

# ENZYME ACTION: How clean is your laundry?

NOTE TO STUDENTS: This is a dry lab. You are only expected to perform the portions of this lab that do not require you to use laboratory equipment or supplies. When appropriate, sample data may be supplied in the lab's data tables to help you answer the questions.

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**This experiment may span two to three days.**

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## **Research**

Do enzyme-containing laundry detergents work better than regular detergents?

## **Goals**

1. To define an enzyme
2. To understand how enzymes work
3. To explain how enzymes would affect the cleaning of laundry
4. To understand the nature of stains
5. To demonstrate how enzyme detergents compare with ones without enzymes

## **Materials and Equipment**

Forceps  
 Laundry detergents, powder (2):  
     1 with enzymes and 1 without  
 Information sheets on each detergent  
 Marker, permanent  
 Scoop, 1 cc  
 Stir rod  
 White cotton fabric

## **Materials Not Included**

Paper towels  
 Scissors that can cut fabric  
 Spoons for mixing (2)  
 Spring water  
     (Can be bought at a grocery or drug store.)  
 Stain makers: (Choose items that make a stain dark enough to see on the piece of cloth.):  
     To make a carbohydrate stain, choose:

ketchup, sauces (eg. barbecue sauce), gravy, ice-cream, tomato sauce, pasta dishes.

To make an oil stain, choose: cooking oil, bacon fat, mayonnaise, butter, lard, hand lotion, suntan oil or lotion, salad dressing, cosmetics, deodorant, or lipstick.

To make a protein stain, choose: meat blood (e.g. beef, chicken), egg, or grass

## **Introduction**

When you travel down the cleaning supply aisle at the grocery store, there are shelves filled with different laundry detergents. What makes one clean better than another? Many advertise having "enzyme action" to better fight stains. Do the enzymes make that much of a difference? Does one detergent work better on a particular type of stain than another?

In this activity, you will be testing enzyme-containing detergents against those that do not contain them to see if they really make a difference in the overall performance of a detergent.

What are enzymes and why might they improve the stain removing power of the detergent? Enzymes are large, protein-based molecules that speed up chemical reactions without changing or becoming a part of the new products. They are very specialized and only work on a particular molecule. For instance, the enzyme named sucrase will only have an effect on the sugar. Because they are so specialized, scientists have been experimenting for years to find ways to use their power to break apart stain molecules in fabric. In fact, the first patent for an enzyme stain remover was in 1913. Since the enzyme protease breaks down

proteins, the enzyme amylase breaks down carbohydrates (starches and sugars), and the enzyme lipase breaks down fats and grease, it would seem logical that they could be a beneficial addition to laundry detergent.

In this lab, you will be testing two laundry detergents using their pre-soak instructions. Perhaps, after the pre-soak, going through a whole laundry cycle, with its additional agitation, would produce better results; but, for this lab, you will be comparing the initial ability to remove stains between a detergent that contains enzymes and one that does not. **Note: It is not necessary but it is advised to prepare the "extension" of this lab, where you create your own variation of this experiment, before you start the first part of the lab so that you can do both parts simultaneously.** You can prepare enough laundry mixture to complete both parts at the same time.

## **Procedure**

1. Cut at least 25 - 1" x 1" squares out of the fabric included in the kit. (There is extra material for use in the Extension exercise or for experimentation of additional detergents or stains, if desired.)

2. Day 1: Making the stains.

### Stain #1:

- a. Take four pieces of white cotton cloth. Stain each piece of cloth with some recommended carbohydrate like ketchup, barbecue sauce, etc. (See materials list.)

- b. Rub the item onto each piece until all four pieces look uniform. Scrape off the excess so you are left with just the stain.

- c. Put the pieces in a clean, dry place to dry.

### Stain #2:

- a. Take four pieces of white cotton cloth. Stain each piece of cloth with some recommended protein like meat blood, grass stain, or egg.

- b. Rub the item onto each piece until all four pieces look uniform. Scrape off the excess so you are left with just the stain.

- c. Put the pieces in a clean, dry place to dry.

