.**

8. **Would a ban on trans fats stop particular foods that contain these fats, such as margarine and crackers, from being sold? Why or why not?**

9. **Would a ban on trans fats succeed in making foods that contain these fats healthier to eat? Why or why not?**

SN EDUCATOR GUIDE

May 13, 2017

Data Back Ban of Artificial Trans Fats

Responses to Article-Based Observation

1. **What is the overall significance of the recent *JAMA Cardiology* report on hospital admission data for counties in New York state that did and did not restrict trans fat use?** Possible student response: According to epidemiologist Frank Hu, this study is significant because it is the first to link a trans fat restriction policy to a reduction in heart disease and stroke for a large population. The study's findings also suggest that a nationwide ban of trans fats by the U.S. FDA in 2018 could have large-scale health benefits.

2. **What has past research found are some health-related effects of consuming foods that contain trans fats, or trans-fatty acids, as mentioned in the article?** Possible student response: Past research has shown that consuming foods containing trans fats increases the risk of coronary disease and raises levels of low-density lipoprotein cholesterol in the blood.

3. **According to the article, what are typical foods that contain trans-fatty acids, and what is the source of the trans fats in these foods?** Possible student response: Deep-fried fast food, baked goods, margarine and crackers often contain trans-fatty acids, because they are often prepared with partially hydrogenated vegetable oils.

4. **New York City, followed by a number of New York counties, began restricting artificial trans fats in 2007. Eric Brandt and his colleagues examined changes in cardiovascular health that followed these restrictions. Describe the design of their study and what they found.** Possible student response: Brandt and his colleagues analyzed data from 11 counties that had restrictions on artificial trans fat and 25 counties that did not. They learned that hospital admissions rates for heart attacks and strokes in the counties where trans fats had been banned dropped 6.2 percent beyond expected population trends. Brandt and his colleagues also separated data for heart attacks and strokes in the counties with bans and found that heart attack rates had dropped. Brandt states that it is likely that the decline in heart attacks is due to artificial trans fats restrictions.

5. **Cardiologist Dariush Mozaffarian outlines the U.S. Food and Drug Administration's determination about partially hydrogenated oils and the upcoming actions. What does he say that the FDA ordered, and why is this study important to that future policy?** Possible student response: The FDA has ordered that U.S. food manufacturers ensure that their products are free of partially hydrogenated oils, which include trans fats, by June 2018. Mozaffarian states that this study supports the FDA's action to ban trans fats.

6. **Does Brandt's study find that the New York trans fats restriction policy *caused* a decrease in cardiovascular events in counties with restrictions? Explain.** Possible student response: Brandt's study found an association between restrictions on trans-fatty acid consumption and a decrease in hospitalization for cardiovascular events. Even though the study controlled for population trends in health, among other variables in the counties, other differences could have developed over time in the counties studied. Therefore, the data from the study alone does not prove causation. However, when the correlation between trans fat bans and cardiovascular events is considered along with data linking the consumption of trans fats to coronary heart disease, a stronger case for causation can be made.

7. **Pick your favorite social media platform, and design a post to inform others about the study described in the article**. Possible student response: I would post on Facebook a picture of my favorite food that contains trans fats, such as a Krispy Kreme doughnut, and the text: "And by June of 2018, the FDA will make this food free of trans fats and possibly healthier to eat! This trans fats ban may even lead to fewer heart attacks and strokes across the U.S., according to a recent study."

8. **Would a ban on trans fats stop particular foods that contain these fats, such as margarine and crackers, from being sold? Why or why not?** Possible student response: No, a ban would require food manufacturers to ensure that their products do not contain partially hydrogenated oils, but they could replace these oils with others that do not contain trans fats.

9. **Would a ban on trans fats succeed in making foods that contain these fats healthier to eat? Why or why not?** Possible student response: Not necessarily. It depends on what ingredient is added to the food to replace the source of the trans fat (likely partially hydrogenated oil). For example, if fat is taken out of the food, is it replaced by extra sugar and salt to try to maintain a similar taste?

