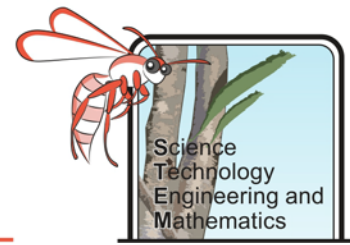
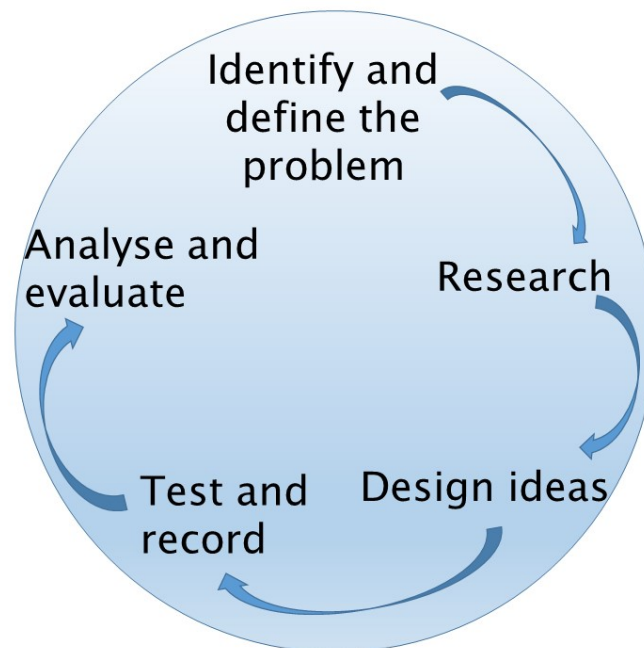


Chopping on Rock – Student Booklet



The Challenge

You are moving house and your parents have decided that they would like some new equipment for the kitchen. They would like to keep it modern and stylish, but also practical. In particular they would like a new chopping board, as they are sick of the flimsy plastic one they have been using. You have decided for their anniversary you would like to have one made for them, and have taken on the challenge of designing it yourself.

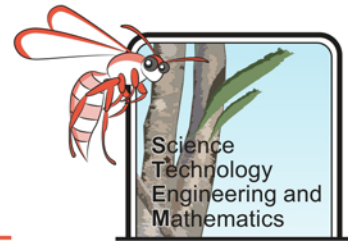


Background Information

Some of the earliest tools ever used by humans were those intended for food preparation; chopping, grinding and tenderising have always been important techniques in the kitchen. The simple chopping board, is actually anything but – and can be designed for multi-purpose use, for example a heat mat and chopping board combined. New designs are still entering the market, with developments to make them more user friendly, or convenient for storage and cleaning.

One of the most important aspects of a chopping board is that it is food safe. Chopping boards need to be able to be cleaned easily and effectively, so that they do not harbour any bacteria. It is vital that their surface is not too absorbent. This will also prevent bad smells as well as staining.

Personalised chopping boards have become very popular in the past few years, especially as house warming, wedding and anniversary gifts. Often they are made with engravings including names or dates. For "foodies" they might include words suggesting what to place where on them, such as cheese names.



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There is a wide array of materials that are used for chopping boards, and it is important that they have been tested properly to ensure that they can withstand everyday use, as well as any accidental knocks or bumps that might occur. Chopping boards need to be durable, reliable, cost effective and convenient.



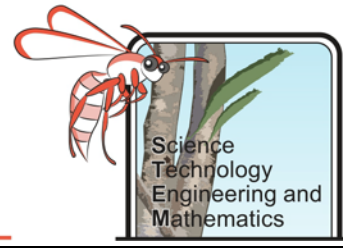
Figure 1. Slate cheese platter. (Acabashi, 2017)

Background Research

1. What are possible materials for a chopping board?

2. How do sedimentary, igneous and metamorphic rocks form? Draw labelled diagrams for each rock type.

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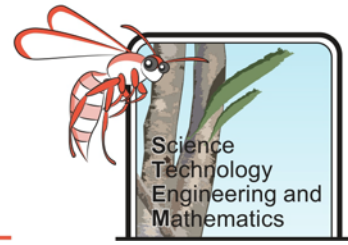


3. What dimensions would be practical for a chopping board?

4. Which materials are most sustainable?

5. What are the most important features and functions of a chopping board?

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Investigation: Density of Different Materials



Figure 2. 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

To determine the density of different materials and consider which materials are most suitable for their intended use.

