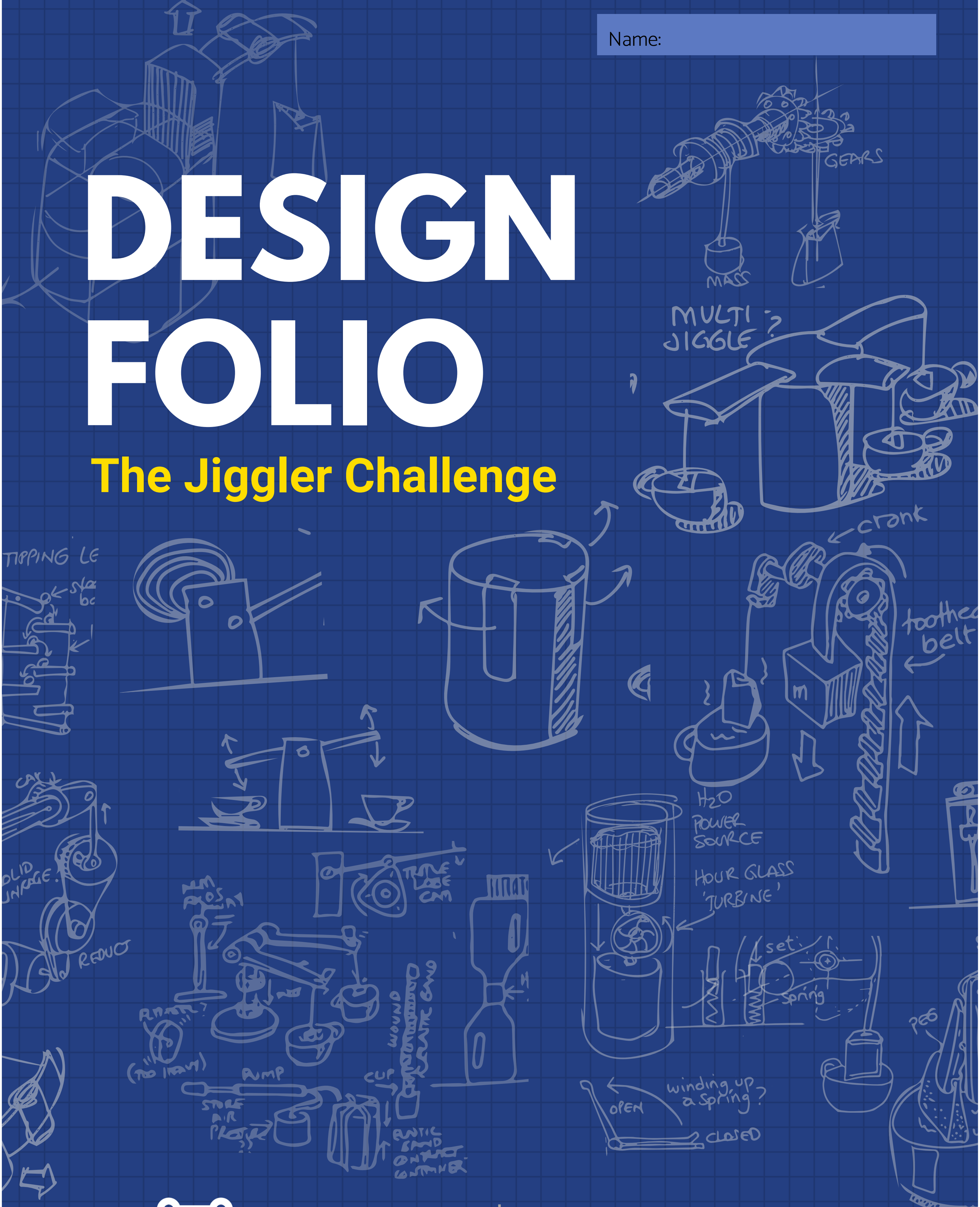
Name:

