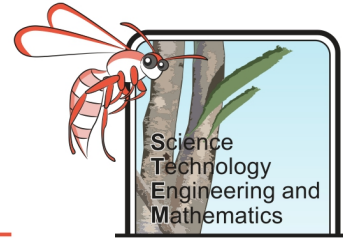
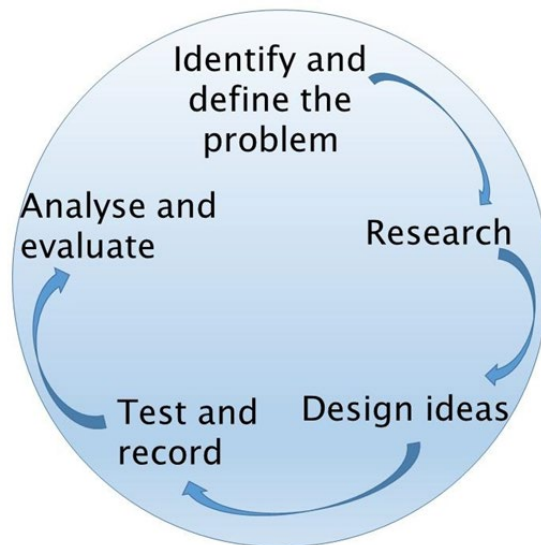


Recycling Water – Student Booklet



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.



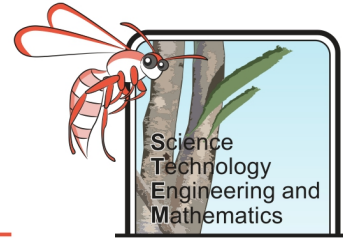
Background Information

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.

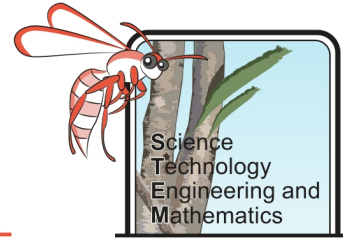
Recycling Water – Student Booklet



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?

Recycling Water – Student Booklet



Washing Away the Water

Objective

To plan and conduct an investigation to determine how much water you use when washing your hands and relate this to saving water.

Equipment

Create an equipment list for this experiment.

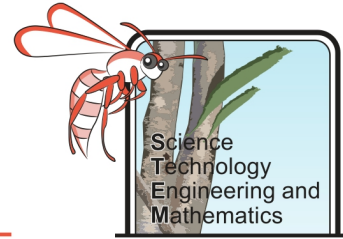
Method

Write a step by step method of how this experiment will be conducted and how you will measure your results. Ensure you consider any health and safety measures that may need to be taken. Once you have done this show it to your teacher to gain their approval to commence the investigation.

Analysis

1. Using the results from the whole class calculate the mean, mode and median volume of water used per student.
2. What was the range in the amount of water used?
3. Discuss how your personal results compare to the average, and where they lie in the range.
4. Were you surprised at how much water you used?
5. How could you reduce the volume of water you use to wash your hands, but still ensure they are cleaned properly?
6. 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.

Recycling Water – Student Booklet



Grey Watering the Garden

Objective

To design and investigate to determine the effects of grey water on plants growth.

Hypothesis

Write a hypothesis to explain what you think will happen to a plant watered with greywater and explain why.

Equipment

Outline the equipment you will need to conduct this investigation.

Method

Write a method which will allow you to test what affect watering a plant with grey water will have. Consider what you will be observing and measuring and how you will make these observations and measurements. Also, consider how you will run a control test alongside, to compare this to the plant given grey water. Show your method to your teacher and gain their approval before conducting the investigation.

Results and Analysis

1. Create a results table, which clearly displays your observations and measurements.
2. Discuss your findings – what happened to the plant watered with grey water, how did it compare to the control?

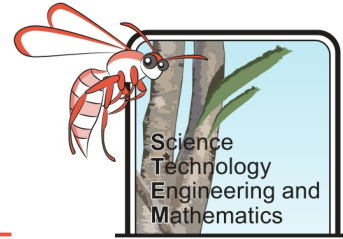
Evaluation

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?

Recycling Water – Student Booklet



Finding Your Daily Average Use of Water

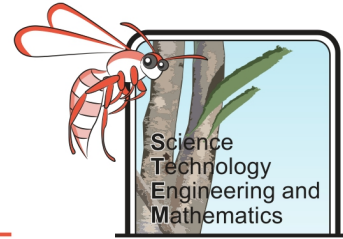
Objective

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

Method

1. Calculate your daily use of water at school.
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, and where does it lie in the range?
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 you design a water collection scheme for the school will you consider trying to replenish **all** the water, you use in a day or just the main ways of using water at school? Explain your answer.

