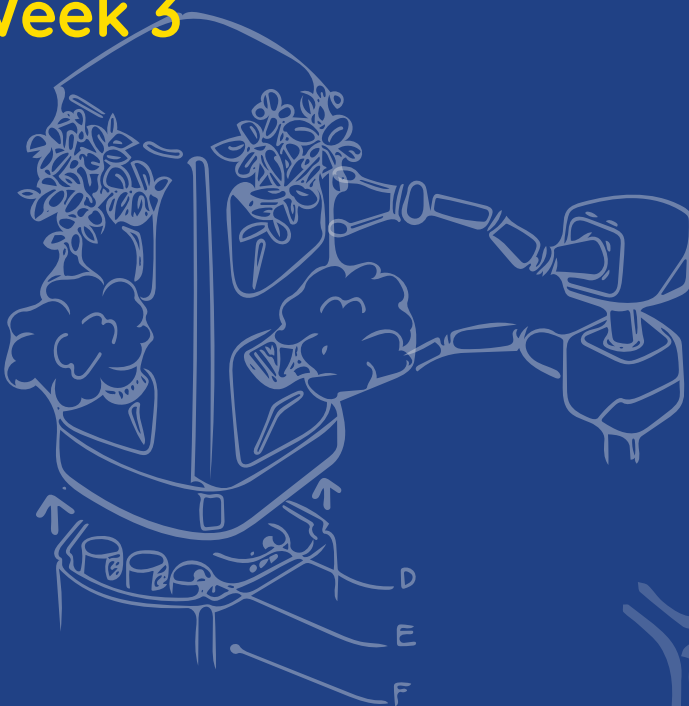


Name:

ENGINEERING DESIGN FOLIO



The Australian Virtual Astronaut Challenge
Week 3



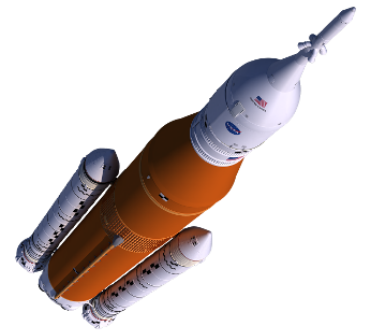


Identify

Criteria

Criteria are the attributes of a design that can be actually measured.

Activity: List some of the criteria for success of your project.



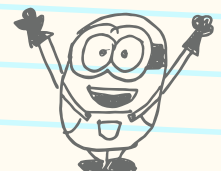
Will the NASA Space Launch System (SLS) use solid fuel or liquid propellant or both?

Now is a good time to identify the tools, workspaces, and machinery that you might need to complete this task.

imaginaturalists.com.au

Missions may have rules and guidelines to follow. Use the space below to make notes.

Tools and Equipment





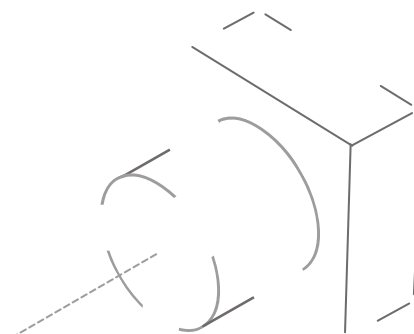
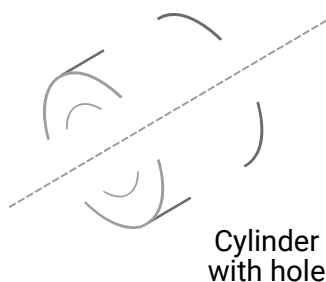
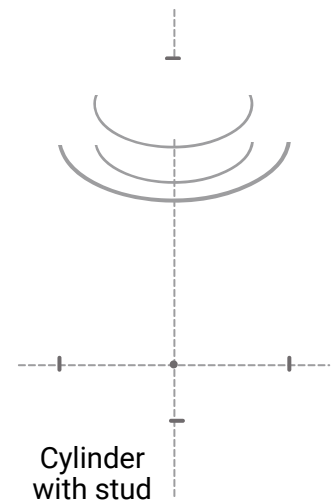
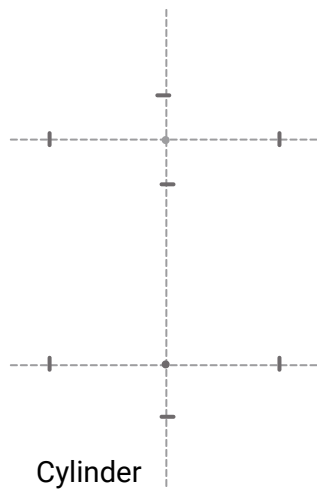
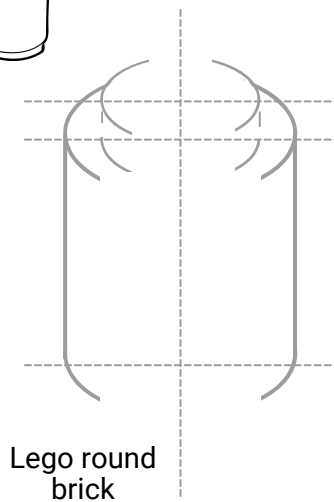
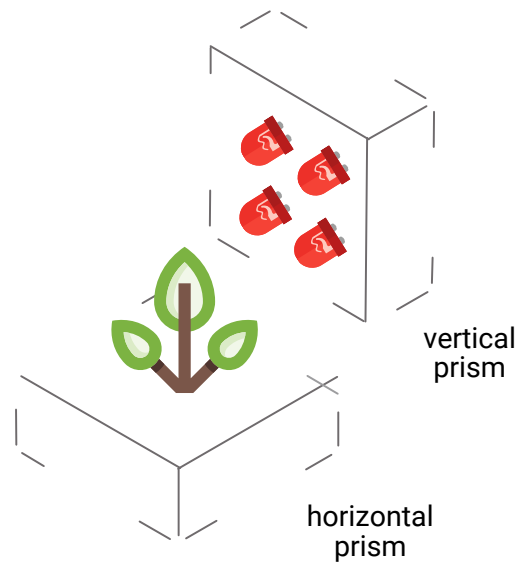
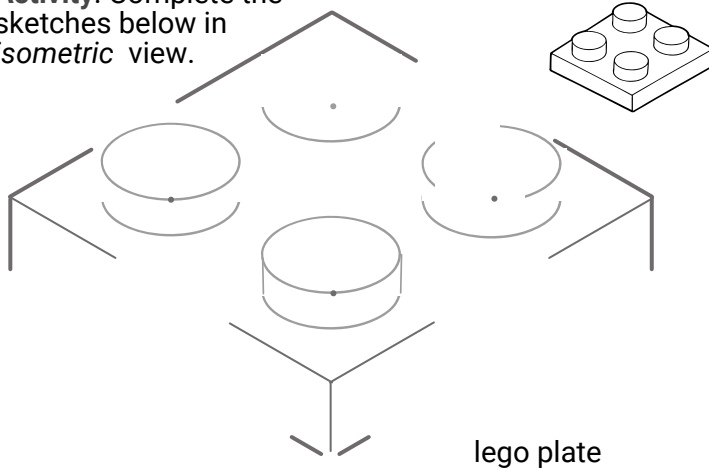
Sketching your ideas in 3D