### Stains #3:

- a. Take four pieces of white cotton cloth. Stain each piece of cloth with some recommended oil/fat like mayonnaise, cosmetics, lipstick, bacon fat, lotions, suntan oil, or salad dressing.

- b. Rub the item onto each piece until all four pieces look uniform. Scrape off the excess so you are left with just the stain.

- c. Put the pieces in a clean, dry place to dry.

You should have 12 pieces of cloth drying to use on the next day. (See Figure 1.)



**Figure 1**

3. Look at the information sheets for both detergents included in your kit. In the Question portion of this lab, fill in the chart by circling the enzymes each laundry detergent contains. Remember, it may not contain any.

4. Fill in the column where you predict which of the stains you think the detergent will remove based on the enzymes it contains.

## 5. Day 2:

Put one cloth from each stain aside so you can look later at what the original stain looked like. See Figure 2.



**Figure 2**

6. Collect the detergent in the kit.  
Choose one of the two laundry detergents.

Detergent #1:

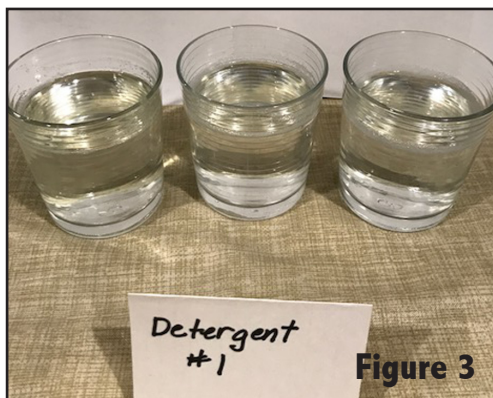
- a. Find three of the 2-oz sample cups in your kit.

- b. Fill each with warm water to about 8 mm or 1/3 inch from the top. Make sure all water levels are the same; this will insure that the concentration of detergent in each cup will be similar.

- c. Using the 1 cc scoop, add one level scoop of detergent to each of the three sample cups and stir gently with the glass rod until the detergent dissolves.

- d. Rinse the stir rod in clean water.

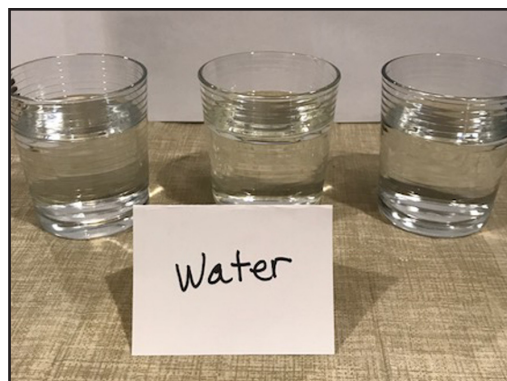
- e. Put the three cups on a plain piece of paper and write the number of the detergent on the paper. See Figure 3.



**Figure 3**

7. Detergent #2: Repeat the steps you used for Detergent #1 for Detergent #2.

8. Fill three more 2-oz sample cups with water. These three cups will contain ONLY water and no detergent. This will be the control, or the part of the experiment that will allow you to see what happens without any detergent. See Figure 4.



**Figure 4**

9. a. Put one of each type of stained cloth in the control sample cup with water.  
b. Put one of each type of stained cloth into the sample cups of each type of detergent. See Figure 5.



**Figure 5**

10. Let the pieces of cloth soak for 30 minutes, stirring each gently, using different spoons, for a few seconds every 10 minutes.
11. After 30 minutes, use the forceps to remove the pieces of cloth.

- a. Lay the cloths from each detergent on a paper or paper towel and mark on the paper towel the number of the detergent they came from. See Figure 6.



**Figure 6**

- b. Do this for the fabrics in the water also.
12. Let them dry completely.
  13. Compare each of the detergent pieces to both the one placed only in water and also the one with the original stain. In the Questions portion of this lab, describe how each stain appears. Also, you can make a drawing or take a photo of the cloths and tape it in that section. See Figure 7. If possible, take a picture like the one in Figure 7 and attach it in the Questions portion of the lab.