SN EDUCATOR GUIDE

May 13, 2017

Data Back Ban of Artificial Trans Fats

Quest Through the Archives

Directions: After reading the article "Data back ban of artificial trans fats," use the archives at www.sciencenews.org to answer these questions:

1. **What are trans fats? Search for a *Science News* article that gives a general overview of what these substances are and describe their chemical and physical properties.**

2. **Search for a *Science News* article describing a "good" trans fat. Explain how the FDA might consider this information for their upcoming ban.**

3. **The U.S. Food and Drug administration is responsible for implementing the future ban on artificial trans fats. Search for a *Science News* article that describes another recent FDA ban. Explain.**

SN IN HIGH SCHOOLS

May 13, 2017

Data Back Ban of Artificial Trans Fats

Responses to Quest Through the Archives

1. **What are trans fats? Search for a *Science News* article that gives a general overview of what these substances are and describe their chemical and physical properties.** Possible student response: The article "Trans Fats," published 11/10/2001, tells us that trans fats transform vegetable oil into solid substances that are found in many foods. Fats get their name from the pattern of carbon chains in their molecules. A trans fat looks like a zigzag because it includes a double bond that creates a bend in the chain. To make oil solid, some of the double bonds are hydrogenated, creating single bonds. The resulting trans structure allows the molecules to stack and therefore become more dense. Unsaturated fats, such as those in corn oil, have a lower melting point and are liquid at room temperature, while saturated fats such as those in margarine are solid at room temperature.

2. **Search for a *Science News* article describing a "good" trans fat. Explain how the FDA might consider this information for their upcoming ban.** Possible student response: The article "This trans fat is vindicated," published 7/28/2008, discusses a natural trans fat called conjugated linoleic acid, or CLA, which can help fight cancer, weight gain, diabetes and arthritis. The article mentions that companies producing products containing CLAs have petitioned the FDA for a "generally regarded as safe" status for their products. The FDA may want to include an exemption in their ban for CLAs if they are generally considered to be safe.

3. **The U.S. Food and Drug administration is responsible for implementing the future ban on artificial trans fats. Search for a *Science News* article that describes another recent FDA ban. Explain.** Possible student response: The article "FDA bans chemicals in antibacterial soap," published 9/2/2016, discusses the FDA's recent ban on antibacterial soap products containing any of 19 specific active ingredients. The FDA asked antibacterial soap companies to present data that proved their products were safe to use every day and more effective than traditional soap. Research has suggested that some antibacterial ingredients, such as Triclosan, are associated with exposure to toxic compounds, so many soap companies have already removed it from their recipes.

SN EDUCATOR GUIDE

May 13, 2017

Data Back Ban of Artificial Trans Fats

Cross-Curricular Discussion

After students have had a chance to review the article "Data back ban of artificial trans fats," lead a classroom discussion based on the questions that follow. You can copy and paste only the questions that apply to your classroom into a different document for your students.

Chemical and Physical Sciences

Discussion Questions:

1. **Describe the chemical structure and general properties of lipids.** [*Lipid molecules include fatty acids, triglycerides, cholesterols and other molecules. They all contain a long hydrocarbon chain: a "tail" containing many carbons (C) and hydrogens (H), and a carboxylic acid "head" made of a carbon double-bonded to an oxygen and single-bonded to an hydroxyl group. Given this chemical structure, lipids don't typically have much electrical charge or electrical polarity, whereas water molecules (H_2O) are very polar (partially negative oxygen and partially positive hydrogens). Because the nonpolar tail is much longer than the polar head, lipids are hydrophobic and act as effective barriers to more polar molecules. Lipids will float on the top of water, form clumps in water and do not dissolve in water. That's why you have to use soap (another lipid) to get rid of greasy residue, instead of simply rinsing with water. Lipids are important in biology and form the outer membranes of cells. Lipids in soap and in cell membranes have charged phosphates connected to one end, so they have intermolecular attraction to water molecules.*]

