Farming for Food – Student Booklet

How to use this document

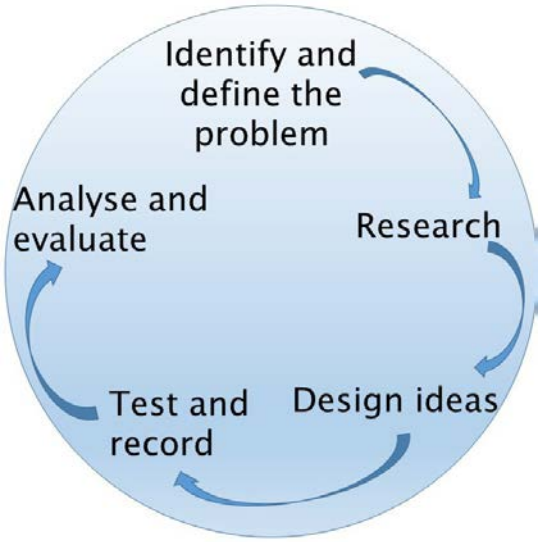
1. Open this file in Adobe Reader. If you do not have this program you can download it for free here: https://acrobat.adobe.com/au/en/acrobat/pdf-reader.html
2. Download the file and **save** it to your computer as Project Name _Your Name e.g. Going for Gold_Joe Bloggs. **It is really important you do this otherwise none of your input will be saved.**
3. Fill in your answers in the spaces provided in the document.
4. Where there are image boxes take photos or scans of your work and upload the picture file. If you cannot do this, for any reason, 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 or upload your completed document (and image files) as your teacher has instructed.

Farming for Food – Student Booklet

The Challenge

As the global population increases more food will be required but there will be less space to grow/produce it. To cope with the demand, farmers currently do things like add fertilisers to their soils, to produce a larger yield. However, fertilisers can leach into the groundwater and be carried long distances, effecting much more than just the intended area. To cope with the demands for space, methods such as vertical farming and the use of hydroponics systems are being utilised more and more.

Your task is to investigate the impacts of these methods of farming and to evaluate their suitability for use in your local area considering social, environmental and economic issues.



Background Information

You will be familiar with the equation for photosynthesis:

carbon dioxide + water → glucose + oxygen

$$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$$

(sunlight energy)

For plants to grow successfully they also need many nutrients, including nitrogen and phosphorus. Naturally plants get these nutrients through the phosphorus and nitrogen cycle. The nitrogen cycle is shown below.