**Figure 7**

14. In the Questions section, describe how successful each detergent was in removing the stains.



## Extension for Enzyme Action

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### Develop your own experiment:

1. Find the blank lab worksheet at the end of this lab (starting on page 9). Use it to extend this experiment by testing a different factor than was tested above or a different detergent, maybe one you have at home. Keep the three food categories the same but you can change another factor.
2. Some factors to consider changing would be:
  - a. The food choice for each group: carbohydrate, protein, fat
  - b. The detergent, maybe the one you use at home.
  - c. The water temperature
  - d. The time the cloth soaked
  - e. The type of fabric (silk, polyester, rayon, blended material)
  - f. Whether to scrub it and rinse it when you take it out of the laundry solution.
3. Choose what you would like to test and write an experiment filling in the different steps of the scientific method on the worksheet reflecting the change in the factor being tested.
  - a. For the "Research" on your worksheet: What is the question you are answering now? Perhaps it would be: "How does \_\_\_\_\_ affect the cleaning effectiveness of the enzyme and non-enzyme detergent?" This would be the "Research" on your worksheet.
  - b. Materials: List all of the materials you will need to use for the experiment.
  - c. Procedure: List the steps in order of how to do your experiment. Make sure to add enough detail so that someone else could perfectly repeat it. Some of the steps might be the same or similar to the ones in the first part of the lab.
  - d. Carry out your experiment.
  - e. Questions: List the results on a separate paper.
  - f. Note: If you used a different detergent, look at the ingredients listed on the box to see if it contains any enzymes (e.g. protease, amylase, or lipase). If the ingredients are not listed on the box, you may need to research that detergent on the internet.
  - g. Use description and perhaps pictures to show the results of the testing.
  - h. Ask and answer similar questions to the ones in the first part of the lab.
  - i. Record your data in the chart on the worksheet.

## LAB

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### Questions for Enzymes — How clean is your laundry? (Main lab activity)

1. What is an enzyme?

An enzyme is a catalyst (material that speeds a chemical reaction without changing itself) made of protein.

2. What is the name of the enzyme that breaks down:

a. Protein? **Protease**

b. Carbohydrate? **Amylase**

c. Fat/oil? **Lipase**

3. Skip this question.

4. Fill in the second row of the table. The rest of the table has already been completed with sample data.

	<b>Detergent 1 Enzyme (Tide™)</b>	<b>Detergent 2 Non-Enzyme (Fab™)</b>
Circle the enzyme present in the detergent.	Protease Amylase Lipase None	Protease Amylase Lipase <b>None</b>
What stains would you expect this detergent to remove?	Carbohydrate ← Protein ← Oil/Fat ← None	Carbohydrate Protein Oil/Fat None ←
How well did the detergent get out the following stains?		
Carbohydrate: ketchup	None Some <b>Most</b> All	None <b>Some</b> Most All
Protein: grass	None Some Most <b>All</b>	None <b>Some</b> Most All
Fat/Oil: butter	None <b>Some</b> Most All	<b>None</b> Some Most All

5. Why do you think the results came out as they did for each detergent?

For each individual macromolecule, the detergent w/ the enzymes did better than their counterpart. I think the main reason for this was due to the presence

~~6. Skip this question.~~ of Enzymes to speed up the cleaning.

7. Did the detergents containing enzymes work better at removing stains than those containing no enzyme? Why or why not?

They did.

The enzymes helped speed up the cleaning reaction. This allowed more to be cleaned up in the same span of time.

8. List the detergent that performed the best at removing each type of stain.

a. Carbohydrate: Detergent # 1

b. Protein: Detergent # 1

c. Fat/Oil: Detergent # 1

9. Research:

- a. How do enzymes work?

They combine with a specific substrate and catalyze the chemical reactions happening.

- b. How do enzymes work on laundry stains to remove them?

Enzymes in laundry stains work on different molecules. They usually help break these molecules down, cleaning the stains.