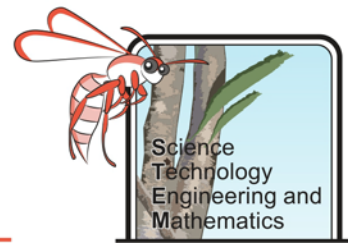
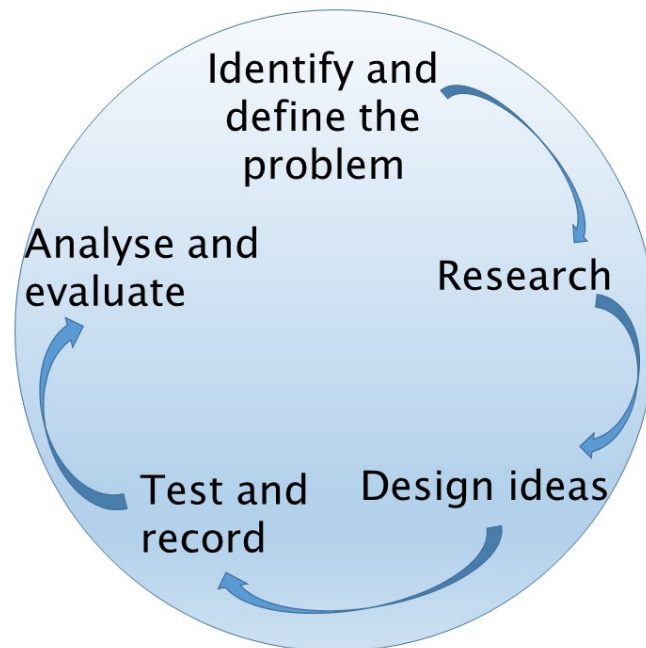


# Going for Gold – Student Booklet



## The 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.



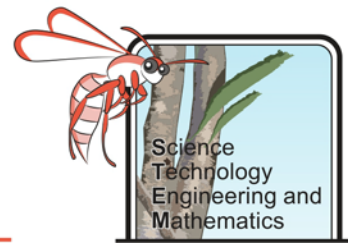
## Background Information

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 Western Australia, including Mount Charlotte, lead to a population boom with over 100,000 people moving to the state in the following 10 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. 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 does not usually react with other elements, and so around 70% of it is found as native gold. 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 what is mined at the SuperPit at Kalgoorlie now.

