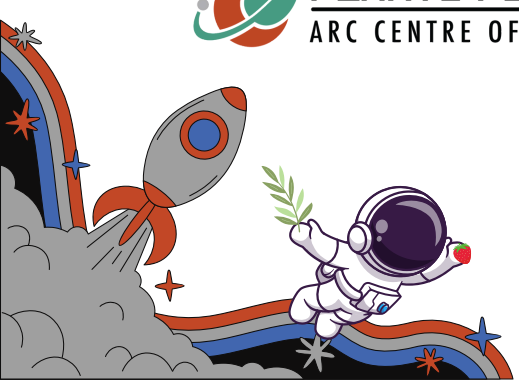
GROW FOR LAUNCH

SCHOOL KIT HANDBOOK

Thank you for participating in Plants for Space National Science Week Grow for Launch program.

Included in the kit are the resources needed to conduct a plant growth experiment as well as extra activities. Further resources can be found on the Plants for Space Education and Engagement webpage: https://plants4space.com/public-programs/education-and-engagement

Grow For Launch is generously sponsored by a National Science Week grant and Plants for Space would like to thank the following supporters:



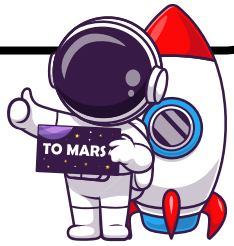
WHAT IS PLANTS FOR SPACE?

PLANTS FOR SPACE
ARC CENTRE OF EXCELLENCE

Plants for Space is a big team of scientists from five Australian Universities, plus space companies, farming experts, the Australian Space Agency, and even NASA!

We are all working together to figure out how to grow plants for food, medicine and materials so people can live in space for a long time without needing so many deliveries from Earth. What we learn can help make better food, and farming friendlier to the planet, here on Earth.

The Plants for Space team studies lots of things, like ways of growing plants without soil, how food affects our health and feelings, and even the rules about growing food in space.

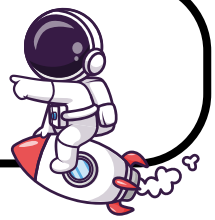


OUR MISSIONS

- Making useful things with plants whenever we need them and when far from Earth
- Designing new plants that grow well inside, and plants that can be used almost completely without waste
- Making healthy, tasty, plant-based food for astronauts and for people on Earth
- Helping kids and adults learn skills to get ready for jobs of the future

Watch more about Plants For Space

MISSION BRIEF



Your mission this National Science Week is to complete:

Plant Growth Experiment

A science investigation of plants grown without soil and in different nutrient concentrations.

Food Sensory Test

Food gives us lots of joy and helps us thrive. We use lots of senses to enjoy food, not just taste! Complete a food sensory test to help think about what makes food enjoyable.

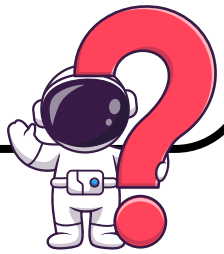
Space Cook

Use what you have learned during this mission to come up with a delicious plant-based recipe that is inspired by space! Maybe you want to make a super healthy salad or a joyful cake.

Bonus activities

There are extra activities at the end of the Mission hand-book to add even more fun to your National Science Week!

PLANT GROWTH EXPERIMENT



Your first mission task is to grow two plants using hydroponics. One plant will be grown in just tap water the other with nutrients added to the water.

What plants do you think will grow best?

What you think will happen is called your *hypothesis*. You will test your hypothesis with the experiment.

To do this:

- Read “Growing Plants in Space”
- Follow the **Experiment Method** to test your hypothesis.
- Record everything you do. Use the **Mission Report** to record your hypothesis and data
- Use your data to see if your hypothesis is correct
- Log your data with Grow for Launch Mission Control

GROWING PLANTS IN SPACE

Why Grow Plants in Space?

Missions are planned to go to the Moon and Mars - this means astronauts will be in space for a long time. Nutrients in packaged food do not last very long so astronauts will need fresh food. Caring for plants can also lift spirits during long, lonely missions. The goal is for astronauts to grow their own food on the Moon, Mars, or space stations. Plants can also be used for materials and medicines.