DESIGN FOLIO

The Jiggler Challenge



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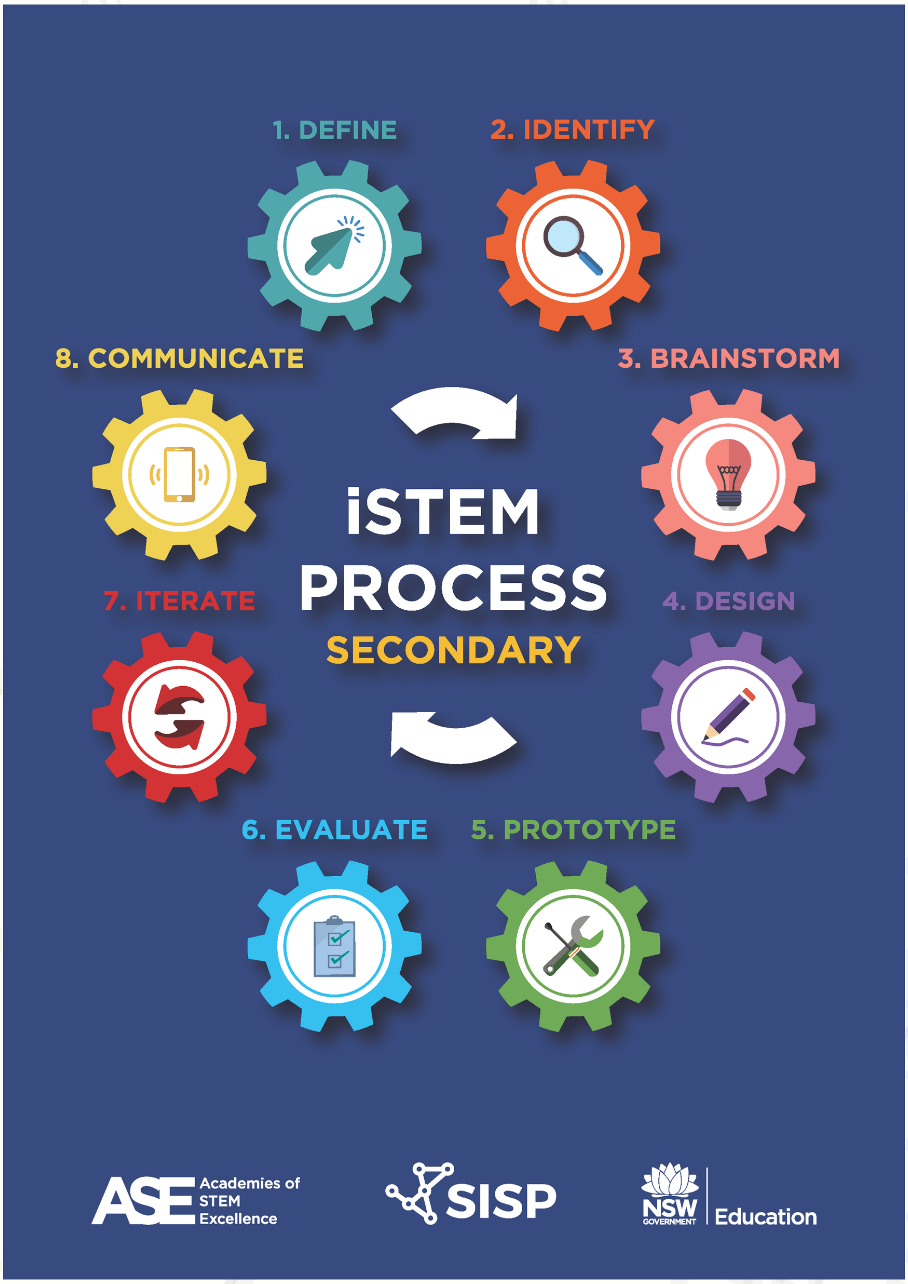
Aug 2020

The Engineering Design Process

The iSTEM Process has been developed by the Cessnock Academy of STEM Excellence which is part of the STEM Industry School Partnerships program. It is a series of steps to guide students through the engineering design process. This eight step design process is for use in secondary schools, which is an extension to the primary school versions, developed for Stages 1, 2 and 3, which are available at the iTeachSTEM website (NSW DoE). Instructional videos and materials that support this folio are available by clicking on the link where you see the camera symbol, or visit www.iteachstem.com.au.

