Kaitiakitanga: Sustainable 3D printing project

Teacher Slides

Nature of Technology – Characteristics of Technology Rubric

Level Achievement Objectives	1 ***Understand** that **technology** is purposeful **intervention by design.***	2 *Understand that **technology reflects and changes society and the environment.** It increases **people's capabilities.***	3 *Understand how **society and the environment impacts are influenced by technology (historical and modern day). Technological knowledge** is knowledge that allows successful function of outcomes.*	4 *Understand how **technological development expands human possibilities. Technology draws on knowledge from a wide range of areas.***	5 *Understand **people's perceptions and acceptance impact technological developments. Technological knowledge can be 'codified'.***
Indicators:	☐ I can identify that technology helps to create the 'made' world.	☐ I can **describe the relationship between man made technology and nature**. ☐ I can explain **how technological outcomes have changed over time**.	☐ I can explain how technological outcomes have changed over time. ☐ I can **explain why technological outcomes have changed over time.**	☐ I can **identify examples of creative, innovative new outcomes/practices** that have resulted in new innovations.	☐ I **can discuss** examples of creative, innovative new outcomes/practices that have resulted in new innovations.
		☐ I can **describe examples of technology that have had a positive impact on society/environment.** ☐ **I can describe examples of technology that have had a negative impact on society/environment.**	☐ I can describe examples of how **technology has impacted on society/environment over time.**	☐ I can **describe technologies that have changed a person's senses and/or abilities.** ☐ **I can explain if these new technologies should happen.** (impact of them)	☐ I can **explain how people's past experiences of technology influences their perception of technology**. ☐ I can explain **how people's perception of technology influences their acceptance of new technology and can impact on future technology**.
			☐ I know that **technological knowledge** is knowledge agreed by technologists to be **useful when developing an outcome** (e.g. codes of standards, ethics, tolerances etc.)	☐ I can explain **how knowledge and skills can come from lots of different areas when developing and making outcomes.**	☐ I can **explain how and why technological knowledge becomes codified.**
	☐ I know that technological practice involves knowing what you are making and why, planning what to do and resources are needed and making/evaluating an outcome.	☐ I can **identify social/environmental issues** that may have changed how things are made or the attributes of the outcomes.	☐ I can **describe how social/environmental issues can influence what people decide to make, how they would make it, how they would choose resources and how they would test it**.	☐ I can identify a **range of technological practices and can identify the knowledge and skills needed to develop** and make the outcomes.	☐ I can explain the **role codified knowledge plays in technological practice.**

Technological Knowledge – Technological Modelling Rubric

Level Achievement Objectives	1 ***Understand** that **functional models** are used to **test design concepts in real situations. Prototypes** are used to **test technological outcomes.***	2 ***Understand** that **functional models** are used to **explore, test and evaluate design concepts** for potential **outcomes. Prototyping tests** a technological outcome **for fitness for purpose.***	3 *Understand **different forms of functional models are used** to help make decisions in development. **Prototypes** can be used to **evaluate the fitness of outcomes for further development.***	4 *Understand how **different forms of functional models are used** to explore possibilities and justify decisions. **Prototypes** can be used to **justify refinement of outcomes.***	5 *Understand how **evidence, reasoning & decision making of functional models help develop design concepts. Prototypes** can be used to **justify ongoing refinement of outcomes.***
Indicators:	☐ I can describe what a functional model is.	☐ I can describe what *sorts of things functional modelling can be used for.*	☐ I can state the *benefits* of particular functional models. ☐ I can state the *limitations* of particular functional models.	☐ I can *identify and discuss information* that has been gathered from models to *help decide suitability of the design.*	☐ I can *explain how evidence gathered from* functional modelling *was used to justify design ideas.*
	☐ I can say why we functional model	☐ I can *identify the design idea being tested* in some functional models.	☐ I can discuss *examples of models* used to test specific information about *suitability of designs.*	☐ I can *describe how prototypes were tested to evaluate fitness for purpose* of an outcome.	☐ I can *identify how modelling can help to set up maintenance requirements for the outcome. (what does it need to last a long time?)*
	☐ I can describe what a prototype is.	☐ I can *say why prototyping is important in technology.*	☐ I can explain *why functional modelling and prototyping are both needed* to support decisions when developing an outcome.	☐ I can explain *how functional modelling and prototyping allows designers to consider what 'can' be done and what 'should' be done.*	☐ I can *explain how models help to decide* technical feasibility (functional) and if the outcome is socially acceptable (reasoned)
	☐ I can identify why we prototype.	☐ I can *identify the specifications used to evaluate certain prototypes.*	☐ I can describe *examples of prototypes that did not meet their specifications.*	☐ I can *identify information that has been gathered from prototyping and describe how the designer used this information.*	☐ I can *explain how evidence for prototyping was used to justify an outcome as fit for purpose or in need of further development.*

