Recycling Water – Student Booklet
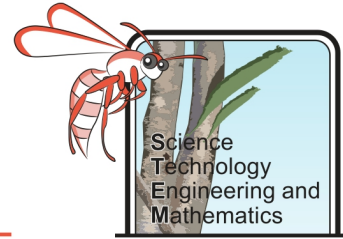
The Challenge

The school uses thousands of litres of water a year for flushing toilets, washing hands, watering the lawn etc. This is not very sustainable or environmentally friendly. The school has asked the students to think of ways to use water more sustainably and hopefully save money as well as water. Your job is to research water saving methods and come up with some recommendations. It is important that these recommendations are backed up with calculations and data.
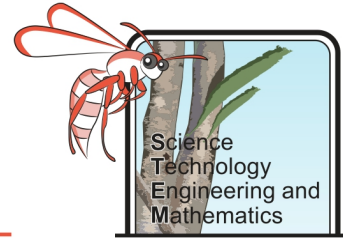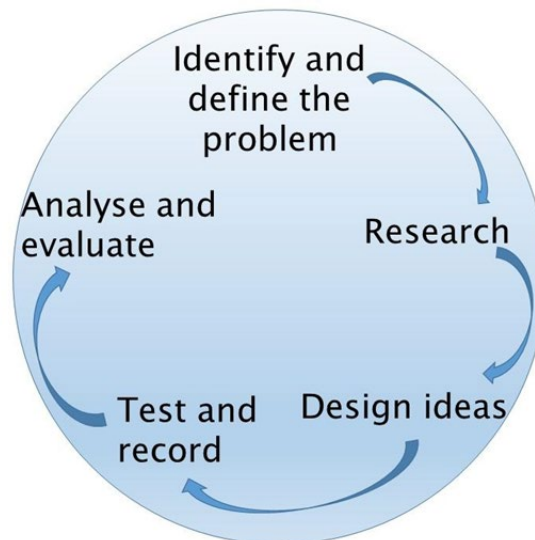

Background Information

Due to a changing climate, Perth's water sources have changed with time. Since the 1970s rainfall has reduced by nearly 20%, according to the Water Corporation, which means less water is flowing into dams. This has caused the Water Corporation to look for new sources of water.

In Perth 48% of water comes from desalination, 40% is from groundwater and 10% from surface water (Water Corporation). The Water Corporation is aiming to reduce the amount of groundwater and surface water used by encouraging households and businesses to use less water and make greater use of recycled water.

There are two main methods of recycling water, they are capturing rainwater and storing it in tanks for future use and re-using water that has been used for washing etc (grey water). Water collected this way can be used for watering gardens, flushing toilets and washing clothes without further treatment.

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Background Research

1. How can rainwater be collected and stored?

_____

2. What are the benefits of collecting rainwater?

_____

_____

3. What are the downfalls of collecting rainwater?

_____

_____

4. What is greywater?

_____
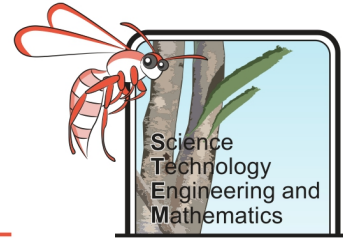
5. What are some of the possible uses for greywater?

_____

_____

6. What are some potential problems with using greywater?

_____

_____

Washing Away the Water

Objective

To determine how much water, you use when washing your hands, and relate this to saving water.

Equipment

- Washing up basin or a bucket
- Large measuring cylinder
- Sink

Method

Using the equipment above, come up with a method to measure how much water you use while washing your hands.
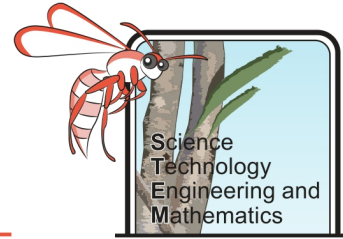
Analysis

1. Using the results from the whole class calculate the mean, mode and median volume of water used per student.

   _____

   _____

   _____

2. Where do your results lie in the range for this data?

    _____

3. Were you surprised at how much water you used?

    _____

4. How could you reduce the volume of water you use to wash your hands, but still ensure they are cleaned properly?
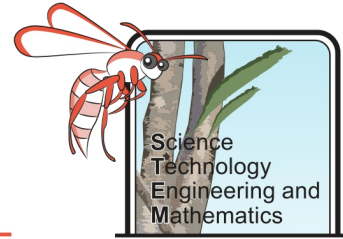
    _____

    _____

5. If each student washed their hands 3 times per day in your school, use the mean to calculate how much water is used per day.

    _____

    _____

Grey Watering the Garden

Objective

To investigate the use of grey water on plants.

Hypothesis

Write a hypothesis to explain what you think will happen to a plant watered with grey water.