Sketching in 3D is a great way to quickly imagine and share new ideas. Most designs start out as a just a cube or a cylinder. Let's practice sketching these two objects.

Introducing 'Glenny-D', one of our guest presenters this week who has taught thousands of his students how to sketch in 3D. See his free YouTube drawing tutorials at Splat3D.

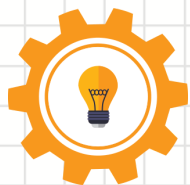


Activity: Complete the sketches below in *isometric view*.



Combine to design !



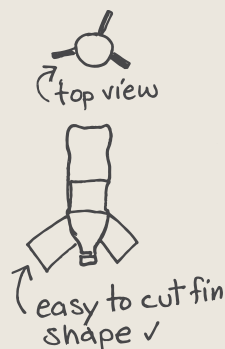


Brainstorm. Use visual thinking.

Sketch *lots* of ideas to encourage creative thinking

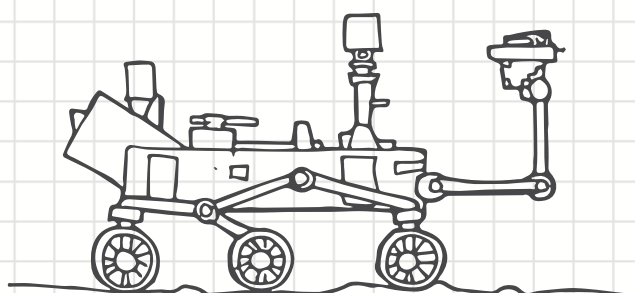
'Thumbnails' are small, quick sketches. They are thoughts on paper, with no time for neatness.

Activity: Practice being creative. In the space below, draw thumbnail sketches of the ideas that you have 'Blitzed'. Be sure to annotate your sketches for further clarity of your ideas.



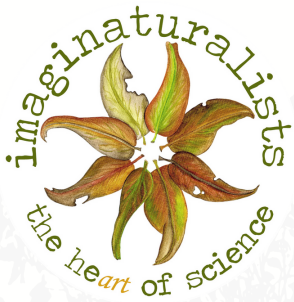
"annotate your sketches", means to use arrows and labels to help explain your ideas.

"A person with good ideas is simply a person with *lots* of ideas!"





Brainstorm



Introducing Gillian Hewitt, one of our guest presenters for week three, she is the founder of Imaginaturalists who wishes to inspire a love of science in children by engaging them with creative expression and experiential learning. Imaginaturalists encourages children to utilise their powers of observation and gives them the skills to express these through fun and creative means.



Drawing is the best way of seeing!

The best way to notice the details about any object or process in our world is to use our Powers of Observation.

The best way to exercise these powers is to use them on a daily basis. The best way to sharpen these skills is to ask yourself to draw what you see.

When we draw something that we are observing, it forces our eyes to take note of the tiny details that come together to make the object complete.

Without noticing these small details, our brains fill in the gaps with 'best guesses' and trick us into thinking we see the true nature of the object. Drawing from observation is the best way to develop the ability to use our eyes and truly observe the way things are.