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

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

Equipment

- Range of samples – different types of wood, rock etc.
- Weighing scales
- 2 x ice cream tubs
- Tray
- Sand
- Measuring beaker (size will depend on size of samples)

Method

1. Use the scales to find the mass of each sample and record it in the table provided.
2. Fill the ice cream container full of water and place it in the tray.
3. Put a sample into the ice-cream container, so that the water overflows into the tray.
4. Pour the water in the tray into the measuring beaker to determine the volume of water displaced, this is equal to the volume of the rock ($1 \text{ ml} = 1 \text{ cm}^3$) and record in the table.

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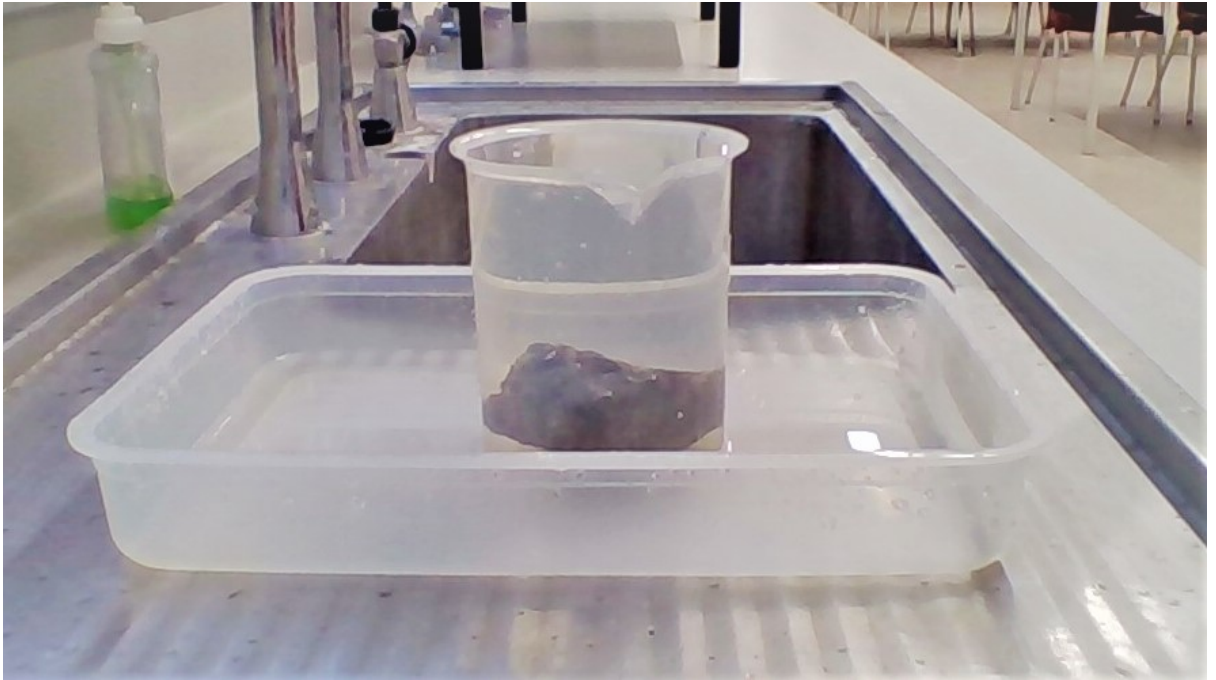


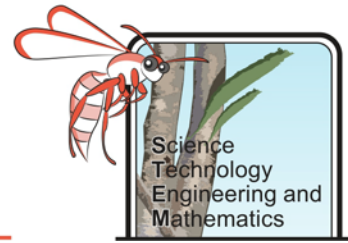
Figure 3. Determining the volume of an irregular shape by placing it in a beaker full of water and then measuring the volume of water which has been displaced into the tray below it.