Progress Outcomes – Designing and developing digital outcomes Rubric

PO's	1 *In **authentic contexts and taking account of end-users,** students participate in teacher-led activities to:*	2 *In **authentic contexts and taking account of end-users, students** make decisions about:*	3 *In **authentic contexts and taking account of end-users, students** follow a defined process:*
Indicators:	☐ I can develop, manipulate, store, retrieve and share digital content in order to meet technological challenges. ☐ I can identify digital devices and their purposes and understand that humans make them. ☐ I know how to use some applications.	☐ I can create, manipulate, store, retrieve, share and test digital content for a specific purpose, given particular parameters, tools, and techniques. ☐ I understand that digital devices impact on humans and society. ☐ I understand that both the devices and their impact change over time.	☐ I can explain what algorithms are. to design, develop, store, test and evaluate digital content to address given contexts or issues. ☐ I take into account immediate social, ethical and end-user considerations. ☐ I can identify the key features of selected software and choose the most appropriate software and file types to develop and combine digital content.
Systems	☐ I can identify the inputs and outputs of a system.	☐ I can identify the specific role of components in a simple input-process-output system. ☐ I can identify how components work together. ☐ I understand the "control role" that humans have in the system	
Data Storage	☐ I understand that digital devices store content, which can be retrieved later.	☐ I can select from a range of applications and file types to develop outcomes for particular purposes.	☐ I understand the role of operating systems in managing digital devices, security, and application software. ☐ I am able to apply file management conventions using a range of storage devices. ☐ I understand that with storing data comes responsibility for ensuring security and privacy.

Lesson 1:
Global Issues

What is the **impact** of plastics in our world?

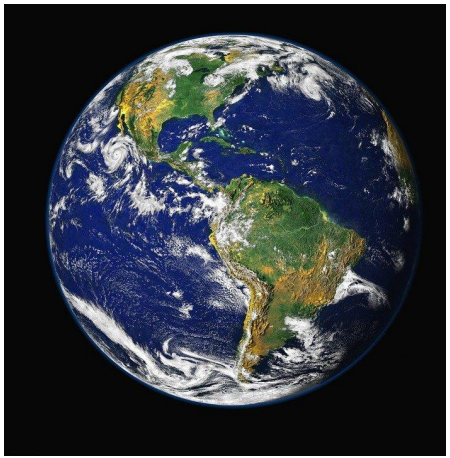
Kaitiakitanga

Today there is growing interest in **kaitiakitanga**. Kaitiakitanga involves the protection or guardianship of Papatūānuku and the organisms on her.

The basic meaning of 'tiaki' is to guard, but it also means to preserve, keep, conserve, nurture, protect and watch over.

A kaitiaki is a guardian, keeper, preserver, conservator or protector. The addition of 'tanga' denotes preservation, conservation and protection. A kaitiaki would ensure that the mauri (life force) of a taonga is healthy and strong.

Kaitiakitanga allows Māori today to feel they are meeting the responsibilities and hopes of their ancestors. It also allows non-Māori to reflect on the notion of kinship with nature, and how this idea might be useful in an environmentally threatened world.



Papatūānuku by pixabay

The effect of plastics on Papatūānuku

Digital Technologies Teachers Aotearoa

Protecting earth by pixabay

Pollution by pixabay

How much plastic are animals eating?

[redacted]

How much plastic are sea animals eating?