This design folio is free for use in schools.



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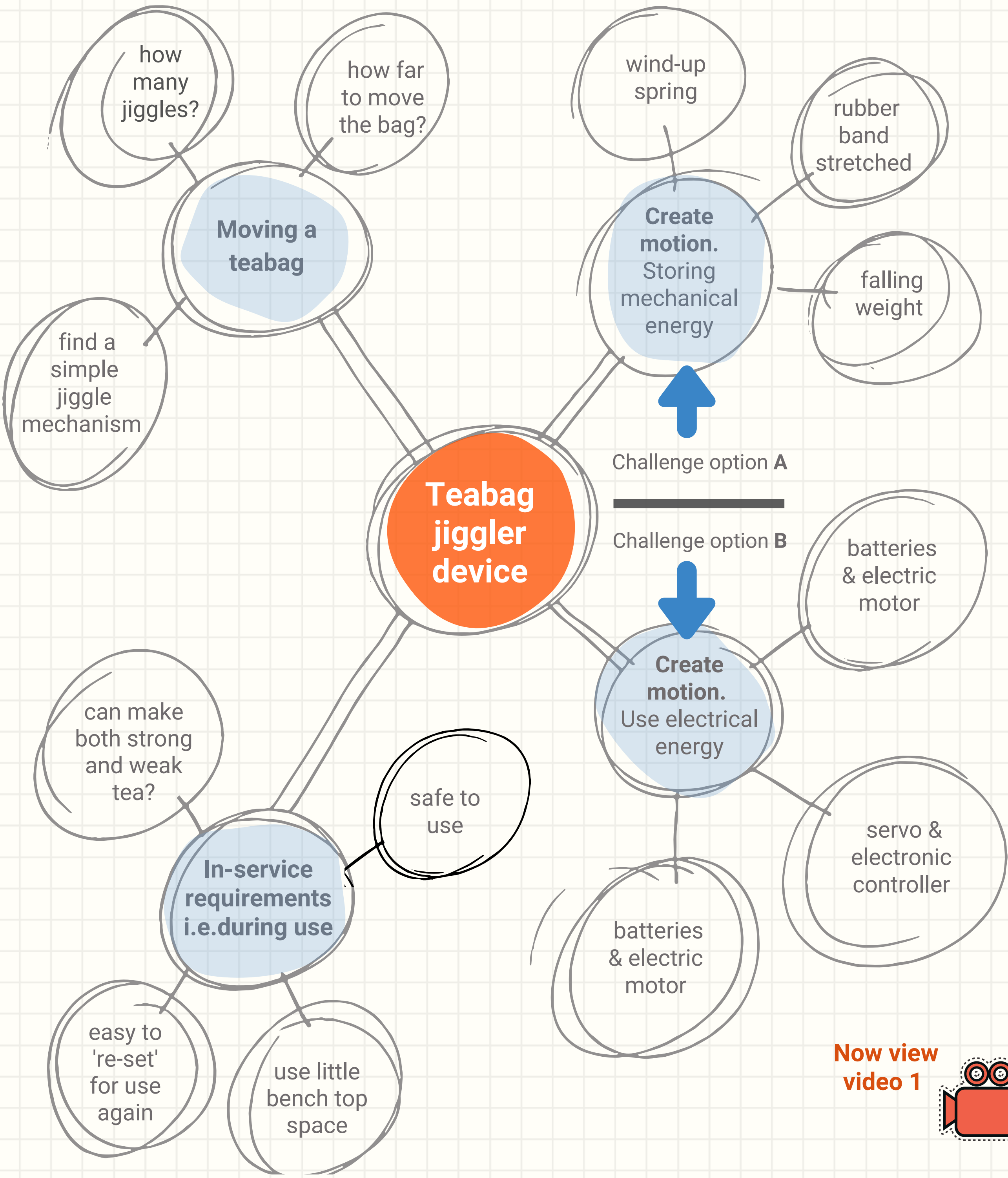
1. Define the problem

A clear statement describing the problem or challenge to be solved.
Example: Design and build a self powered device which will jiggle a teabag in a cup of tea.