Observation is the first step in many scientific journeys, leading the scientist to ask many important questions, such as why is it like that, was it like that before, has it changed and if so why, how does it relate to its surroundings?

Drawing is one of the most important tools in communicating information in Science.

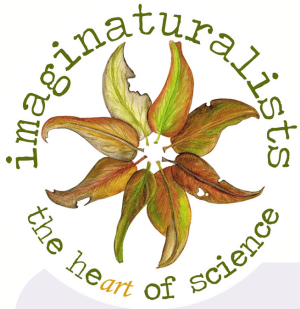
In this brainstorming session, Gillian will demonstrate how to draw plans from observation and how to prepare herbarium sheets to preserve specimens of plants for study.



Images courtesy Imaginaturalists



Brainstorm



Plants are the keystone to many of the natural processes on our Earth. Around 80% of plants growing on Earth today are flowering plants or Angiosperms. Understanding the anatomy of a plant, how it looks outside and what is inside is key to understanding life cycles, germination and pollination in angiosperms.

Activity:

Go into your garden and select something to draw, if possible, choose a specimen with a flower and a small number of leaves for your observations.

Hold your flower or place it in a vase for observation.

Look closely at the flower, notice the important details of how it is constructed. How many petals does it have? What colour is it? Does it have a distinctive repetitive pattern or is the pattern variegated (different coloured zones)?

On the next page make some quick observations of your plant. Start to make some rapid line drawing sketches. These drawings are meant to be informative and remind you of your observations.

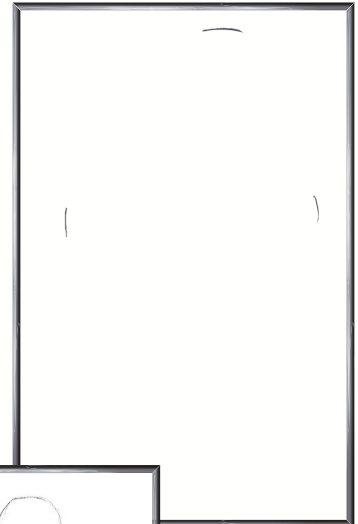
Step 1. Begin by identifying the overall shapes that make up your plant. Put very light guidelines at the top and bottom, left and right of where your sketch will sit on your paper.

Step 2. Very lightly map in the overall shapes and how they will fit on your page before adding your detail.

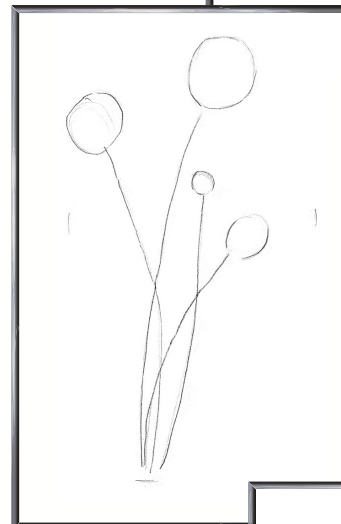
Step 3. Add the detail. How are the petals arranged? Do the leaves grow exactly opposite each other on the stem or are they skewed? Is every petal, every leaf the same as each other or do they vary?

These may be questions you can ask yourself as you draw but keep in mind to use your own observations!

step 1



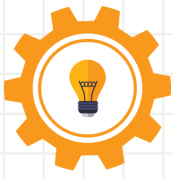
step 2



step 3

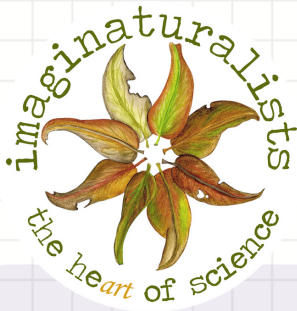


(Above) The steps to do an observational sketch, using clover as an example



Brainstorm

Use the space below to sketch out your plant



Step 4. Now that you have spent some time looking closely at your plant, you can add shading to make your sketch appear 3 dimensional.

Add small amount of pencil and use your finger to smudge it. The darkest shadows will be in the deepest corners between petals.

Don't be afraid to push the dark tones to make your sketch pop! You may also choose one aspect of your plant to draw in greater detail, for instance in the clover example, the flower head is many flowers arranged in a sphere. Draw one of the flowers in close detail.

Here is an example of the clover example as a shaded sketch.



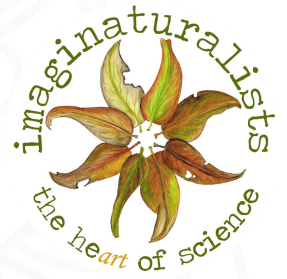
Reflection:

Did you find that your plant specimen was more complex than you thought it would be when you started to draw it?

Did you notice any details that you hadn't seen before you drew your specimen?



Brainstorm



Herbarium Sheets

Botanists (scientists who study plants) often create **herbarium sheets** to preserve specimens of the plants that they are studying. There are many herbariums all over the world that store plant specimens in buildings just like libraries. Properly prepared plant specimens can last for hundreds of years in herbariums and are an important record of species diversity. Some plant species which have now become extinct, only exist in the preserved specimens in herbariums.



Herbarium sheets are created using acid-free heavy weight paper, cotton gloves and thread to stitch the specimen to the page, under climate-controlled conditions.