# Going for Gold – Student Booklet



## Mines, deposits and prospects

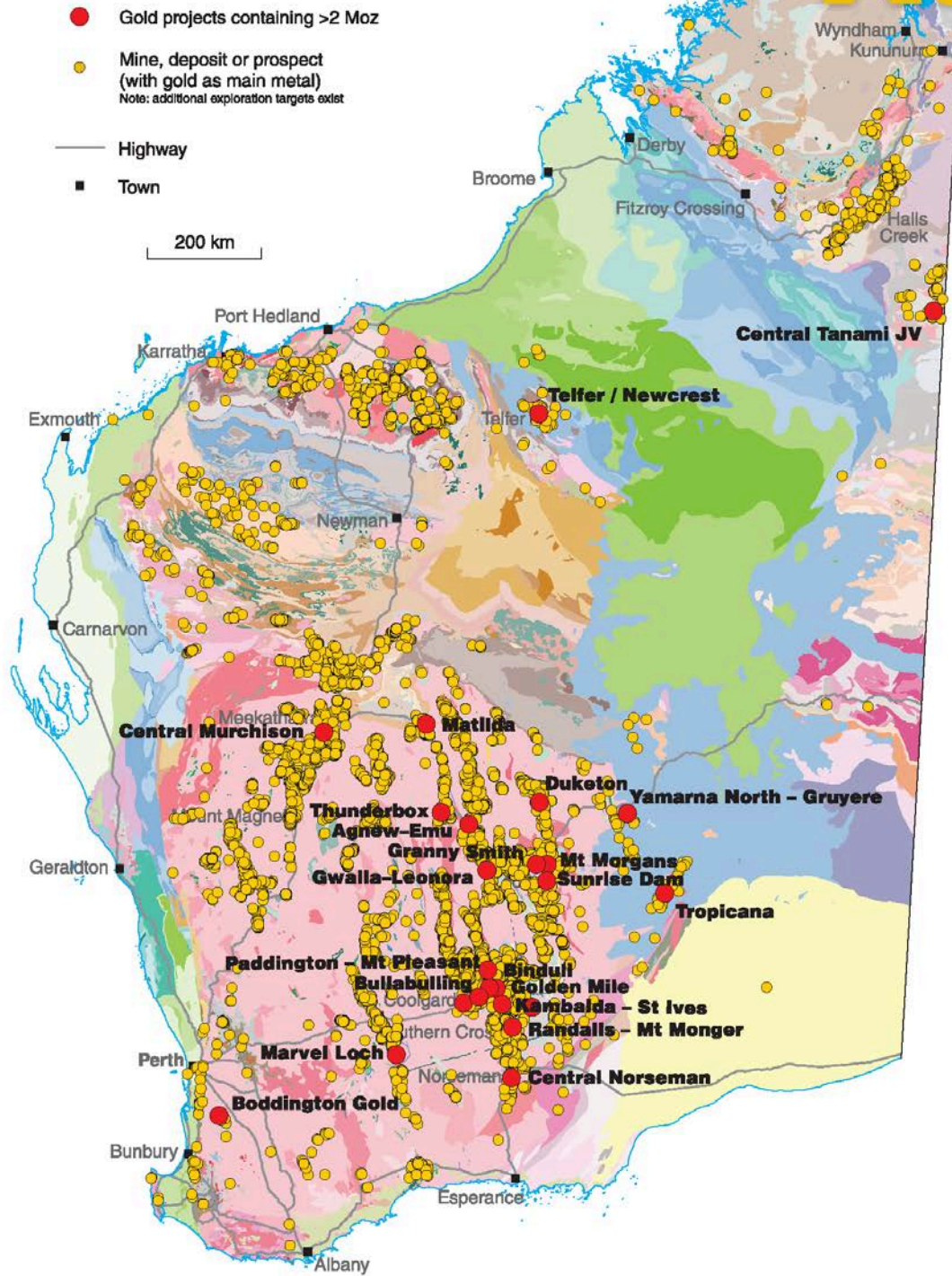
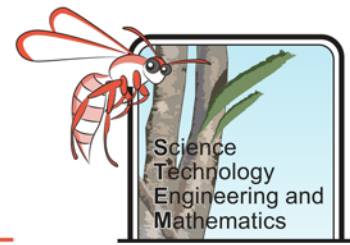


Figure 1. Map of Western Australia, showing some key locations where gold has been found (Geological survey of Western Australia, 2017).

## Going for Gold – Student Booklet



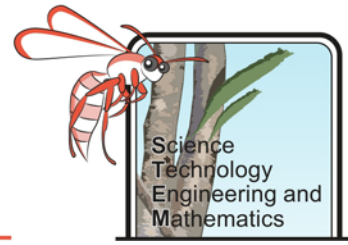
For thousands of years gold has been sought after and used for jewellery and coins all over the globe. However, it has only been in the last hundred years that developments in technology and medicine have led to its other properties being exploited. Nearly all computers and mobile phones will contain 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 has always been a prized and valuable mineral, even with its market price constantly fluctuating, you can be sure that if you strike gold – you've struck gold!

### Background Research

1. Where in Western Australia are the three largest gold mines found?
2. Which rock types are the gold mines in Western Australia often associated with?
3. How is gold formed and brought to the surface? Add labelled images/diagrams.
4. How can gold be separated from surrounding rock?
5. What are some of the properties of gold which could assist you to identify it?
6. What properties of gold make it useful for medicine and electronics?
7. Have there been any recent large finds by fossickers, if so where and how big were the nuggets/ finds?
8. What is the current price of gold?
9. How much will your holiday cost approximately?
10. How much gold will you have to find to finance your holiday?