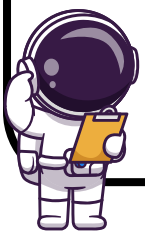
Growing plants in space comes with many challenges. On Earth, gravity helps roots grow down, and light helps stems and leaves grow up.

Plants floating in zero gravity grow differently and can become stressed. To help plants grow in space the temperature and humidity needs to be controlled. Special energy-saving LED lights are used. Since soil is heavy and hard to use in space, astronauts grow plants using hydroponics (in water) or aeroponics (with mist). Space scientists are working out the best mix of nutrients and light so plants grow quickly and are more nutritious

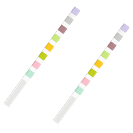
On the International Space Station (ISS), astronauts use closed growth systems with LED lights and rooting pillows to grow lettuce, mustard greens, and even flowers. They recycle water, air, and nutrients, even the carbon dioxide from astronauts' breath!

The researchers at Plants for Space are studying how to change plants so they can grow better in space, for example, making tiny tomato plants, sweeter strawberries with less roots, and even leaves that make medicine!

Work by Plants for Space aims to make farming more sustainable by using less water and chemicals, and help create delicious and nutritious future foods!



GROW 4 LAUNCH! KIT

☐	**2 Bottles**		Not included in the kit you will need to find 2 used bottles with wide openings (34mm)
☐	**Seeds**		Provided is a small container of coriander seeds
☐	**Tweezers**		Used to place seeds in the Gyrosnaps
☐	**Gyrosnaps**		Gyrosnaps are a substrate-free reusable plant growth system
☐	**2x Hydrogel**		Hydrogel will take up water to make a gel, help seeds germinate and will biodegrade
☐	**Dropper**		Used to water seeds while germinating
☐	**Nutrients**		This is a mixture of nutrients that plants need such as Nitrogen, Potassium, and Posphate.
☐	**2 Test Strips**		These test strips measure different chemicals found in water
☐	**Mission Sticker**		Your very our mission sticker

EXPERIMENT METHOD

Step 1

- Check you have all your materials
- Collect two wide-mouth plastic bottles about 250 - 300ml in size
- Decorate your plant bottle rocket to look awesome!

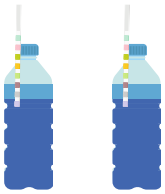
Step 2

- Label your bottles **W** for just tap water and **N** for water and nutrients
- With the dropper, add warm tap water to the top of the container with nutrients, shake until all nutrients are dissolved

Warning: If undiluted nutrients contact skin, wash immediately

Step 3

- Add nutrient solution to the bottles labeled **N**
- Fill both **W** and **N** bottles to the same level with tap water
- Shake well (careful not to spill any!)

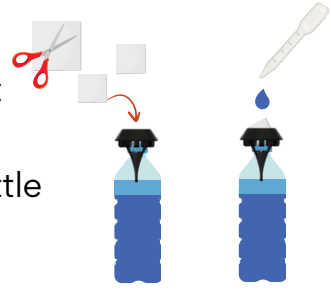


Step 4

- Dip 1 test strip into the **W** bottle and a new test strip into the **N** bottle for 2 seconds
- Remove test strips and **DO NOT** shake off extra water
- Wait 30 seconds
- Compare the test strips to the test analyzer on the Mission Report to see what nutrients are in the two samples
- Record results in the “Nutrients in water” table in the Mission Report

Step 5

- Fold 1 piece of hydrogel in half and place between the two flat flaps of the Gyrosnap. Repeat with second Gyrosnap
- Place one Gyrosnap in the **W** bottle and the other in the **N** bottle
- Use the dropper to add water onto the hydrogel.
- Wait 1 min until soaked. Add more water if needed.



