Evaluating experiments

Learning objectives

1 Understand what is required when evaluating an experiment or investigation.

2 Identify the aspects of a named investigation that are relevant to its evaluation.

3 Evaluate the aspects identified and use them to write an overall evaluation, if required.

Introduction

Practical skills are an important part of most chemistry courses. They include being able to evaluate the methods used, data collected and the conclusion. This worksheet will help you evaluate your experiment as you are doing it. You can use the glossary at the end of the sheet to help with any words you are unsure of.

General guidance

Complete the table at suitable intervals during your experiment. You must decide when this is appropriate. Complete the 'Evaluating the planning stage' and 'Evaluating the apparatus' sections before you carry out your experiment. Answer the 'Evaluating the method' questions either as you carry out the experiment or soon after. If you are completing this section as you are carrying out the experiment, take care that it is safe to leave the experiment and that you are not introducing additional errors. Write your answers in the 'Evaluating the conclusion' and 'Improvements' sections after you have processed the data.

Your course may require you to write an overall evaluation. Your teacher will tell you if you need to do this.

Experiment:	
Evaluating the planning stage	**Answer**
What is the independent variable? This is what you are changing in your experiment.	The independent variable is:
What is the dependent variable? This is what you are measuring.	The dependent variable is:
Which variables are you controlling? These are the things you are keeping the same.	The variables I am controlling are:
Are there any variables you cannot control? If so, name them. These are things that might affect your experiment that you cannot control, such as the room temperature.	The variables I cannot control are:
Will your method provide valid data relevant to your hypothesis? Explain your answer. Your hypothesis is a statement of what you think will happen. Will your experiment give results to see if your hypothesis is correct?	My method will/will not provide valid data relevant to my hypothesis because:

Evaluating the apparatus	
Which pieces of apparatus that you are using have uncertainties? (errors). The uncertainties on apparatus tell us how accurate the apparatus is. It is usually printed on the apparatus. It will be, for example, ±1.0 cm^3.	The pieces of apparatus with uncertainties are:
What are you doing to limit errors from apparatus? You should use the smallest measuring apparatus you can. If you are measuring 8 cm^3 of water, a 10 cm^3 measuring cylinder will be more accurate than a 50 cm^3 measuring cylinder.	I am limiting errors from apparatus by:
Evaluating the method	
List any errors due to the method you are using. What is wrong with the method you are using?	The errors due to the method we are using are:
List any errors due to the way you carried out the investigation. These are human errors such as delays in starting a stopwatch and not identifying colour changes consistently.	The errors due to the way we carried out the investigation are:
What is your biggest source of error? Do you think your biggest source of error is human error, errors from inaccurate apparatus or the method you used?	I think the biggest source of error is:

Evaluating the conclusion	
Have you identified and dismissed any anomalous results? Did you have any results that didn't fit the overall pattern?	I have/have not identified and dismissed anomalous results.
Have you used a suitable range for the independent variable? A range of values for the independent variable is the values you are changing from the lowest to the highest, eg 10°C to 50°C. Usually, a wide range of values is better than a narrow one.	I have/have not used a suitable range of values for the independent variable.
Have you done enough repeats? Have you taken an average of repeat values, excluding any anomalous results? Repeating your experiment several times is a way of checking whether your results are reliable.	I have/have not done enough repeats. I have/have not taken an average of repeat values and excluded any anomalous results.
What are the limitations of your investigation and conclusion? Can you apply your conclusion to the wider world? For example, if you've concluded increases in temperature increase the rate of reaction for a certain reaction, does that apply to all reactions?	The limitations of my investigation and conclusion are:
Is your conclusion reproducible? Would another group in your class get the same results if they used the same method and apparatus as you?	My conclusion is/is not reproducible.
You have now completed your evaluation. **How could you improve the experiment?**	
What changes can be made to the apparatus and method to improve the validity of the results? Look back at your answers in this table. What can you change to improve your experiment and results?	To improve the validity of the results, I could:

Glossary

Anomalous result – a result that does not fit the pattern of other results. This may be in the pattern of the overall results or in a number of repeats under the same conditions.

Control variable – a variable which you keep constant so that it does not affect the results. For example, keeping a constant temperature or concentration of a solution.

Dependent variable – the variable for which the values change when the independent variable is changed. This is the variable you measure. For example, if you are changing the temperature of a reaction and timing how long it takes, time is the dependent variable.

Errors – things that are inaccurate in an experiment. They can be due to the method, the apparatus or human error. Errors can make your results less accurate.

Hypothesis – a statement of what you think will happen in your investigation.

Independent variable – the variable for which you select the values. This is the variable you change in an investigation. For example, if you are changing the temperature of a reaction and timing how long it takes, temperature is the independent variable.

Limitations – how far you can apply your conclusion. For example, if you conclude that an increase in temperature increases the rate of reaction of a certain reaction, does this apply to all reactions?

Range – the maximum and minimum values of the independent and dependent variables. For example, if temperature is the independent variable, the range of values investigated maybe from 10°C to 50°C.

Reproducible – measurements are reproducible if different learners obtain the same results using the same apparatus and method.

Uncertainty – the range you'd expect a measurement to be between. For example, a burette has an uncertainty of ± 0.05 cm^3, so a reading of 25.00 cm^3 may be between 24.95 cm^3 and 25.05 cm^3.

Validity – the suitability of the procedure to test the hypothesis. This includes the suitability of the method and apparatus used to test the hypothesis.

Variable – something that can change in an investigation.