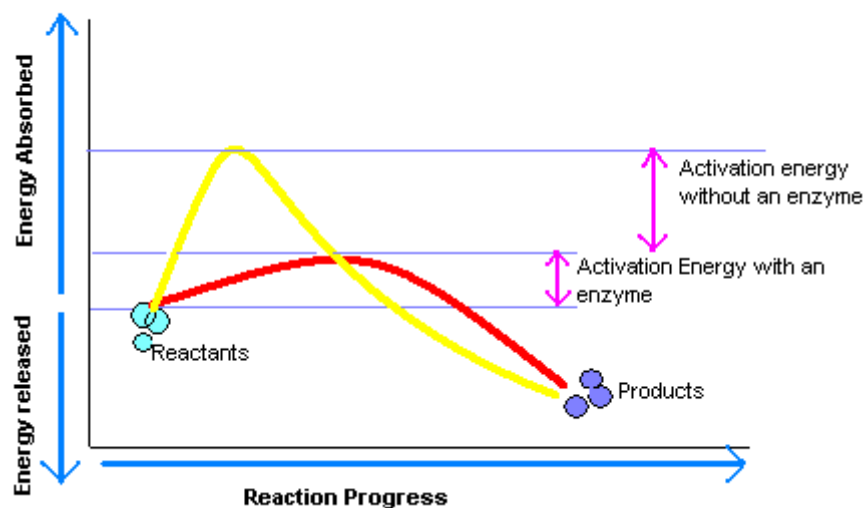# Is Your Detergent Effective?

Introduction:

Are you confident in your detergent? Does it really clean as effectively as it claims to?
How can we find out which detergent actually does the job?

Background:

Definition:

Almost all detergents have enzymes which are used to fight stubborn stains.   An
enzyme is a special protein which is responsible for most of the chemical activities of
living organisms. It acts as a catalyst by increasing the rate of reaction without
destroying the actual process. Enzymes are extremely efficient and resourceful, which
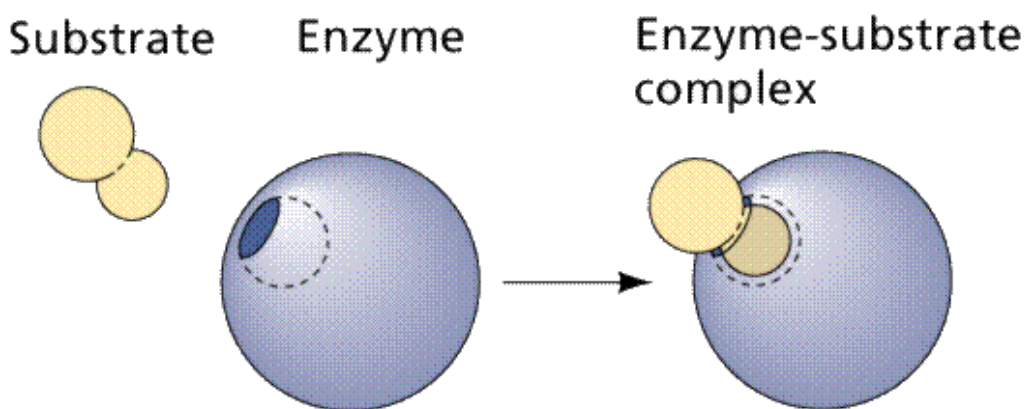can be used over and over again.

How do Enzymes Function:

Most of the enzymes are protein. Enzymes bind temporarily to one or more of the reactants of the reaction they catalyze. In doing so, they lower the amount of activation energy needed and thus speed up the reaction.

Enzymes are named after the substances they catalyze. For example, the enzyme lactase is used for lactose and amylase is used for breaking down starch. The names of enzymes are based on what it reacts with, how it reacts and by adding "ase" to the end.

The shape of the enzyme is very important. The molecules of the enzymes are arranged in such a manner that it produces a site where the substrate (the material or substance on which an enzyme acts) is surrounded by the enzyme.

Factors Affecting the Enzyme:

✓ Temperature

✓ Concentration of the enzyme and substrate

✓ pH level

All of these factors affect the shape of the enzyme. An enzyme's functionality is based on its shape. If the temperature is too high, or the concentration of the enzyme is too low, or if the pH at which the enzyme functions is too acidic, then the enzyme will "unravel" until it is no longer in the shape that is necessary for it to function properly.

