

NZQA Approved

Internal Assessment Resource

Chemistry Level 3

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| This resource supports assessment against:  Achievement Standard 91387  Carry out an investigation in chemistry involving quantitative analysis |
| Resource title: Is your pool sterile? |
| 4 credits |
| This resource:   * Clarifies the requirements of the standard * Supports good assessment practice * Should be subjected to the school’s usual assessment quality assurance process * Should be modified to make the context relevant to students in their school environment and ensure that submitted evidence is authentic |

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| Date version published by Ministry of Education | February 2017 Version 2  To support internal assessment from 2017 |
| Quality assurance status | These materials have been quality assured by NZQA.  NZQA Approved number A-A-02-2017-91387-02-6369 |
| Authenticity of evidence | Teachers must manage authenticity for any assessment from a public source, because students may have access to the assessment schedule or student exemplar material.  Using this assessment resource without modification may mean that students’ work is not authentic. The teacher may need to change figures, measurements or data sources or set a different context or topic to be investigated or a different text to read or perform. |

**Internal Assessment Resource**

Achievement Standard Chemistry 91387: Carry out an investigation in chemistry involving quantitative analysis

Resource reference: Chemistry 3.1A v2

Resource title: Is your pool sterile?

Credits: 4

Teacher guidelines

The following guidelines are supplied to enable teachers to carry out valid and consistent assessment using this internal assessment resource.

Teachers need to be very familiar with the outcome being assessed by Achievement Standard Chemistry 91387. The achievement criteria and the explanatory notes contain information, definitions, and requirements that are crucial when interpreting the Standard and assessing students against it.

Context/setting

This activity requires students to investigate the concentration of sodium hypochlorite in swimming pool water, under different conditions.

Students may plan and carry out the investigation in groups, but each student must collect data for at least one independent variable. Students may also carry out the whole investigation individually.

Students keep a logbook, process the group data, and write their report individually.

Conditions

Students must be given sufficient time to show their understanding.

Ensure that they follow standard laboratory safety procedures as outlined in *Safety and Science: A Guidance Manual for New Zealand Schools*.

Resource requirements

Samples containing sodium hypochlorite need to be collected/made by the student.

Students must be provided with these standard solutions:

* sodium thiosulfate solution (approx 0.2 mol L–1)
* 10% potassium iodide solution
* 2 mol L–1 sulfuric acid
* starch solution.

Equipment needed:

* normal laboratory glassware, including a burette and pipette.

Additional information

Further information on assessment and management issues, other practical investigation examples, and a question and answer archive, can be found at: [www.chemteach.ac.nz](http://www.chemteach.ac.nz)

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| Achievement | Achievement with Merit | Achievement with Excellence |
| Carry out an investigation in chemistry involving quantitative analysis. | Carry out an in-depth investigation in chemistry involving quantitative analysis. | Carry out a comprehensive investigation in chemistry involving quantitative analysis. |

Student instructions

Introduction

This activity requires you to investigate the concentration of sodium hypochlorite in swimming pool water under different conditions (such as UV exposure, pH, or concentration of chlorine stabilisers).

You can plan and carry out the investigation as a group. However, you need to keep your own logbook throughout the investigation, and you must process the data on your own and write an individual report for submission.

You will be assessed on the quality of your investigation, which involves:

* keeping a logbook
* developing and carrying out a procedure to collect data about the concentration of sodium hypochlorite in swimming pool water
* processing the data to reach a conclusion
* discussing the investigation in terms of the procedure used and the reliability of the data
* comprehensively reporting your investigation in a written report.

You have approximately two to three weeks of in-class time to complete this task.

Task

In your group, define the purpose of your investigation, conduct background research, and identify how you will ensure safety. The purpose should include exploring possible trend or pattern in the quantity of sodium hypochlorite. Then plan your practical work and conduct some trials to refine your method. Each member of the group should collect and record data for at least one of the independent variables. All data should then be collected together and shared with the group. Finally, you must individually process the group data and write your report.

