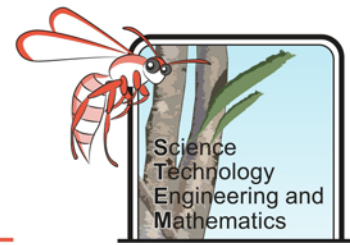


Going for Gold – Teacher Resource



Intended Use of Resources

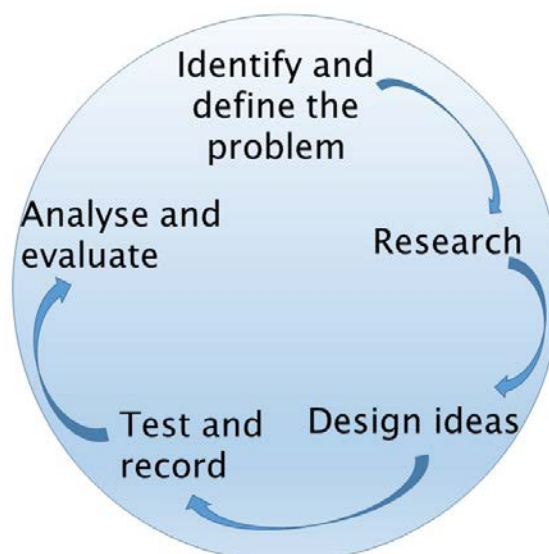
This project has been designed so that teachers from different STEM areas can pick and choose sections relevant to their subject area to work on. All activities in this package do not need to be completed to get value from the package – each activity can be completed as a stand-alone or can be approached, as a team, as a larger project. The package has potential to be extended into a much longer project to include curriculum points from different STEM subjects.

There are three **student workbooks - Open, Guided and Scaffolded**, that go alongside this resource; all have the same suggestions for activities, however, they have been written and edited to provide differentiated learning options to support good teaching practice. Teachers may pick and choose which versions they give which students, and may wish to edit them further to address their learning needs. Due to the differentiation of the workbooks, the **Open** activities will enable more syllabus links to be addressed, which is why each activity has its own syllabus links key. However, if you wish to give a truly open ended investigation then you could just give the students the challenge and background information section of the Student Booklet.

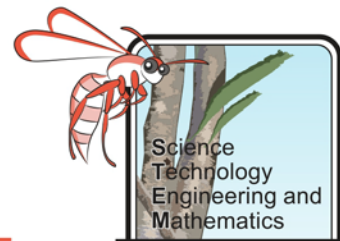
The Woodside Australian Science Project (WASP) STEM resources aim to be accessible and supportive for teachers and students, please contact us if you have questions, feedback, require assistance or would like to arrange an incursion or a professional development workshop - www.wasp.edu.au.

The Student Challenge

Realising that in Western Australia you have a unique opportunity to find a small fortune or at the very least have an adventure, your family decides that their next holiday will be spent fossicking for gold. You know that this could be very hard and also dangerous, so you decide to do some research and investigations in advance to ensure you are well prepared for the undertaking ahead.



Going for Gold – Teacher Resource



Background Information

The discovery of gold in the Kimberley in 1885 sparked the excitement of many, but it was in 1892 when the Gold Rush of Western Australia really started, with the first big discovery at Coolgardie being announced. Further discoveries in the region, including at Mount Charlotte, lead to a population boom, with over 100,000 people moving to WA in the following ten years.

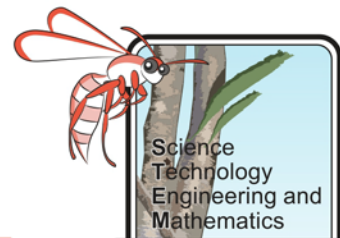
In 2015/16 gold was the third largest resource exported by Western Australia in regards to value, with a value of \$10 billion dollars. This equated to 6.27 million troy ounces (Wikivisuals, 2018). The mine which produced the most in this time period was the Super Pit Gold Mine in Kalgoorlie which produced 700,000 Troy ounces. However, gold is mined all over the state with mines nearly as far north as Port Hedland, stretching all the way down south to Norseman.

Gold is very unreactive, and so around 70% of it is found as native gold (pure). However, around 20% of it will form compounds with other elements (tellurium, sulphur or selenium) creating minerals known as tellurides. Rocks containing tellurides were initially thought to be fool's gold and were discarded, used as building stone and thrown on walkways (literally paving the streets with gold!). It was only a few years into the gold rush that the tellurides were discovered to be gold bearing. This is the majority of what is currently mined at the Super Pit.

