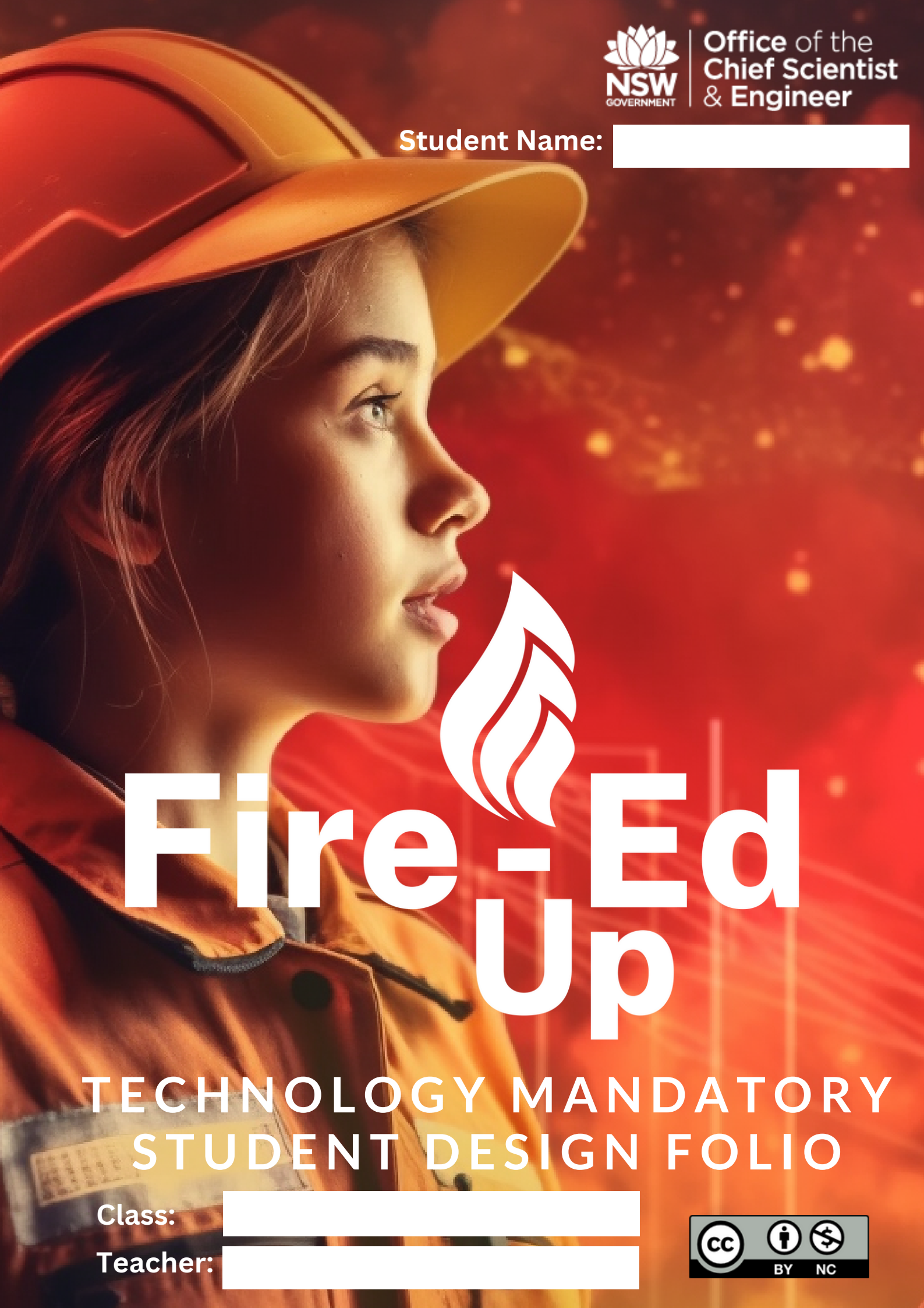


NSW GOVERNMENT | Office of the Chief Scientist & Engineer

Student Name:

Fire-Ed Up

TECHNOLOGY MANDATORY STUDENT DESIGN FOLIO

Class:

Teacher:

Design situation

In 2022 Australia introduced a new fire danger rating system providing clearer and more accurate information to communities at risk of bush fire. The Australian Fire Danger Rating System brings together the latest science and knowledge of fire behaviour, is supported by extensive community research, and is the most significant change to the fire danger rating system in more than 50 years.

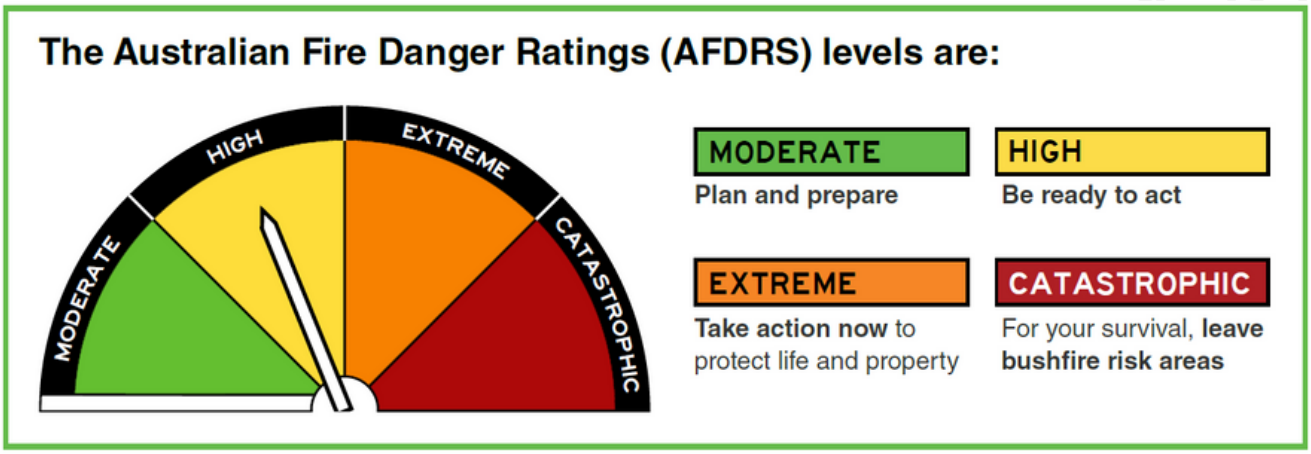
Under the previous system, fire danger ratings were based on only bush and grass based vegetation. The new system uses eight different types of vegetation, which have been mapped across the entire country.

The display of daily ratings has been simplified, four levels of fire danger rating are now used, with simple actions for the community to take at each level.

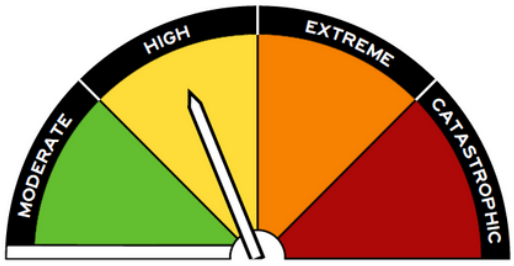
- Moderate (Green) – Plan and prepare
- High (Yellow) – Be ready to act
- Extreme (Orange) – Take action now to protect life and property
- Catastrophic (Red) – For your survival, leave bush fire risk areas

Fire danger ratings are used to communicate the consequences of a fire, if one was to start. On days when there is minimal risk, 'No rating' is used.