Enzymes in Detergents:

Detergents usually contain enzymes such as lipase, amylase, peroxidase and protease. They are used to generally break up fat or oil based stains, starch based stains, inhibit dye transfer and protein based stains. The condition in which these detergents are being used is crucial. For those who have done laundry before, they may be aware of the temperature restrictions required to effectively clean dirty laundry.

How does a Colorimeter Work:

The light from the LED source passes through the cuvette containing a solution. Some of the incoming light is absorbed and some is passed through. The light that passes through a solution is known as transmittance which is a ratio of transmitted light and the initial intensity. The light of a lower intensity strikes a photodiode. In this experiment, with the presence of enzymes from a detergent, the color of the stain solution should be altered. The change in the color will be monitored depending on the situation.

Objective:

- ✓ To test the effectiveness of different detergents
- ✓ To test which conditions maximize the functionality of detergents

Materials:

- ✓ 3 Graduated cylinder (10 ml)
- ✓ Droppers (6)
- ✓ Hot Plate
- ✓ acidic solution (pH 2 and pH 5)
- ✓ basic solution (pH 8 and pH 12)
- ✓ ice

- ✓ thermometer

- ✓ stirring rod

- ✓ Vernier Colorimeter sensor

- ✓ 3 different detergents

- ✓ Distilled water

- ✓ 3 beakers

- ✓ stain colored solution

Procedure:

<u>Effect of Different Concentrations:</u>

1. Connect the colorimeter sensor to the LabPro and connect to the computer.

2. Open up the Logger Pro program

3. Fill a cuvette with distilled water and put it in the colorimeter

4. Set the wavelength to 635nm by using the arrows on the colorimeter

5. Press the CAL button on the colorimeter and release it when the red light starts flashing

6. The absorbance reading on the top left corner of the computer screen should read about 0.000-0.001

7. Obtain a stain-colored solution

8. Measure 3.5 mL using a graduated cylinder of the stain solution and put it in a cuvette

9. Put 1 drop of detergent A in that cuvette and cover it

10. Shake the cuvette and put it in the colorimeter

11. Click the ▶ Collect button and collect the data for 120 seconds

12. Click ■ Stop and store the latest run

13. Discard the cuvette

14. Repeat steps 7-13 for

    a. 3 drops of detergent A

    b. 6 drops of detergent A

15. Save the data by labeling it <u>DetergentName</u>Concentrationtest.cmbl

16. Repeat steps 7-15 for detergent B and C

    <u>Effect of pH:</u>

1. Measure 3.5 ml using a graduated cylinder of the stain solution and put it in a cuvette

2. Put 3 drops of detergent A in the cuvette

3. Add 3 drops of an acid solution of pH 2 to the cuvette

4. Cover the cuvette and shake the container and put it in the colorimeter

5. Click the ▯▶ Collect ▯ button and collect the data for 120 seconds

6. Click ▯ ■ Stop ▯ and store the latest run

7. Discard the cuvette

8. Repeat steps 1-7 for

    a. 3 drops of acid solution of pH 4

    b. 3 drops of base solution of pH 10

    c. 3 drops of base solution of pH 12.5

9. Save the data by labeling it <u>DetergentName</u>pHtest.cmbl

10. Repeat steps 1-9 for detergent B and C

    <u>Effect of temperature:</u>

1. Put the stain solution in a cold bath (put the stain solution in a beaker of ice)

2. Lower the temperature of the stain solution to about $20\ °C$ (use a thermometer to check

    the temperature)

3. Measure 3.5ml using a graduated cylinder of the stain solution and put it in a cuvette

4. Put 3 drops of detergent A in the cuvette

5. Cover the cuvette and shake the container

6. Put the cuvette in the colorimeter

7. Click the [▷ Collect] button and collect the data for 120 seconds

8. Click [■ Stop] and store the latest run

9. Discard the cuvette

10. Repeat steps 1-9 for

    a. $30°C$

    b. $40°C$

11. Save the data by labeling it <u>DetergentName</u>Temperaturetest.cmbl

12. Repeat steps 1-11 for detergent B and C

Analysis:

1- Based on your data, at which pH level might the detergent work effectively? Why not at other ph levels? Explain.

2- Based on the data collected, which conditions are ideal for dissolving the stain for each detergent?

3- Which detergent is the best out of the three?

4- Does this mean that the detergent with the best results will always dissolve all types of stains effectively? Why or why not?

5- How did the three factors tested in this lab affect enzyme activity? Give an explanation for each factor.