_____

_____

Equipment

Create a list of required equipment to carry out this investigation (see method for clues).

Method

1) Label the plant pots 1 and 2.
2) Put the washing basin/bucket in a sink.
3) Wash your hands using the hand soap and collect the water in the basin/bucket.
4) Use the measuring cylinder to scoop out 50mL water from the basin and pour this into the soil surrounding plant 1.
5) Measure out 50mL of water straight from the tap and pour this into the soil surrounding plant 2.
6) Take a photo of the plants and measure their height, record this in a table.
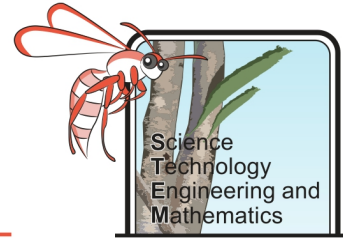7) Repeat steps 1 – 5 every day that you can for two weeks.
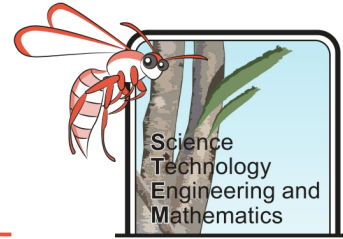
Results and Analysis

1) Create a table with annotated photos of the plants highlighting any visual changes, and recorded height.

2) Did the plants grow over the two weeks? If so by how much?

_____

Recycling Water – Student Booklet

1. Was your experiment a fair test?

_____

2. What were the strengths of the investigation?

_____

_____

3. What would you change about your investigation?

_____

_____

4. Why would those changes improve the investigation?

_____

_____

Conclusion

Discuss how the plant was affected by using greywater and relate this to watering the schools playing fields and gardens. Overall, would you recommend the school uses greywater and if so how?
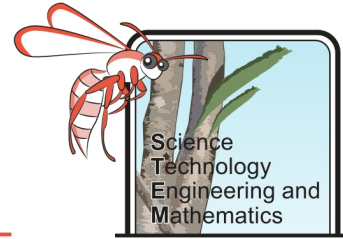
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Finding your Daily Average Use of Water

Objective

To determine your daily water use and compare this to the class average.

Method

1. Calculate your daily use of water at school and record it in the table below.

Activity	No of litres used	No of times per day	Total volume of water used (L)
Flushing the toilet	10		
Washing your hands	2		
Refilling water bottle	1		
Shower	60		
		Total	

2. Share your data with the class and collect their results.
3. Create a bar chart with the class results for the total volume of water used per day for each activity.
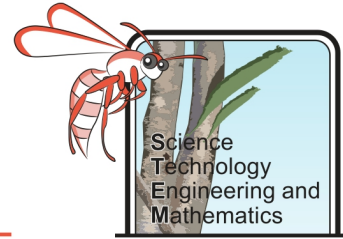4. Find the mean, median and mode volume of water each student uses per day at school.

_____

5. How does your water use compare to the averages?

_____

6. Use the online tool https://www.watercalculator.org/ to calculate the daily use of water in your home. (Note you will have to do some conversions e.g. miles to kilometres and gallons to litres, you will also have to pick a US state for power purposes).

_____

7. How does your daily use from the water calculator compare to your first calculation?

_____

8. According to the water calculator, what was your biggest use of water and how can you reduce this? Were you surprised?

    _____

    _____

9. If everyone in the school used the same amount of water as you, how many litres of water would be used each day?
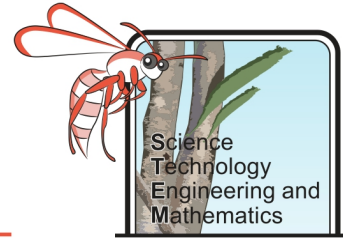
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10. The average water tank holds around 10,000L. If you design a water collection scheme for the school will you consider trying to replenish all the water you use or just the main ways of using water at school? Explain your answer.

    _____

    _____

Recycling Water – Student Booklet

Planning for Rain

One way to collect water is by using water storage tanks which are located at the bottom of downpipes on buildings. The potential amount of water collected will depend on the area of roof available.

Objective

To determine the surface area of the school roof and calculate how much water could be collected each month.

Advanced students should consider that the roof is at an angle and draw scale diagrams to consider the actual surface area of the roof.
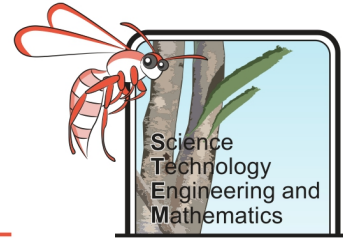
Method and Results

1. Using Google maps in satellite mode, locate your school.
2. Using the "measure distance" tool (right click on the mouse) find the length and width of the buildings and add them to the table below.
3. Calculate the surface area of the roof of each building, by using the formula:
    area = length x width

Building	Length (m)	Width (m)	Area (m²)
			TOTAL =

4. Adjust this area to account for the angle of the roof, if possible.
5. Add all roof areas together to find the total surface area of the roof of the school.
6. Calculate the potential volume of rain (L) that could be collected each month by multiplying the surface area of the roofs (m) by the average rainfall (mm) for each month.