[redacted]

bottleby unsplash

Sea turtle by pixabay

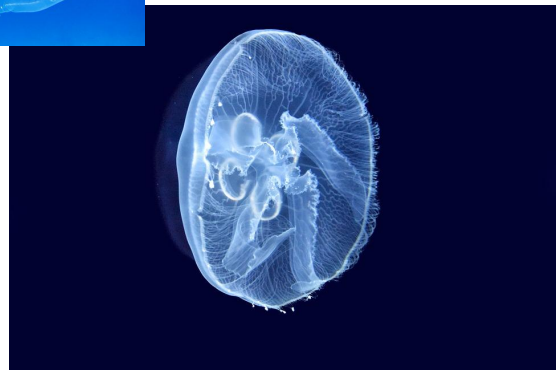
DTTA Digital Technologies Teachers Aotearoa

How are plastics harming animals?

Jellyfish by pixabay

Plastic bag in water

fish in bag by unsplash



Jellyfish by pixabay

Pollution by flickr

DTTA Digital Technologies Teachers Aotearoa

How are plastics harming animals?

The curse of plastics by flickr

DTTA Digital Technologies Teachers Aotearoa

Primary: Research: Pollution in waterways

1. How does plastic waste get into the sea?
2. How long does plastic waste last in the ocean?
3. What is the global extent of this pollution in the ocean? (how has it affected the whole world?)
4. Why do animals eat plastic waste?
5. What is a gyre? (waste gyre)
6. What are the biggest threats of plastic in the sea?
7. Can you find any interesting facts about plastic pollution?

DTTA Digital Technologies Teachers Aotearoa

Task: In pairs, create a presentation (slideshow, doc, powtoon, etc) explaining the problem of plastic. Use the questions to help.

Intermediate Research: Pollution across the world

1. What types of plastic are thrown away?
2. What types of plastic products are thrown away?
3. Where does plastic waste end up?
4. What is the global extent of this pollution?

   (how has it affected the whole world?)
5. What is the impact of plastic waste in our environment?
6. Have there been any innovative solutions to plastic waste?
7. Can you find any interesting facts about plastic pollution?

DTTA Digital Technologies Teachers Aotearoa

Task: In pairs, create a presentation (slideshow, doc, powtoon, etc) explaining the problem of plastic. Use the questions to help.

Senior: Research: Impact of Pollution across the world

1. What types of plastic and plastic products are thrown away?
2. Where does plastic waste end up?
3. What is the global extent of this pollution?
   (how has it affected the whole world?)
4. What is the impact of plastic waste in our environment?
5. What is the impact of plastic waste on our society?
6. Have there been any innovative solutions to plastic waste?
7. Can you justify why it is important to consider where plastic ends up as a product designer?

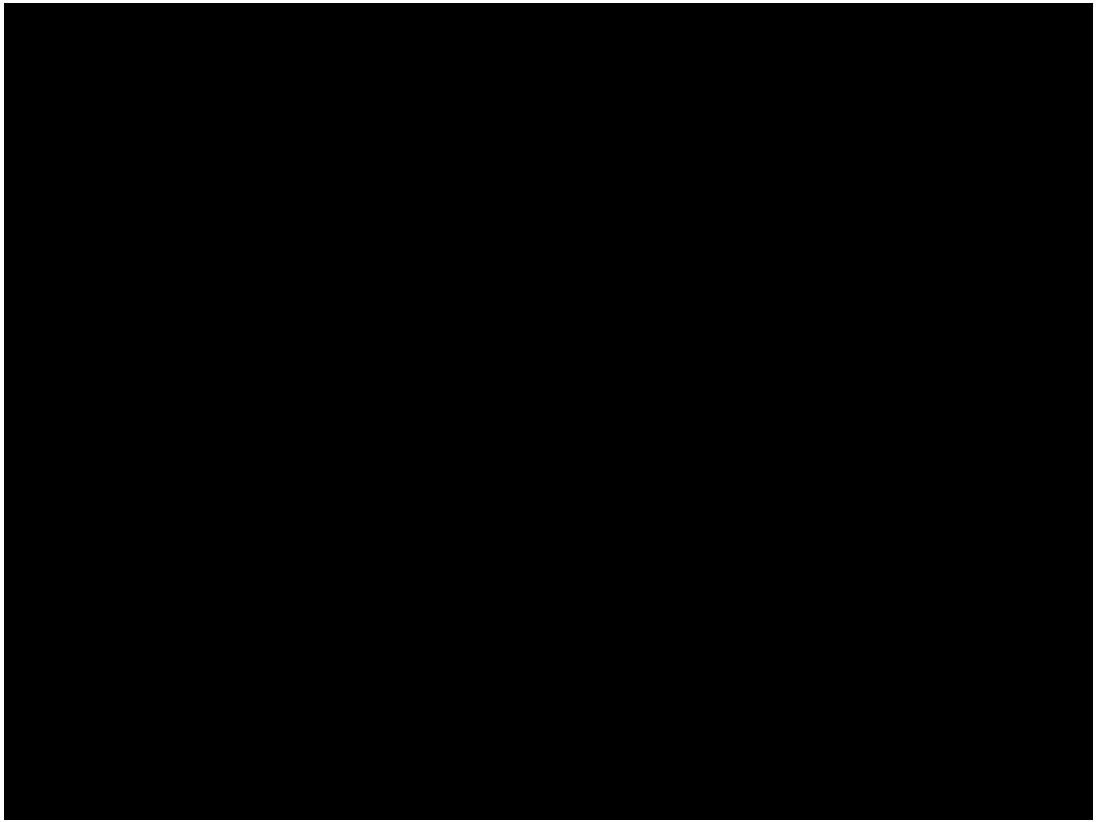
DTTA Digital Technologies Teachers Aotearoa