For thousands of years gold has been sought after and used for jewellery and coins all over the globe. However, it has only been in the last hundred years that developments in technology and medicine have led to its other properties being exploited. Gold has very low resistivity - which means it can conduct electricity well. Gold is also malleable, can be drawn into wires, making it ideal for micro-circuitry. Thus, nearly all computers and mobile phones will contain small amounts of gold – which is one of the reasons why many phone companies will give you a discount on a new phone if you exchange your old one. Gold separation can be done in a number of ways. Panning is probably the most well-known technique, this is most frequently used when looking for “secondary” gold – where it has been weathered and eroded from its source and deposited in a river bed. Sediments from a river bed can be panned for gold, as the gold is heavier than the surrounding sediment, this technique causes gravity separation. One drawback of the technique is the need for a water source, such as a river.

Due to the lack of water in Western Australia, panning was not feasible and in 1893 Jon Banfield and Stephen Lorden invented a Cradle Dryblower to separate gold from old river sediments and other sources. It worked by using a series of sieves to separate out the heavier gold together with a blast of air to blow away unwanted material. Separating gold from within a telluride mineral requires much more processing. This usually involves a complex process which includes roasting and the addition of cyanide to chemically leach it out. Companies are continuously working on improving these techniques with the Super Pit moving to a micro-grinding process rather than roasting in recent years.

Going for Gold – Teacher Resource



Activities

This booklet contains extra information on each activity, including syllabus links the overall activity objective, suggestions for recommended equipment or alternative ways to run investigations as well as useful resources and website links*.

The syllabus links have been colour coded. These links to the Australian Curriculum are also relevant to the Western Australian Syllabus. – Please see the colour key below:

Covered in Scaffolded, Guided and Open Student Booklet

Covered in Guided and Open Student Booklet

Covered in Open Student Booklet

Italics – WA syllabus for DT and D and T

List of activities:

[Background Research](#)

[How Much is Your Gold Worth?](#)

[Creating a Risk Assessment](#)

[Rock Identification](#)

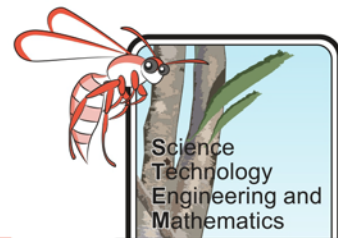
[Determining Densities](#)

[Panning for Gold](#)

[Designing a Dry Blower](#)

**Please note that these were accessed in February 2018 – these addresses may change slightly, we would be grateful if you could let us know if these sites are no longer accessible.*

Going for Gold – Teacher Resource



Background Research

Objective:

Students will gain an insight into the formation of gold and how and where it is found in WA, as well as the properties of gold which make it desirable and identifiable.

The background questions should lead them to start thinking about how they could separate gold in the field, how they might identify it and how much they could get for any gold that they do find. They are “teaser” questions which students will be able to find out more about through the other activities. Therefore if you do not have time to complete all the activities you may wish to add further research to the background questions.

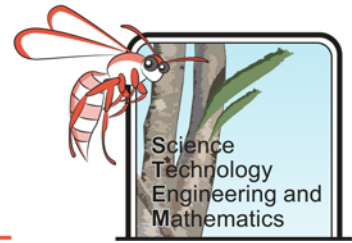
Australian Syllabus Links	
Science	<p>ACSSU153 Sedimentary, igneous and metamorphic rocks contain minerals and are formed by processes that occur within Earth over a variety of timescales.</p> <p>ACSSU225 Chemical change involves substances reacting to form new substances.</p> <p>ACSSU152 Differences between elements, compounds and mixtures can be described at a particle model.</p> <p>ACSHE226 Science knowledge can develop through collaboration across the disciplines of science and the contributions of people from a range of cultures.</p> <p>ACSHE225 Scientific knowledge has changed people’s understanding of the world and is refined as new evidence becomes available.</p>
Digital technologies	<p>ACTDIP025 Acquire data from a range of sources and evaluate authenticity, accuracy and timelines.</p>
Mathematics	<p>ACMNA189 Solve problems involving profit and loss, with and without digital technologies.</p> <p>ACMSP284 Investigate techniques for collecting data, including census, sampling and observation</p>

Useful websites

WASP Year 8 Rock Cycle worksheets, posters and information:
<http://www.wasp.edu.au/mod/page/view.php?id=87>

WASP rocks and minerals video:

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<https://www.youtube.com/watch?v=WYtF-ZdTr7s>

The Geology of Gold – written by Dr Bill Birch, Senior Curator, Geosciences, Museum Victoria, contains useful information plus an interactive map:

<https://www.sbs.com.au/gold/story.php?storyid=128#>

Educational factsheet from the Australian Mines Atlas:

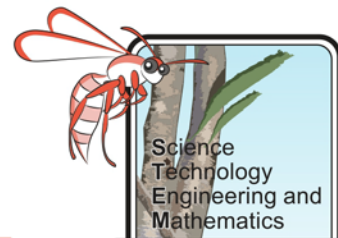
http://www.australianminesatlas.gov.au/education/fact_sheets/gold.html

Interactive geological map of Western Australia with multi-layer facets including geology, geophysics and mine index: <https://geoview.dmp.wa.gov.au/GeoViews/?Viewer=GeoVIEW>

Short (3 ½ minute) video/ animation of how gold is formed on Earth by National Geographic:

<https://www.youtube.com/watch?v=PWx8twycMbl>

Going for Gold – Teacher Resource



How Much is Your Gold Worth

Objective

Students will improve their math skills by completing multi-step calculations to make conversions. They will use actual data from graphs and look for trends. Higher level students will create word formulas and create spreadsheets which will do calculations for them.

By the end of the activity students will have a good understanding that the market fluctuates greatly and that there are times when it is better to sell gold than others. This is a good introduction into stocks and shares which can be a very important life skill for students to learn about and have some understanding of. It is particularly meaningful for students to understand the fluctuation of the market value of resources in Western Australia as this can have major impact on jobs and the economy of the state. Learning to live in a boom-bust economy and living within ones means are very important to ensuring a financially secure future.

Australian Syllabus Links	
Mathematics	<p>ACMNA189 Solve problems involving profit and loss, with and without digital technologies.</p> <p>ACMNA Solve a range of problems involving rates and ratios, with and without digital technologies.</p> <p>ACMNA192 Simplify algebraic expressions involving the four operations.</p>

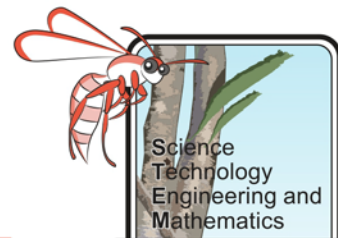
Useful websites

How to find the value of scrap gold – with pictures and illustrations to aid understanding:
<https://www.wikihow.com/Calculate-the-Value-of-Scrap-Gold>

Price of gold interactive chart:
<https://goldprice.org/gold-price-chart.html>

Determining the median and interquartile range – BBC bitesize activity:
<http://www.bbc.co.uk/schools/gcsebitesize/maths/statistics/representingdata3hirev4.shtml>

Going for Gold – Teacher Resource



Creating a Risk Assessment

Objective

Students will learn how to use a risk assessment matrix and score activities. They will make considerations to mitigate and manage risks to make the activities safer. Higher level students will design an app to enable others to complete risk assessments.

This skill is undoubtedly one that students will have to use time and again in future – not only in school but in their working and everyday life after school, even if it is just done subconsciously. It prepares students well for adulthood, and enables them to start thinking for themselves about risks they may take. This worksheet can be altered and used for numerous subjects, such as health, D and T, Science and even when considering eSafety.

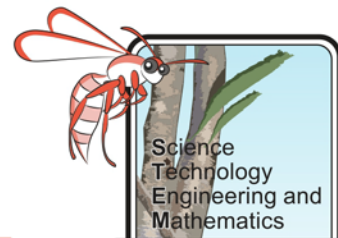
Australian Syllabus Links	
Science	AC SIS140 Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed.
Digital technologies	ACD TDIP029 Design algorithms represented diagrammatically and in English, and trace algorithms to predict output for a given input to identify error sources. ACTDIP026 Analyse and visualise data using a range of software to create information, and use structured data to model objects or events.
Design and Technologies	ACTDEP039 Use project management processes when working individually and collaboratively to coordinate production of designed solutions.

Useful websites and resources

BBC bitesize revision, activity and test for risk assessments in Design and Technology:

<http://www.bbc.co.uk/schools/gcsebitesize/design/resistantmaterials/designhealthrev1.shtml>

Going for Gold – Teacher Resource



Rock Identification

Objective

Students will gain an insight into how the formation of rocks leads to differences in their appearance, and which rocks are most commonly found around gold in Western Australia.

As most gold in WA is brought to the surface through hydrothermal mineral veins, it is very helpful to show them rocks which contain veins. Most commonly you might find quartz veins in your school rock collection – or you may just have samples of quartz that they can look at. Rocks with pyrite (fool's gold) are also good to show as pyrite is often a tracer mineral – showing gold could be nearby. It is useful for students to look at a variety of rock types so that they also know what they are NOT looking for.