After investigating a problem, you often find there's more to the problem than you thought. A mind-map helps to define the problem. The diagram below splits the challenge into smaller challenges. This often helps to 'get to know' a problem.

Always speak to people who will use your solution. To spark ideas, research other designs and try to understand their mechanisms. A series of five videos will help guide you through this project. For more information visit iTeachSTEM.com.au



Now view video 1

Can you name the four types of motion?

________________ ________________ ________________ ________________

Motion. Choose how you would like your teabag to move or 'jiggle'. Sketch and describe below.

Activity: Research possible *mechanisms* for creating the motion which you described above.
'A mechanism is a system of parts that work together in a machine'.

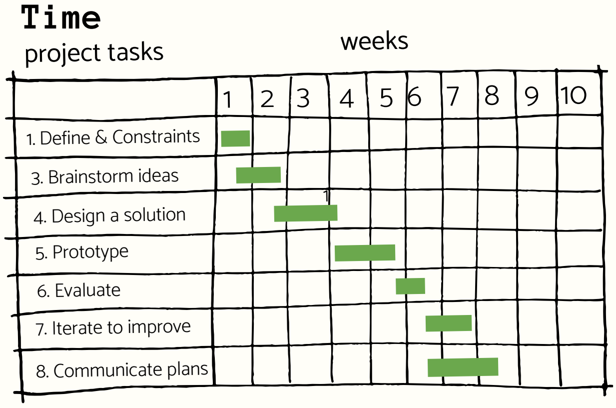
Create motion from energy.

Every machine requires energy to work. Sketch three possible ideas on how your device could store energy. How is this energy transformed into movement?

2. Identify constraints

A constraint is a limitation that must be satisfied by a design, e.g. time, materials or cost.

Time



A Gantt chart is commonly used by industry as a tool in project planning. In the project shown (left) 'Iterate' and 'Communicate' are scheduled for the same week. Why might that be?

Task: Find out how many weeks it takes a builder to have an average house designed, constructed and inspected.

Activity

Try scheduling your own project in this blank Gantt chart (right) . Your teacher will specify a project completion date. You may also be given a date for 'deliverables'. It could be that you report on your progress at agreed 'milestones'.

project tasks	week numbers 1	2	3	4	5	6	7	8	9	10
1. Define & Constraints										
3. Brainstorm ideas										
4. Design a solution										
5. Prototype										
6. Evaluate/test										
7. Iterate & improve										
8. Communicate plans										

Identify materials

The available materials is a constraint to work within. Identify (name) the materials that you have access to. Add to this list as the project goes forward. Consider the following:

- How to store energy.
- Mechanism for motion of the teabag.
- A structure to hold it all together.
- Method of fastening parts together.

Materials

Design Brief:

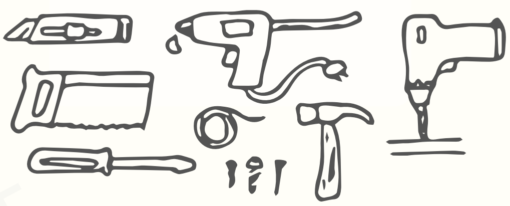
A 'brief' is what designers e.g. architects, interior designers and product designers write down to show they understand a project. It states the purpose of the design and how success will be measured, i.e. visually appealing to a particular group of people, sales numbers, easy to use, etc. Note here whether you decided to accept challenge 'A', or challenge 'B' for this project.

Criteria:

Criteria are the attributes of a design and that can be actually measured (numbers/data). Engineering projects tend to focus more on criteria. List some criterion for your project.