Task: In pairs, create a presentation (slideshow, doc, powtoon, etc) explaining the problem of plastic. Use the questions to help.

Lesson 2:
Plastic products

Lifecycle of technological outcomes
Old versus new

Plastics: Why is environmental design important?



Primary: Research: Characteristics of Technology

Old versus new outcomes:

Choose an 'old' plastic product.

Describe its attributes. (physical & functional)

Discover a modern version of this outcome.

Describe its attributes. (physical & functional)

DTTA Digital Technologies Teachers Aotearoa

Intermediate: Research: Characteristics of Technology

Old versus new outcomes:

Choose an 'old' plastic product.

Describe its attributes.

What is it's negative impact on society and the environment?

Discover a modern version of this outcome.

Describe its attributes (physical & functional)

What is it's positive impact on society and the environment?

DTTA Digital Technologies Teachers Aotearoa

Senior: Research: Characteristics of Technology

Old versus new outcomes:

Choose an 'old' plastic product.

Describe its attributes. (physical & functional)

What is it's positive & negative impact on society and the environment?

Discover a modern version of this outcome.

Describe its attributes. (physical & functional)

What is it's positive & negative impact on society and the environment?

Explain *why* the outcome has changed over time.

DTTA Digital Technologies Teachers Aotearoa

Compare **old** versus **new**

Shopping bags

Plastic bag by pixabay

Shopping bag by flickr

Compare **old** versus **new**

Toothbrush

Toothbrushes by pixabay

Toothbrush by pixabay

Compare **old** versus **new**

Milk bottle

Milk bottles by flickr

Milk bottle by flickr

Compare **old** versus **new**

Clothes Pegs

Clothes pegs by pixabay

Clothes pegs by pixabay

Compare **old** versus **new**

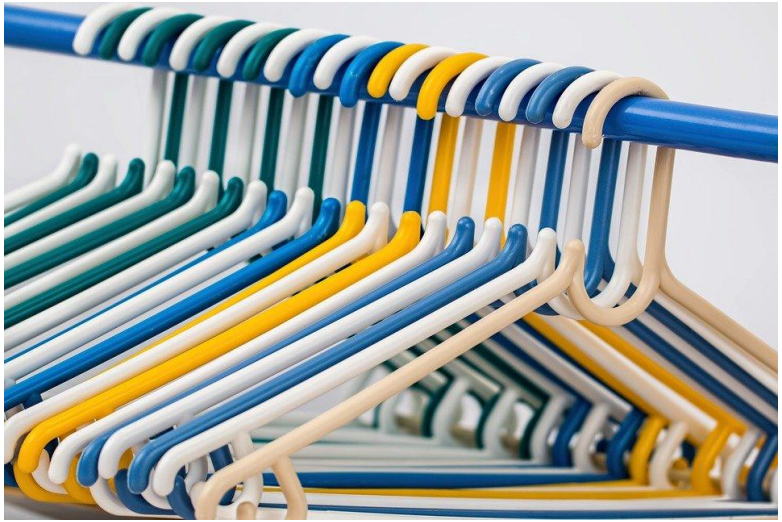
Drinking straws

Drinking straws by pixabay

Metal straw by unsplash

Compare **old** versus **new**

Coat hangers



Coat hangers by pixabay

Coat hanger by pixabay

You are to survey your **waste** at home over one day, three days or a week.

