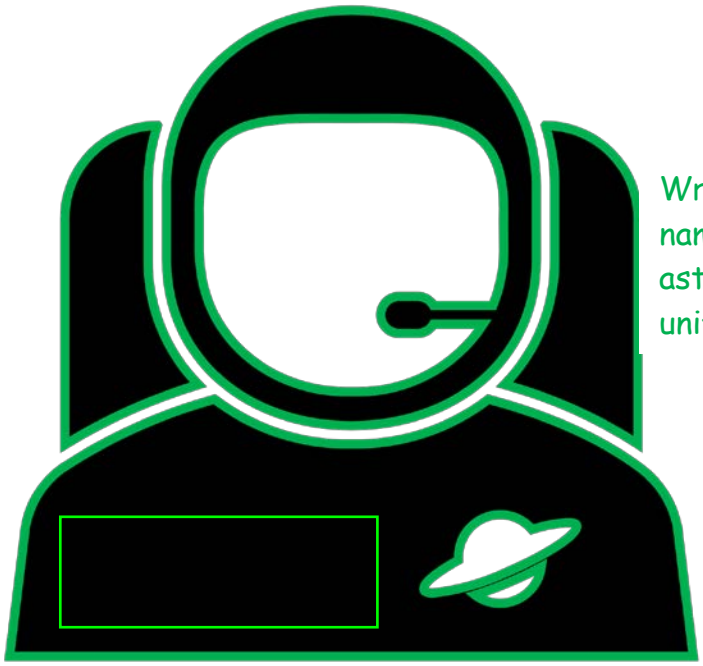
STEM Project 1D - Crop Fertiliser

International Space Farm

The Challenge

To address food security issues by designing an International Space Farm (ISF)!



Write your name on the astronaut's uniform

Ways to Meet the Challenge

This project has many different parts to it, and you will be looking at one area in particular.

Investigating the fertiliser requirements of crops.

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Find Out More and Get Thinking

Here are some points you might like to consider in your project to investigate the fertiliser requirements of different crops:

1. When you design your experiment, think carefully about what you are going to change (independent variable). Are you going to test:
    - different types of fertilisers?
    - different brands of the same type of fertiliser?
    - different amounts of the same fertiliser?
    - different ways of applying the fertiliser?
    - different strengths of the same fertiliser (e.g. if it is one you mix with water)?

2. Think carefully about the independent and dependent variables for your experiment – remember there should only be one of each. Also, carefully consider the controlled variables such as soil, water, sunlight and pot size.

3. Think about the kinds of food crops you can grow easily. Plants such as tomatoes, lettuce, beans, alfalfa, wheat or barley work well.

4. What kind of fertiliser are you going to test? Will it be solid or liquid? How will it be applied to the plants – poured on, sprinkled on, sprayed on?

5. Are you going to use seeds or seedlings? This will affect how long your experiment takes and perhaps which fertiliser you use. Your experiment may look at how many seeds germinate (sprout or start to grow) or how tall seedlings grow in a certain time.

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6. How will you measure plant growth or health? Will you measure the change in plant height? Remember to measure the height of seedlings before you start your experiment. Will you count how many new leaves they grow? Will you measure how many fruits they may produce (eg. tomatoes)?

7. What will you be growing the crop in or on (the growing medium)? You don't necessarily need to use soil as some things will grow well on cotton wool, paper towel or even just water.

8. Always follow safety advice when using potting mix such as wearing gloves, perhaps a face mask and always thoroughly washing hands with soap and water after use.

9. Place plants in a position they will not be interfered with by pets or siblings! Include a description of the position you grow the plants in as one of your controlled variables.

10. If you have a greenhouse available, you might like to use this but don't worry if you don't, it's not a requirement. Include the dimensions of the greenhouse, or a labelled diagram in your equipment list.

11. Consider which crops might offer the best nutritional value if they were being grown on the International Space Farm. It would take quite a bit of effort to grow crops and transport them so they should be high in nutritional value to make it worthwhile.

12. If you don't have access to seeds or seedlings of plants you can eat, use whatever you have available. Your results will still help you to understand the fertiliser requirements of plants.

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In the space below, brainstorm all the ideas you have about how you could investigate the fertiliser requirements of different crops to grow on the International Space Farm.

When you were brainstorming, were there some things that you found you need to know more about? Write those down here. You may like to use the PALMS 6 STEM Research Guide - Digital to find out more about these things.

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Scientists all over the world organise the way they think about and carry out their work in the same way – we call this the *scientific method*. They also write quite formally in the 'third-person' style (not using phrases such as 'you', 'we' or 'I)'.

To try and solve your part of the STEM problem and meet the challenge, you will carry out an investigation, by designing and carrying out an experiment.

When you are going to design an experiment, there are certain things that you always need to consider and include. The STEM Project Experiment Worksheet on the next pages will help you to design your experiment and organise the data you collect. It is important that you include as much detail as possible so your experiment could be repeated by anyone who reads it.

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Below are explanations of the terms used in the STEM Project Experiment Worksheet.

Problem/Aim – What problem are you investigating? What is the purpose of the experiment? You only need to write a sentence or two for this section. You would write something like "To investigate the amount of fertiliser tomato seedlings require." You may even like to write it as a question e.g. "How high will wheat grow when different amounts of fertiliser are added?"

Variable – A variable is any part of an experiment that can be measured, changed or controlled. It may have factors such as an ingredient, a way of doing something or be part of the surroundings, like temperature.

Independent variable – This is the variable that you are going to change to see what effect it has. A fair test only changes one thing so there is only ever one independent variable.

Dependent variable – This is the variable that you are testing so it is the one you are going to measure.