Herbarium sheets are basically pressings of the flower specimens. We can do this by using absorbent paper with tooth or weave in the texture. Heavy kitchen paper will work well. Do not use smooth photocopier paper as this will stick to your plant specimen. The open weave in absorbent paper (like a kitchen towel) will draw moisture out of the plant, yet leave open spaces so the specimen doesn't become stuck to the paper.





Brainstorm

Herbarium Sheet Instructions

Activity: Choose a sample that exhibits as many features of the plant as possible, as this is used for species identification. Leave on the stalks to show position, flowers and buds. Heavy things like nuts are stored in a little paper envelope next to the pressing. Juicy fruits such as mulberries should be avoided as the juice will lead to mould in your pressing.

If you are only pressing one sample, you can use the pages of a very heavy book. If you are doing multiple samples start with a piece of cardboard from a box, layer multiple pieces of newspaper on this for padding.

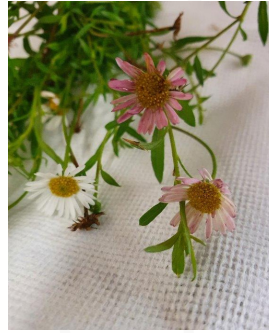
Next, lay your kitchen towel on the stack arrange your specimen so that the leaves are lying in a visible way, lay the flower open so you can see the inner petals and stamens if possible. Arrange all the parts so they are next to each other and easily visible.

Place another piece of kitchen towel on the top and add more newspaper, another piece of kitchen paper and your next specimen and so on until you are finished.

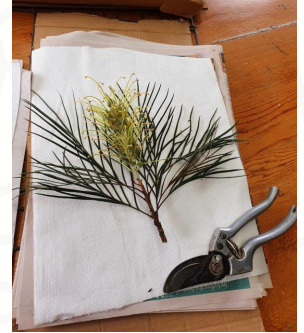
Top the pile off with another piece of cardboard and a piece of wood if you have one. Place a lot of weight on top and try to spread this evenly. Leave your press in a cool dry place for a few weeks, the longer you can leave it the better.

When your sample is dry and pressed, carefully open your press. Ease the samples from the kitchen towel carefully. You may need to use something like the tip of a skewer to tease them off without damaging them.

1



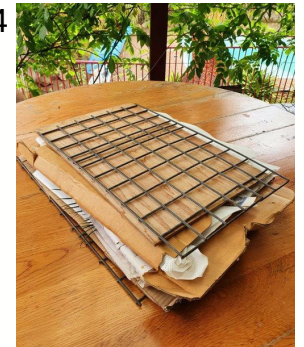
2



3



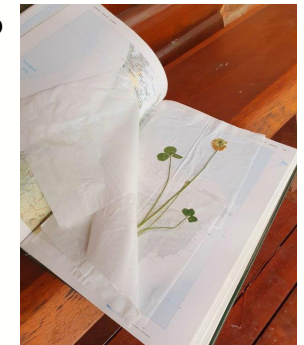
4



5



6



7



Lay your specimen in an orientation similar to how it grows in life. This is referred to as its "habit". Using a needle and thread stitch the specimen to the paper in positions that will stop the plant from moving. Tie off the thread at the back. This should make your specimen look nice and neat from the front. Fill in your herbarium label and place it in the lower-left corner of your herbarium sheet.



Be Creative - Unleash Your Creativity

Extension Activity: Plants grow in many different ways in all climates on Earth and have many different life strategies (ways to survive). If we were to be able to grow plants in space. What would some of the different forces and processes do to their growth. Would it affect orientation, size, adaptation?

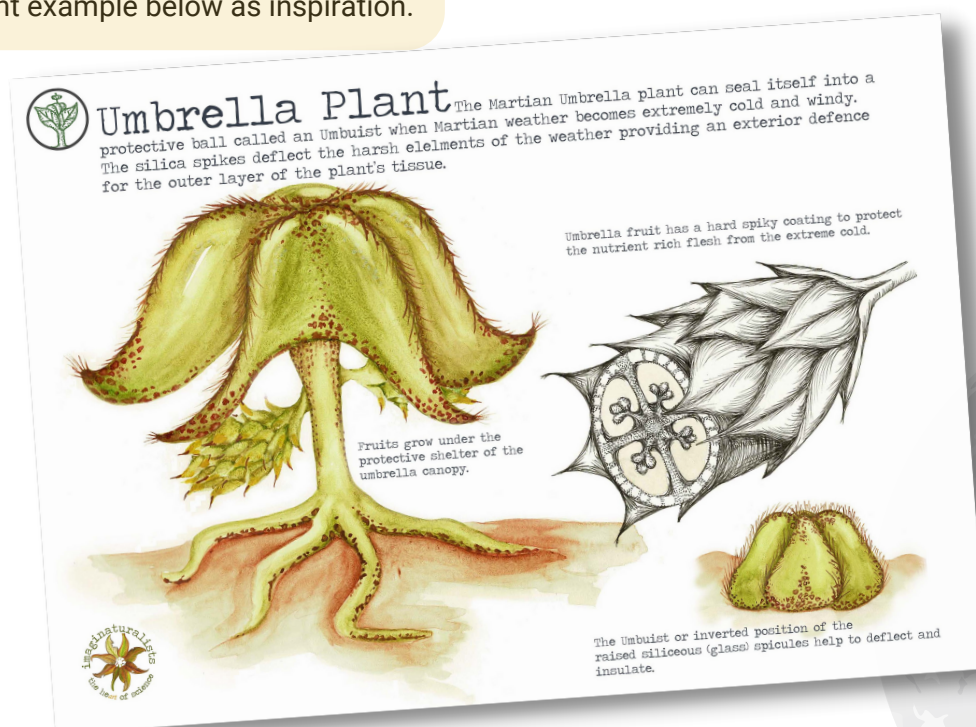
How would plants change in zero and microgravity environments? What if we could grow plants on the moon or Mars. How would the plants adapt to the pressures of these environments? Think about the things that plants in space would have to cope with to survive.