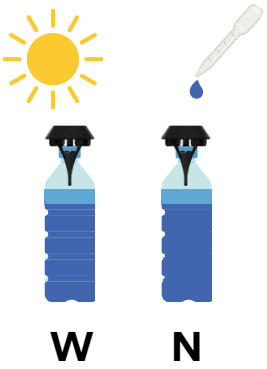
Step 6

- Use tweezers and place three seeds onto the wet hydrogel and push in slightly
- Using the dropper, carefully add water through the Gyrosnap so that the water level is just below the seeds.
- While the seeds are germinating, use the dropper to keep the seeds wet and top up the bottle with water as needed

Note: Seeds can take up to 7 days or longer to germinate

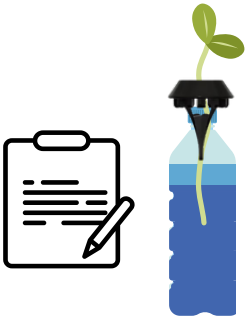
Step 7

- Place bottles in sunlight and wait for plants to grow.
- When seeds have germinated (day 0) and the root has grown past the bottom of the Gyrosnap, check water levels every day and add as needed to keep just below the Gyrosnap. If more than one seed germinates select the healthiest looking plant and cut the other plants off



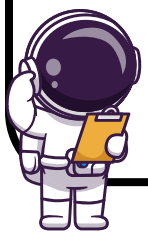
Step 8

- Let plants grow for 14 days after germination
- Record every two days
  - How tall the sprout is
  - How long the roots are
  - How many leaves there are
  - How healthy the plant looks on a scale of 1 to 10 (1 being very sick looking 10 being very healthy looking)



Step 9

- Based on your observations complete the **Mission Report**



GROW 4 LAUNCH!
CLASS STUDENT KIT

- [ ] **Seeds**

Provided are a number of coriander seeds.

- [ ] **Nutrients**

This is a mixture of nutrients that plants need such as Nitrogen, Potassium, and Phosphate.

- [ ] **Jiffy pods**

This is a substrate/soil alternative for the seeds to grow on. It doesn't give plants any nutrients. It is possible space farming substrate.

Class Protocol

Step 1

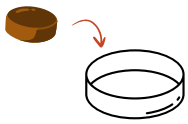
As a class demonstration set up the Gyroplants from the "Class Demonstration kit" to model what to do and highlight the experimental aims and design.

Step 2

- Add the full vial of nutrient power to a 2 litre bottle, fill with water and mix well to dissolve.

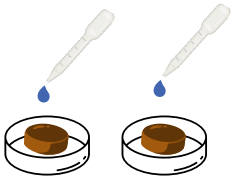
Step 3

- Place a jiffy pods in disposable waterproof container such as a take away container.



Step 4

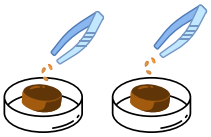
- Re-hydrate jiffy pods by soaking in warm tape water until fully expanded ~15 min. Then drain excess water.
- Designate half the jiffy pods to be grown with water and label the container W and the other half to be grown with the nutrient solution. Label those with N.



Step 5

- Use tweezers to pick up seeds and sow them into top of the jiffy pods.

Note: The top of the jiffy pod has a hole in the liner.



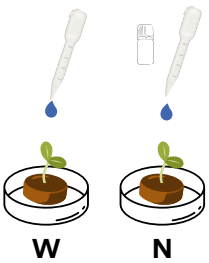
Step 6

- Place sets in sunlight and wait for them to germinate.
- Keep jiffy pods hydrated with tap water.

If the class set is large enough you might want to place them in different location, e.g. in dark, shaded, cold/warmer to make even more comparisons to find what works best!

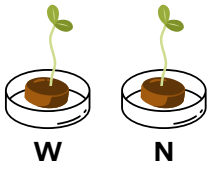
Step 7

- When seeds germinate begin to water the N set plants with nutrient solution.