Perth monthly rainfall (information from https://www.watercorporation.com.au/water-supply/rainfall-and-dams/rainfall)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
Average rainfall (1994 - 2017)* (mm)	16.7	13.0	21.0	37.2	88.7	126.9	146.6	122.1	87.0	38.7	23.2	11.7	732.8
Potential volume of rain to be collected (L)													

Analysis

1. Discuss whether using rain water alone will be enough to cater for the school's water use or if grey water will be needed to top up the water supply.
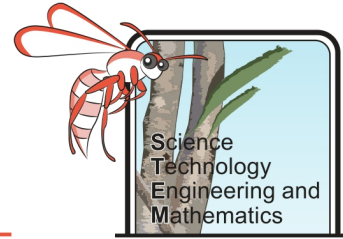
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    _____

2. Is there any reason that the actual collected rainfall could be less than the potential collected rainfall from the school roofs?

    _____

    _____

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Calculating the Cost

Rain water storage tanks can be above or below ground. The benefit of having them below ground is that they don't take up as much space in the outdoor area. Underwater storage tanks are generally much larger, and are reinforced, so you can even drive or park cars over the top of them. However, they are much more expensive to install.

Objective

To compare the cost of installation of above ground and below ground water tanks, and discuss, with regards to location and area, which would be better to install at the school.

Important statistics:

Price of water $ 5/kL = $ 0.05/L (Water Corporation)

Average water use per person per day for washing hands and flushing the toilet = 100L/day

Type of tank	Volume (L)	Cost to buy and install ($)	Dimension (l x w x h) (m)
Above ground	5,000 L	1500	2 x 1.25 x 2
Above ground	10,000	2000	2 x 2 x 2.5
Below ground	5,000	4000	2 x 2 x 1.25
Below ground	10,000	6000	2 x 2.5 x 2

1. Calculate how much water is used by your school every day for washing hands and flushing the toilet.

   _____

2. Calculate the cost of using this much water per day.
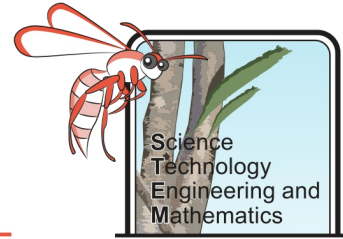
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3. How many 5,000L water tanks would you need to supply the school with rainwater?

   _____

4. How many 10,000 L water tanks would you need to supply the school with rainwater?

   _____

5. What would be the cost of installing this many above ground water tanks?
a) Using the 5,000L tanks

_____

b) Using the 10000L tanks

_____

6. What would be the cost of installing this many below ground water tanks?
a) Using the 5,000L tanks

_____

b) Using the 10000L tanks

_____

7. Calculate the area required to install enough 5,000L above ground tanks that would service the school. (area = length x width)

_____

8. Calculate the area required to install enough 10,000L above ground tanks that would service the school? (area = length x width)
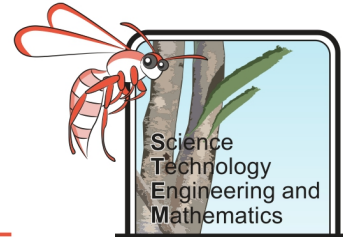
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9. Which takes up the largest area, using 10,000L or 5,000L tanks? Show your working.

_____

10. Print off a map of the school from Google Maps or elsewhere and mark out to scale the area which would be required to use above ground tanks. (use a different colour to differentiate between if you used 10,000L or 5,000L tanks)

11. Assuming that the rainwater tanks are full each day, calculate the how long it would take the school to make its money back on the price of installing each water tank systems (payback time) by completing the table below:

Number of staff and students in the school	
Volume of water used each day in the school	
Cost of using this volume of water each day	
Cost of installing the required number of 5,000L above ground tanks	
Number of days it takes to cover the cost (cost of installing tanks/cost of water)	
Cost of installing the required number of 10,000L above ground tanks	
Number of days it takes to cover the cost (cost of installing tanks/cost of water)	
Cost of installing the required number of 5,000L below ground tanks	
Number of days it takes to cover the cost (cost of installing tanks/cost of water)	
Cost of installing the required number of 10,000L below ground tanks	
Number of days it takes to cover the cost (cost of installing tanks/cost of water)	

12. Is it realistic to assume the water tanks will be full each day?

_____

13. Using the information and your calculations, discuss whether it would be better for the school to install above or below ground water storage tanks at your school.

_____

_____

_____