Activity: In the space provided on the next page, create an imaginative new plant species for either the environment of the Moon, Mars or on an orbiting space station. What features would it have? Use our mars umbrella plant example below as inspiration.

List of Conditions

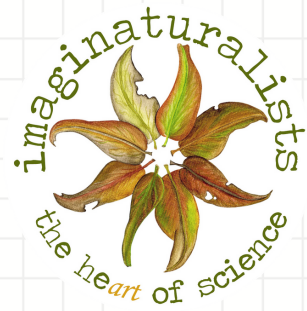
Activity:

Write a list of conditions that plants might need to be able to survive in space. How would they do this?





Design



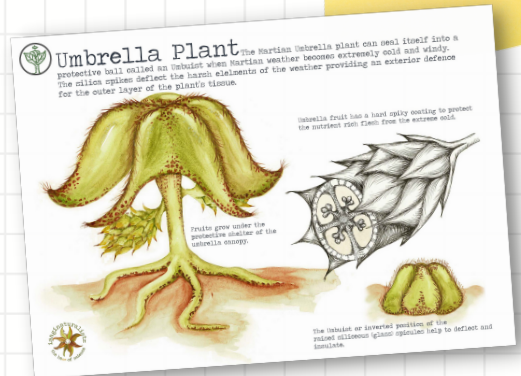
Be Creative - Unleash Your Creativity

Use your sketching skills to "Nut out" your ideas with quick rapid pencils line sketches. When you have worked out its features add shading and colour to communicate the properties your new plant has and how it would survive in its environment.

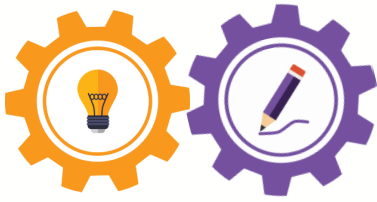
Annotate your design using notes with arrows. Explain the highlights of your design.

Identify the different features of your design.

Visit <https://imaginaturlists.com.au/> for more ideas



New Plant Species for Space



Brainstorm & Design

Let's get creative!

Mission Patches:

A mission patch is a cloth reproduction of a spaceflight mission emblem worn by astronauts and other personnel affiliated with that mission. It is usually executed as an embroidered patch. The term space patch is mostly applied to an emblem designed for a crewed space mission. Traditionally, the patch is worn on the space suit that astronauts and cosmonauts wear when launched into space. Mission patches have been adopted by the crew and personnel of many other space ventures, public and private.

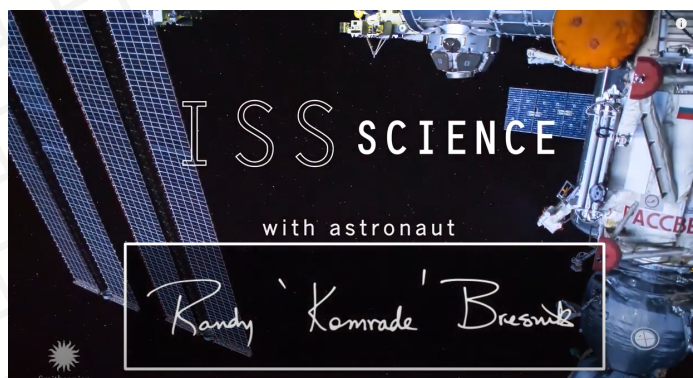


Now you have created your teams, selected a mission, and developed your drawing/sketching skills, it is time to design a mission patch.



Learn More!

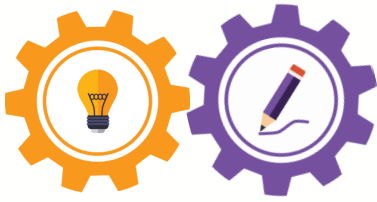
What's the meaning of the patches that astronauts wear? Astronaut Randy Bresnik has the answer. Also check out this [ISS Science lesson](#) for how to make your very own mission patch.