# Going for Gold – Student Booklet



## Investigation: How Much is Your Gold Worth?

Although you can always be pretty sure that your gold is going to be valuable, the price of gold is always fluctuating. Therefore if you find gold, or have gold you want to sell, it is always worth analysing the markets to decide if it is a good time to sell, or if you might be better off waiting to see if the market price increases.

### Objective

To create a spreadsheet that will calculate the spot price of any gold you find during your exploration holiday, as well as the maximum and minimum amount it would have been worth over the past 5 years to help you decide whether you should sell it straight away or keep it.

1. Find an interactive graph online which shows the price of gold over the past 5 years and paste it into a document.
2. Add annotations to the graph, showing the maximum and minimum value.
3. Can you see any patterns in the gold price fluctuation, e.g. seasonal changes, a linear relationship or does it just seem random? Use data to support your answer.
4. What was the price of gold on today's date for the past 5 years?
5. Calculate the mean price of gold on this day over the past 5 years. (Show your calculations).
6. Is the price of gold today above or below the mean price on this day over the past 5 years, by how much?
7. Determine the median and the interquartile range for the price of gold over the past 5 years and create a box and whisker plot.

The price of gold will depend on its Karat value, and its weight. The purest gold is 24 Karat gold, the lower the number the less pure the gold is. Gold is measured in troy ounces (ozt), there are 31.1 grams in a troy ounce.

8. How many troy ounces are in a kilogram of gold? (Show your calculations).

How to calculate the price of your gold – EXAMPLE.

Price of gold today (spot price)	\$ 1700
Weight of gold	5 grams
Karat	14 k

Step 1. Divide the karat value by 24, and multiply by 100 to find the percentage of pure gold content.

$$14 / 24 = 0.583$$

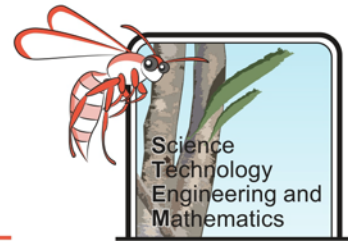
$$0.583 \times 100 = 58.3\%$$

Therefore the percentage of pure gold in 14 k is 58.3%

Step 2. Divide the spot price by 31.1 to determine the price of 1 gram of pure gold (24 karat)

$$1700 / 31.1 = \$54.66$$

## Going for Gold – Student Booklet



Step 3. Multiply the price per gram of pure gold, by the percentage of gold content as a decimal

$$\$54.66 \times 0.583 = \$31.87$$

*Therefore the price per gram of 14 K gold is \$31.87*

Step 4. Multiply the price per gram by the number of grams you have.

$$\$31.87 \times 5g = \$159.35$$

*So the total value of the gold is \$159.35*

Find the price of the following, using today's spot price:

- a) 1 g of 24 k gold
- b) 10 g of 18 k gold
- c) 20 g of 14 k gold

Come up with a word formula to represent the steps. Remember to use BODMAS/ BIMDAS rules.

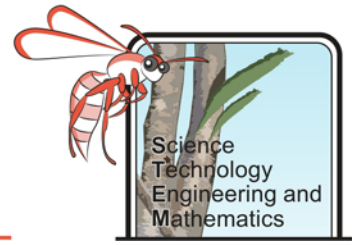
Use your formula to create a spreadsheet on Microsoft Excel which will enable the calculation of the price of gold to be carried out for the spot price, and the maximum and minimum value it would have been worth in the past 5 years. This will enable you to calculate the price of gold as you find it on your exploration holiday.

