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| Chemical Investigations |
| Hydrolysis of Starch |
| Teacher/Technician Guide |



Hydrolysis of Starch

*UNIT 2 PPA 3*

**INTRODUCTION**

Starch is a condensation polymer made from glucose monomer units. When these large starch molecules react with water they break down into smaller sugar molecules. The starch is said to be hydrolysed. We can tell if starch has been hydrolysed by testing for the small sugar molecules that are formed in the process. This can be achieved by heating the reaction mixture with Benedict's solution. Benedict's solution is blue but turns cloudy orange if certain sugar molecules† are present.

Starch hydrolysis is a very slow reaction but it can be speeded up by using an enzyme or an acid as catalyst.

The aim of this experiment is to hydrolyse starch in the presence of either an enzyme or an acid and to demonstrate that the enzyme or acid catalyses the reaction.

Decide which catalyst (the enzyme or the acid) you are going to use and then proceed to the appropriate section below.

† Not all sugars give a positive test with Benedict's solution but those formed in starch hydrolysis do.

**Enzyme catalysis**

**Each group will need**

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| 2 x test tubes and rack | 1 x 250 cm3 glass beaker |
| Selection of syringes (1 x 1 cm3, 3 x 5 cm3 ) | 0-100°C thermometer |
| mineral wool | Bunsen burner and heating mat |
| Tripod | ~6 cm3 starch solution |
| ~1 cm3 1% amylase (enzyme) solution\* | ~ 4 cm3 Benedict's solution\*\* |

\* saliva can quite safely be used as a source of amylase instead. It is up to the teacher to decide whether this is appropriate for a particular class.

\*\* Fehling's solutions No. 1 (harmful) and No. 2 (corrosive) can be used as an alternative to Benedict's solution.

Sandell's reagent can also be used as a substitute for Benedict's solution. Details of its preparation can be found on the SSERC website

**Safety**

Wash off any solutions on skin straight away.

**Procedure**

1. Half fill the beaker with water and heat it until it reaches about 40 °C but no more.
2. Using a syringe add 3 cm3 of starch solution to each of two test tubes.
3. To one of the test tubes add 1 cm3 of water from a syringe - this will be the control. To the other test tube carefully add 1 cm3 of amylase solution.
4. Place both test tubes in the beaker of warm water and leave them for 5 minutes.
5. After 5 minutes, use a syringe to add 2 cm3 of Benedict's solution to each test tube.
6. Keep the test tubes in the beaker of water and then heat the water until it boils.
7. Observe and record what happens to the Benedict's solution in each test tube.

**Acid catalysis**

**Each group will need**

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| test tubes and rack | 2 x 50 cm3 beakers |
| Selection of syringes (1 x 1 cm3, 1 x 5 cm3 , 1 x 10 cm3 ) | thermometer |
| mineral wool | Bunsen burner and heating mat |
| Tripod | ~ 20 cm3 starch solution |
| 1 cm3 2 mol l-1 dilute hydrochloric acid | ~10 cm3 Benedict's solution |
| 2g sodium hydrogencarbonate |  |

**Safety**

Wash off any solutions on skin straight away.

**Procedure**

1. Using a syringe add 10 cm3 of starch solution to each of two small beakers.
2. To one of the beakers add 1 cm3 of water from a syringe - this will be the control. To the other beaker add 1 cm3 of dilute hydrochloric acid.
3. Place the beakers on the tripods and heat the reaction mixtures until they boil. Continue gentle boiling of the mixtures for 5 minutes and then remove the Bunsen burners.
4. Take great care in this next step since the mixture will froth up quite violently.
5. Using a spatula add a tiny amount (equivalent to half a pea) of sodium hydrogencarbonate† to the beaker containing the acid/starch mixture. It is not necessary to add sodium hydrogencarbonate to the other mixture.

*† The sodium hydrogencarbonate is added to neutralise the acid catalyst since Benedict's test won't work in acidic conditions.*

1. Continue adding tiny amounts of sodium hydrogencarbonate until no more bubbles of gas are produced.
2. Using a syringe add 5 cm3 of Benedict's solution to each beaker and heat the reaction mixtures.
3. Observe and record what happens to the Benedict's solution in each beaker.