Controlled variables – These are all the other variables that you keep the same to make sure a fair test is carried out. There will always be more than one of these, including making sure that you are using the same equipment and methods for repeat experiments. You do only need to list the things that will have a direct effect on the experiment.

Hypothesis – What do you think is going to happen? Another way to think of a hypothesis is that it is an informed guess, using the knowledge you gained by researching your problem. This is a sentence that predicts how the independent variable will affect the dependent variable. You could use a sentence such as 'If tomato seedlings have an increasing amount of

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fertiliser applied, they will produce more tomatoes'. In this example, the amount of fertiliser is the independent variable (you are changing this) and how many tomatoes are produced, is the dependent variable (you are measuring this and it will depend on the independent variable).

Materials and Equipment – This is a detailed list of all the things you will need to complete the experiment. You should include the size of equipment (e.g. 250mL black plastic plant pot) and the quantity.

Method – Write a step by step description of how you will do the experiment. Remember, it needs to be written in third person point of view so avoid using 'I' or 'we'. Make sure you are very detailed so someone else can do exactly the same experiment by following your method. You may even like to include some diagrams or photos of how your experiment is set up.

Safety – Make a list of any things you'll need to do to make sure you work safely and don't create a hazard for anyone else or the environment.

Results – In this section you will record any observations or measurements you make. It is usually best to put your data in a table, making sure you have titles on all your columns and that the units you are measuring in are included. Whatever your independent variable is should be in the left column. Make sure you make space in your table for any repeat trials you do. You may also like to take photographs or videos to record your results. Check with your teacher how they would like to see your results.

Conclusions – What do your results tell you about your original aim or hypothesis? You should write a sentence or two stating whether your results support your hypothesis or not and explain any patterns you notice in your results.

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STEM Project Experiment Worksheet

Title:
Problem/Aim: (What problem are you investigating? What is the purpose of the experiment?)
Variables: Independent Variable (what are you changing?): Dependent Variable (what are you measuring?): Controlled Variables (what are you keeping the same to make it a fair test?):
Hypothesis: (What do you think is going to happen? An informed guess)
Materials and Equipment: (List all things you will need for the experiment)

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Method: (A step by step description of how you will do the experiment. Avoid using 'I' or 'we'. Labelled diagrams might help)

Safety: (What will you do to minimise hazards to people and the environment?)

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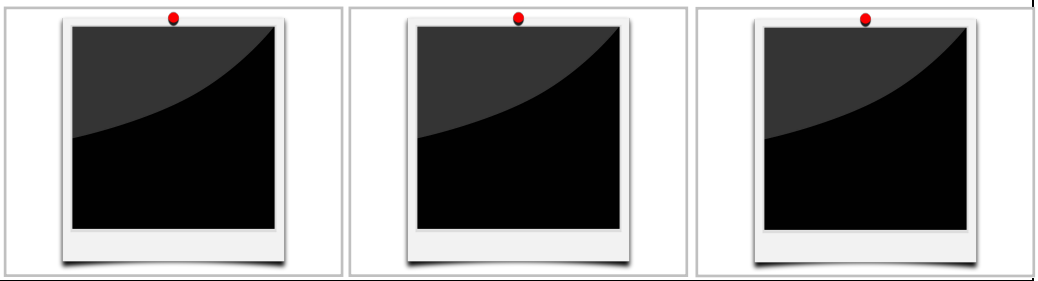
Submit your experiment design to your teacher for checking before continuing!

Once they have approved your experiment, you can get started.

Results: (Record your observations and measurements. A table may be best for this. Remember that the independent variable should be in the left column and you must include the units of measurement. Attach photographs, if required, and write the file names in this box with a brief explanation of what the photo is showing)

Photos:



Conclusions: (What do the results tell you about your original aim or hypothesis?)

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Could It Be Better?

Once you have carried out your experiments, built and tested your prototype or programmed and tested your solution, you need to review your ideas and work. In this section, you can identify any problems or difficulties you encountered and suggest ways you could improve your project if you were to start again.

These questions will help with your review process. Write or draw your ideas for improvement in the table below.

- Do you currently have access to enough of the materials you used to make a full-size farm? Is there enough of it available in Australia? On Earth?
- Will current technology be useful, or do you need something more, something faster or better?
- Estimate how much it would cost to put your plan in place.
- Estimate how long it would take to put your plan in place.
- Can you do all of this yourself or do you need to bring in some experts? Who might these experts be?
- Did your experiments or tests give you enough information to start an International Space Farm tomorrow? What further experiments or tests might you need to do?

Problem encountered	Possible Solution

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Problem encountered	Possible Solution
Any other ways to improve your solution if you have unlimited resources, time and access to the best people!	

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Report Back To Base

To finish off your STEM Project, you or your group need to let everyone know what you found out and what solution you came up with for your problem.

There are many ways you could do this, and your teacher may ask you to do it a particular way or have you come up with your own ideas. When writing or making your presentation, make sure you think carefully about who your audience is and how much detail you need to include. More visual presentations (colourful or with lots of pictures) are always more interesting.

Whatever kind of presentation you end up doing, you should cover the following things:

- What you found out or discovered that you didn't know before.
- What you designed, built, programmed, tested.
- The STEM skills you used (problem solving, creativity, critical analysis, teamwork, independent thinking, communication, digital literacy).
- The data you generated in your investigation and what this shows (this may be in the form of tables or graphs and may not be relevant to every section of the project).
- How you could better investigate the challenge if you had no limit on resources or time.
- The most challenging aspect of the project.

Don't forget!

- Save this file as a PDF and submit it to your teacher. Don't forget to include your name!
- Check that any photos have uploaded or send them to your teacher separately (tell them the file name)
- Submit your Report Back To Base presentation to your teacher.

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