What kind of waste do you have at home? *How* much do you have?

Where does it go:

- Landfill?
- Recycling?
- Compost?
- Wormfarm?
- Reuse?

Home Learning Task: Research: Waste Audit

Lesson 3:
Sustainability

What is Sustainability?

Sustainability: What is this?

UN Sustainable Development Goals

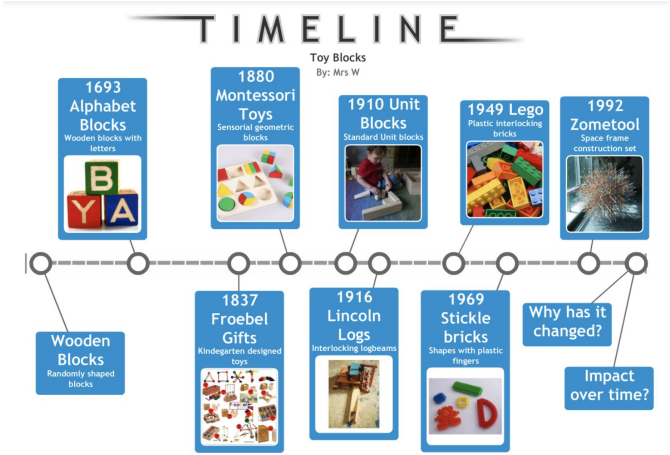
As a designer, **why** is it important to know about the SDG's?

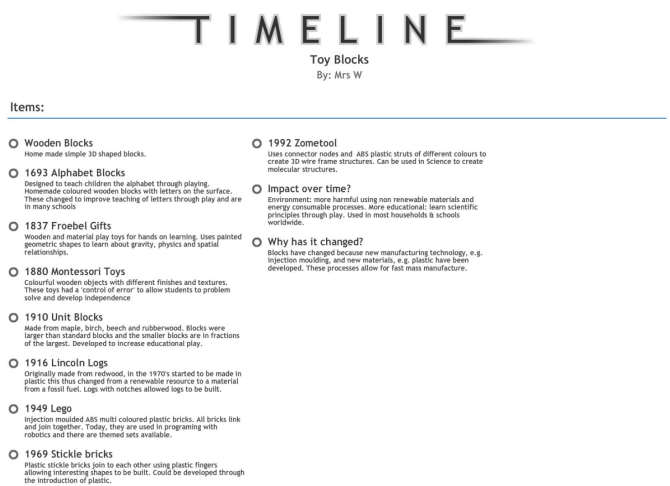
Research: Timeline

Task: To create a timeline of product development - looking at how and why a technological outcome has changed over time.

You can use digital tools or create by hand using paper.

Example of a digital timeline:





Primary: Research: Timeline

Choose a small everyday product that you would normally throw away onced used e.g. biro pen, plastic razor, drinking straws, coffee cups, clothes pegs, veggie peelers, etc

Create a timeline of images showing how the products/outcomes have changed over time.

Describe each product
(e.g. Physical & Functional attributes: features, materials, inspiration, why it was designed, etc)

Explain HOW the products have changed over time.

Intermediate: Research: Timeline

Choose a small everyday product that you would normally throw away onced used e.g. biro pen, plastic razor, drinking straws, coffee cups, clothes pegs, veggie peelers, etc

Create a timeline of images showing how the products/outcomes have changed over time.

Describe each product
(e.g. Physical & Functional attributes: features, materials, inspiration, why it was designed, etc)

Explain HOW the products have changed over time.

Explain WHY the designs the products have changed over time.
(link to Social/Environmental impact)

Senior: Research: Timeline

Choose a small everyday product that you would normally throw away onced used e.g. biro pen, plastic razor, drinking straws, coffee cups, clothes pegs, veggie peelers, etc

Create a timeline of images showing how the products/outcomes have changed over time.

Describe each product
(e.g. Physical & Functional attributes: features, materials, inspiration, why it was designed, etc)

Explain HOW the products have changed over time.

Explain WHY the designs the products have changed over time.
(link to Social/Environmental impact)

Justify: Should these technologies have been developed? why?

You are to survey your **waste** at school.

What kind of waste do you have at school?
Where is waste collected?
How much waste does the school produce ?