2. **What is the chemical difference between saturated and unsaturated fatty acids? What does monounsaturated versus polyunsaturated mean?** [*Saturated fatty acids are saturated with as many hydrogens as their carbon backbones can hold; the carbons just have single bonds between each other. Unsaturated fatty acids have fewer hydrogens bonded to the carbon backbone, because some of the carbons have double or even triple bonds between them. Monounsaturated fats contain only one double bond in the carbon chain, and polyunsaturated fats contain more than one double bond.*]

3. **Are trans fats saturated or unsaturated fatty acids, and where do they come from in foods?** [*Trans fats are a type, or one isomer, of unsaturated fatty acid. Most natural unsaturated fats in foods are in the cis form, as opposed to the trans form (though natural trans fats do exist). Trans fats in food generally come from artificially produced partially hydrogenated vegetable oils that are used in cooking, especially for fast food.*]

Extension Prompts:

4. **What are isomers? Explain the difference between cis and trans isomers.** [*Isomers are two or more molecules with the same chemical formula but a different arrangement of atoms (either by structural connectivity or spatial arrangement). Cis and trans isomers create different spatial arrangements of atoms.*

In the cis conformation, the hydrogens bonded to the two double-bonded carbons are on the same side of the double bond, which bend the carbon chain segments on either side of the double bond toward each other, creating a "kink" in the molecule. In the trans conformation, the hydrogens bonded to the two double-bonded carbons on either side of the double bond from each other. In this conformation, the two parts of the carbon chain go away from one another, creating a long, linear molecule. If a molecule kit is available to build the structures illustrating the different structures of trans and cis unsaturated fats, then have groups of students build the molecules.]

5. **Saturated fats and trans fats tend to have a higher melting point than unsaturated fats. Explain the difference in their physical properties based on their differences in molecular structure.** [*Generally, the greater the saturation, the lower the melting point. But a molecule in the trans conformation will have a higher melting point than a molecule with the same number of double bonds in the cis conformation. Saturated fats and trans unsaturated fats are more dense than cis unsaturated fats, because the molecules of cis unsaturated fats tend to be less linear in nature and don't stack together as well.*]

6. **What is the hydrogenation process, and what does it have to do with trans fats?** [*Many trans fats are added to food because the foods are prepared with partially hydrogenated vegetable oil. The hydrogenation process forces hydrogens to saturate double bonds. Partial hydrogenation generally yields the trans molecular configuration, which raises the fat's melting point and flash point. These "new" fats can serve different purposes such as long-lasting oils for frying or butter substitutes such as margarine.*]

Chemical and Physical Sciences Question Bank

Describe the chemical structure and general properties of lipids.

What is the chemical difference between saturated and unsaturated fatty acids? What does monounsaturated versus polyunsaturated mean?

Are trans fats saturated or unsaturated fatty acids, and where do they come from in foods?

What are isomers? Explain the difference between cis and trans isomers.

Saturated fats and trans fats tend to have a higher melting point than unsaturated fats. Explain the difference in their physical properties based on their differences in molecular structure.

What is the hydrogenation process, and what does it have to do with trans fats?

Biological Sciences
Discussion Questions:

1. **How are fats metabolized when you eat them, and what are the main purposes they serve in the body?** [*Enzymes called lipases break down fatty acids and other lipids into small pieces. Those pieces can be broken down all the way to produce energy in the mitochondria of cells, or used by cells to build up new lipid molecules. Lipids also provide insulation for the skin and around certain organs and act as an energy reserve.*]

2. **How are trans fats metabolized differently than natural fats?** [*This is still a subject of scientific research. There are many types of enzymes called lipases involved in breaking down fats, and it appears that they respond differently to the types of bonds that are in trans fats vs. regular fats. This could have to do with the fact that both saturated and cis-unsaturated fats are naturally produced. Our bodies have the enzymes required to break down the natural fats, but it is not clear if these enzymes work as well on trans fats that are synthetically produced.*]

Extension Prompts:

