Stone Tools

YEAR 8
EARTH AND SPACE SCIENCES

QGC | FUTUREMAKERS | QUEENSLAND MUSEUM NETWORK | Queensland Government

Future Makers

Future Makers is an innovative partnership between Queensland Museum Network and Shell's QGC business aiming to increase awareness and understanding of the value of science, technology, engineering and maths (STEM) education and skills in Queensland.

This partnership aims to engage and inspire people with the wonder of science, and increase the participation and performance of students in STEM-related subjects and careers — creating a highly capable workforce for the future.

Cover image: A morah grindstone. QM, Peter Waddington.

QUEENSLAND MUSEUM NETWORK

Queensland Government

THE UNIVERSITY OF QUEENSLAND AUSTRALIA

This teacher resource is produced by Future Makers, a partnership between Queensland Museum Network and Shell's QGC business, with support from the Australian Research Council and other parties to ARC Linkage Project LP160101374: The University of Queensland, Australian Catholic University Limited and Queensland Department of Education.

ELABORATE

Stone Tools

Teacher Resource

Students have been investigating rocks and minerals, and can identify different types of rocks based on their properties. The properties of an object make it useful for different purposes. For example, you would choose a spoon to eat soup, and a knife and fork to eat steak.

Before people had large-scale manufacturing, many tools were made of stone. You may start this activity with a discussion to gauge background knowledge: How did Aboriginal and Torres Strait Islander People use stone? Students may discuss cutting, grinding, axes etc. They may also conduct research to identify and consider the varieties of stone tools designed and manufactured by Aboriginal and Torres Strait Islander People. How were they used and re-used (for example, tulas, axes, grinding stones and spear heads)? Additional research may be conducted through a visit to Queensland Museum's Discovery Centre to see the stone tools on display, or by searching Queensland Museum Learning Resources to see some of the stone tools in Queensland Museum's collection.

Thousands of years of Aboriginal and Torres Strait Islander research went into the manufacture and improvement of stone tools. Specialty stones and tools could travel hundreds of kilometres from quarry sites. We can identify where a stone tool originated by looking at the elemental composition of the rock used to make the tool, and by comparing this with the composition of quarry sites and rock outcrops.

Aboriginal people were the first Australian botanists, chemists, geologists and zoologists. They developed a deep knowledge of the dangers, possibilities and dynamics of the natural world that enabled Aboriginal people to manage diverse environments for over 60,000 years. It is important to recognise that Indigenous scientific practices have great antiquity, and are carefully embedded within Aboriginal culture. Indigenous science knowledge continues to inform contemporary culture.

Analysing Materials

The properties of a stone determine what it may be used for. In this activity, students will justify what type of stone would be best for making different tools (e.g. cutting tool or grinding tool), and analyse how the properties of stone determine its use. Students may wish to observe and handle different stones when assessing the advantages and disadvantages.

As an additional activity, students could investigate how stone tools were made and try to make their own tool out of a selected stone. If you choose to conduct this activity with students please ensure the risks are carefully controlled. Additionally, making stone tools took thousands of years of research and much practice. Students are unlikely to achieve success, however this can lead into important discussions about the amount of expertise, technology and knowledge required by Indigenous people to make effective tools. You can find some excellent video tutorials online about the production of stone tools.

The *Morah* Stone and Investigating Grinding

The *morah* stone is a grinding and grating tool, used by Aboriginal people in northern Queensland to process toxic seeds and kernels. More information about this amazing tool can be found in the student activity. Students will learn about the *morah* stone using information from Queensland Museum, and then conduct their own investigation to determine what materials may make effective grinding tools and why.

More on the *morah* stone and the processing of poisonous plants can be seen in the *First Scientists* display in the Discovery Centre on Level 4 of Queensland Museum in Brisbane. You can see examples of other stone tools in the Queensland Museum collection by searching 'stone tool', 'grindstone', 'axe', 'tula' etc. on Queensland Museum Learning Resources.

In this activity, students will conduct an investigation to assess the potential for materials to be used for grinding. Students may develop their own investigations or you may wish to supply set materials. For example, students could use sandpaper with different grit to grind a chestnut or 1 cm^3 piece of raw potato to investigate the effect of surface roughness. We would not recommend students use Zamia Palm, Black Bean or Cycad seeds due to their toxicity.

The scientific report should be specific to the materials and investigation students have selected, and they should control variables for a fair experiment.