The previous fire danger rating system was found to be approximately 40% accurate whilst the new reporting system is now more than 60% accurate, but there is room for improvement.



Design brief



Utilising STEM technologies and local environmental insights to enhance your community's bush fire danger rating system.
Get ready to be tech heroes for your town!

Digital technologies

Gear up to use Raspberry Pi microcomputers to recreate and improve how we predict bushfires with the Australian fire danger rating system. You'll:
1. **Tweak the Code:** Modify existing code to get better at predicting fires using local data.
2. **Tech Exploration**: Discover how satellites and drones can help in bushfire safety.

You'll become mini tech experts, using cool gadgets to make a difference in keeping our community safe from fires!

Deliverables

1. Design folio

Students are to complete a design folio that captures your journey through the iSTEM engineering design process in developing digital solutions related to making the Australian fire danger rating system more accurate. Students have two options:

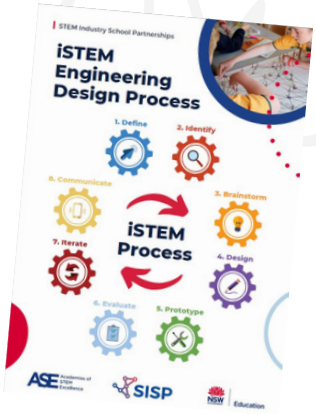
- **Custom folio:** Create your own, focusing on sketches, milestones, and decision-making.
- **Guided template:** Use the worksheets provided in this document for a more structured approach.

2. Prototype design solution

Students are to produce a digital design solution prototype that can be used to improve the accuracy of the Australian fire danger rating system. This could include modifying the Raspberry Pi based Fire-Ed Up kit or may involve the development of new or different technologies.

Fire-Ed Up Defining the Problem!

Design brief statement



An integral part of the iSTEM engineering design process is the definition of a meaningful and actionable, statement. This is one of the most challenging parts of the process, as the definition of a problem also known as the **design brief statement** requires careful consideration.

The **design brief statement** builds upon the design brief given, but is your opportunity to guide you and your team's work and will kickstart the ideation process. The statement should be specific to the problem that you wish to solve based on the given design brief.

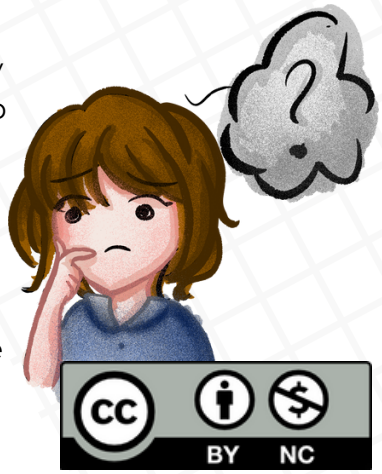
A design brief statement should have the following traits. It should be:

- **Human-centred.** This requires you to frame your design brief statement according to specific users, their needs and the insights. The statement should be about the people the team is trying to assist, rather than focusing on aspects such as; technology, money or product details.

- **Broad enough to be creative.** This means that the design brief statement should not focus too narrowly on a specifics regarding the implementation of the solution.

- **Narrow enough so it can be achieved.** On the other hand, a design brief statement such as, “Stop all wildfires worldwide,” is too broad and will likely cause team members to easily feel daunted. Design brief statements should have sufficient constraints to make the project achievable.

How to produce a design brief statement?

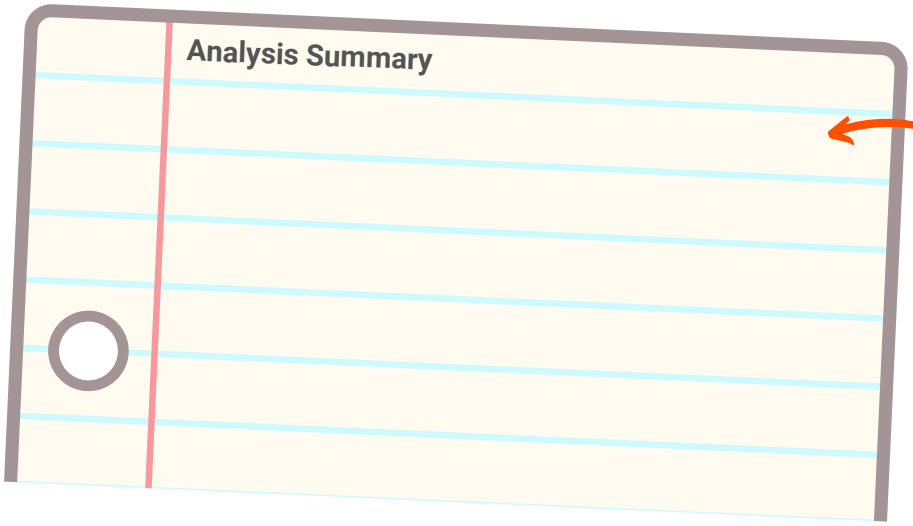


In order to produce a good design brief statement you need to clearly define, 'What is the problem you are going to solve'? In the Fire-Ed Up Mandatory Technology unit you have been given the design brief of ‘enhancing the accuracy of the bush fire danger rating system.’

To effectively define the problem, begin by thoroughly analysing the situation, then identify and evaluate potential issues within that context, and finally, gain a clear understanding of the target audience for your solution.

Fire-EdUp Analysing the problem

Analysing the problem worksheet



Analysis task: Review the design brief and situation to better understand the task. Investigate the fire topic, and consider the users' needs as you prepare to create your design solution. Outline your findings in the space provided.

Constraints

Deliverables task: In the space to the right list any possible constraints your team might have, e.g functional, economic, environmental, social, technical and usability.

Problem solving task: In the boxes below indicate;

- Who is the problem being solved for?
- What are you going to solve? and,
- Why does the problem need to be solved.

Problem Solving

Who	What	Why

Fire-EdUp Research

Exploring information systems in bushfire management

Hey everyone, it's time for a research mission! We're going to investigate two information systems that help in managing bushfires. Specifically, we'll focus on systems related to figuring out the Fire Danger Rating System or its key parts.

Your research task:

- Look for two different information systems e.g. GIS, that are used in bushfire management.
- Dive into how these systems work, meet needs, are innovative and take into account of future risks and sustainability. Find out how they help in giving us the Fire Danger Ratings.

Information system 1: **About**	**Information system 2:** **About**
Findings	**Findings**

Fire-EdUp Brainstorming

Hey Team! We've done some awesome analysis, and now it's time to get our creative hats on. Let's put on our thinking caps and come up with some super ideas for problems we want to tackle. Based on all the awesome work we've already done, it's time to brainstorm.