3. **What causes atherosclerosis? How does atherosclerosis relate to heart attacks and stroke? What roles do macrophages, high-density lipoproteins and low-density lipoproteins play in atherosclerosis?** [*Atherosclerosis is the buildup over time of plaque in arteries, constricting the flow of blood and potentially causing heart attacks (if enough oxygen-carrying blood cannot get to the heart muscle) and strokes (if enough blood can no longer get to areas of the brain). Low-density lipoprotein, or LDL, is blood protein carrying lots of lipids such as fats and cholesterol. High-density lipoprotein, or HDL, is blood protein not carrying many lipids; it is called high-density because protein is more dense than in LDLs. In small amounts, LDL provides useful supplies of lipids for cells, but in large amounts it causes problems. Macrophage cells are the "goats" of the body, wandering around eating garbage to help clean up. If macrophages consume too much LDL, they cannot digest it and get very sluggish and "sick." The "sick" macrophages accumulate on the walls of arteries, and over time they form a plaque.*]

Biological Sciences Question Bank

How are fats metabolized when you eat them, and what are the main purposes they serve in the body?

How are trans fats metabolized differently than natural fats?

What causes atherosclerosis? How does atherosclerosis relate to heart attacks and stroke?

What roles do macrophages, high-density lipoproteins and low-density lipoproteins play in atherosclerosis?

Experimental Design and Public Policy

Discussion Questions:

1. **After thinking about the general design of the study and answering the article-based observation questions, what changes to the study design might show even better evidence linking trans fats regulation policies to cardiovascular disease risk?** [*Larger populations in areas with and without trans fats, longer periods of time from areas with the ban, measuring or minimizing how many people move from counties with the ban to counties without and vice versa. Students may have other ideas.*]

Extension Prompts:

2. **Based on previous research showing evidence that trans fats can increase the risks for cardiovascular disease, what, in your opinion, should be done?** [*Have the students "vote with their feet" by assigning a choice to a corner of the room, for example: (A) Do more studies to check the risks but do*

not take any action yet. (B) Put a required warning label on foods containing trans fats to inform consumers. (C) Charge significant additional taxes on foods containing trans fats to try to dissuade people from buying them. (D) Ban the sale of foods with trans fats. Once students assemble, ask the individuals within a group to reflect on the reasons for their choice. Then ask each group to share their thoughts with other groups. Finally, have groups reflect again among themselves about the responses from other groups.]

3. **There is strong evidence that smoking or chewing tobacco greatly increases the risk of cancer as well as other life-threatening problems. What should be done?** *[Again have students move to different corners of the room to choose their response: (A) Just do more studies. (B) Require warning labels. (C) Impose taxes on the product. (D) Ban sale of the product. Once students assemble, ask the individuals within a group to reflect on the reasons for their choice. Then ask each group to share their thoughts with other groups. Finally, have groups reflect again among themselves about the responses from other groups.]*

4. **There is evidence that consuming too many drinks and foods that are high in sugar can increase the risk of diabetes. What should be done?** *[Again have students move to different corners of the room to choose their response: (A) More studies. (B) Warning labels. (C) Taxes. (D) Ban the sale of certain products, as New York City tried with large sodas (Sugary Drinks Portion Cap Rule). Once students assemble, ask the individuals within a group to reflect on the reasons for their choice. Then ask each group to share their thoughts with other groups. Finally, have groups reflect again among themselves about the responses from other groups.]*

5. **There is evidence that consuming too many foods that are high in salt can increase the risk of high blood pressure. What should be done?** *[Again have students move to different corners of the room to choose their response: (A) More studies. (B) Warning labels. (C) Taxes. (D) Ban the sale of certain products. Once students assemble, ask the individuals within a group to reflect on the reasons for their choice. Then ask each group to share their thoughts with other groups. Finally, have groups reflect again among themselves about the responses from other groups.]*

6. **Research and write about it: Outline what role the government currently takes in protecting people from food and drug risks. How does scientific research influence government policy and regulation? In your opinion, what is the proper role of government in protecting people from risks? What actions are reasonable and what actions encroach too much on personal choices?** *[Different government agencies, such as the FDA and the Food Safety and Inspection Service (FSIS), play different roles in government regulation of food, drugs and other commercial products. At one end of the spectrum, it is wise for the government to ban private individuals from owning nuclear weapons. At the other end of the spectrum, should government require everyone to eat only healthy foods? Students can compare views, place themselves along the spectrum, and discuss.]*

Experimental Design and Public Policy Question Bank

After thinking about the general design of the study and answering the article-based observation questions, what changes to the study design might show even better evidence linking trans fats regulation policies to cardiovascular disease risk?