We are happy to run incursions at schools to help with rock identification and have a wide range of rock samples we can take with us.

Australian Syllabus Links	
Science	<p>ACSSU153 Sedimentary, igneous and metamorphic rocks contain minerals and are formed by processes that occur within Earth over a variety of timescales.</p> <p>ACSIS145 Summarise data, from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions based on evidence.</p>
Design and Technologies	<p>ACTDEP035 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.</p>

Useful websites and resources:

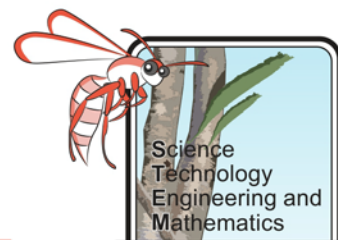
WASP rock identification poster and information:

<http://www.wasp.edu.au/mod/page/view.php?id=87>

WASP rock identification app:

<http://www.wasp.edu.au/mod/page/view.php?id=85>

Going for Gold – Teacher Resource



Determining Densities

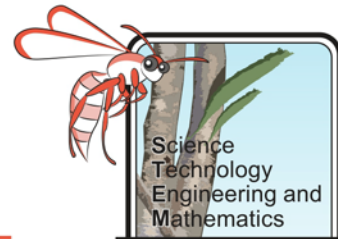
Objective

Students will improve their practical science skills, as well as their mathematics skills through rearranging formulas and following multi-stage calculations.

The size of the rocks and the equipment your school has will really determine how big a measuring beaker/container you will need to use. If you have small samples students could easily measure the volume just by half filling a beaker, adding the sample and then finding the difference in volume as the water level will have risen. If you have displacement cans these can also be used instead of beakers/ice-cream tubs.

Use plastic containers as glass can easily break if students drop the rocks into the water. Large graduated cylinders will give most accurate measurements, however, you will either need to use very small samples, or add an extra step where the students pour the water into them - it could get messy, so a funnel might be needed.

Australian Syllabus Links	
Science	<p>ACSIS141 Measure and control variables, select equipment appropriate to the task and collect data with accuracy.</p> <p>ACSIS145 Summarise data, from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions based on evidence.</p> <p>ACSIS146 Reflect on scientific investigations including evaluation the quality of the data collected, and identifying improvements.</p> <p>ACSIS140 Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed.</p>
Digital technologies	<p>ACTDIP025 Acquire data from a range of sources and evaluate authenticity, accuracy and timelines.</p>
Design and technology	<p>ACTDEP035 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.</p> <p>ACTDEP036 Generate, develop, test and communicate design ideas, plans and processes for various audiences using appropriate technical terms and technologies including graphical representation techniques.</p> <p>ACTDEP037 Select and justify choices of materials, components, tools, equipment and techniques to effectively and safely make designed solutions.</p>



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Mathematics	<p>ACMMG195 Choose appropriate units of measurement for area and volume and convert from one unit to another.</p> <p>ACMMG196 Find perimeters and areas of parallelograms, trapeziums, rhombuses and kites.</p> <p>ACMMG198 Develop formulas for volumes of rectangular and triangular prisms and prisms in general. Use formulas to solve problems involving volume.</p>
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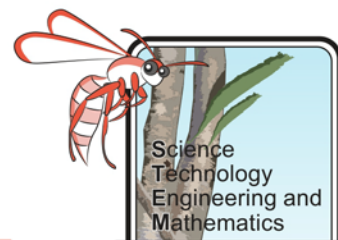
Useful websites and resources:

BBC bitesize activity on determining density and finding the volume of an irregular shape:
<https://www.bbc.co.uk/education/guides/zb7hyc/revision>

Video on how to measure the volume of an irregular shape:
<https://www.youtube.com/watch?v=e0geXKxeTn4>

Densities of Common Rocks and Minerals:
<https://www.thoughtco.com/densities-of-common-rocks-and-minerals-1439119>

Going for Gold – Teacher Resource

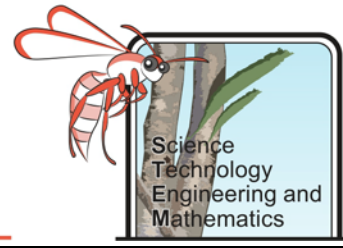


Panning for Gold

Objective

Students will gain a better understanding of gravity separation techniques and the properties of different materials through practical investigation. Complete this investigation outside to avoid water spillage and slips. 25L storage boxes are about the right size for the sediment mixture to go in, and fill them to about $\frac{1}{4}$ full. The pans can be made from various simple pieces of equipment such as plastic plates/ bowls and disposable foil roasting trays. Substitute gold pieces can be bought online, or different metals can be substituted to represent the gold – however, make sure that they are easy to visually identify and pick out from the surrounding sediment and that they have a higher density than the rest of the material, to make them easier to separate.