Step 8

- *Let plants grow for 14 days after germination*
- *Record every two days*
  - *How tall the sprout is*
  - *How long the roots are*
  - *How many leaves there are*
  - *How healthy the plant looks on a scale of 1 to 10 (1 being very sick looking 10 being very healthy looking)*
  -

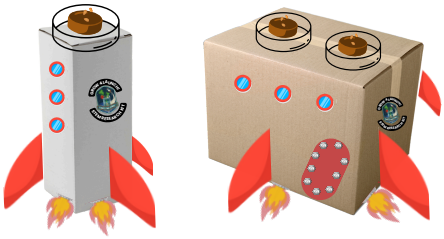


Step 9

- Record results on the **Mission Report**

Extention:

- *Have student craft space themed Growth boxes to hold plant containers. Use the Astrobotany Challenge temple provided as inspiration.*



- *For larger classes and whole school participation students can select different substrates to grow plants hydroponically (see the next page for instructions)*

Extension: Class Protocol

"Simple Seeds"
Australian Virtual Astronaut Challenge

1. Collect Materials

- Growth chamber
- Growth substrate
- Water
- Seeds

2. Prepare Growth Chamber

- Use any clear container that can hold growth medium and house plant up to 20 cm tall and can be sealed. e.g. 2 Liter bottle, storage container, large glass container.

3. Prepare Substrate and Plant Seeds

- Create a substrate mix that the plants will be able to grow and thrive in without adding additional water or nutrients.
- Example of growth substrates are: Agar, Sand, peat, gravel, soil or a mixture.
- Add seeds!

Note: The challenge of growing plants in space is giving the plants the right amount of water. The substrate the plant grows in can help.

4. Seal Growth Chamber

- Seal growth chamber
- Once sealed nothing can be added during the mission.
- Place in well lit area

5. Record and Analyse

- Record the growth substrate used, amount of water added, location in the world, and position and orientation in e.g south facing window.
- Record the growth of plants and observation very few days

Complete the online form at: https://avachallenge.org/simple-seeds/

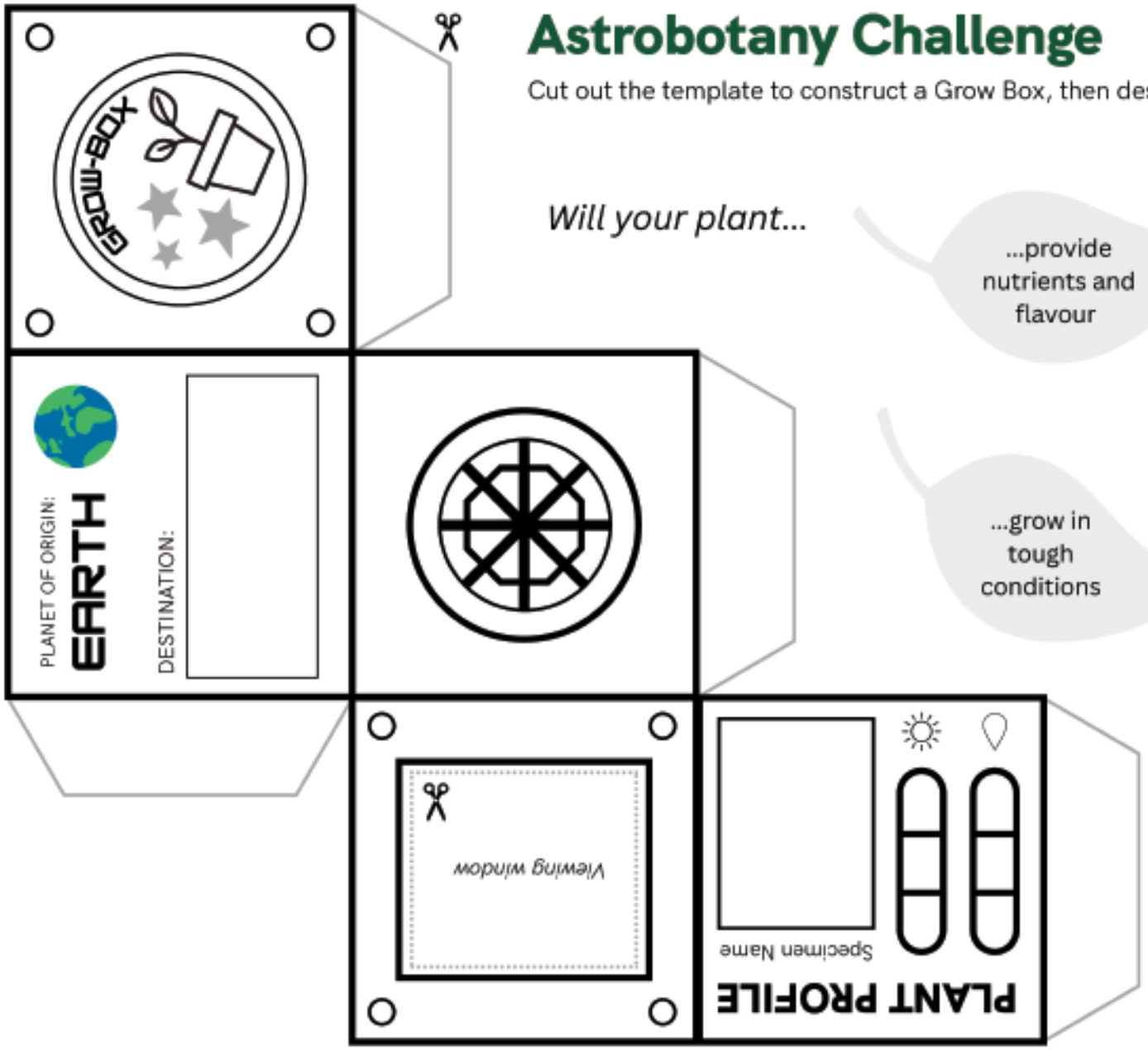
- Share any images or updates of your project on LinkedIn and Instagram using @Magnitude.io, @ARC Centre of Excellence in Plants for Space, @Australian Pastures Genebank, and @AVA Challenge.

