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## GCSE Biology required practical activity 4: Enzymes

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### Student sheet

Required practical activity	Apparatus and techniques
Investigate the effect of pH on the rate of reaction of amylase enzyme. Students should use a continuous sampling technique to determine the time taken to completely digest a starch solution at a range of pH values. Iodine reagent is to be used to test for starch every 30 seconds. Temperature must be controlled by use of a water bath or electric heater.	AT 1, AT 2, AT 5, AT 8

#### Investigating the effect of temperature on the enzyme amylase

The enzyme amylase controls the breakdown of starch in our digestive system. We are able to simulate digestion, using solutions of starch and amylase in test tubes, and find the optimum conditions required.

The presence or absence of starch can be determined using iodine solution and, in this experiment, we can measure how long the amylase takes to break down the starch at different temperatures.

Learning outcomes
1
2
<b>Teachers to add these with particular reference to working scientifically</b>

### Method

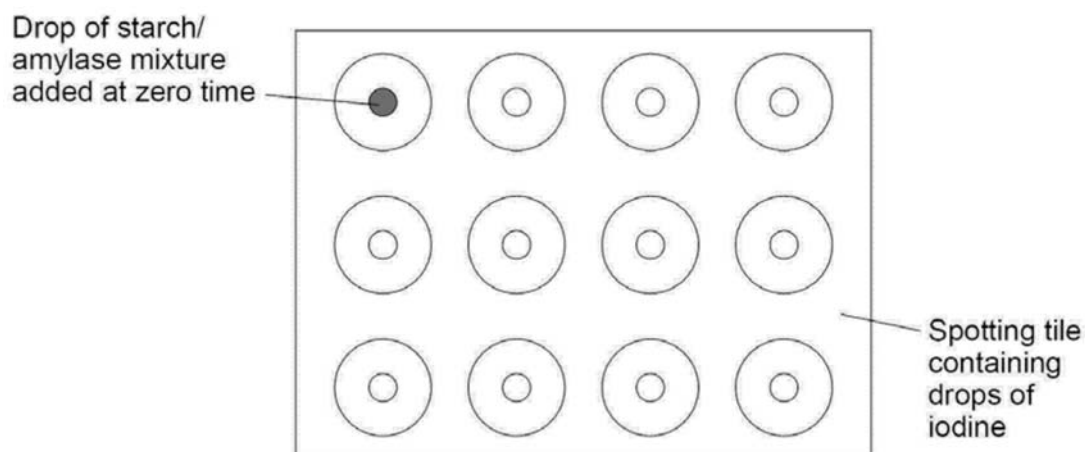
You are provided with the following:

- test tubes
- a test tube rack
- water baths (electrical or Bunsen burners and beakers)
- spotting tiles

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- a 5 cm<sup>3</sup> measuring cylinder or syringe
  - glass rods
  - a stop watch
  - starch solution
  - amylase solution
  - iodine solution
  - thermometers.

**You should read these instructions carefully before you start work.**

1. Place one drop of iodine solution into each depression on the spotting tile.
2. Set up water baths for every temperature you want to test (suggest one cold with ice, one at room temperature, one around body temperature 35–40 °C and one above 50 °C).
3. Measure out 5 cm<sup>3</sup> of starch solution, using the measuring cylinder or syringe, into 4 test tubes.
4. Place one test tube of starch solution into each water bath.
5. Measure out 1 cm<sup>3</sup> of amylase solution, using a measuring cylinder or syringe, into 4 different test tubes.
6. Place one test tube of amylase solution into each water bath.
7. Leave the test tubes in the water baths until the contents of each test tube have reached the temperature of the water baths. Check this with a thermometer.
8. When the contents of the test tubes in one water bath have both reached the required temperature, make a note of this temperature. Then, carefully pour the amylase solution into the test tube with the starch solution and mix with the glass rod.
9. Remove one drop of the mixed solution on the end of the glass rod and place on the first depression of the spotting tile with the iodine solution. This is 'time zero'.



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10. Immediately start the stop clock.
  11. Using the glass rod, remove one drop every minute and place onto the iodine solution in the next depression on the spotting tile. Rinse the glass rod with water after each drop.
  12. Continue until the iodine solution no longer turns black. This indicates that the starch has been broken down.
  13. Record the temperature of the water bath and the time taken for the starch to be broken down in a table such as the one here.

Temperature of water bath in °C	Time taken for amylase to completely break down the starch in minutes

Repeat for the other temperatures.