NB: Should you find an artefact or quarry site there are a couple of very important things to keep in mind. Firstly, do not move the artefact. Artefacts always reveal the most information when their context is recorded as well, including their exact location and associated geological layer. The next thing to do is to contact the Department of Aboriginal and Torres Strait Islander Partnerships *on 13 74 68 or enquiries@datsip.qld.gov.au, so their trained staff can help manage and document the discovery.*

NB: When studying rock artefacts, archaeologists use the term stone rather rock. In this activity we will use similar terms to archaeologists, hence the use of the word stone. Stone tools may also be referred to lithics or geological resources.

For further information on *morahs* please see the following:

Field, J., Cosgrove, R., Fullagar, R., and Lance, B. (2009). Starch residues on grinding stones in private collections: A study of *morahs* from the tropical rainforests of NE Queensland. In Archaeological Science Under a Microscope: Studies in Residue and Ancient DNA Analysis in Honour of Thomas H. Loy (pp. 228–238). Retrieved from http://press-files.anu.edu.au/downloads/press/p123961/pdf/17.pdf

Curriculum Links

Science

YEAR 8

Science Understanding

Sedimentary, igneous and metamorphic rocks contain minerals and are formed by processes that occur within Earth over a variety of timescales (ACSSU153)

Science as a Human Endeavour

Science knowledge can develop through collaboration across the disciplines of science and the contributions of people from a range of cultures (ACSHE226)

Science Inquiry Skills

Identify questions and problems that can be investigated scientifically and make predictions based on scientific knowledge (ACSIS139)

Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed (ACSIS140)

Measure and control variables, select equipment appropriate to the task and collect data with accuracy (ACSIS141)

Construct and use a range of representations, including graphs, keys and models to represent and analyse patterns or relationships in data using digital technologies as appropriate (ACSIS144)

Summarise data, from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions based on evidence (ACSIS145)

Reflect on scientific investigations including evaluating the quality of the data collected, and identifying improvements (ACSIS146)

Use scientific knowledge and findings from investigations to evaluate claims based on evidence (ACSIS234)

Communicate ideas, findings and evidence based solutions to problems using scientific language, and representations, using digital technologies as appropriate (ACSIS148)

Design and Technologies

YEAR 7 AND 8

Design and Technologies Knowledge and Understanding

Analyse ways to produce designed solutions through selecting and combining characteristics and properties of materials, systems, components, tools and equipment (ACTDEK034)

Design and Technologies Processes and Production Skills

Critique needs or opportunities for designing and investigate, analyse and select from a range of materials, components, tools, equipment and processes to develop design ideas (ACTDEP035)

Select and justify choices of materials, components, tools, equipment and techniques to effectively and safely make designed solutions (ACTDEP037)

Independently develop criteria for success to evaluate design ideas, processes and solutions and their sustainability (ACTDEP038)

Cross-Curriculum Priorities

Aboriginal and Torres Strait Islander Histories and Cultures

Aboriginal and Torres Strait Islander communities maintain a special connection to and responsibility for Country/Place. (OI.2)

Aboriginal and Torres Strait Islander Peoples' ways of life are uniquely expressed through ways of being, knowing, thinking and doing. (OI.5)

Stone Tools

Student Activity

Analysing Materials

Stone has been used to make tools by people and our ancestors for many millennia. Over thousands of years people have refined methods for making tools from a variety of stone, and developed different tools to do different jobs and respond to changing needs (for example, increasing population, changing trade networks, and changing environments and social and cultural customs). Stone artefacts provide useful clues that can tell us about the lives of people who manufactured, traded and used them. For example, individual tools can be tracked back to their quarry sites sometimes hundreds of kilometres away, providing information about trade and travel.

Effective rock types (stone) for the manufacture of different tools

Type of Tool	Properties Required	Rock Type	Justify how you selected the rock type

Additional activity: Create a stone tool out of a material you selected in the above table.

The *Morah* Stone and Investigating Grinding

How do the properties of a stone tool determine their use?

The *morah* stone is no ordinary rock. To the Aboriginal people of the northern Queensland rainforest, this stone technology aided their ability to survive, sustain themselves and prosper. This is because the *morah* stone was used to process toxic plants such as the Zamia Palm (*Lepidozamia hopei*), Black Bean (*Castanospermum australe*) and Cycad (*Cycads media*). The Bama people knew about the toxicity of these plants and, through scientific processes, discovered how to extract the toxin from them. The *morah* stone was invented as an aid in extracting toxins from the seeds of the toxic plants.