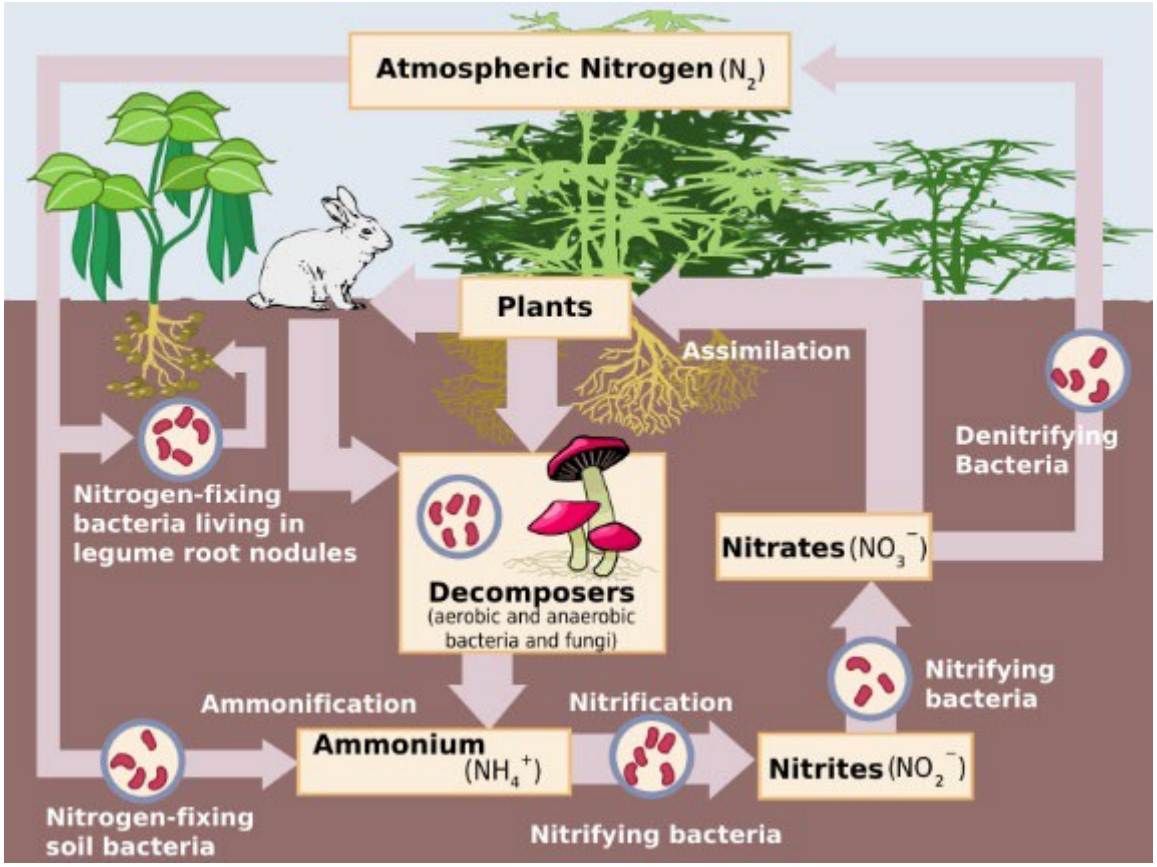


Figure 1: The nitrogen cycle.

Prior to the Industrial Revolution, the majority of farming was subsistence farming, where people grew enough only for their families. To ensure enough food for the year and maintain healthy soil as well as a varied diet, people would use crop rotation methods (changing the crop that was growing on the land over seasons or even from year to year). As different plants required different nutrients, this allowed time for the soil to replenish in the nutrients that had been used by a previous crop. However with industrialisation, farmers greatly increased the size of fields and scale of crops. As a result, it was more economical to grow the same crop as it required less machinery and specialisation than varied crops. However, this led to depleted soils and farmers began to add fertilisers to maintain the nutrients needed for crops to grow.

Most commonly, synthetic fertilisers are used as they provide predictable and efficient sources of nutrients and farmers can select how much they need of each type. In comparison, natural fertilisers, such as animal manure, have relative amounts of nutrients that are unknown. The addition of synthetic fertilisers to soils can lead to higher yield harvests and also speed up growth rates of some crops. They are also much easier to transport than organic fertilisers, which could possibly reduce fuel costs and CO_2 emissions. A problem with using synthetic fertilisers is that many of them contain high amounts of acidic chemicals, which can be a health hazard. With a period of heavy rain the fertilisers

run-off, entering water bodies. As they are high in nitrogen they can cause algal blooms (algae are plants after all!) and enter the groundwater, carrying toxins that can be poisonous to animals and humans.

Different methods of farming are being introduced around the world to minimise the amounts of fertiliser being used, as well as to cut down on water and land usage. These include small scale hydroponic farms, vertical farms and the farming of genetically modified (GM) crops (which can be seen as controversial). Technologies are also being used more frequently by farmers to measure nutrient and water levels in the soil, ensuring that any additions are actually necessary and making the process more efficient and cost effective.

Farming for Food – Student Booklet

Background Research

1. Which crops are grown by farmers in your local area?

Suggested site: Google – "crops grown in … (home state)", Department of Agriculture sites are very useful.

2. List some common fertilisers that are used for farming that fit the following criteria:

    a. Organic: _____

    b. Synthetic: _____

Suggested sites: https://groundgrocer.com/categories/Organic-Fertilisers/ and https://www.incitecpivotfertilisers.com.au/products-and-services/our-products

3. What are the dangers of synthetic fertilisers?

Suggested site: https://homeguides.sfgate.com/effects-synthetic-fertilizers-45466.html

4. What are some of the disadvantages of using organic fertilisers?

Suggested sites: https://www.sciencedaily.com/releases/2008/10/081030194236.htm and https://www.charliecarp.com.au/news/pros-cons-using-organic-fertiliser/

5. Complete the table below outlining the features of a range of common fertilisers.

Fertiliser	*Price (per 100g or 100mL)	Organic or synthetic?
Osmocote Controlled Release All		
Seasol Hose On Complete Garden Health		
Hortico Organic Garden Fertiliser		

*You will need to do some mathematical calculations here

Hint: the product details tab will be very helpful

Suggested site: https://www.bunnings.com.au/our-range/garden/gardening/fertilisers

6. What are algal blooms and why are they a problem?

Suggested site: http://theconversation.com/explainer-what-causes-algal-blooms-and-how-we-can-stop-them-109646

Testing Fertilisers

Objective

To investigate the effects of different fertilisers on plant growth.

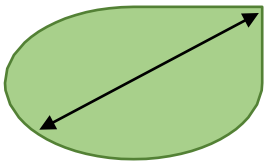
Ensure that you label your plants clearly.