Space, saturate and group method

Let's get brainstorming!

Alright everyone, it's time to put on your thinking caps and dive into a fun brainstorming adventure. Here's how we're going to do it:

Step 1: Idea time!

- Grab some post-it notes. You can write or draw on them.
- Think of all the problems you want to solve related to bushfire management. Let your imagination go wild!
- You've got 5 to 10 minutes to come up with as many ideas as you can.

Step 2: Make a problem gallery:

- Now, let's cover a wall, desk, or whiteboard with your post-it notes.
- It's like creating an art gallery of bushfire management problems that need solving!

Step 3: Sort it out:

- Time to organise! Group similar ideas together on the post-its.
- This will help us see the main themes and make sense of all our cool ideas.

Step 4: Ranking rally:

- As a team, let's decide which ideas are the most interesting.
- Move the top ideas to the top of our board. Remember, every idea is important, so let's be respectful.

Fire-EdUp Synthesize

Let's pick our top ideas!

Hey team! After our super fun brainstorming, it's time to choose our four favourite ideas. But remember, we're looking at problems we want to solve, not the solutions just yet.

Choose the best four:

- Look at all the ideas we came up with, as a team, pick the top four problems that really stand out to us.
- For each problem, let's write down what's good about it (Pros) and what might be tricky (Cons).

Idea 1:

Idea 2:

Pros	Cons

Pros	Cons

Fire-EdUp Synthesize

Idea 3:

Idea 4:

Pros	Cons

Pros	Cons

Fire-EdUp Synthesize

Choosing Our #1 Fire-Ed Up Mission Idea!

Hey team! Remember those top four problems we thought about solving for our Fire-Ed Up project? Well, it's time to pick the one we're going to tackle!

Here's What to Do:
1. Think About Our Options:
- Look back at the four problems we thought were really cool.

2. Make the Big Choice:
- Decide which one we're super excited to solve. It could be one we already talked about, or maybe we mix a couple of them together to make an even better challenge!

3. Write It Down:
- In the space below, let's write down the problem we're going to solve. This is our mission!

Why It's Exciting:

- Choosing our own problem to solve makes this project really yours. It's like being the captain of our own adventure!

Ready to make our decision and dive into solving it? Let's go!

Fire-Ed Up Mission Problem - Description

Fire-EdUp Empathy mapping

Let's make an empathy map!
Alright, team! We've picked a great problem to solve. Now, let's understand who we're solving it for, with something called an empathy map.

What's an empathy map?

- **It's like a user's guide:** An empathy map is like a map that shows us what someone might think, do, say, and feel. It's a way to step into their shoes.

Empathy mapping adventure:

1. **Who are we helping?**
   - Think of the person you're solving the problem for, like a family living in a bushfire area. They're at the centre of our map.
   - Maybe have a friend or team member pretend to be them for fun!

2. Be a detective:

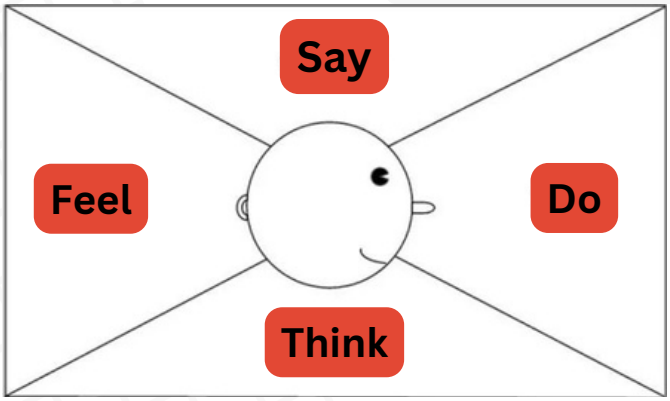
- Watch what they do and ask them questions.
- Use post-it notes to jot down notes or draw pictures.

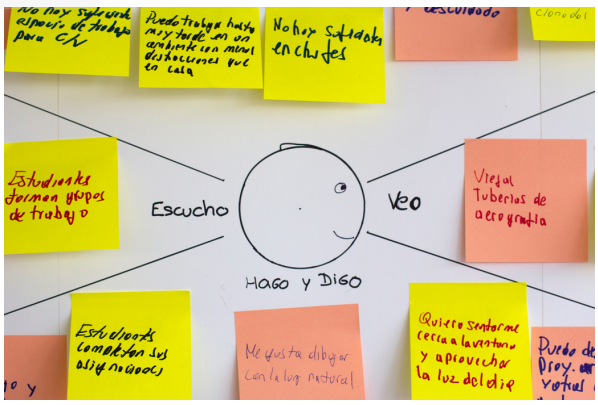
3. Set up your map:

- Find a wall or whiteboard, or just draw a big picture with the four parts: Say, Do, Think, and Feel.

4. Fill in the quadrants:

- **What did they SAY?** Write down their exact words or key phrases.
- **What did they DO?** Note their actions, or draw them.
- **What might they THINK?** Guess their thoughts, like their goals or wishes.
- **How did they FEEL?** Think about their emotions from how they act or speak.





Fire-EdUp Empathy map

Say

Feel

Do

Think

Fire-EdUp Design brief statement

By now you have done the following tasks;

- Identified who is the problem being solved for, what is being solved and why.
- Brainstormed and determined the problem that you wish to solve
- Completed an empathy map to better understand the needs of the end user.

You are now going to produce a **design brief statement** that will guide you and your team's work based on the research and analysis that you have undertaken.

Design Brief Statement

Task: In the space provided write your design brief statement which is human centred, not to broad, but is also narrow enough to be achieved.

Sample design brief statements

- **Team X:** The issue we aim to address is the need for more accurate determination of the Fire Behaviour Index in our area, by developing an automated satellite-based system capable of precisely identifying various types of local vegetation.

- **Team Y:** The challenge is to enhance the precision of the local Fire Danger Rating System through a new field experiment that incorporates real-time environmental data and community insights, aiming for more accurate and reliable fire risk assessments.

- **Team Z:** We are addressing the need for a real-time, comprehensive fire danger indication by designing a digital sign that simultaneously presents the Fire Behaviour Index (FBI) and the current fire danger rating, improving community safety and awareness of bushfires.

Identify the constraints

What's a Design Constraint? Let's Learn with Nick De Leon!
Hey everyone, let's talk about something called a design constraint. Think of it like a rule or a limit that shapes how we create something. Watch video.

Why Constraints Matter:

- Constraints are like the lines in a colouring book – they guide our design, but we get to choose the colours and patterns.
- Some constraints are things we can't change, like the size of a room. Others are rules we make to challenge ourselves, like trying to use recycled materials.

Meet Our Expert: Nick De Leon:

- Nick is a super-smart guy from the Royal College of Art in the UK. He's got a lot of experience in design and technology.
- He started at IBM as a designer and then helped create new businesses.

Learning from Nick:

- Nick says, "Every constraint is a gift." It's like a puzzle that helps us be more creative and innovative.
- He'll teach us how designers look at the world, focusing on the people using what we design and the rules we need to follow.

