

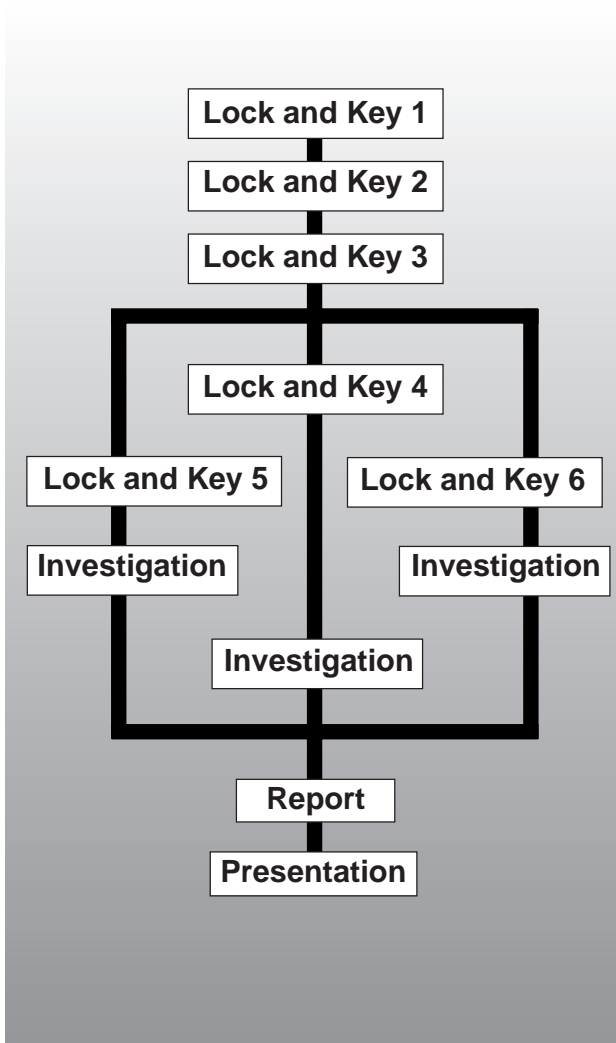
Pupil Research Brief

Teachers' Notes

Syllabus Coverage *Subject Knowledge and Understanding*

- the breakdown of large molecules into smaller molecules is speeded up (catalysed) by enzymes
- carbohydrase enzymes catalyse the breakdown of starch into sugars
- protease enzymes catalyse the breakdown of proteins into amino acids
- lipase enzymes catalyse the breakdown of fats into fatty acids and glycerol
- a catalyst increases the rate of a reaction but is not used up during the reaction
- living cells use chemical reactions to produce new substances
- yeast cells convert sugar into carbon dioxide and alcohol in a process called fermentation
- fermentation is used to produce alcohol in beer and wine, and to produce the bubbles of carbon dioxide which make bread rise
- bacteria are used to make yoghurt from milk
- bacteria convert the sugars in milk into lactic acid
- the chemical reactions brought about by living cells are quite fast in conditions which are warm rather than hot because cells use catalysts called enzymes
- enzymes are proteins which are usually damaged by temperatures above 45°C

Route through the Brief



Introduction

In this Brief pupils carry out one or two investigations into the properties of enzymes. They can conduct an experiment to determine what substances the enzymes in germinating seeds digest; they can investigate the specificity of enzymes; they can also investigate the effects of temperature on enzyme activity. The investigations are based on asking a question, testing an hypothesis or testing a prediction.

Experimental and investigative skills

- planning experimental procedures
- obtaining evidence
- analysing evidence and drawing conclusions
- evaluating evidence

Prior knowledge

Pupils should be able to carry out the food tests for starch, glucose, protein and lipids. They should also have a basic understanding of the process of digestion.

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Teachers' Notes continued

Running the Brief

Pupil grouping

Pupils could work in a number of groupings during this Brief. Suggestions are :

- Initial briefing* - whole class; teacher introduces topic and sets the context for the activities
- Background papers* - individual or pairs
Lock and Key 1 and 2
- Carrying out investigation* - pairs, threes or fours (depending on equipment availability)
Lock and Key 4,5 or 6
- Analysis of results* - pairs, threes or fours, or individually if the work is to be assessed
- Communication* - compilation of written reports (individual or small groups). Small group presentation to whole class (optional).