Also note that if you are using small samples, you could just put them in a beaker half filled with water and measure how much the water rises when the sample is placed inside, subtracting the difference. Or if you have regular shaped samples you could find the volume mathematically.



Figure 4. If you have a smaller sample you can measure the difference in the level of water before and after a rock is placed into the beaker.

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5. *If you have pumice or a sample that will float and hence not displace water:*

- Fill an ice cream tub to the very top with sand.
- Put the sample in another identical ice cream tub.
- Pour the sand over the sample, shaking it gently so the sand works its way into as many interconnected pore spaces as possible, until the container is full and the rock is completely buried.
- Measure the volume of sand that is left in the first ice-cream container by pouring it into the beaker. The volume of sand in the beaker is equal to the volume of the rock. NB – make sure that everything is kept very dry for this stage otherwise the sand will get stuck to the container and sample.

Results and Analysis

1. Calculate the density of the samples by dividing the mass by its volume.

Sample	Mass (g)	Volume (cm ³)	Density (g/cm ³)

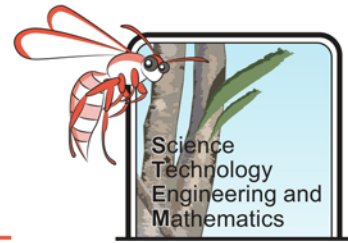
2. List the samples in order from lowest density to highest density.

Lowest Density							Highest density

3. Considering usual dimensions for a stone chopping board are around 40 x 22 x 1 cm calculate what the mass of a board that size would be for each sample material. Remember: **Density x Volume = mass**

Sample	Density (g/cm ³)	Volume (cm ³)	Mass (g)	Mass (kg)
		880		
		880		
		880		
		880		
		880		

4. Will any of the boards be so heavy that they become impractical, if so which ones?



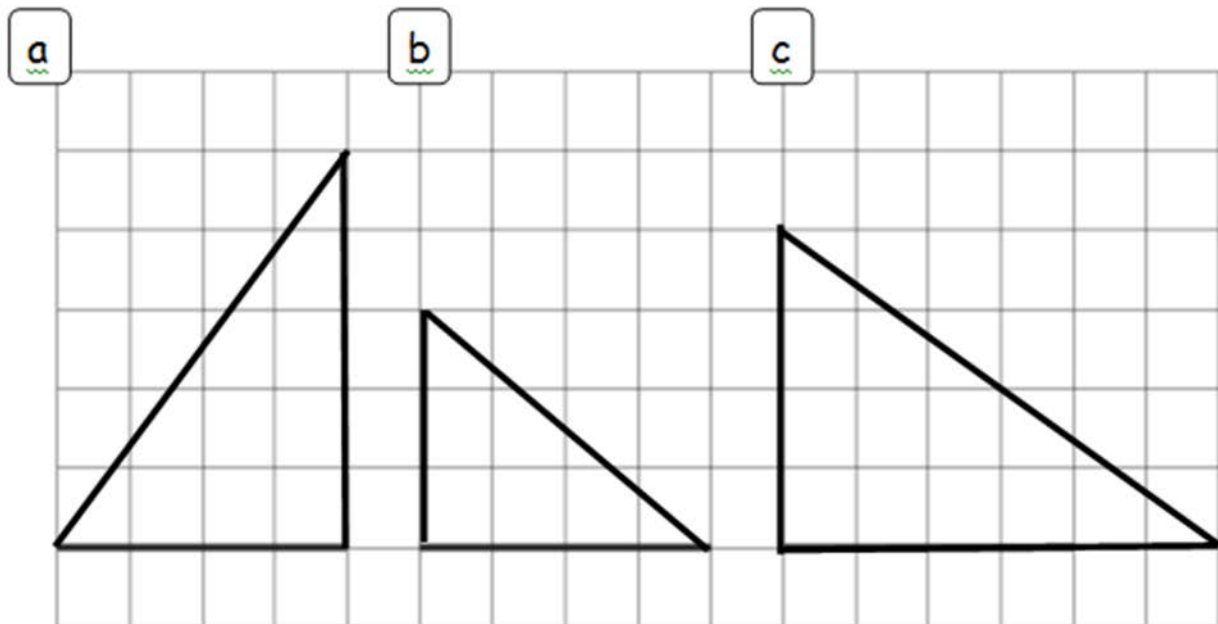
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Investigation: Shaking Up the Style

