**NZQA**

**Approved**

Achievement standard: 90943 Version 3

Standard title: Investigate implications of heat for everyday life

Level: 1

Credits: 4

Resource title: Safe glass slumping

Resource reference: Science VP-1.4 v2

Vocational pathway: Construction and Infrastructure

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| Quality assurance status | These materials have been quality assured by NZQA. NZQA Approved number A-A-02-2015-90943-02-7287 |
| Authenticity of evidence | Assessors/educators must manage authenticity for any assessment from a public source, because learners may have access to the assessment schedule or exemplar material.Using this assessment resource without modification may mean that learners’ work is not authentic. Assessors/ educators 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. |

Vocational Pathway Assessment Resource

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Learner instructions

# Introduction

This assessment activity requires you to investigate the implications of heat transfer in a kiln used for glass production.

You are going to be assessed on how comprehensively you investigate the implications of heat transfer in a kiln used for a process known as slumping. This process is used to heat glass so that it becomes soft and takes on the shape of a mould. Understanding how heat is transferred is important so that the correct temperature is reached safely and a quality product is achieved.

The following instructions provide you with a way to structure your work so you can demonstrate what you have learnt and achieve success in this standard.

Assessor/educator note: It is expected that the assessor/educator will read the learner instructions and modify them if necessary to suit their learners.

# Task

To create decorative pieces of glass the slumping method can be used. This technique requires the ability to understand how a kiln can achieve very high temperatures by the way heat is transferred in the kiln.

You will produce a report using experimental data and observations you have gathered to explain aspects of heat transfer behind how high temperatures can be achieved in a kiln for glass production. Your report is to be used as part of a training guide to explain the process of heat transfer for safe and correct operation of a slumping kiln.

You will use primary evidence and/or secondary data from your investigation to support your explanations in your report.

## Gather primary data

Using a range of materials provided by your assessor/educator, and working in a group of up to three learners, investigate how heat is transferred from a heat source to an object during glass production.

Record your data in an organised way, for example by drawing and labelling diagrams or using data tables linked to any observations you make (for example sights, smells or sounds).

Make sure each member of your group agrees on and records the same data.

## Gather secondary data

A glass kiln produces very high heat levels. Work independently to collect relevant information on how heat is transferred from the heat source in a kiln to generate high temperature levels.

Collect enough information to allow you to discuss the links between the scientific theory of heat transfer and the results of your experiment, for example identifying and explaining the general mechanisms of heat transfer in glass kilns.

## Prepare and present your report

Produce a report that comprehensively explains the transfer of heat in a kiln to achieve the high heat values required for glass production.

Include in your report:

* data you have gathered (for example information and experimental data results)
* how the temperature of the heat is measured and recorded
* the transfer of heat by radiation, convection and conduction
* how heat is/ could be lost in a kiln
* why heat loss should be prevented
* why some materials show a change of phase at certain temperatures
* evidence of your own critical thinking, for example you might elaborate, justify, relate, evaluate, compare and contrast, or analyse the science information you have gathered
* the scientific theory of heat transfer as you critically evaluate the implications in glass production.

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Assessor/Educator guidelines

# Introduction

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

As with all assessment resources, education providers will need to follow their own quality control processes. Assessors/educators must manage authenticity for any assessment from a public source, because learners may have access to the assessment schedule or exemplar material. Using this assessment resource without modification may mean that learners' work is not authentic. The assessor/educator may need to change figures, measurements or data sources or set a different context or topic. Assessors/educators need to consider the local context in which learning is taking place and its relevance for learners.

Assessors/educators need to be very familiar with the outcome being assessed by the achievement standard. The achievement criteria and the explanatory notes contain information, definitions, and requirements that are crucial when interpreting the standard and assessing learners against it.

# Context/setting

This activity requires learners to comprehensively investigate and produce a report on the way heat is transferred from a heat source to achieve the high temperatures required to melt glass.

Learners will perform a practical investigation with direction, conduct research and then process this information to present a report of their findings. The findings and conclusions in their report should link their prior knowledge, understanding of the scientific theory of heat, the information gathered, and their experimental data. The aspects of heat in this assessment are based on heat transfer and require prior knowledge of heat energy, radiation, conduction, convection, specific heat capacity, and temperature as a measure of heat energy.