Based on previous research showing evidence that trans fats can increase the risks for cardiovascular disease, what, in your opinion, should be done?

There is strong evidence that smoking or chewing tobacco greatly increases the risk of cancer as well as other life-threatening problems. What should be done?

There is evidence that consuming too many drinks and foods that are high in sugar can increase the risk of diabetes. What should be done?

There is evidence that consuming too many foods that are high in salt can increase the risk of high blood pressure. What should be done?

Research and write about it: Outline what role the government currently takes in protecting people from food and drug risks. How does scientific research influence government policy and regulation? In your opinion, what is the proper role of government in protecting people from risks? What actions are reasonable and what actions encroach too much on personal choices?

SN EDUCATOR GUIDE

May 13, 2017

Data Back Ban of Artificial Trans Fats

Teacher Guide: Greasy Spots

Class time: 30-50 minutes.

Purpose: Students can use three different types of assays to test a variety of foods for the presence of lipids, or fats. In addition, students may research the types of fats that foods contain and relate their findings to dietary health.

Notes to the teacher: Feel free to scale this activity up or down, depending on your class time and the level of your students. You might tell students a day or two in advance that they can bring in their own foods to test. Student interest will likely be heightened if they are testing their own food.

Emphasize the importance of doing additional assays in tubes without food as a negative control.

As a further chemistry-based exploration, have your students measure the amount of saturated vs. unsaturated fat by titrating different oils with an iodine solution (to determine the iodine number). Amrita Vishwa Vidyapeetham University provides a virtual lab example here.

Another option for developing a slightly more inquiry-based lab is to choose the oils or foods for your students (picking similar-looking foods) and have students determine the food type based on fat content.

Also, feel free to remove the anticipated results and interpretation of each assay test, and have students interpret their results within their lab group.

Potential Foods Materials (choose or have students choose 10 foods):

- Vegetable oil (can be considered a positive control)
- Skim milk
- 1% fat milk
- 2% fat milk
- Whole milk
- Cream
- Ice cream
- Nonfat yogurt
- Cheeses
- Bacon or other meats
- French fries
- Apple juice

- Peanut butter
- Butter
- Corn
- Green peas
- Crackers
- Cookies
- Peanuts
- Sunflower seeds

Other Materials:

- The attached student guide, Blackline Master 3
- Gloves
- Lab goggles
- Solid and liquid foods to test for lipids (or students can bring their own — see above list)
- Bowls for foods
- Access to a microwave (for melting butter and getting fatty liquid from meats, cheese, etc.)
- Assorted tools, such as spoons or mortar and pestle for scooping, grinding, mincing or smashing foods
- Test tubes (at least a dozen per student lab group)
- Caps or stoppers for test tubes
- Test tube racks
- Balances
- Weigh paper/foil/plastic boats
- Alcohol (91% isopropyl rubbing alcohol from the drug store or grocery store)
- Water (distilled water is ideal, or you can use tap water if it has a fairly normal pH and not many impurities)
- 10 ml-graduated cylinders or pipettes for measuring small volumes of alcohol, water and liquid foods
- Sudan III stain (one bottle per lab group, $4.50 for 15 ml-bottle at Home Science Tools)
- Q-tips (at least a dozen per student lab group)
- Paper for grease spot tests (plain brown paper bags are ideal, or regular printing paper also works)
- Hair dryers (optional for speeding up the drying process)
- Markers to write on the test tubes and paper

SN IN HIGH SCHOOLS May 13, 2017

Data Back Ban of Artificial Trans Fats

Student Guide: Greasy Spots

Lipids include fatty acids, triglycerides and cholesterols. In the body, lipids provide insulation for the skin and certain organs, act as energy reserves and are used by the body to make more lipids. We often think of lipids, or typically the triglycerides, when we are talking about food composition as it relates to our diet.