A rectangular chopping board might be a bit boring, how about making your chopping board a different shape?

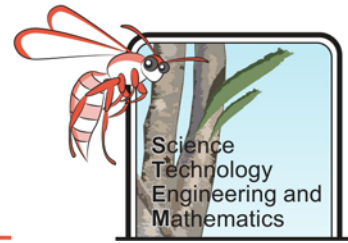
1. A triangular chopping board could look good, especially if used for cheese. What is the formula used to calculate the area of a triangle?

2. Calculate the area of the following triangles, if each square represents 10 cm (show working):



A	
B	
C	

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3. If the chopping boards are 3 cm thick, calculate the volume of each:

A	
B	
C	

4. The density of granite is 2.7 g/cm^3 calculate the mass of each chopping board by multiplying this figure by its volume.

A	
B	
C	

5. It has become very fashionable to have round chopping boards, as they look stylish in the center of a table.

a. What is the formula for the area of a circle?

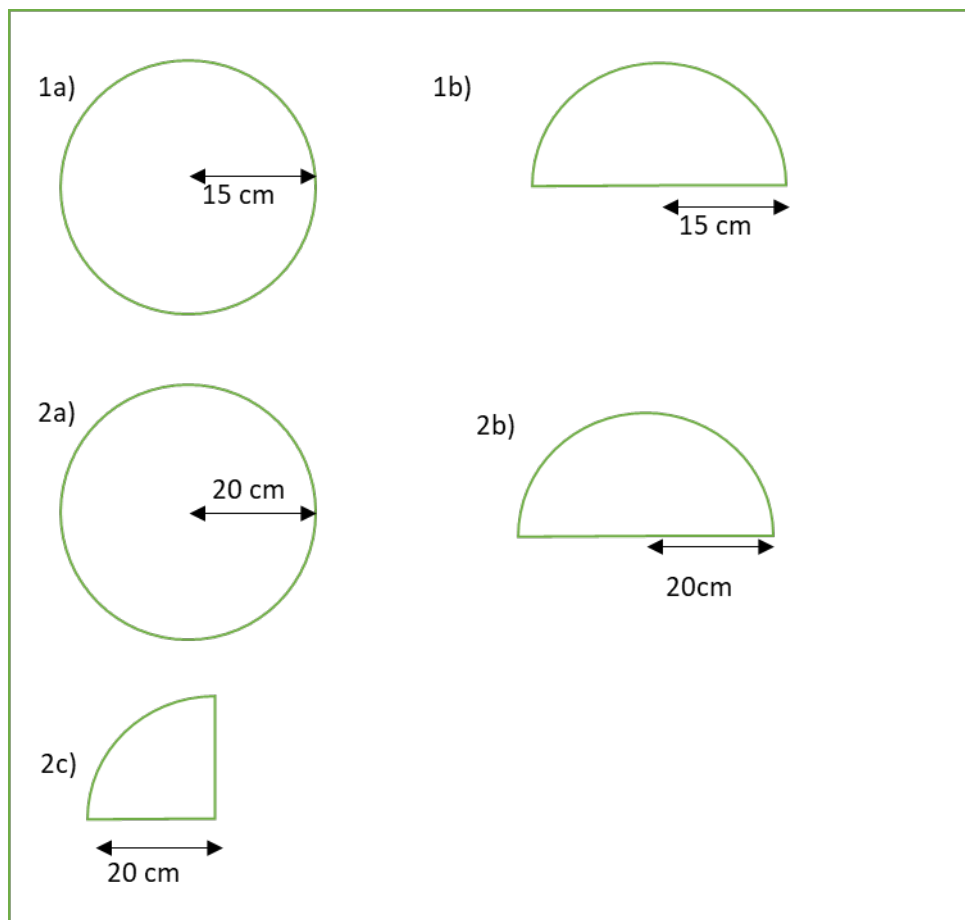
b. What is the formula for the circumference of a circle?