AVA AUSTRALIAN VIRTUAL ASTRONAUT

PLANTS FOR SPACE
ARC CENTRE OF EXCELLENCE

Astrobotany Challenge

Cut out the template to construct a Grow Box, then design your very own **space plant**!



Will your plant...

...provide nutrients and flavour

...improve wellbeing or calmness

...grow in tough conditions

...produce fresh air

...something else?

Plants For Nutrition

Living in space is hard and takes its toll on astronauts' bodies. They need nutrients and fresh food to keep them healthy. Can you grow a nutritious (and delicious!) plant for astronauts to eat?

Plants For Well-Being

Living in space is nothing like living on Earth. Life up there can be difficult and may affect the astronaut's mental health. Can you grow a plant that will remind the astronauts of home and help make them happy?

Plants That Grow in Tough Conditions

There's not a lot of room on a spacecraft. Soil and water for plants take up a lot of room! Can you grow a plant that doesn't require a lot of water or soil but can still thrive?

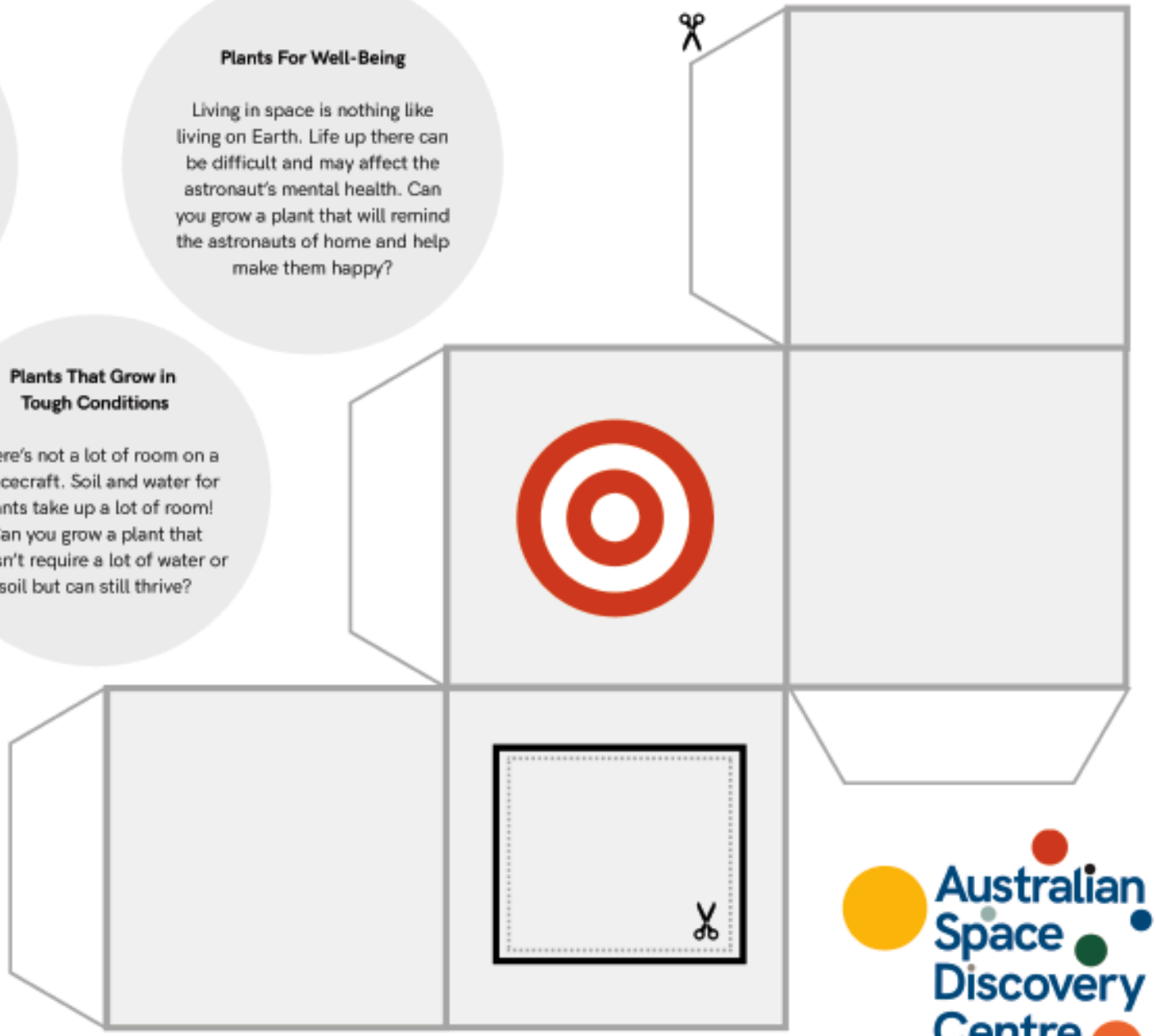
Plants For Fresh Air

People breathe in oxygen, and breathe out carbon dioxide. Plants breathe in carbon dioxide and breathe out oxygen. They do this via their leaves. Can you grow a leafy plant that helps astronauts breathe fresh air?

Something Else....

What else could we use plants for in space? Are there any unique or special plants you might not have thought about?

Get creative and design a plant of your choosing.



Australian Space Discovery Centre

MISSION REPORT

Hypothesis:

(Circle what your hypothesis is)

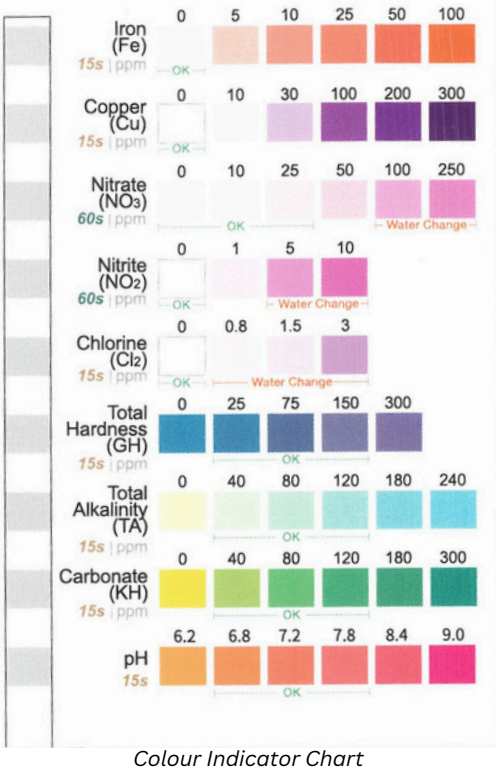
1. The plants that grow best will be in just tap water.

or

2. The plants that grow best will be in water and nutrients.

Do you have any other hypothesis or predictions about how the plants will grow?