# Conditions

Learners could work in groups of no more than three to gather the required experimental results. Learners should work independently to gather secondary information and to produce their reports.

# Resource requirements

Provide each group with:

* a variety of heat sources and objects/materials to be heated to investigate heat transfer, for example metal rods to show conduction
* laboratory equipment, for example heat proof tiles/mats, wooden tongs, a thermometer/reliable thermostat on a heater, a heat source such as a Bunsen burner, an electric element or an oil fin heater.

# Additional information

Provide specific guidance or instruction to learners about how to carry out the experiment(s).

Gathering of primary data can be carried out independently or in groups. Final work will be individually assessed. Decide on the format of the final presentation. It could be a written report, oral presentation, poster, PowerPoint, or any other suitable format. You may wish to take learners’ preferences into account in deciding on the format.

Procedures outlined in *Safety in Science:* *a Guidance Manual for New Zealand Schools,* Learning Media*,* Ministry of Education, 2000 should be followed.

Safety guidelines must be given and safety equipment, for example safety glasses, must be provided.

## Other possible contexts for this vocational pathway

Heat transfer related to the production of ceramics used in building; making clay bricks; and tiles (roofing or flooring).

# Assessment schedule: Science 90943 – Safe glass slumping

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| Evidence/Judgements for Achievement | Evidence/Judgements for Achievement with Merit | Evidence/Judgements for Achievement with Excellence |
| The learner investigates implications of how heat is transferred in a kiln to achieve the high heat values for glass production. At least one of the following is required:* collecting and processing primary evidence from an investigation and relating it to the scientific theory relevant to the implications of heat transfer
* collecting and processing secondary data and identifying the scientific theory relevant to the implications of heat transfer in glass production

For example, the learner describes:* + how heat is transferred (conduction, convection and/or radiation) related to how the high temperatures are achieved for the glass industry. The report may include a diagram or narrative description of experimental results
	+ how heat flows from a hotter region to a colder region
	+ how heat transfer in this context will predominantly be via convection and radiation
	+ how having a poor heat conductor between the inside and outside of the kiln reduces conduction and therefore heat loss from the kiln
	+ how most glass kilns have temperature differences from top to bottom as the result of convection.

*The above expected learner responses are indicative only and relate to just part of what is required.* | The learner investigates, in depth, implications of how heat is transferred in a kiln to achieve the high heat values for glass production. At least one of the following is required:* collecting and processing primary evidence from an investigation and relating it to the scientific theory relevant to the implications in order to give an explanation of heat transfer
* collecting sufficient and relevant secondary data and applying scientific theory to explain the implications of heat transfer in glass production

For example, the learner explains:* + methods of heat transfer (conduction, convection and/or radiation) related to how high temperatures are achieved and maintained, and how this is relevant to the glass industry
	+ why the extent of temperature differences from top to bottom depends on the design of the kiln, age of the heating elements, load distribution in the kiln, and the pyrometric cone number to which the kiln is fired
	+ why downdraft venting will also even out the variation in temperatures
	+ why the slumping of a pyrometric cone may be used to measure temperature in a kiln.

*The above expected learner responses are indicative only and relate to just part of what is required.* | The learner investigates, comprehensively, implications of how heat is transferred in a kiln to achieve the high heat values for glass production. At least one of the following is required:* collecting and processing primary evidence from an investigation and relating it to the scientific theory relevant to the implications in order to give a comprehensive and critical explanation of heat transfer
* collecting sufficient and relevant secondary data and applying scientific theory to critically evaluate the implications of heat transfer in glass production

For example, the learner explains comprehensively:* + methods of heat transfer, and the key method that allows high temperatures to be achieved linked to the glass industry
	+ how kilns usually have a greater temperature difference at cooler cone numbers. Cones should be used on the lower, middle and top shelves to determine how much difference exists during firing. This helps in the way the kiln is loaded and fired to minimise temperature differences
	+ limitations of their experiment and the effect on their conclusions/findings
	+ variations between their experimental data and any prior or researched science knowledge, and explains why these variations may have happened.

*The above expected learner responses are indicative only and relate to just part of what is required.* |

Final grades will be decided using professional judgement based on an examination of the evidence provided against the criteria in the Achievement Standard. Judgements should be holistic, rather than based on a checklist approach.