Types of Constraints in Fire-Ed Up:

Technological Constraints:

- This is about the tech tools we have at our disposal, like whether we're using simple gadgets or high-tech equipment.

Spatial Constraints:

- This deals with the physical space where we're working or the area our project will impact. It's like figuring out how much room we have to set up our experiments or displays.

People Constraints:

- Here, we think about who we're making our project for. It could be our classmates, our community, or even firefighters.

Social Constraints:

- These are about what's important to our community or society, like being environmentally friendly or ensuring our projects help in bushfire safety.

Commercial Constraints:

- This is all about budget – making sure our ideas are awesome but also affordable, so they can be used by as many people as possible.

Understanding these constraints will help us create interesting, practical, and helpful projects in the Fire-Ed Up program. Let's get ready to innovate within these limits!

Fire-Ed Up Identify constraints - Mind maps

Let's Find Out Our Project Limits with a Mind Map!

Alright, team Fire-Ed Up! After we made our design brief, it's time to figure out what limits or 'constraints' we have for our project.

Making a Mind Map:
A mind map is a super fun way to draw out our ideas and see how they connect. It starts with one main idea and grows with lots of branches that have more details.

How to Create Your Mind Map:

Start in the Middle:
- Write "Fire-Ed Up Constraints" in the middle of a big piece of paper, on the sheet on the next page or on a computer screen.
- Circle this as the main idea of our map.

Draw the Big Branches:
- Make lines going out from the middle for big topics like "Time," "Tech," and "What We Need."

Add More Details:
- On each big branch, add smaller branches for specific things, like how long we have to work or what kind of gadgets we can use.

Keep It Simple:
- Use just a few words or small phrases on each branch.

Add Some Doodles:
- If you like, draw little pictures or symbols next to your words.

Change as You Go:
- As we work on our project, we can change our mind map if we find new things or solve some problems.

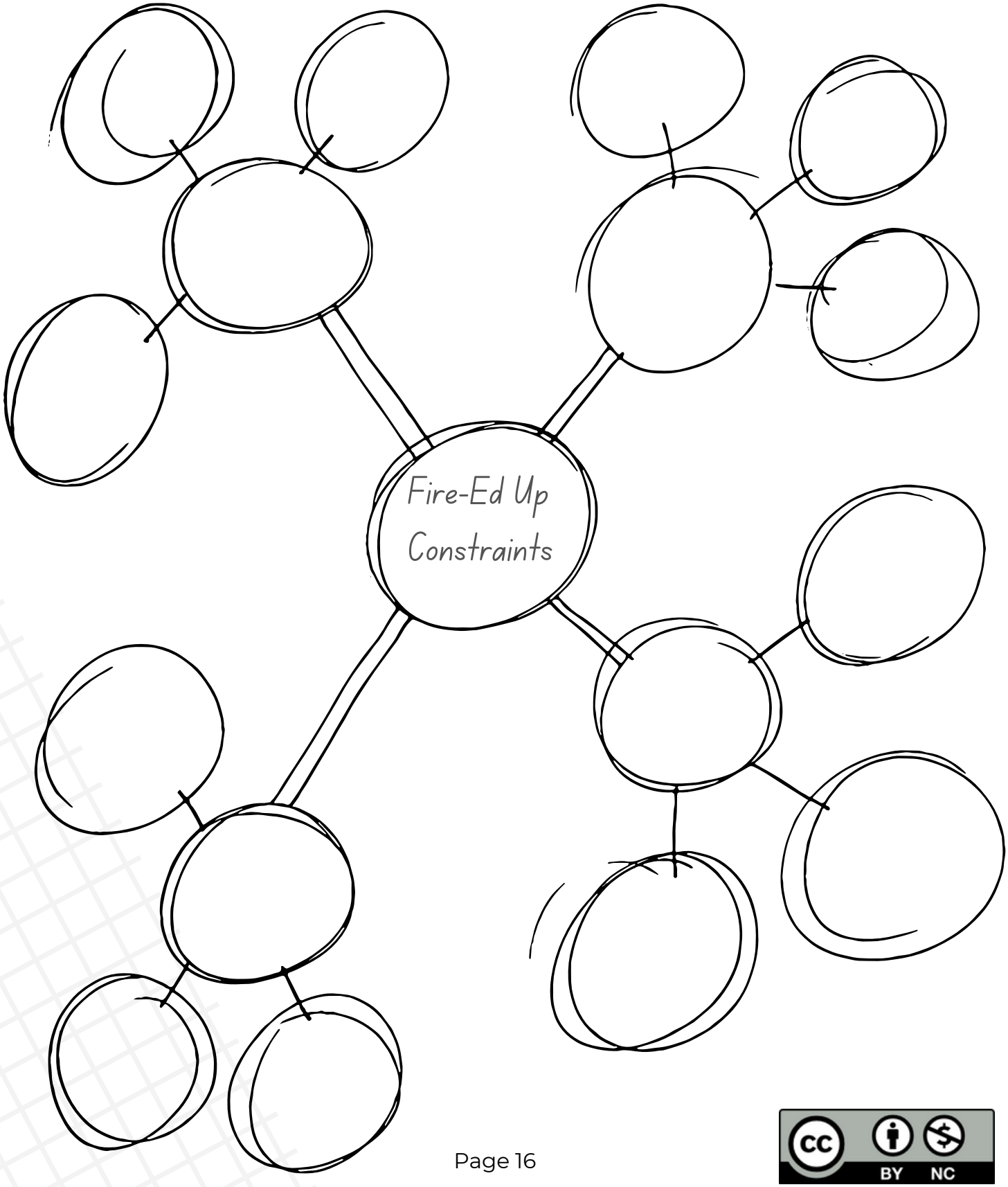
Why Do This?
This helps us see what we need to think about for our project and prepares us for any challenges.

So let's start our mind map and discover all the things that will shape our awesome project. Ready, set, map!

Fire-Ed Up Identify constraints - Mind maps

Clearly identify the constraints of the Fire-Ed Up challenge

Team Fire-Ed Up you can use this model or create your own mind maps on a large piece of paper or a whiteboard.



Fire-Ed Up Identify the constraints

Constraints

Figuring Out Our Project Limits
Hey team, great job brainstorming all those different constraints! Now, let's pick the most important ones and set some limits for our project to make sure we can do it well.
Your Task:
In the spaces provided, write down the constraints we're going to follow.. Here are some ideas to get you started:
When's the Deadline? Like, "We need to finish our project by next Friday."
What About Our Prototype? How about, "We need to create a prototype that can do some things on its own (semi-autonomous)."

Criteria for success

What Makes Our Project Awesome? Let's Decide!
Alright, team, let's think about how we'll know if our project is a big hit. What does a successful design look like? Let's figure it out now.

Your Mission:
In the space provided, write down your 'Criteria for success. Here are some ideas:

Does It Work Well? Like, "Our design should do exactly what we planned it to do."
Is It Cool to Look At? Think about, "Our project should look really neat and grab people's attention."
Are People Happy With It? Ask, "Does our design make things easier or more fun for the people using it?"
How to Check If We Nailed It: Let's also think about how we'll know we've succeeded. Maybe:

- Ask a teacher or an expert what they think of our project.
- Get opinions from our classmates or friends.