Timing

The Brief should take about 1.5 hours for reading background information and doing one investigation. You may however decide that pupils should tackle more than one investigation. Extra time will most probably be needed to write up individual investigation reports if these are to be used for examination assessment purposes. Optional follow-up or extension work may add 1 - 2 hours to the teaching time.

Activities

This Brief does not require the pupils to get into role. Pupils should be issued with the **Study Guide**, which provides them with a summary of what they should produce as they work through the Brief. It can also be used as a checklist so that they can monitor their own progress.

The teacher should then issue the first two background information papers, **Lock and Key 1** and **2**. These papers are intended to provide useful background information on enzymes, their properties and uses. They also provide stimulus material to lead into the investigative work on enzymes.

If time is available pupils could tackle all three investigations which are based on: asking a question (**Lock and Key 4**); testing an hypothesis (**Lock and Key 5**) or testing a prediction (**Lock and Key 6**). It is suggested that different groups tackle a different investigation and present their findings to the whole class.

In order to plan their experiments the pupils may be issued with the **Investigation Flowchart** (see General Teacher's Notes). Pupils can use this flowchart to help them plan their investigations. Since pupils are asked to devise their own experiment, they may require guidance on what it is possible to do with the equipment available in a school laboratory. It may be useful to set out a bench with a range of materials and apparatus and ask pupils to select only from these the equipment they will use to carry out their investigations.

Investigation details

After reading through the background papers, Lock and Key 1 and 2, pupils can be given their respective sheet, Lock and Key 4, 5 or 6. They can also be given a copy of the Investigation Flowchart and/or **Lock and Key 3** (*Steps in an investigation*) to help them with their planning.

Lock and Key 4: a group of pupils could investigate the digestive effect of the enzymes extracted from germinating seeds on starch, protein and fat. The question posed in Lock and Key 4 could be answered very simply by individually placing 1cm³ of each food solution into a test tube and carrying out the standard respective food test. Positive results should be achieved in each case. 1cm³ of each food solution should again be placed into a clean test tube and this time 1cm³ of the germinating seed enzyme extract provided should be added to each test tube. After about five minutes the standard respective food test should be carried out on the solutions. Of course, they will find that the enzymes have digested the starch and in this case a negative test result will be recorded. Some groups of pupils could carry out the enzyme extraction from germinating barley seeds themselves.

Lock and Key 5: small groups of pupils could plan and carry out the investigation into whether different enzymes are needed to digest different food types such as starch, protein and fat. The hypothesis in Lock and Key 5 can be tested by investigating the effect of amylase, pepsin, and lipase on solutions of starch, protein and fat in a similar way to that described above for Lock and Key 4. They will have to investigate the effect of each enzyme on each solution.

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Further pupil research opportunities

1. Investigate the effect of 'biological' and 'non-biological' washing powders on different types of stains at different temperatures. They could test the claims of a washing powder advertisement. The article entitled Biological Washing Powder in Issue 2 of PRISM provides additional background information for the pupils to read when carrying out this Brief. It also provides an excellent source for further pupil research opportunities. This article was written by pupils at the Brakenhale School, Berkshire. You can find out more about their 'Washing Powders' project on the school Web site:

<http://www.Brakenhale.berks.sch.uk/>

2. Investigate the effects of pectinase on juice extraction of different fruits, especially non-citrus and citrus fruits. The fruit should be chopped into small cubes put into a beaker to which 1cm³ of pectinase is added and mixed. The mixture should then be placed in a filter paper in a filter funnel. The juice passing through the filter funnel can be collected in a measuring cylinder and its final volume recorded.

3. Investigate the effects of enzyme concentration on the amount of product produced, using the same equipment as Lock and Key 6.

4. Investigate the effects of substrate concentration on the amount of product produced, using the same equipment as Lock and Key 6.