Recycling Water – Student Booklet



Planning for Rain

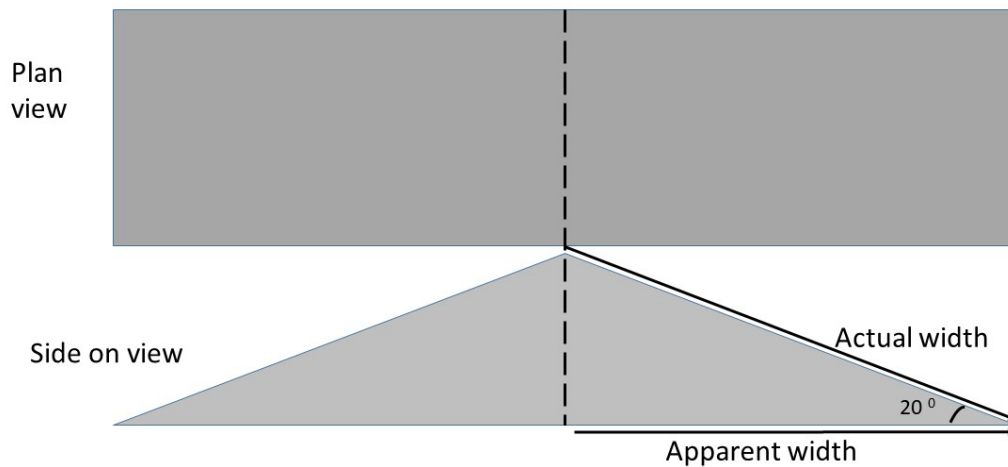
One way to collect water is by using water storage tanks which are located at the bottom of down pipes on buildings. The potential amount of water collected will depend on the area of roof.

Objective

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

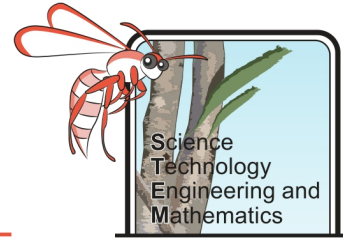
Method and Results

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 apparent width of the buildings and add them to the table.
3. Most roofs have a 20-degree angle. Draw triangles to scale to find the actual width of the roofs.



4. Find the actual surface area of the roof(s) by using the formula:
$$\text{area} = \text{length} \times \text{actual width}.$$
5. Add all the areas together to find the total surface area of roof of the school.
6. Calculate the volume of rain (L) collected each month by multiplying the surface area of the roofs (m) by the average rainfall (mm) for each month.

Recycling Water – Student Booklet



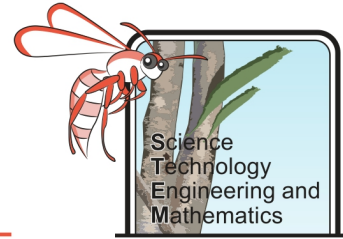
Perth monthly rainfall (information from <https://www.watercorporation.com.au/water-supply/rainfall-and-dams/rainfall>)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AVE (1994 - 2017)*	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

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

Recycling Water – Student Booklet



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:

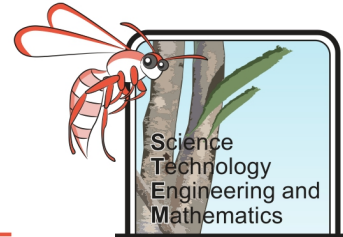
Price of water \$ 5/kL = \$ 0.05/L (Water Corporation)

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.
2. Calculate the cost of using this much water per day.
3. How many 5,000 L 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
7. What would be the cost of buying and installing this many below ground water tanks?
 - a) Using the 5,000L tanks
 - b) Using the 10,000L tanks

Recycling Water – Student Booklet



8. Calculate the area required to install enough 5,000L above ground tanks that would service the school?
9. Calculate the area required to install enough 10,000L above ground tanks that would service the school?
10. Which takes up the largest area, using 10,000L or 5,000L tanks? Show your working
11. Print of 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 10000L or 5000L tanks)
12. If 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 system (payback time).
13. Is it realistic to assume the water tanks will be full each day?
14. Using the information and your calculations, discuss whether it would be better for the school to install above or below ground water storage tanks, and what further measure the school can take to reduce water usage.