Water Test Results:
Use the test strip colour indicator chart to determine the nutrient levels in the **W** and **N** bottles. Record the data from water test strips in the table.



Colour Indicator Chart

Nutrients in Water

Nutrient	Water	Water + Nutrients
Iron (Fe)		
Copper (CU		
Nitrate (NO3)		
Nitrite (NO2)		
Chlorine (CL2)		
Total Hardness		
Total Alkalinity		
Carbonate		
PH		

Plant Growth Results

Day		0		2		4		6		8		10		12		14	
		W	N	W	N	W	N	W	N	W	N	W	N	W	N	W	N
Shoot height (cm)																	
Root length (cm)																	
Number of leaves																	
Health score (0-5)																	

Plant Growth Debrief

Scientists love to tell others about what they find out, how their finding might help people, or what their findings might mean for the future. This is done by showing people their results and coming up with a conclusion.

Look at your results.
Did one plant grow better than the other?
Which one?
Why might that be?
Do these results match your hypothesis?

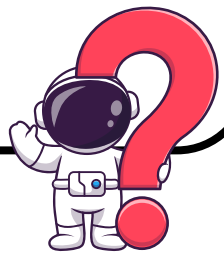
Write what you found out:

What do you think this might mean for farming in space?

What do you think this might mean for farming in on Earth?

Share your experiment results here:
https://plants4space.com/public-programs/education-and-engagement/grow-for-launch-results

FOOD SENSORY TEST

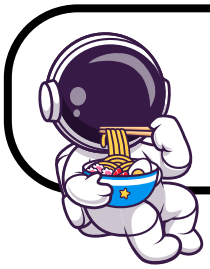


Your second mission task is to conduct a food sensory test to determine other than taste what sensory qualities are important for making food enjoyable.

What senses do we use to enjoy food?

To do this:

- Read about food in space
- Conduct the Food Sensory Test
- Think about what plant based ingredients give you joy



FOOD IN SPACE

Cooking in Space

Astronauts don't cook food the way we do on Earth. Their meals are prepared and processed on Earth so they are safe and easy to eat in space.

Most space food is freeze-dried or dehydrated, which means the water is removed. This makes the food lighter and last longer. Some meals are treated with heat to kill germs so they can be stored safely. Astronauts can warm these meals later on the space station.

There are no pots, pans, or open flames in space. Instead, astronauts use special tools to heat or add water to their food.

To heat a meal, they put the sealed food pouch into a special food warmer. It works like a tiny oven but uses heat panels instead of fire.

For freeze-dried meals, astronauts use a water dispenser that gives hot or cold water. They attach the food pouch to the dispenser and add the water. That's how they "cook" their food in space!

Eating in Space

Because of weightlessness, astronauts use trays with Velcro, springs, and magnets to hold food and utensils in place. Most food comes in plastic bags, so scissors are important for opening them.

Utensils have magnets so they won't float away. Drinks come in plastic pouches with special straws. It's also very important not to make crumbs. Crumbs can float around and damage equipment. That's why astronauts use wraps instead of bread.

Example of food eaten on the ISS

Fresh food like apples, carrots, and salad is only available on short missions or right after a supply ship arrives at the International Space Station.

SENSORY TEST

Take a look at the two pictures below. Think about how each one makes you feel? Does one make you feel happier?

Plants for Space scientists are studying how plants grow in space. They are also thinking about food that is made from plants.
They don't just think about how food tastes or how healthy it is. They also study how food can make people feel happy.

Eating isn't only about taste, we use many of our senses when we enjoy food.
Did the second picture make you feel happier? Why do you think that is?

To learn how people experience food, scientists perform sensory tests. You can do your own sensory test at home using fresh plants and other foods from your kitchen.