Identify the Constraints

Materials

Let's Choose Our Project Materials!
Hey everyone, it's time to think about what stuff we can use to build our project. What materials do we have? Let's make a list!

Your Task:
We're going to write down all the materials we can use for our design. Keep adding to the list as we work on our project. Here's what to think about:

Prototype Stuff:
- What do we need to make a mini version (prototype) of our design? It could be things like cardboard, glue, or small motors.

Materials for the Final Design:
Think about what we'll need for the real deal. Maybe stuff like a Raspberry-Pi, metal pieces, or special sensors.

Tools and equipment

What Tools Do We Need for Our Project?
Alright team, let's figure out what tools, workspaces, and equipment we'll need to make our project awesome!

Your Task:
We're going to make a list of all the things we might need to get our project done.

Think about:

Tools:
- Do we need scissors, glue guns, or maybe some techy stuff?

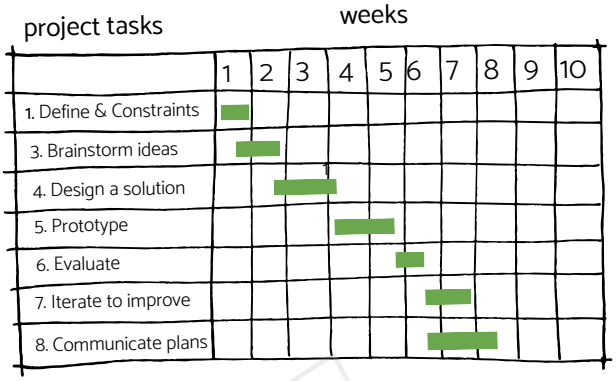
Where to Work:
- Will we work in the classroom, a lab, or somewhere else?

Special Equipment:
- Maybe we need a computer, a camera, or something else to help us out.

Project management

Project Management

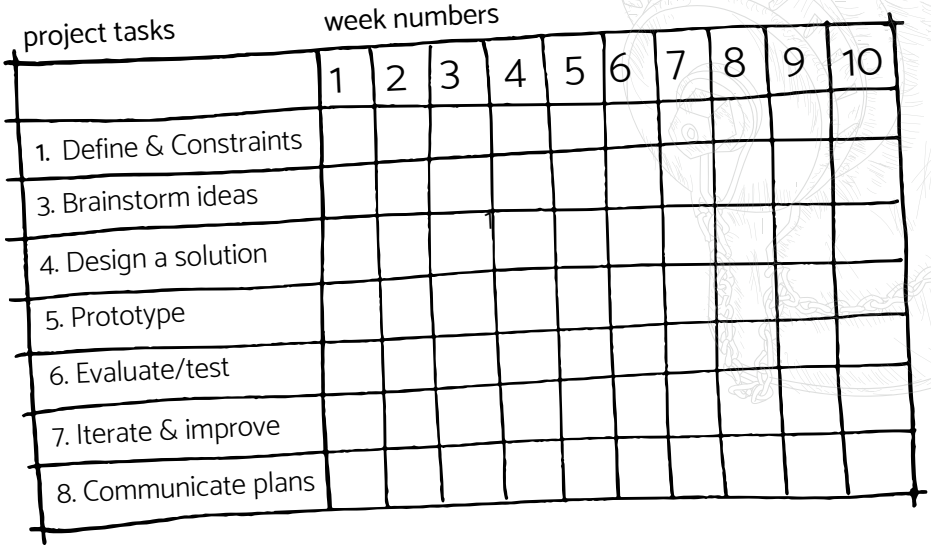
Time Plan



Gannt Chart

A Gannt chart is a visual project management tool that displays the progression of tasks and activities over time. It represents the start and finish dates of individual tasks, their dependencies, and the overall timeline of a project. By showcasing tasks in a chronological sequence against a calendar, Gannt charts help teams understand the relationship between different tasks and track project milestones, making them essential for planning and scheduling projects.

Activity:
Try scheduling your own project in this blank Gantt chart (right) or by using a MS Excel Spreadsheet. 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'.



Action Plan

An action plan is a list of steps you plan to follow to complete a project. This is usually completed in sequential order and details what actions need to be taken to complete the project.

Activity:
Teams complete an action plan for the Fire-Ed Up mission.

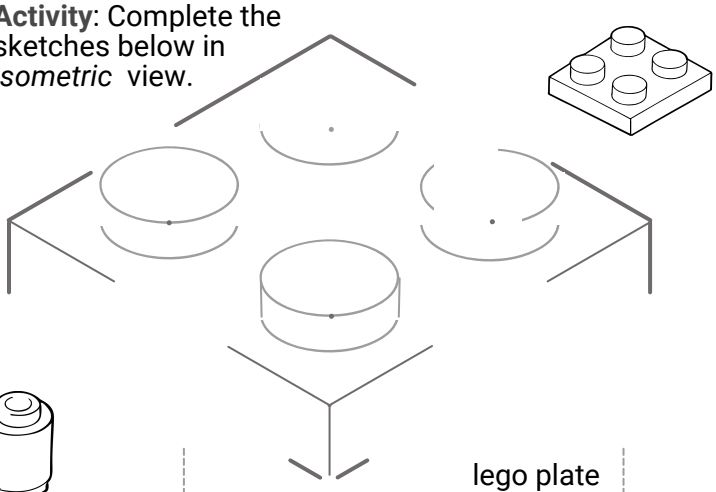
Fire-EdUp Brainstorm

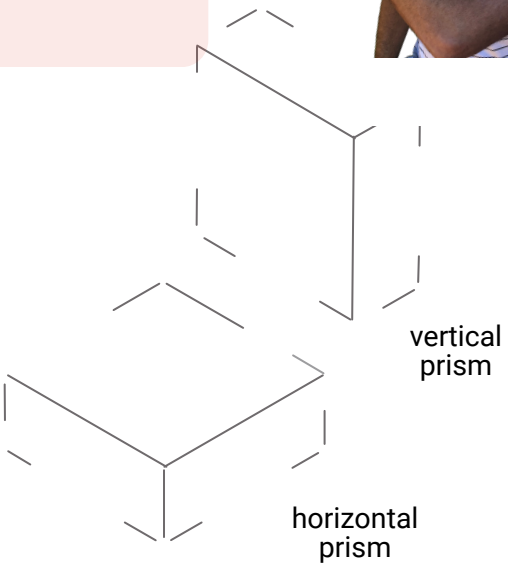
Sketching your ideas in 3D

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 those two objects.

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

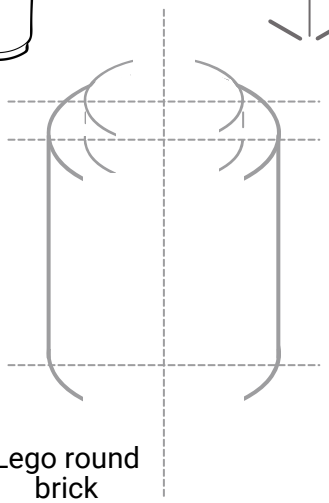
Activity: Complete the sketches below in *isometric* view.