As food labels show, fats can be fully saturated or unsaturated to some degree — monounsaturated or polyunsaturated. In the United States, you will also see that the amount of trans unsaturated fat in a food is required to be listed on the label (the rest of the unsaturated fat is in the cis conformation). The suggested dietary intake of each fat type varies, because of their unique chemical structures and thus different interactions with your body.

In this experiment, you will use three different types of assays to test a variety of foods for the presence of lipids, or fats. Once the assays are complete, you should explore the types of fats that foods contain and determine, based on their health effects, how frequently you think you should eat them.

Procedure:

1. Your teacher will provide different types of foods to analyze, or will give you instructions for bringing in your own food.

2. Wear gloves and goggles during the experiment.

3. Follow instructions from your teacher to prepare your food. For solid foods, grind, mince or smash the food so you will be able to put it in a test tube and then weigh out 2 grams of the food on a balance (use special weigh paper, foil or a plastic “boat” between the food and the balance, and make sure to tare, or zero out, the balance before adding the food). Put 2 grams of that food into a test tube and label the tube. For liquid foods, add 2 ml of the food to a test tube and label the tube. According to your teacher’s specific instructions, feel free to microwave foods to melt them or extract liquid from them. However, be careful to not burn your food in the microwave.

6. Next, test the fat’s solubility in alcohol by adding 2 ml of alcohol to each food-containing test tube. Cap the tube firmly, point it away from any faces including your own, and shake the tube vigorously for 30 seconds. Then let the tube sit for 60 seconds.

7. Gently pour 2 ml of water into each food-containing test tube. DO NOT SHAKE, RATTLE OR ROLL! Let the tube sit for two or three minutes.

8. Use the data table provided to record observations and data when you perform the following assays:

Assay 1. If the food contained lipids, they should form a cloudy whitish layer at or near the top of the liquid in the test tube. The more lipids there are, the thicker that layer should be. If you look closely, you may even see tiny globules of fat in the layer. If you do not see a cloudy layer, there probably was not much or any fat in the food.

Assay 2. Gently dip a clean Q-tip into the upper part of the liquid in the test tube, then rub it on paper. Write next to the spot what the food was. Let the spot dry for a while. According to your teacher's instructions, you may use a hair dryer to speed up the drying process. Fat-containing foods should dry to leave a greasy, translucent spot, just like fast food does to paper bags. Foods without fat should dry to look like normal paper, albeit possibly slightly stained or distorted.

Assay 3. DO THIS ONLY AFTER YOU HAVE ALREADY FINISHED THE FIRST TWO ASSAYS FOR ALL TUBES. Add two or three drops of red Sudan III stain to each tube. The stain is nonpolar and should dissolve in the lipid layer, if there is one. Observe the test tube and note where the Sudan stain goes.

Data Table for Assay Observations:

	Type of Food	Assay 1 Observations	Assay 2 Observations	Assay 3 Observations
Tube A				
Tube B				
Tube C				
Tube D				
Tube E				
Tube F				
Tube G				
Tube H				
Tube I				
Tube J				

Answer the following questions to analyze your results:

1. **Which foods had the most fat? Explain your answer with observational data. How did your results compare with what you would have predicted based on your knowledge of the food you chose?**

2. **Which foods had the least fat? Explain your answer with observational data. How did your results compare with what you would have predicted based on your knowledge of the food you chose?**

3. **How well did the results of the three assays agree with each other?**

4. **Research the composition of each type of food using the Internet or library. What types of fats (saturated or unsaturated) do foods contain? Do they contain any trans fats as indicated on the nutrition label or according to your research? Does the ingredient list say that the food includes partially hydrogenated oil? If so, how does this compare with the trans fats percentage? Create your own chart containing this information below, and be sure to cite your credible resources.**

5. **What is the suggested serving size of your food? How many grams of fat does each contain per serving?**

6. **Research your recommended daily, suggested serving of each type of fat (saturated, unsaturated and trans unsaturated). Feel free to also list monounsaturated and polyunsaturated fat recommendations as well.**

7. **Make a recommendation as to how often you should consume each type of food, if at all.**