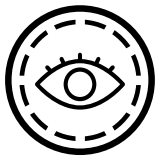
Do Your Own Sensory Test:

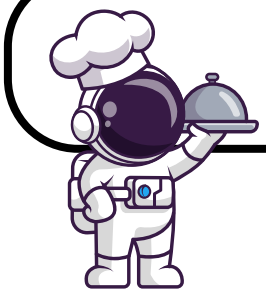
Pick 5 or more different foods from your pantry or fridge. Try to include as many fruits and vegetable as you can.
Use the table in the Mission Report to rate each food on a scale from 1 to 10 in these categories:

- How the food looks
- How the food smells
- How the food feels (texture)
- How the food tastes
- How much joy the food gives you overall

This activity will help you understand how your senses work together when making your own space recipe!

Sensory test

FOOD					
 **SIGHT**					
 **SMELL**					
 **FEEL**					
 **TASTE**					
 **JOY**					
TOTAL					



SPACE COOK

Your third mission task is to create a plant-based recipe that is inspired by space and you would be happy to take on a space adventure!

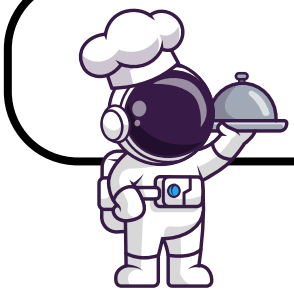
What would you want to eat while living in space?

Imagine you are an astronaut who in the future, is living on the Moon or traveling on an 18-month journey to Mars.

What food would you bring with you?
What favorite foods would you miss the most?

Now, imagine you could grow your own food right in your Moon base or spaceship!

What plants would you grow to make a special meal that brings you joy and keeps you healthy?



SPACE RECIPE

To help you design your own space recipe have a think about:

- What plants do you enjoy eating?
- How do they taste, look, smell, and feel? (Use your sensory test results!)
- What recipes do you like eating here on earth?

Your recipe must use only plant-based ingredients and it should bring you joy! Use the recipe template in your Mission Report to design your dish, then share your recipe and a picture of your creation at:
https://www.newlywords.com/space-cookbook

Get creative... and blast off into the future of space food!

Need some inspiration?

Here's a picture of a special salad made by scientists for space!

Every ingredient was carefully chosen so that, when mixed together, it gives astronauts the nutrients they need to stay healthy on long missions.

Want to see more space-inspired recipes created by plant, food, and space experts?

Super Nova Energy Bowl
Shu Linag and Volker Hessel

Space Recipe

What is your Space Recipe Called?

Preparation time:

Ingredients:
for example 50g beans , 5g minced garlic

Instructions:

What is the space inspiration for your dish?

Share a favorite class space recipe by going to https://www.newlywords.com/space-cookbook

Don’t forget to take a picture of your prepared dish!

Please submit only one recipe per class

national science week

Australian Government
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PLANTS FOR SPACE
ARC CENTRE OF EXCELLENCE

CABBAGE INDICATOR

The water test strips used in this kit are colour indicators to measure how much of something is in a liquid. You can make your own indicator using red cabbage. It changes colour to show if something is an acid or a base. This is called pH.
You can make your own Red Cabbage pH indicator

What You'll Need:

- ¼ of a red cabbage chopped
- Hot water
- Large bowl and spoon
- A strainer or sieve
- Clear cups or jars
- Spoon or stirrer

For testing:

- Vinegar
- Lemon juice
- Baking soda mixed with water
- Dishwashing liquid
- Tap water
- Other liquids from your kitchen (milk, soda, juice)

Instructions:

1. Make the cabbage indicator
   - Chop up ¼ of a red cabbage into small pieces (ask an adult for help).
   - Put the cabbage into a bowl.
   - Add about 2 cups of hot water.
   - Mash and stir the cabbage for a few minutes until the water turns purple.
   - Strain the liquid through a sieve into another container.

Test different liquids:

- Pour a small amount of the cabbage juice into several clear cups or jars.
- Add a different liquid to each cup — just a few drops or a spoonful.
- Stir gently and watch the colour change.

What the Colours Mean:

- Red or pink = acid (like vinegar or lemon juice)
- Purple = neutral (like water)
- Blue, green, or yellow = base (like baking soda or dishwashing liquid)

What's Going On?
Red cabbage contains a natural chemical called anthocyanin. It changes colour depending on whether it's in an acid or a base.