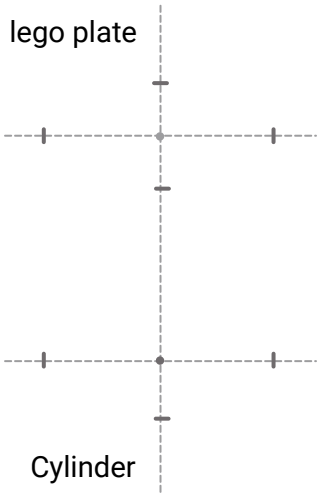
vertical prism

horizontal prism

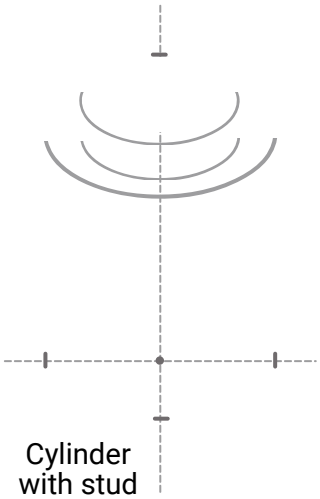


Lego round brick

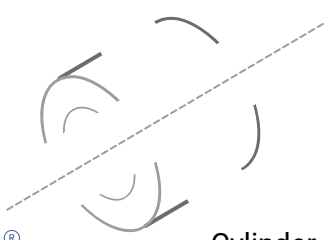
lego plate



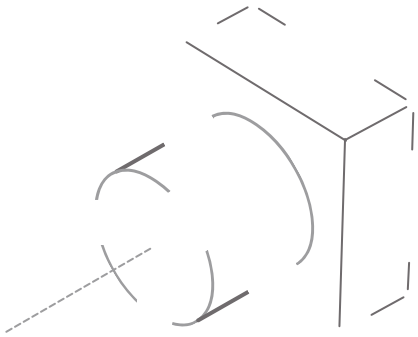
Cylinder



Cylinder with stud



Cylinder with hole



Combine to design !

HOW TO RENDER CYLINDERS

Splat 3D

Brainstorm - Sketching

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 your ideas for a prototype. 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 student with good ideas is simply a person with ***lots*** of ideas!"

Brainstorming

Let's Get Creative with Brainstorming!

Hey everyone, welcome to the super fun world of brainstorming for our Fire-Ed Up project! Brainstorming is all about thinking in cool, unusual ways to solve problems. It's like using our imaginations to the max!

What's Brainstorming All About?

- Think Wild: Brainstorming lets us come up with all sorts of wild and wacky ideas. Sometimes the craziest ideas turn into the best solutions.
- No Idea Too Crazy: Even if an idea sounds totally out there, it might lead to something awesome or give us even more great ideas.
- Get Unstuck: It helps us think in new ways and look at our problem from different angles.

Rules for Brainstorming:

1. No Judging:
- When we're brainstorming, there's no saying 'that's a bad idea'. Every idea is a star in this phase!

2. Be Open:
- It's all about letting our imaginations fly and not worrying about if it's right or wrong.

Why It's Important:

- Brainstorming helps us break free from the usual ways we think and opens up a whole world of creative solutions.

So, let's start brainstorming and see what amazing ideas we come up with for our Fire-Ed Up challenge. Ready, set, brainstorm!

Learn more about brainstorming at https://www.mindtools.com/brainstm.html

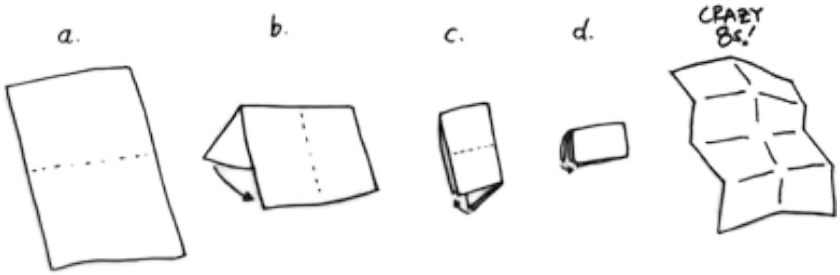
Fire-EdUp Brainstorming

Crazy 8's

Let's Try Crazy 8's: A quick sketch challenge!
Crazy 8's is super fun– it's all about quick drawing and coming up with lots of ideas. Here's how we do it:

Step 1: Paper folding fun:

- Take a piece of A4 paper and fold it in half three times.
- Unfold it, and you'll have 8 equal boxes to work with.



Step 2: Solo brainstorming blitz:

- On your own, sketch a different problem in each box. Add a few words to explain each one.
- You've got 8 minutes to fill all 8 boxes with your ideas.

Step 3: Idea gathering:

- Let's see what everyone's come up with. Group similar problem sketches together.

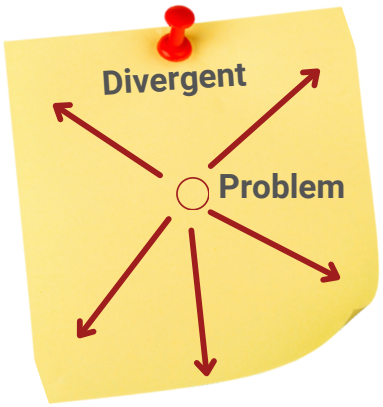
Step 4: Group brainstorming:

- Now that we've seen all the ideas, let's do the sketching again, but this time as a team.
- For a fun twist, in the last two boxes, think like Elon Musk or a NASA scientist. What would they come up with?

Designing

Design thinking include both divergent and convergent thinking techniques. Up until know most of the techniques we have used have been divergent.

Divergent Thinking



Divergent thinking is the process of generating multiple ideas to maximize the range of possible solutions, applications, examples, etc. It is the initial stage of creative problem solving where learners have the space and freedom to explore out-of-the-box ideas, take risks, push beyond obvious answers, probe deeper, and defy some of the conventional boundaries and constraints of a particular discipline. Typically, divergent thinking involves brainstorming, collecting spontaneous and random associations with a given topic, and increasingly expansive ideation.
In the design phase of the engineering design process, we ask students to use convergent thinking techniques.

Convergent Thinking

Convergent thinking usually follows divergent thinking. It is a process in which learners critically sift through the collection of possible solutions by considering realistic limitations and feasibility, comparing positive and negative attributes. Divergent thinking unfolds and broadens; convergent thinking narrows down and focuses, filtering the set of creative options to identify and clarify the next step. The challenge during divergent thinking is pushing through the initial blockers, blinders, and biases, and resisting the natural inclinations to turn toward convergent thinking prematurely.

In the design phase of the engineering design process, we ask students to use convergent thinking techniques.

Activity: Based on the work of Anne Manning from Harvard Professional Development get students to complete the following exercise which demonstrates the concepts of divergent and convergent thinking to inspire new ways to approach problem-solving.