Equipment

- 4 x seedlings in pots
- Stickers and markers to label pots
- 3 x Pre-mixed fertiliser solution
- Ruler

Method

1. Label your seedlings (fertiliser solution name and plant number).
2. Water one seedling with just water, and then add the same volume of each fertiliser solution to seedling.
3. Put the seedlings in a well-lit area.
4. Add water or solution to the seedlings each day, ensuring you add the same volume to each plant and give each seedling only the fertiliser solution that you initially gave it (check your label).
5. Measure the length of the longest leaf for each plant and record this in the table every day. Note: Once you have chosen the longest leaf on each plant continue to measure this leaf only.



Results and Analysis

1. Record your results in the table below.

Day	Leaf Length (mm)				
	Plant 1 (water only)	Plant 2	Plant 3	Plant 4	Average (for plants 2-4 only)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

2. Calculate the increase in leaf length for each plant, each day to complete the table below.

Day	Increase in Leaf Length from Day 1 (mm)				
	Plant 1	Plant 2	Plant 3	Plant 4	Average (for plants 2-4 only)
1	0	0	0	0	0
2					
3					
4					
5					
6					
7					
8					
9					
10					

3. Graph the results of your experiments.

6. Which fertiliser produced the largest increase in leaf length from day 1 to 10?

7. Which fertiliser produced the smallest increase in leaf length from day 1 to 10?

8. How did the plant that grew in just water compare to others?

Research

9. What is the cost (per 100 mL or 100 g) for each of the fertilisers used?

10. Was there a relationship between the cost of a fertiliser and the average increase in leaf length?

11. Which fertiliser would you recommend and why? Ensure you use data from your research to back up your answer.

Evaluation

1. Were there any potential sources of error in your investigation?

2. How could you improve this investigation?

Farming for Food – Student Booklet

Investigating the Health of Your Local Waterway

Objective

To use biotic water quality parameters to investigate the health of your local waterway, as well as to explore if human influence is affecting its health.

Background Information

A healthy waterway will have a large number of different types of macroinvertebrates present with no one type dominating the system. A polluted waterway will have only a few different types of macroinvertebrates present, often in large numbers, and will generally include things like aquatic worms, water fleas and non-biting midge larvae (Government of Western Australia, Department of Water and Environmental Regulation, 2017)

Equipment

- Glass Jar with lid
- Gum boots
- Camera microscope attachment if you have one (often available in Kmart for ~$5)

Safety

For this activity you must be very aware of your surroundings, ensuring you keep to paths and avoid disturbing wildlife. Watch out for snakes and go with someone. Let someone else know where you are going.

Method

1. When you reach the waterway, make observations of the flora and fauna surrounding it, taking note of what you have seen, and if possible the number of each species. You may need to take photos so that you can identify things later. Record these in the table.
2. Carefully dip your jar into the water, you will probably get more macroinvertibrates near the bottom.

Do not enter the water unless you are wearing gum boots and it is safe and okay to do so.

3. Pour some of the water into the lid and have a look for macro-invertebrates, take a photo of any you see.
4. Pour the water from the lid back into the waterway and then pour some more from the jar into the lid to make observations. Keep doing this until you have looked at all the water you collected.
5. Return home and research macroinvertebrate species, to identify the organisms you saw.

Results and Analysis

1. Complete the table below adding in fauna and flora that you observed around the water way.

Species name					
Number of times observed					

2. Complete the frequency tables below for macroinvertebrates observed.

Pollution Sensitive			
	Mayfly	**Stonefly**	**Caddisfly**
Number of times observed			

Somewhat Pollution Tolerant			
	Scud	**Dragonfly Nymph**	**Damselfly Nymph**
Number of times observed			

Pollution Tolerant			
	Aquatic Worm	**Water Flea**	**Mosquito Larvae**
Number of times observed			

4. Create pie charts to show the percentage of each macroinvertebrate identified. Colour code your pie chart so that pollution sensitive species are coloured green, somewhat pollution tolerant species are orange and very pollution tolerant species are red. Attach these as separate documents.
5. Which macroinvertebrate was most frequently observed in **your** sample?

6. Overall how healthy is your local waterway? Use data from your investigation to support your conclusion.

Evaluation

1. Were there any potential sources of error in your investigation?

2. How could you improve this investigation?

3. Does your investigation give a fair reflection of the health of your waterway? If not, why not? What other information is needed to make this assessment?

Farming for Food – Student Booklet

Modern Methods of Farming

Objective

To explain the principles behind modern farming methods and discuss the pros and cons of each farming type for use in your local area.

Method

1. Research methods of farming to complete the table below.

Farming method	Overview	Link to a picture or video	Example or case study	Pros	Cons
Hydroponics					
Aeroponics					
Aquaponics					

Farming for Food – Student Booklet

Farming method	Overview	Link to a picture of video	Example or case study	Pros	Cons
Vertical farming					
Precision farming					

Results and Analysis

1. Which type of farming would be most suitable for your local area? Explain your choice.

2. Which type of farming would be least suitable for your area? Explain why.