Australian Syllabus Links	
Science	<p>ACSSU153 Sedimentary, igneous and metamorphic rocks contain minerals and are formed by processes that occur within Earth over a variety of timescales.</p> <p>ACSSU152 Differences between elements, compounds and mixtures can be described at a particle model.</p> <p>ACSHE136 People use science understanding and skills in their occupations and these have influenced the development of practices in areas of human activities.</p> <p>AC SIS146 Reflect on scientific investigations including evaluation the quality of the data collected, and identifying improvements.</p> <p>AC SIS140 Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed.</p>
Design and technology	<p>ACTDEP035 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.</p> <p>ACTDEP036 Generate, develop, test and communicate design ideas, plans and processes for various audiences using appropriate technical terms and technologies including graphical representation techniques.</p> <p>ACTDEP037 Select and justify choices of materials, components, tools, equipment and techniques to effectively and safely make designed solutions.</p> <p>ACTDEP037 Select and justify choices of materials, components, tools, equipment and techniques to effectively and safely make designed solutions.</p>



Going for Gold – Teacher Resource

Mathematics	<p>ACMNA189 Solve problems involving profit and loss, with and without digital technologies.</p> <p>ACMSP284 Investigate techniques for collecting data, including census, sampling and observation</p>
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Useful websites and resources

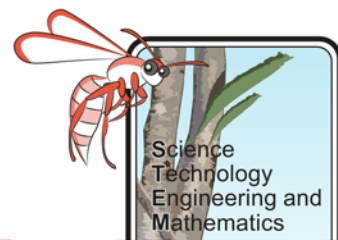
Video explaining the technique of gold panning:

<https://www.youtube.com/watch?v=rLyWrYHJ1E>

Step by step instructions on how to pan for gold:

<http://www.goldgold.com/gold-prospectinggold-panning-instructions.html>

Going for Gold – Teacher Resource



Designing a Dry Blower

Objective

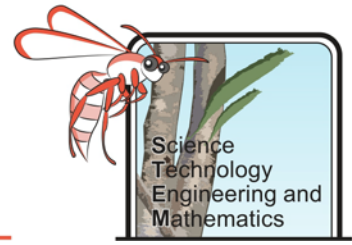
Students will create a simple machine to aid the separation of gold from surrounding rocks without any water, using recycled equipment where possible.

This is a very design focused activity where students will draw design ideas, and evaluate the pros and cons of their own ideas and previous design models to come up with a final design solution. They will test and evaluate their design.

It is useful, although not necessary, if students have already completed the panning for gold activity, so that they already have a good idea about gravity separation techniques.

Australian Syllabus Links	
Science	<p>ACSSU153 Sedimentary, igneous and metamorphic rocks contain minerals and are formed by processes that occur within Earth over a variety of timescales.</p> <p>ACSHE136 People use science understanding and skills in their occupations and these have influenced the development of practices in areas of human activities.</p> <p>ACSIS Communicate ideas, findings and evidence based solutions to problems using scientific language, and representations, using digital technologies as appropriate</p>
Digital technologies	<p>ACTDIP028 Design the user experience of a digital system, generating, evaluating and communicating alternative designs</p>
Design and technology	<p>ACTDEK031 Analyse how motion, force and energy are used to manipulate and control electrochemical systems when designing simple, engineered solutions.</p> <p>ACTDEK034 Analyse ways to produce designed solutions through electing and combining characteristics and properties of materials, systems, components, tools and equipment.</p> <p>ACTDEK031 Analyse how motion, force and energy are used to manipulate and control electromechanical systems when designing simple, engineered solutions.</p> <p>ACTDEP035 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.</p> <p>ACTDEP036 Generate, develop, test and communicate design ideas, plans and processes for various audiences using appropriate technical terms and technologies including graphical representation techniques.</p>
Mathematics	<p>ACMNA189 Solve problems involving profit and loss, with and without digital technologies.</p>

Going for Gold – Teacher Resource



Useful websites and resources

Basics on how a dry blower works and links to DIY dry blower:

http://nevada-outback-gems.com/basic_prospecting/dry_washing.htm

Instructional video on how a dry blower works (~ 4 mins):

<https://www.youtube.com/watch?v=AaYlufhakBE>