Mission-Patch.Com

You will find online software to help make your own mission patches. Mission-Patch.com is one online site that you could use to get some ideas. <https://mission-patch.com/design>



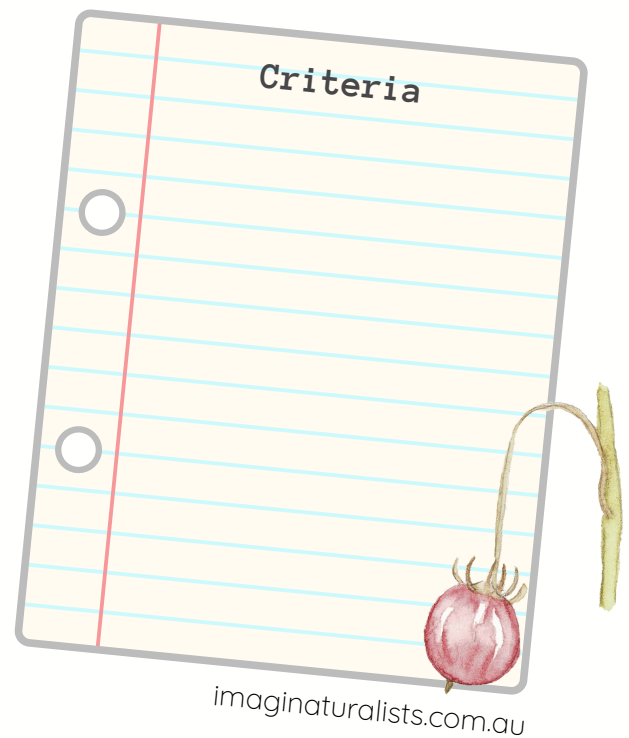


Brainstorm & Design

Let's get creative!

Brainstorming Activity: Practice being creative. List the type of things that should appear on your teams mission patch. Watch s ISS Science lesson on the previous page for inspiration. On the note pad to the right list all the different criteria that should be covered in designing your mission patch.

Activity: the In the circles below, design your very own mission patch. Come up with at least six different designs.



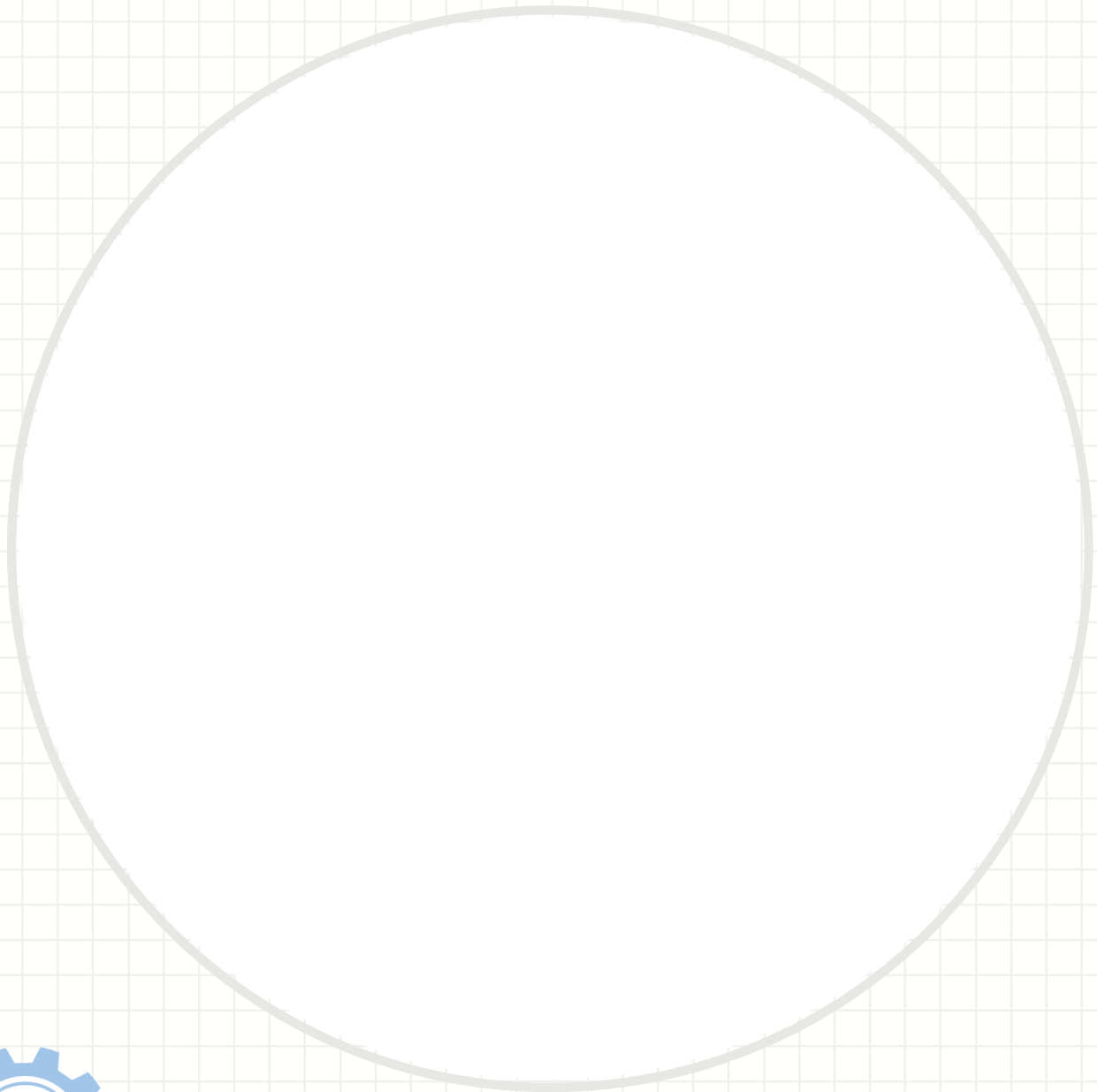
Evaluate

Evaluate each of the designs using a 1 - 10 scale based on how well it meets the criteria you set above. Select your favourite design and use the space on the next page to draw your final design.