6. Calculate the circumference and area for the shapes on the next page (show working):

Shape	Circumference (cm)	Area (cm ²)
1a		
1b		

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2a		
2b		
2c		



7. Which shape do you think would be best for your chopping board design? Explain why and give suggested dimensions.

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Investigation: Durability of Materials



Figure 5. Testing the durability of materials for knocks and blows needn't be this hard! (wikipedia, 2016)

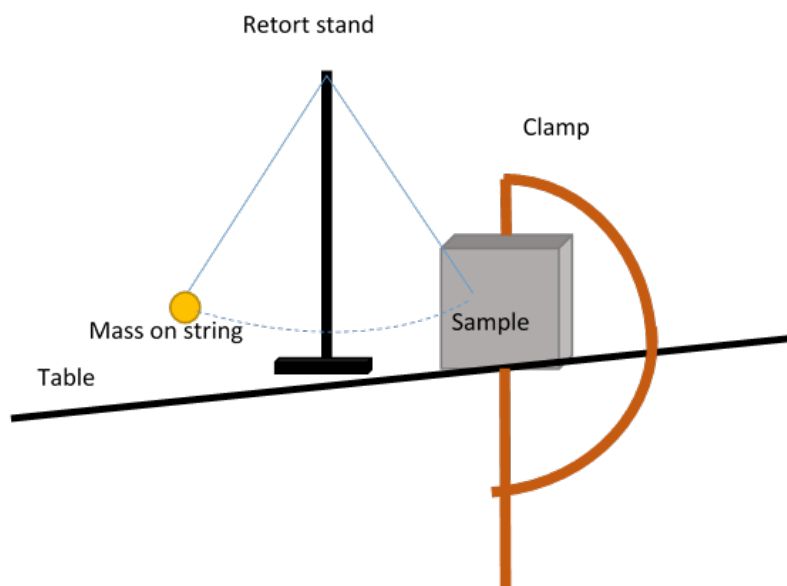
Objective

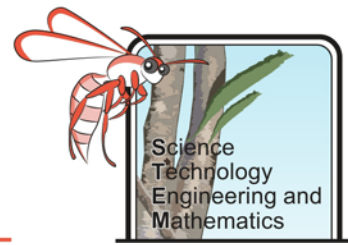
Investigate the durability of different materials, and determine which materials will be most suitable for use as a chopping board.

Equipment

- Samples of possible materials to make a chopping board from (around 5 x 5 x 2 cm)
- A clamp
- A retort stand and books
- Mass on a string
- Meter rule
- Safety glasses
- Camera

Method





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- 1) Take a photo of your samples.
- 2) Clamp a sample to the table so that it is upright on the narrow edge.
- 3) Connect the mass on a string to the retort stand, and secure the retort stand with books (or even a second clamp) so that it will not topple over.
- 4) Adjust the height and location of the retort stand so that when the mass on a string is brought back and released it will hit the sample.
- 5) Put on your safety glasses
- 6) Pull the mass back so that it is a set height off the table, record this height, and ensure you always pull it back to the same height each time.

What is your set height?

- 7) Release the mass, allowing it to hit the sample.
- 8) Repeat steps 5 and 6 a set number of times.

How many times will you hit the sample with the mass?

- 9) Repeat the experiment for all the samples, ensuring you keep the height of the mass on the string the same and the number of times you hit the sample the same.