Now is a good time to find out which tools and equipment you will have access to.

Will you need training before using some machinery?



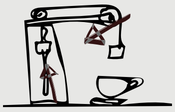
Think about safety. Identify the hazards and write down your top safety tips.

3. Brainstorm
multiple solutions

List or sketch *lots* of ideas. This will encourage creative thinking.

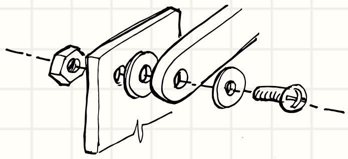
Activity: Fill two pages with thumbnail sketches. Draw parts individually, or as an 'assembly'.

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



Now view video 2

Thumbnail sketches continued.



An exploded view is a great way to imagine how parts will assemble or fit together.

4. Design
the most promising solution

Design drawings show the shape, material and size of all physical components.

Activity: Sketch orthogonal views of the design you want to make.
Draw to a scale if you can. i.e 1:2 (half size) or 1:4 (quarter size).

Now view the first part of video 3

Top view

Side view

Front view

Activity: Make an isometric drawing/sketch of your design. Annotate your work.

For a tutorial on how to sketch an isometric drawing go to www.iteachstem.com.au (e.g. Stage 6 resources, Technical Drawing, P1) or Youtube ,'Drawing with Mr Lawrence how to draw cube shapes'.
Also see YouTube Splat3D if you own a Splat drawing tool. Draw on a separate sheet if you wish.

5. Prototype your solution

A prototype is where you construct a working example of your design.

Activity: Attach some photographs of your prototype to this page and, if possible, a link to a video of your prototype in action.

Activity: Alternatively, outline the steps in construction of your prototype.
Describe at least two ways you overcame obstacles during the construction.

Unlike a static model, a prototype is for testing whether the design will work as expected. Usually new insights are gained once the engineers get to experiment with the physical product.

Review the last part of video 3

6. Evaluate
& test your design

Test and evaluate prototypes against the set constraints and criteria.

Testing: The best conditions for testing a new design is under real conditions, i.e. jiggling a teabag in warm water (avoid boiling water). You may choose to film your test as evidence.

PMI is a quick method for evaluating ideas. Write down all the positive points of your design, then all the negative. Note anything interesting, e.g. questions that need to be answered to move forward.

Test results Did you meet your criteria and constraints? e.g.required number of jiggles.

Now view video 4

Plus Write down all the good points of your design e.g. 'aesthetics'

Minus Consider where your design did not perform as well as expected.

Interesting Observations that are neither plus or minus, although worth noting.

7. Iterate
to improve your solution

An iteration is the next or improved version of a design.

Often with school projects, we don't get time to make an improved version/iteration. You may have more time if you are making your design at home. Let's at least consider a second iteration.

Activity: In the boxes below, sketch and explain four possible improvements to your design. Apply what you learnt from testing & evaluating.

Tip: 'Annotate' your work, i.e. use arrows and notes on your sketches. Work like an engineer! Possible areas for improvement may include:

- The mechanism operates more smoothly.
- Easier to use and reset the device.
- Simpler bag attachment method.
- Greater reliability.
- Improved aesthetics.

1

2

3

4

8. Communicate & share with the world

Records of the design are kept, usually as a digital (CAD) file. This information is important for other members of a team who may have to update or modify the design in the future.

Now view video 5

Activity: Attach your final plans after this page. Your teacher may ask you to draw using a scale (e.g. 1:2 or 1:4) or to draw using full scale i.e. actual size. You may need a large sheet of paper, or tape together several sheets of A4 paper.

The Australian standard that engineers follow when creating technical drawings is called AS1100. The final video in a series of supporting videos shows a suggested layout for the Jiggler drawings.

Three orthogonal views of an aircraft component (below) are arranged in what is called '3rd angle dimension'. To view an introduction on how to sketch orthogonal drawings, visit www.iteachstem.com.au (e.g. Stage 6 resources, Technical Drawing, P1)