Step 1: Stand up, and stretch your arms into the air for about 30 seconds. (Divergent Thinking)
Step 2: Bend over and touch your toes for about 30 seconds. (Convergent Thinking)

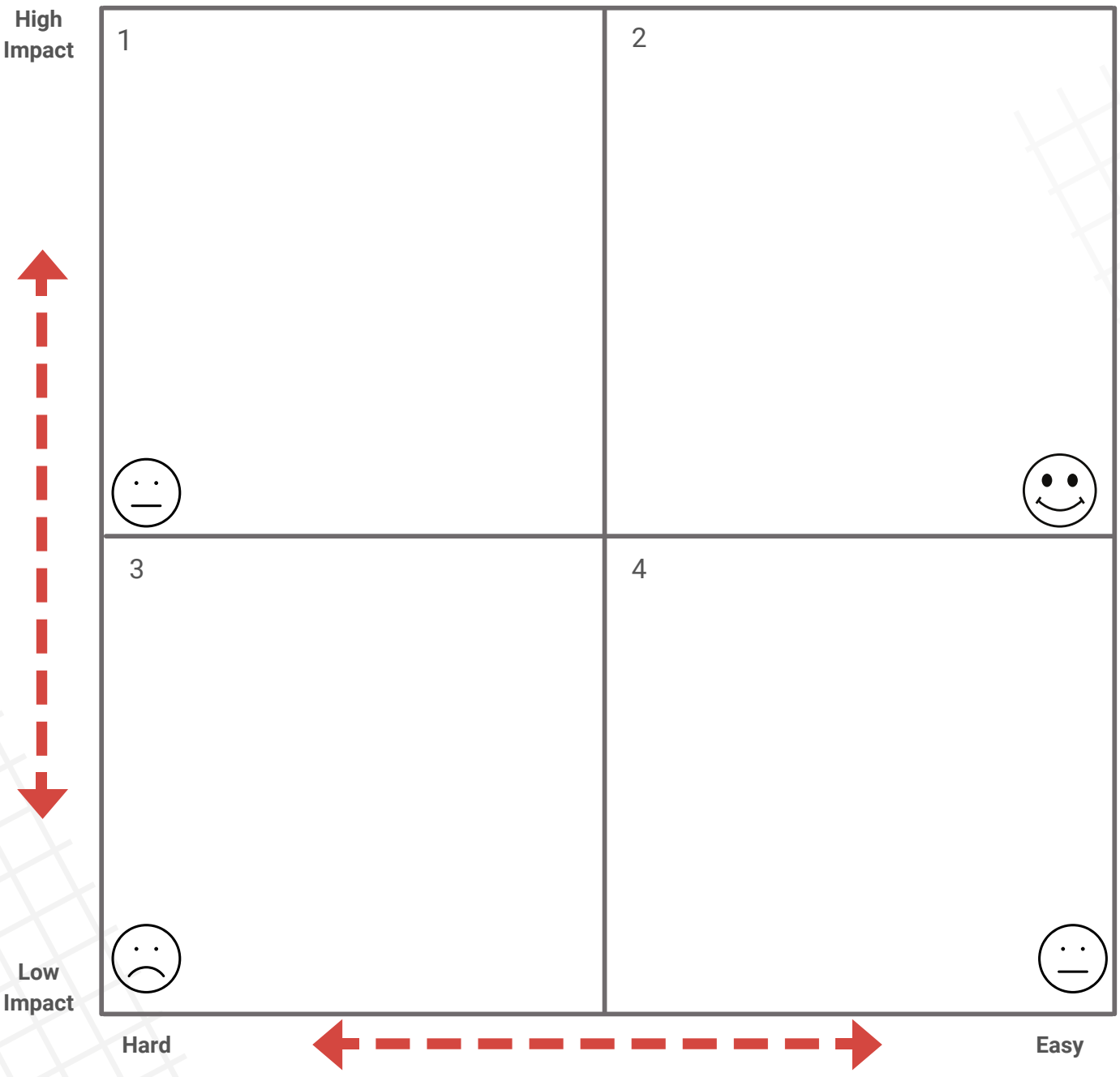
Discussion: Think about how you felt when doing each of the exercises.

Convergent Design

Convergent Thinking Activity 1: Choose six designs from the Crazy 8 brainstorming. Sketch these in the circles provided and annotate around them to describe each design in more detail.

Evaluate

Evaluate - Now evaluate your six best ideas further using the impact/effort matrix below. Add all six ideas and connections into one of the four segments.



What is an Impact Effort Matrix?
An impact effort matrix is a decision-making tool that assists people to manage their time more efficiently. Each potential idea, strategy or project is assessed based on the level of effort required and the potential impact or benefits they will have.

Convergent Design

Convergent Thinking Activity 2: In the circles below, combine the best aspects of your top six designs to produce two new combined design solutions. These should have aspects of two or more ideas. Use the space around the circles to annotate you ideas or make detail sketches.

Final Design Idea

Convergent Thinking Activity 3: Finally, select one the final design solution that you wish to prototype. Ideally, it will combine some of the successful features of the two previous combined design ideas. Sketch your idea in the space provided and use the space around the out side to annotate and provide detail sketches.

In the space provided, tell us why you think this one is the best design.

Design Drawings

Activity: Draw a top view and a either a side or front view of your final design idea.

Sketching a front and top view.

What is Design?
A design is a plan or specification for the construction of an object or system. The result of that plan or specification can be in the form of a prototype, product or process.

The design usually has to satisfy certain goals and constraints, may take into account aesthetic, functional, or economic considerations, and is expected to interact with a certain environment. Major examples of designs include architectural blueprints, engineering drawings, detail drawings, concept drawings as well as sketches, renderings or artist impressions.

Design Drawings
Design drawings are typically aesthetic drawings or renderings that represent possible solutions. Drawings are typically the first step in the design phase.

Design Activities
In some cases, constructing an object first, without plans may also be considered to be a design activity.

TOP VIEW

FRONT/SIDE VIEW

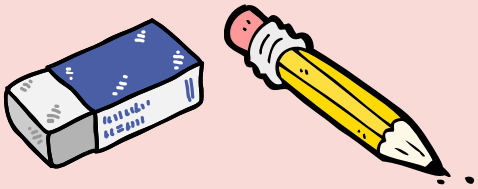
Design Drawings

Activity: Pictorial views
Practise sketching one small part of your design as a pictorial view.

Sketching pictorial drawings at www.iteachstem.com.au

ISOMETRIC VIEW

Design Drawings



Rendering
Rendering is the process of creating the effects of light, shade and light source to achieve contrast in drawings. rendering improves the quality of line drawings. while line drawing indicate more of the shape than the form of an object drawn, rendering improves the quality of the drawing so as to give it a photo- realistic quality.

Colouring vs Rendering
Colouring = Coloured "in the lines", or put colour in the areas they belong.
Rendering = Making the image really pop, by adding shading and details so it looks more polished and professional.

Annotations
Annotations are brief, written explanations provided with design deliverables in order to define & describe aspects of the design.