The *morah* stone is a specialised grooved grindstone formed from slate, a smooth, flat metamorphic rock. Slate has a low water absorption index. This is important because when toxic seeds are ground using the *morah* stone, toxic materials are not absorbed by the rock and will not contaminate other food. Slate is also fireproof, has a level of resistance to breakage and is easily portable. It is a very handy tool. Most *morahs* have roughly parallel incised grooves running across the grinding surface perpendicular to the axis of the stone. These grooves or incisions would most likely have been made with a sharp, hard rock such as quartz or granite, a pointed bone or piece of sharp coral. The grooves increased the friction for grinding, and helped to separate the plant pulp and liquid.

Seeds or kernels were placed on the incised *morah* stone and the *moogi*, usually a harder stone, was placed on top. A rolling pushing and pulling motion was used to grate and grind the seeds or kernels using the *moogi*. This motion across the stone over the incised grooves facilitated the efficient breakup of the starchy kernels to create a powder which could then be used to make a type of damper or bread. Before this powder could be used however, it was placed in a basket in running water to leach the remaining toxins from the material.

How do we know which seeds were processed? The residue analysis from some *morah* stones found in northern Queensland revealed the specific types of seeds which were ground down. Food sources such as the Zamia seeds provided a high carbohydrate, protein and energy diet as well as being low in fat. Six species of toxic plant sources in the rainforest provided and formed part of the Bama people's staple food source, and they were cultivated in groves to increase the production of food resources. This readily-available, high-energy food source allowed Bama people to settle on a more permanent basis in the rainforest.

Questions

1. What were the properties of *morahs* that made them useful for processing toxic seeds?

2. Write the procedure used to process the toxic seeds.

3. What kitchen tools could we use today to complete this process?

More on the *morah* stone and the processing of poisonous plants can be seen in the *First Scientists* display in the Discovery Centre on Level 4 of Queensland Museum. Here you can learn more about the Indigenous cultivation of the land to grow important food sources, and the engineering of bicornual baskets.

You can see examples of other stone tools in Queensland Museum's collection at Queensland Museum Learning Resources. You may wish to try search terms such as 'flake', 'grindstone' or 'axe'.

Additionally, you can learn more about the work of Nick Hadnutt, an archaeologist at Queensland Museum, in the ABC article, Archaeology more down to earth than high adventure of Indiana Jones.

The *Morah* Stone and Investigating Grinding

Investigating Grinding

The grooves were made in the *morah* stone to increase the friction as seeds were pushed across the surface, making the stone more effective for grating and grinding seeds and kernels.

In this activity, you will design and conduct your own experiment to investigate how the properties of materials affect their ability to be used as an effective grinding tool.

Structure of a Scientific Investigation

Aim: Statement about what the experiment will do. Often this statement starts with to investigate or to determine. For example, *to investigate how the surface roughness of a material affects the ability to grind a piece of coconut.*

Introduction: Give background information on the topic being investigated, and explain the purpose of the experiment and how it will be conducted.

Hypothesis: Write an educated prediction as to the outcome of the experiment. This must incorporate the independent variable and the dependent variable. Remember to justify the hypothesis by giving reasons for why the particular prediction was made.

Variables: Include an independent variable (variable that is purposely changed), a dependent variable (variable that is measured), and at least five control variables (variables that are kept the same for a fair experiment).

Materials: List all equipment used in the experiment, include number and amounts.
E.g. 4 x 250 mL beakers.

Method/ Procedure: List the steps taken to conduct the experiment. Remember, there should be enough detail for someone else to pick up the method and conduct the exact same experiment, and the method should be written in past tense.

Risk Assessment: What safety considerations must be made before, during and after this experiment? Include AT LEAST five hazards and how to minimise them.

Results: Include both qualitative observations and quantitative data. Record the results in a table. Use Microsoft Excel to graph the results, and briefly summarise the observations in a paragraph.

Discussion: Analysis of results and experimental design.

- Describe what the results found. Include data in the analysis.
- Explain if the results support or do not support (refute) the hypothesis.
- How do the results compare with the information in the introduction?
- Give possible reasons for why the results occurred. Include background knowledge, and an explanation for any inconsistent or unexpected results.
- What problems were encountered and how could these be overcome in future investigations?
- Evaluate the experiment and results:
  - Were the results fair? (Were all the control variables kept the same throughout the experiment?)
  - Were the results reliable? (Has the experiment been repeated many times with similar results?)
  - Were the results accurate? (Were the measurements precise?)
- Suggest how the experiment could be improved in the future.
- Explain future experiments that would be useful for collecting further information, and answering unknown questions.
- Where is this experiment useful or important to real life?

Conclusion: Summarise the experiment and the results. Was the hypothesis supported or refuted?

References: List all sources in a consistent format and include in-text referencing in the introduction and discussion.