Results and Analysis

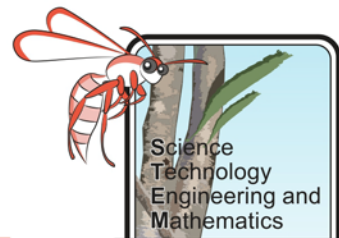
1. Were there any materials which did not stand up to the test?

2. Did any materials complete the test unaltered?

3. Which materials will be most suitable for the intended design in relation to durability?

4. Add photos below to show the samples before and after the test.

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Investigation: Reactivity of Materials

Objective

To test the reactivity of different materials with everyday household cleaning products which it may be subjected to when used as a chopping board.

Equipment

- Multiple small samples of each material (number will depend on how many solutions you wish to test)
- 200 ml beakers for each sample
- Dilute acid and alkali solutions, with similar strength to everyday household liquids such as water, lemon juice, vinegar and cleaning product.
- Camera (optional)

Method

1. Take photos of the samples (optional).
2. Measure 100 ml of each solution for each sample in the beakers and label the beakers.
3. Place a sample into each of the different solutions and record any observations.
4. Leave overnight and make observations again.
5. Take photos of the samples (optional).

Results and Analysis

1. Record your results/ observations.

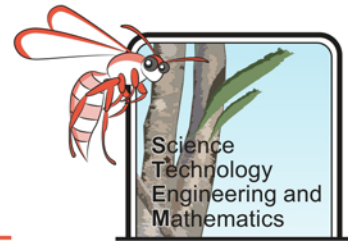
Sample	Observations				
	Solution 1	Solution 2	Solution 3	Solution 4	Solution 5

2. Which samples changed/ reacted and what did they react to?

3. Can you think of any means of stopping the reaction, for example coatings?

You may wish to redo this experiment with coatings applied to the surfaces – remember the intended purpose and that all coatings used must be food safe.

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Porosity and Permeability

Objective

To determine which materials are permeable to assess their suitability for chopping boards.

Equipment

- Selection of different samples with similar dimensions
- Tray
- Pipette
- Cup of water (you may want to add food colouring, to make it easier to observe)

Method

1. Place a sample in the tray
2. Suck up water into the pipette from the cup
3. Add 5 drops of water onto the surface of the sample and note if the water runs off or “dissolves” into the sample.
4. If the water has entered the sample, touch the bottom of the sample and feel if it is damp. If not, continue adding drops of water and count how many drops it takes before the water passes through. NB: if the water has just run off the sample, it may get wet underneath from the water pooling under it, therefore this does not mean it has allowed the water to pass through. *If you find that the material allows some water to enter, but then after a few more drops it starts to run off this means the rock is porous but not very permeable.*

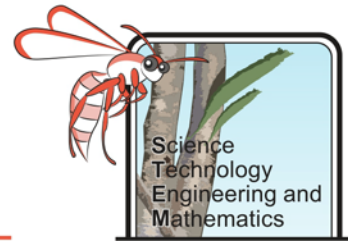
Results and Analysis

1. Complete the table below.

Sample	Permeable?	Number of drops it took for water to pass through

2. Which material was the most permeable?

3. Which material was the least permeable?



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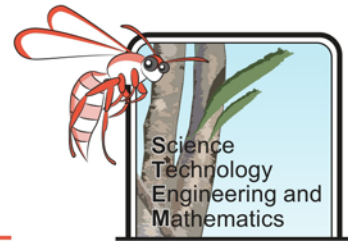
4. Were any of the samples porous (had holes in them) but not permeable?

5. If you were chopping a juicy lemon, or a bloody steak on the chopping board, would the juices run through any of them?

6. Are any of the sample types unsafe for food prep, if so, why?

You may wish to redo this experiment with varnish/ coatings applied to the surfaces – remember the intended purpose and that all varnishes used must be food safe.

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Testing for Bacteria

Objective

To test a range of materials to see which ones host bacteria, even after they have been cleaned, to determine which might be best to use for a chopping board.