Watch the video by Splat 3D on how to produce annotated and rendered drawings such as those to the right/top.

Above: Design sketches and renderings

Below: Click on any of the five core 3D objects for a demonstration of how to render them.

Design Drawings

Activity: Using the isometric grid below try drawing/sketching a more detailed example of your design. Include some measurements.

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

Identify the materials in your design.

Final Design Drawing

Activity: Bring all your design ideas into one final design drawing or blueprint for your Fire-Ed Up design. This does not need to be a fantastic drawing, it just helps to get to the next stage in the iSTEM process - prototyping. It is a good idea to base your drawing on the materials, parts or lab equipment that you know will be available to use while constructing your prototype.

Fire-EdUp Prototype

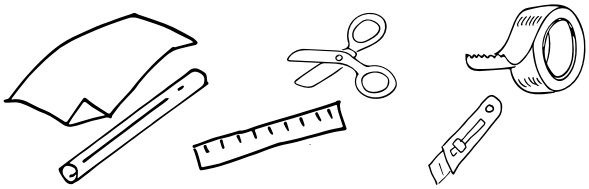
A prototype is where you construct a physical example of your design.

Constructing a prototype

Prototypes are for validating a design or a hypothesis. A prototype is used for testing whether the design will work as expected or not. Usually new insights are gained once the engineers and scientists get to experiment with the physical product. Prototypes are for learning, so it is a good idea to keep them as simple as possible.

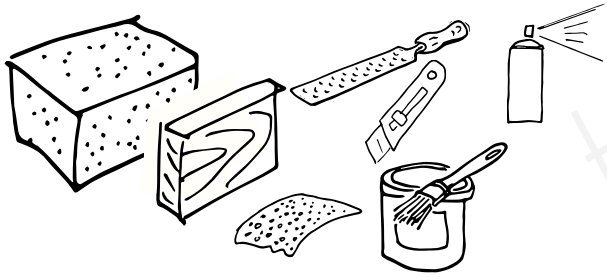
Different kinds of prototypes

1. **Paper prototypes** - 'thinking in paper' are super quick to make and help us to visualise our ideas, especially those that are hard to sketch . They are most often used in the early stages of design. Typical materials include;



2. **Rough prototype** - a proof of concept is a working prototype that proves a device or system works. It does not need to look like your final design, and will be constructed as quickly as possible. Sometimes just one part of your design is prototyped to demonstrate it works. This rough build is sometimes called a 'mock-up'.

Materials may include MDF sheet, Coreflute panel, corrugated cardboard, hot glue, acrylic, aluminium rod, screws, nuts and bolts, plastic bricks, elastic bands, springs, microcontroller, motors, sensors etc.



3. **Appearance prototype** - a static model is used to show the final look and feel of a design, especially for products that must have visual (aesthetic) appeal. 3D printed parts are often smoothed and painted for this purpose. Materials may include balsa wood, plaster, blue foam, styrofoam, wood, undercoat/sealer and brush, spray paint, abrasive paper etc

4. **Engineering prototype** - is a working example of a design but also has the appearance, size and the same materials found in the design/blueprint. This type of prototype can be very expensive to make because it requires specialist knowledge and equipment.

Fire-EdUp

Testing your Solution

Testing can be undertaken throughout the progression of a project, although it is most commonly undertaken concurrently with the **Prototype** phase.

Testing, using the iSTEM process involves:
1. using the prototype to see if it actually works or performs to the specifications set at the beginning.
2. generating user feedback as related to the prototypes you have developed, as well as gaining a deeper understanding of your users

When undertaken correctly, testing can often feed into most phases of the iSTEM process:

- it allows you to **empathise** and gain a better understanding of your users
- it may lead to insights that change the way you **define** your problem
- it may generate new ideas in the **brainstorming** phase and finally
- it might lead to an **iteration** of your Prototype

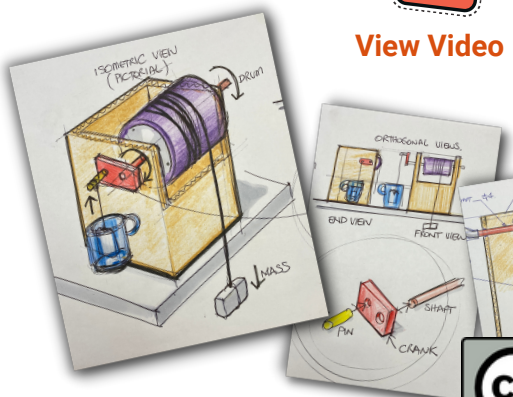
Prototype Testing

Activity: Previously you were asked to list some of the criteria for success of your project. Relist them below as they will become the criteria you will use to test and evaluate your project.

Criteria

Design with Glenny D:
The best conditions for testing a new design is under real conditions, watch Glenny D, our resident designer, as he tests and Iterates his Jiggler machine.

View Video



Prototype Documentation

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

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

Activity: Outline the steps in the construction of your prototype and describe at least two obstacles encountered in the process.

Evaluate - Testing

Test and evaluate prototypes against the set constraints and criteria

Activity: Devise an appropriate test for your design solution. In this test make sure that you can assess at least one **criteria for success** that you set earlier in the design process.

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: Does your design solution meet your criteria for success?

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.

Evaluate

Test and evaluate prototypes against the criteria to evaluate the success of the project

Activity: Using the table below list the criteria to evaluate the success of your project that you set at the start of the design challenge. Indicate in the table if the criteria has been met and if so to what extent has it been met.

Criteria	Yes/No	Basic	Satisifactory	Good	Excellent

Activity: Based off the results of the evaluation above, please indicate if you believe that the prototype has been successful and describe why?

Evaluate

SWOT Analysis
Students to identify the Strengths, Weaknesses, Opportunities or Threats related to their prototype design.

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Extension
Based on the responses recorded, identify two actions that could be taken to improve the prototype.

Iterate - Improvements

An iteration is the next or improved version of a design

Often with projects, we do not 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.

Tip: 'Annotate' your work, i.e. use arrows and notes on your sketches. Work like an engineer!

Activity: In the boxes below, sketch and explain four possible improvements to your design.

Apply what you learnt from testing & evaluating.

1	2
3	4

Iterate - Improvements

Activity: Evaluate the design improvements for your Fire-Ed Up design from the previous page. In the space below produce a second iteration design drawing or blueprint. These drawings will also be included in the final stage, ***Communicate***, *where you get to share/explain/present your final design.*

Iteration - Design Drawings

Activity: Draw a top view and a either a side or front view of your final design idea.

Sketching a front and top view.

TOP VIEW

FRONT/SIDE VIEW

Iteration - Design Drawings

Activity: Pictorial views
Sketch one small part of your iterated design as a pictorial view.

ISOMETRIC VIEW

Iterated Design

Activity: Using the isometric grid below try drawing/sketching a more detailed example of your iterated design. Include some measurements.

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

Fire-Ed Up Communication - Final Drawing

Activity: Bring all your ideas from your iterated design and produce one final design drawing in the space below.