

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

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Lipids include fatty acids, triglycerides and cholesterol. 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.