Design

Final Patch Design



Evaluate

In the space below, evaluate your mission patch. Tell us why you think this one is the best design.



Brainstorm

There's no innovation without experimentation

Experimentation helps us to make more informed decisions about our ideas and projects. A common mistake is that people take their idea and run with it without testing the assumptions behind the concept.

Below is an example of an experiment that Design Nuts have developed to determine the centre of pressure and centre of mass in a rocket. Use this as a template/example to design **your own** experiment, to test your assumptions.

Experiment. Rocket Science!!

Aim:

To understand how changing the distance between the Centre of Mass (CM) and the Centre of Pressure (CP) affects the stability of a rocket during flight.

Method:

Construct and test a model rocket. Find a short cardboard tube. Attach a paper nosecone at one end and paper fins at the other. Tie a 1m length of string around the rocket body, then swing the rocket in a flat circle above your head. Observe the rocket to see whether it tumbles in the air or if it remains stable.

Test 1:

Mark the positions of CM & CP on the rocket body. Test for flight stability, then record results in 'Test 1' below.

Test 2:

Add a small amount of nose ballast. Find and mark the new CM using the string balance. Test fly. Add results under 'Test 2'

Test 3:

Remove the nose ballast and slide the fins as far down as you can. Find and mark the new CP, new CM, and test fly.

Test 4:

Make fins that are double the size. Find new CP then retest.

Conclusion:

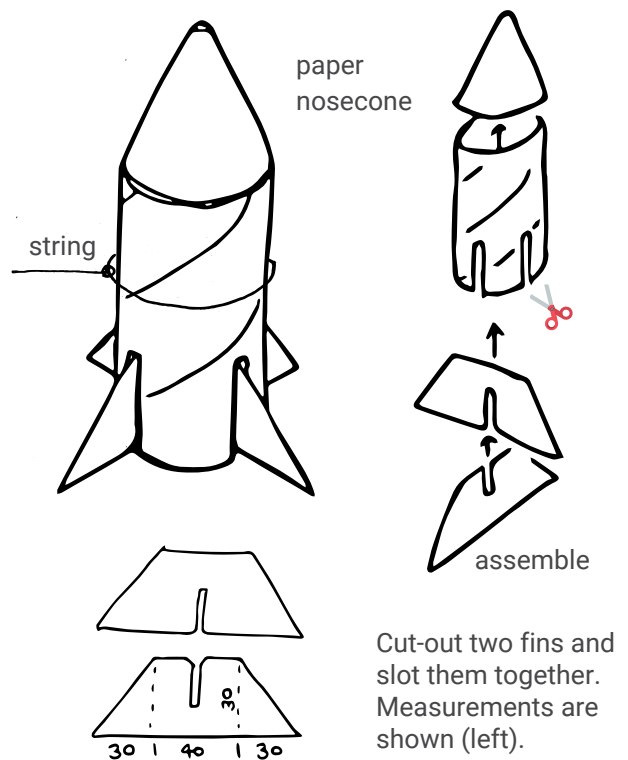
What have you learned? Write a conclusion in your own words (remember the aim of the experiment).

[Video of this experiment](#)



Extension Activity:

Follow the plans below to construct a simple rocket. Complete the experiment described in the video.



Test 1

Distance between the CM and CP
----- mm
stable/unstable flight

Test 2

Distance between the CM and CP
----- mm
stable/unstable flight

Test 3

Distance between the CM and CP
----- mm
stable/unstable flight

Test 4

Distance between the CM and CP
----- mm
stable/unstable flight



Brainstorm

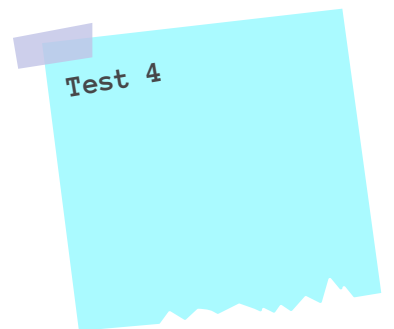
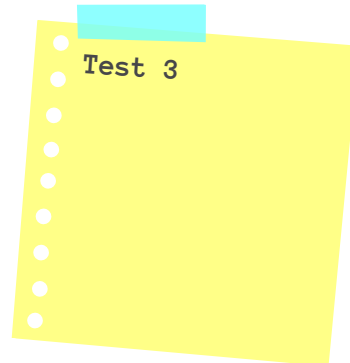
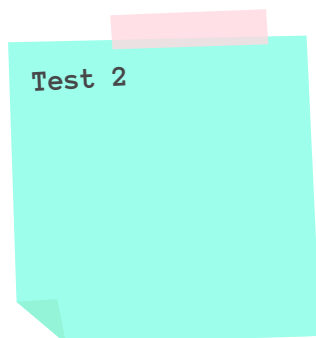
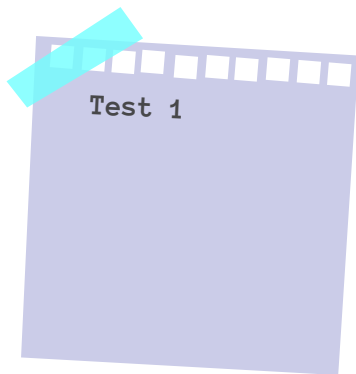
Experiment. In the space below design your own experiment to test one of your assumptions.

