

## How does temperature affect how enzymes work? - Improvement

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**Aim: At what temperature do you think amylase will work best?**

### **Background information**

Enzymes are biological catalysts that help accelerate and speed up chemical reactions. They are an important part of food digestion, as they break down certain substances. Amylase is an enzyme which breaks down carbohydrates (starches) into individual glucose molecules. This is produced in the salivary glands, pancreas and small intestine. Protease is produced in the stomach, pancreas, small intestine, and catalyses protein, forming amino acid molecules. The final enzyme is called lipase, found in only the pancreas and small intestine, which breaks down lipids, this includes fats and oils, into fatty acid and glycerol molecules.

Different enzymes work in different pH values. In the stomach, hydrochloric acid is produced, helping to begin digestion, and kills bacteria and other harmful microorganisms that have been swallowed with your food. Enzymes in the stomach, e.g. Protease, works best in acidic conditions, at a low pH value. After, the food travels into the small intestine, when the food is acidic. A substance called bile, which is produced in the liver and stored in the gall bladder, neutralises the acid, because the enzymes in the small intestine are most effective in alkaline conditions. Bile also helps catalyse and emulsify fats.

### **Variables**

Dependent – How many seconds it takes for mixture to turn blue or black in different temperatures.

Independent – Temperature of each test tube

Controlled – The amount of amylase is added to each test tube, the time that the mixture is in the water bath, the amount of iodine put into each tile.

### **Equipment**

Amylase, beaker of water, iodine, pipette, six test tubes, starch suspension, stopwatch, test tube rack, two syringes, three water baths at different temperatures, spotting tile, goggles

### **Risk assessment**

- Must wear goggles during the experiment
- Do not put iodine or amylase into eyes or mouth
- Hold **ONE** piece of equipment in each hand

### **Prediction**

I think amylase will work best from 40 degrees C, because that is the temperature of the human body (37 degrees C).

### **Method**

1. With a syringe, add 5cm<sup>3</sup> of starch suspension into three different test tubes, and put them in three water baths, one at 10 degrees C, one at 40 degrees C, one at 60 degrees C.

2. Then, with a different syringe, put 1cm<sup>3</sup> of amylase into three more test tubes, and add them to the different temperature water baths.
3. Set the stopwatch to 5 minutes and start it, and in the meantime, use a pipette to add a drop of iodine into each dimple of the spotting tile. Then you can wash the pipette out in the beaker of water.
4. After 5 minutes, pour the amylase into the starch suspension, then mix it.
5. Immediately add a drop from a tube into a different dimple, and time how long it takes for the mixture to turn a dark blue or black colour, then stop the timer, and record the time in a table.
6. Repeat step 5 for the other two temperatures, and record the time in the table.

## Results

TEMPERATURE OF THE MIXTURE (DEGREES C)	AMOUNT OF TIME FOR MIXTURE TO TURN BLUE/BLACK (SECONDS)
10	160
40	100
60	170

## Conclusion

The results tell us that amylase, which is an enzyme in saliva, catalyses starches into glucose molecules quickest at 40 degrees C, which is the closest temperature to the oral and body temperature.

## Evaluation

If I were to perform the experiment again, I could improve the experiment by adding all three mixtures to the iodine at the same time, one person for each test tube. I could put and take out the test tubes from the water baths at the same time as well, this will make it a fair test. And, I could repeat the experiment twice, and calculate the mean, in case one of my answers are an anomaly.

## References

Information in red is from -

[http://www.bbc.co.uk/schools/gcsebitesize/science/add\\_aqa\\_pre\\_2011/enzymes/enzymes\\_and\\_digestion1.shtml](http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa_pre_2011/enzymes/enzymes_and_digestion1.shtml)