### Evaluation

1. What is the range in price for each sample using the maximum and minimum values for gold over the past 5 years?
2. If you only have a small piece of gold do you think it is worth holding onto for the market value to increase, or does it not really make a big difference? Use your previous answers to justify your explanation.
3. Determine what has the biggest impact, increasing the karat of the gold or increasing the weight.
4. How many grams of 18K gold would you have to find to equal the equivalent of finding 500g of 24K gold?



# Going for Gold – Student Booklet



## Investigation: Creating a Risk Assessment

### Objective

Going fossicking for gold should be an adventure, but it will be tough and could be dangerous. It is very important that you are well prepared and have completed a risk assessment.

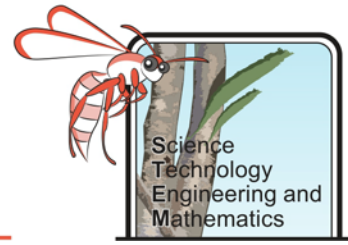
### Scoring the risk

Research a range of risk assessment matrices that are used to score risk of activities or event. Choose one that is suitable to assess the risk of your fossicking trip and complete a detailed assessment. Don't forget to consider seriously the severity of the risks and the likelihood of them occurring.

### Extension - Digitising Safety

Design an algorithm that could be used for an app to allow people to determine their risk rating. Consider how to make it user friendly and visually aesthetic.

# Going for Gold – Student Booklet



## Investigation: Rock Identification

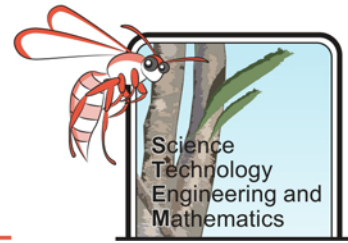
### Objective

To create a resource guide (either digital or paper) to enable different rock types to be identified, in particular those which are commonly linked to where gold is found in Western Australia, and explain how their appearance is linked to their formation.

### Method

- 1) Draw labelled diagrams to show how sedimentary, igneous and metamorphic rocks form, and explain the relationship between their properties and appearance and their formation. Include these terms in your explanation: pressure, temperature, crystallise, cool, cement, sediment, time, intrusive and extrusive.
- 2) Make and record observations of different known rock samples, to create a branching dichotomous key/resource guide to help you and others identify rock types.
- 3) Research the rock types where gold is most commonly found in Western Australia.
- 4) Add detail to your dichotomous key/resource guide to highlight the gold bearing rock types to make it easier for others to find.

# Going for Gold – Student Booklet



## Investigation: Determining Densities



Figure 3. Archimedes reportedly cried "Eureka! Eureka!" after he stepped into a bath and noticed the water level rising. He realised that the volume of water displaced must be equal to his volume. (Arlindi, 1999)

### Objective

Design an experiment to determine the density of different rock types, and evaluate how useful determining the density of rocks in the field will be at helping you identify which rocks may be gold bearing.

Useful links: video on how to measure the volume of an irregular shape:

<https://www.youtube.com/watch?v=e0geXKxeTn4>

### Method

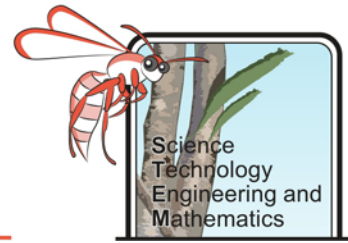
1. Research how to calculate density
2. Brainstorm methods you could use to find the volume of rocks.
3. Create a table to record data collected from your experiments.
4. Create a method for your investigation, including how you will ensure it is conducted safely, add diagrams to show the set up – show this and your table to your teacher and get approval, before carrying out the investigation.

### Evaluation

1. How easy was it to find the density of different rock types?
2. Do you think it will be practical to do this in the field?
3. Was there a big difference in densities between different rock types?
4. Research the density of the different rock types that you have determined, and compare your results to those given online. How similar were they?
5. Evaluate the strengths and weaknesses of your method.
6. Using your knowledge and understanding of rock formation discuss why there is range of densities for each rock type rather than one exact number.