Aim:

Method:

Test :

Results



Conclusion:



Train Like an Astronaut

Let's get active!

Your Mission: Peake Liftoff!

You will perform an activity that is designed to promote a combination of muscular strength, agility, coordination and endurance. This activity blends together squats, pushups, and jumping in the air, so get ready for Peake Liftoff!

Being physically active is an important way to keep your muscles strong and your heart and lungs healthy. To produce the complex motions we need in life, it is important to work many muscles together. As you move during the day, such as to and from class at school, your muscles, heart, and lungs benefit. They get stronger by being worked for long periods of time. Many movements also require a coordinated effort between the brain and different muscles to perform complex actions. Muscle flexibility can help reduce risk of injury and activities from jumping can help strengthen bones. Put it all together in a Peake Liftoff!!!

MISSION QUESTION: How could you perform a series of physical activities that would improve your lungs and heart, and increase muscular coordination and endurance?

Mission Assignment: Full Body Training

- Move more than an arms-length away from others to make a safe Touchdown and Liftoff area
- Start in the standing position
- Drop to a squatting position, with your hands touching the floor in front of you, and yell "5"
- Move your feet behind you, to the beginning of a pushup position, and yell "4"
- **Once in the pushup position, pay attention to your form and keep your back straight** • Lower your chest to the floor and yell "3"
- Raise your chest back to the beginning push up position and yell "2"
- Slide your feet back under you to a squat with your hands touching the floor and yell "1"
- Jump high in the air and yell "LIFTOFF!" • Repeat 10 times, maintaining proper form



Building muscular endurance and coordination is an important foundation to making complex motions. Performing a series of physical motions over time increases heart and lung health while allowing you to increase your ability to move yourself and other objects without experiencing exhaustion.



<https://trainlikeanastronaut.org/>



Train Like an Astronaut

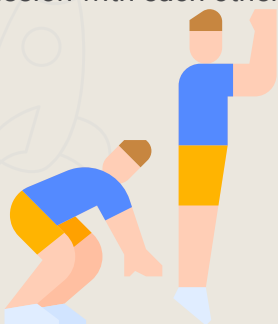
Let's get active!

Strength Training:

Physical activities which use resistance to increase muscle and bone strength, and help improve overall health and fitness.

Crew (crew members):

People working together on a common activity or for a common purpose; a term for astronauts who share their mission with each other.



Repetition:

A motion (such as a bodyweight squat or a push-up) that is repeated and usually counted.

Resistance: An opposing force (through gravity, weight, including your own bodyweight or equipment).

By doing exercises that use your own body weight, you can increase the strength of your muscles and bones. Lack of physical activity can increase the chances of injury because your muscles and bones may be weak. Even easy physical tasks might seem hard!

It's a Space fact:

There are many reasons astronauts must have strong muscles and bones. In a reduced gravity environment, muscles and bones can become weak, so astronauts must engage in strength training to counter the weakening effect of zero gravity. Also, when working on the ISS and exploring in space, astronauts have to be fit to perform spacewalks or move objects that are hundreds of kilograms! How do they do all of that? Before, during, and after living in space astronauts work closely with exercise specialists to train hard and keep their muscles and bones strong for exploration missions and discovery activities. Activities that exercise the whole body are important to prepare for the challenges involved with living and working in space.

Fitness Accelerations:

- Do five burpees and for the last burpee, do a "tuck jump." Instead of jumping straight up into the air on "LIFTOFF!" tuck your knees into your chest as you jump up. Complete three sets of five burpees with a tuck jump, rest for twenty seconds between each set.
- For this one you will need more space, so make sure you are in a wide open area, like your backyard or the school gym with your classmate or friend at least ten feet away from you. You will do one set of eight burpees, adding a lateral (sideways) jump at the end. Like the tuck jump, instead of jumping straight up into the air, you will do a different jump, called a lateral jump. When you jump and "LIFTOFF!" from the ground, jump to the side.

Think Safety:

- Astronauts carefully practice proper strength training on Earth so they can safely strength train in space.
- Make sure there is plenty of room around you to avoid hitting your crewmates during liftoff!
- It is important to do these activities slowly and correctly to avoid injury.
- Remember that drinking plenty of water is important before, during, and after physical activities

Mission Assignment: Full Body Training

- Count how many burpees you can properly do in 30 seconds.
- Teach someone else how to do a burpee.
- Jump as high as you can during the burpee and land softly, trying to make little noise as you land.
- Learn how to say, "5, 4, 3, 2, 1 Liftoff!" using another language and perform it together with others.yell