Your report should include the following sections:

* purpose
* description of procedure – include a description of how significant variables are controlled, the preparation of samples, and any modifications made to the method during the course of the investigation
* results
* conclusion
* discussion – an evaluation of the whole investigation that considers:
* an evaluation of the reliability of data by considering the procedure used and possible sources of error
* reasons for any modifications made to the original method
* the accuracy and reliability of the data collected
* comments on the significance and validity of the conclusion
* links between conclusion(s) and chemical principles and/or real life applications
* bibliography – an acknowledgement and identification of sources of information.

A method used to measure the concentration of hypochlorite ions in solution is given in Resource A.

Resource A

***Determination of the hypochlorite ion concentration***

Taken fromInternal Assessment Resource 3/2 – D3, NZQA(2006) <http://ncea.tki.org.nz/Resources-for-non-aligned-standards/Science/Chemistry/Level-3-Chemistry-existing>

Swimming pool water can be analysed by titration to determine the concentration of NaOCl present. The first step involves the formation of iodine from a solution containing an excess of iodide ions. The iodide ions undergo an oxidation-reduction reaction with OCl– ions, which produces iodine (yellow/brown in solution).

Hypochlorite ions react with iodide ions according to the equation:

OC + 2I- + 2H+ → Cl− + I2 + H2O

The iodine produced is then titrated with standardised sodium thiosulfate solution.   
It reacts according to the equation below:

I2 + 2S2O32− → 2I− + S4O62–

Since starch turns blue in the presence of iodine, it is used as an indicator for this final reaction.

The overall equation for both reactions is:

OCl− + 2H+ + 2S2O32− → Cl− + S4O62− + H2O

***Solutions***

* sodium thiosulfate solution (approx 0.2 mol L–1)
* 10% potassium iodide solution
* 2 mol L–1 sulfuric acid
* starch solution.

***Procedure***

1. Pipette 25 mL of the sample solution into a conical flask.
2. Using a measuring cylinder, add about 10 mL of 10% aqueous potassium iodide solution. Swirl well to dissolve.
3. Using a measuring cylinder, add about 5 mL of dilute sulfuric acid and mix.
4. Titrate the liberated iodine with the standard sodium thiosulfate solution until a pale yellow colour is obtained.
5. Add starch solution and continue titrating until the blue-black colour just disappears.
6. Repeat the titration until you have concordant results.
7. Using the titration data, determine the concentration of sodium hypochlorite in the sample.

Assessment schedule: Chemistry 91387: Is your pool sterile?

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| Evidence/Judgements for Achievement | Evidence/Judgements for Achievement with Merit | Evidence/Judgements for Achievement with Excellence |
| The student carries out an investigation in chemistry involving quantitative analysis.  They do this by investigating the concentration of sodium hypochlorite under certain conditions leading to a conclusion based on the processed data.  They have kept a logbook and produced a report.  In their investigation the student:   * develops a purpose * includes a description of the procedure that includes preparation of samples and the analytical technique used * has a range of values for the independent variable * includes a summary of the collected and processed data * makes a conclusion based on processed data. | The student carries out an in-depth investigation in chemistry involving quantitative analysis.  They do this by investigating the concentration of sodium hypochlorite under certain conditions leading to a conclusion that links the processed data to the purpose of the investigation.  They have kept a logbook and produced a report.  In their investigation the student:   * carries out trials * controls significant variables * has a valid range values for the independent variable * describes their method in sufficient detail to enable it to be duplicated * standardises standard solution(s) * shows the mathematical steps used to process the data * makes a valid conclusion relevant to the purpose of the investigation * explains how the procedure used contributed to the collection of quality data. | The student carries out a comprehensive investigation in chemistry involving quantitative analysis  They do this by investigating the concentration of sodium hypochlorite under certain conditions leading to a comprehensive conclusion  They have kept a logbook and produced a report.  In their investigation the student:   * accurately processes the data and used appropriate significant figures * justifies the steps used in the procedure in relation to the reaction(s) and to the nature of the samples being analysed * justifies how the processed data supports the conclusion(s) * evaluates the reliability of the data by considering the procedure used and sources of error * links the conclusion(s) to chemical principles and/or real life applications. |

Final grades will be decided using professional judgement based on a holistic examination of the evidence provided against the criteria in the Achievement Standard.