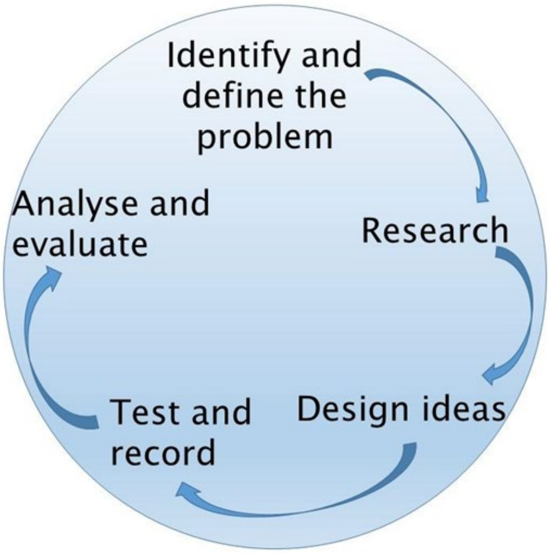
How to use this document

1. Open this file in Adobe Reader. If you do not have this program you can download it for free here: https://acrobat.adobe.com/au/en/acrobat/pdf-reader.html
2. Download the file and **save** it as Project Name _Your Name e.g. Going for Gold_Joe Bloggs **It is really important you do this otherwise none of your input will be saved.**
3. Fill in your answers in the text boxes
4. Where there are image boxes take photos/scans of your work and upload the picture file. If you cannot do this upload the pictures as separate files and save them as Project Name_Your Name_Image number e.g. Going for Gold_Joe Bloggs_Image 1
5. Save your work as you go along
6. When you have finished email/upload as your teacher has instructed.

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, 2019). 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?

Suggested website: https://www.choice.com.au/home-improvement/water/saving-water/buying-guides/rainwater-tanks

2. What are the benefits of collecting rainwater?

Suggested website: http://yourhome.gov.au/water/rainwater

3. What are the downfalls of collecting rainwater?

4. What is greywater?

Suggested website: https://ecologyartisans.com/what-is-greywater/

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

Suggested website: http://yourhome.gov.au/water/wastewater-reuse

6. What are some potential problems with using greywater?

Suggested website: https://www.choice.com.au/home-improvement/water/saving-water/articles/guide-to-greywater-systems

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 jug
- Sink

Method

1. Place the bucket or washing up basin into the sink.
2. Wash your hands as you normally would.
3. Dry your hands and then pour the water you used to wash your hands, which has collected in the basin, into the measuring jug – you may need to fill it several times (be sure to keep count of how many)
4. Note how much water you used to wash your hands.
   (You can use this water on the garden or just pour it down the sink.)
5. Repeat the investigation two more times.

Analysis

1. What was the range in the amount of water you used?
2. Calculate the mean and compare the volume of water for each trial to the mean.

3. Calculate the median and compare the volume of water you used to the median.

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 in your school 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

The plant watered with grey water added will grow ________________________________ (*just as well/ better/less well*) than a plant watered with fresh water.

Equipment

- 2 x plants in pots
- Hand soap
- Bucket or washing basin
- Measuring cylinder
- Sticky labels

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.

An initiative supported by Woodside and ESWA

Results and Analysis

1. Complete the table below

Day	Plant 1 height (cm)	Plant 2 height (cm)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

2. What was the initial height of the plants?

3. What was the final height of the plants?

4. Did the plants grow over the two weeks? If so by how much?

5. Create a document with your photos of the plant in order from day 1 – 10 and attach it below.

6. Were there any visual changes to plant 1? For example, change of colour, more leaves, wilted etc. that did not happen to plant 2? Add annotations to the pictures to highlight these changes.

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?

Science
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Finding Your Daily Average Use of Water

Objective

To determine your daily water use and compare this to our people in your class or household.

Method

1. Calculate your daily use of water 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	

1. Share your data with your class/household and collect their results.
2. Find the average (mean) volume of water each person uses per day at home.

3. How does your water use compare to the average?

4. 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).
5. How does your daily use from the water calculator compare to your first calculation?

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

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Mathematics

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 roof of each school building to calculate how much water could be collected each month.

Method and Results

1. Using Google maps in satellite mode, locate the building/s you are measuring.
2. Using the "measure distance" tool (right click on the mouse) find the length and width of the building/s 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 (m^2)
			TOTAL =

4. Add all roof areas together to find the total surface area available.
5. 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 your schools 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?

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 your school.

Important statistics:

Price of water $ 5/kL = $ 0.05/L (Water Corporation, 2019)

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

Type of tank	Volume (L)	Cost to buy and install ($)	Dimension (l x w x h) (m)
Above ground	5,000	1,500	2 x 1.25 x 2
Above ground	10,000	2,000	2 x 2 x 2.5
Below ground	5,000	4,000	2 x 2 x 1.25
Below ground	10,000	6,000	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 (number of staff and students x 100 L).

2. Calculate the cost of using this much water per day (total water use x 0.05)

3. How many 5,000 L water tanks would you need to supply your school with rainwater? (total water use/5,000)

4. How many 10,000 L water tanks would you need to supply your school with rainwater? (total water use/10,000)

5. What would be the cost of installing this many above ground water tanks?

a) Using the 5,000L tanks (5,000L tanks needed x 1,500)

b) Using the 10,000L tanks (10,000L tanks needed x 2,000)

6. What would be the cost of installing this many below ground water tanks?

a) Using the 5,000L tanks (5,000L tanks needed x 4,000)

b) Using the 10,000L tanks (10,000L tanks needed x 6,000)

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

8. Calculate the area required to install enough 10,000L above ground tanks (area = length x width)

9. Which takes up the largest area, using 10,000L or 5,000L tanks? Show your working.

10. Discuss whether it would be better for your school to install above or below ground water storage tanks.