Equipment

- Range of samples of chopping board materials, e.g. granite, marble, slate etc.
- Cleaning product
- Agar plate for each sample with lid
- Cotton bud/ swab
- Sticky tape
- Marker pen
- Microscope (optional)

Method

1. Wash all the samples the same way, using the same cleaning product and rinse well.
2. Leave overnight to dry, and longer if possible in a warm area (a windowsill will be ideal).
3. Use a fresh cotton bud to swab a sample and gently brush the bud on the agar plate.
4. Close the lid of the plate and stick down tight with tape. **These should not be re-opened**
5. Label the agar plate with the sample type and your group name.
6. Repeat steps 3 – 5 for each sample.
7. Leave for a few days in a warm spot or incubator, and then make observations with the lid still tightly sealed (under the microscope if possible).

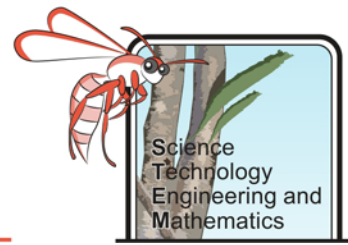
Results and Analysis

1. Did any bacteria grow on the agar plates? If so which samples did it grow from?

2. Which sample had the largest colonies of bacteria?

3. Which sample had the largest variety of bacteria?

4. Are any of the samples unsafe for using for a chopping board? _____



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Cost analysis

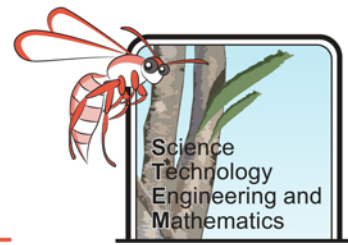
Objective

The price of materials will always affect a designer’s decision on what material to use for a design. Your job is to investigate the price of different materials to determine how much it will cost to make your chopping board

Method

1. Create a table which will allow you to input calculations and data (Excel will do calculations for you – example below).
2. Decide on the ideal dimensions you will use for your product.
3. Research different merchants to find at least 3 quotes for the price of the materials, ensure you note where you got each quote from.
4. Consider the size that you can buy the material in – will it need to be cut down? If so will there be lots of waste, or would it even be possible to make a few?
5. Will you have to varnish the product, if so how many times? How much varnish will you use, and how much will that cost?
6. How much time will it take to make the product roughly? Consider that a tougher material may take more time to cut. Adding layers of varnish will also add time. How much is your time worth?
7. Will you have to buy new tools to make the product? If so what is the cost of the tools?

Sample type	Dimensions for board	merchant 1				merchant 2				merchant 3				How many coats of varnish required	cost of varnish	how much time will it take to make?	cost of new tools	total cost including labour
		price	size available	amount wasted	website	how many boards can you make?	price	size available	amount wasted	website	how many boards can you make?	price	size available					



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Designing and planning the product

Objective

To create different design ideas to decide on the most suitable design for the intention. To make a clear and safe plan of how the product will be made.

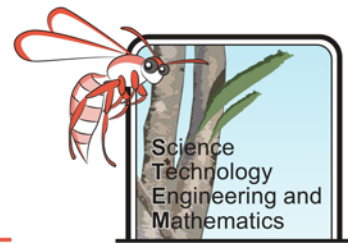
Method

1. Carry out some background research into products that have already been made, filling them into this table, highlighting their pros and cons.

<u>Idea</u>	<u>Pros</u>	<u>Cons</u>

2. If possible, create 3D scale drawings of different design ideas, highlighting the features which make them appropriate for the design brief. You may wish to do this on the computer using SketchUp or CAD.
3. Write a plan of how you could make your chosen design, ensuring you have completed a risk assessment.

Equipment and tools needed:



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Method/ Steps:

Risk assessment

Hazard	Risk	Prevention
Spilling varnish	Could damage clothing, and surfaces, may stain skin	Use care, and cover surfaces. Wear an apron and roll up sleeves. Ensure lid is put straight back onto bottle after use Clean spillages straight away and dispose of tissues safely.