## Going for Gold – Student Booklet

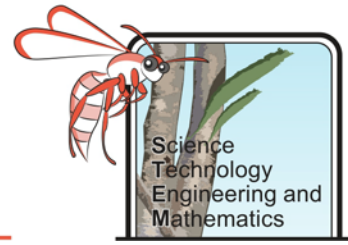


7. When you are in the field and find a rock outcrop, to what extent would determining density help you identify the rock type, and therefore decide if it could be gold bearing or not?

### Extension

1. Some materials may be buoyant. What does buoyant mean?
2. Can you think of a way a solid can behave like a fluid (it can be poured and will fill the container it enters)? Hint, think about the size of the solid.
3. Can you come up with a method to find the volume of an irregular shape that would float in water?

# Going for Gold – Student Booklet



## Investigation: Panning for “Gold”

### Objective

To design a method to practice panning for gold before you go on holiday - you don't want lack of practice to lose you time and money!

### Method

1. Research panning for gold, and watch videos so that you will have a good idea of how the method works.
2. Brainstorms ideas how you can set up your own panning practice area, what tools and equipment will you need and what can you use in place of gold (think about why it is left in the bottom of the pan)?
3. Create an equipment list and method for your investigation, including how you will ensure it is conducted safely, add diagrams to show the set up – show this and your table to your teacher and get approval before you set up your practice area.

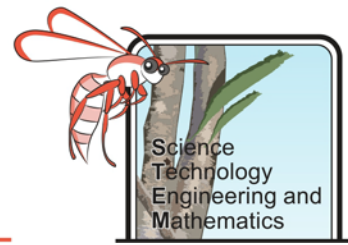
### Results and Analysis

1. How much did your “gold” weigh?
2. What is the price per gram of gold today?
3. Calculate how much your “gold” is worth.
4. How long did you spend fossicking (in hours)?
5. Research: what is the minimum wage in Australia?
6. At your current rate of fossicking have you managed to find enough “gold” to pay yourself the minimum wage?
7. At your current rate how long would you have to fossick for to make \$1000?

### Evaluation

1. How realistic was your set up?
2. Did you test different pans? If so which one worked best?
3. What were the strengths and weaknesses of your practice set up?
4. What improvements, if any, will you need to make to your equipment/ technique before you go fossicking?

# Going for Gold – Student Booklet



## Investigation: Designing a Dry Blower

### Objective

Panning for gold using water is not particularly viable in Western Australia, therefore for your adventure to succeed you will need to design a different means of separating gold, without the use of water.

### Specifications

The device needs to be portable so that you can take it on your adventure with you, so therefore must be able to fit into the boot of your car/back of your trailer.

Remember the aim of the adventure is to make money – so you should keep the cost as low as possible, perhaps you can recycle old, unwanted items.

### Method

1. Research gold separation methods, particularly ones used in Western Australia, and how they work.
2. Decide on one that you would like to work with and draw a labelled diagram to show the key mechanisms.
3. Below your diagram outline the function of each of the key mechanisms.
4. Research other DIY gold separation designs, and compare their strengths and weaknesses.
5. Draw and label design ideas, comparing the pros and cons of them.
6. Keeping in mind that your equipment is going to have to be small, cheap and possible for you to construct. Brainstorm replacement materials that could be used to build something yourself.
7. Write a plan of how you will make your chosen design, ensuring you have completed a risk assessment. Show this to your teacher and make any necessary changes before making the product.

### Testing the design

Create a plan that will allow you to determine how effective your design actually is. Write an equipment list, method and risk assessment and create a results table to show how you will present your findings. Show this to your teacher before you test your design.

### Evaluation

1. How well did your design work? Did you manage to catch lots of “gold” using your design?
2. What were the strengths and weaknesses of the design?
3. What are your suggestions for improvement to the design?