Where does it go:

- Landfill?
- Recycling?
- Compost?
- Wormfarm?
- Reuse?

Home Learning Task: Research: Waste Audit

Lesson 4:
Brief Development

How can you develop a brief?

Brief Development

Context: *Sustainable Product Design*

Given Brief: In your latest design challenge you are to look at the potential for 3D printing to upcycle and re-invent a common item you would normally just throw away into something brand new.

You need to choose a disposable product and repurposing it for home, travel, garden, sports, science or anything that sparks your imagination.

Work through the design process to design and develop a technological outcome for a purpose.

Brief Development

Given Brief: In your latest design challenge you are to look at the potential for 3D printing to upcycle and re-invent a common item you would normally just throw away into something brand new.

Examples of Upcycling:

https://www.sculpteo.com/blog/2018/01/22/upcycling-and-3d-printing-how-to-give-a-second-life-to-objects/

Brief Development

What are **Attributes?**

Attributes are descriptive aspects of the physical and functional nature of a technological outcome.

Functional Attribute: What an outcome, or part of an outcome does e.g. ‘provides grip’, ‘ stores water’, ‘joins surfaces’.

Physical Attribute: A spatial or sensory aspect of a technological outcome.
Physical attributes describe how the outcome looks or feels e.g. ‘hard’, ‘salty’, Spherical’, ‘loud’, ‘luminous’, ‘big’.

Brief Development

What is a **Specification?**

Specifications define the requirements of the physical and functional nature of the outcome in a way that is measurable.

For example, an attribute may refer to the outcome being small enough to be comfortably held, whereas the specification would give the precise measurement in terms of length, width and depth.

Brief Development

Context: *Sustainable Product Design*

Attributes:

- Designs need to be aesthetically pleasing as well as functional.
- Products to be upcycled must be ones that are ‘disposable’.
- 3D print designs must be able to fit into the 3D printer.
- 3D prints need to attach firmly to the repurposed product, so that the parts join together securely.
- 3D print material will be ABS, as this is recyclable after the product has finished its use, or PLA, which is a compostable material.

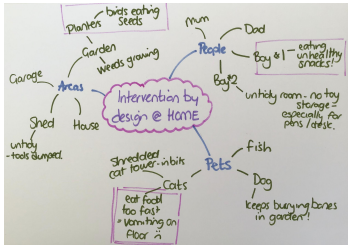
Brief Development

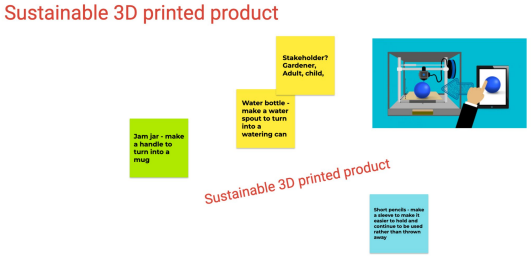
Brainstorming a context

Choose a digital tool to brainstorm ideas for the given brief.

Think about:

- what product you could repurpose,
- what its new function could be,
- who it could be for.





Possible digital tools:

Google Jamboard
LucidChart
Padlet
Google Suite
Mindmup
Popplet

You need to choose a couple of items that would normally be thrown away for you to ‘repurpose’.

For example, cardboard rolls, milk bottles, cork, egg cartons etc.

Bring in to your next lesson.

Home Learning Task: Research: Collecting a waste product

Lesson 5:
Brief Development

How to develop a brief through research

Types of Research

On the next slides are examples of a type of research you could do to help you to develop your brief.

You need to choose the research which will be the most helpful to your product.

You may find that further along the design process you need to come back and do some more research to help you.

Decide how to present your research: *Possible digital tools:*
Google Jamboard
LucidChart
Padlet
Google Suite
Mindmup
Popplet
Analogue tools:
Design folio
Technology Book

A **mood board** is a collection of images and materials that can help designers to be inspired when they are designing.

Images can include:

- Products
- Users
- Colours
- Materials, etc

Types of Research: **Mood board**

Mood boardby flickr

Types of Research: Product Analysis

Product Analysis is when you look at a range of products that are currently in use or being sold. It helps to find great ideas, see what doesn't work (and if you could improve) and if there are any gaps in the market.

- Analyse the features, good and bad points.
- Are there any inspiring features that you may be able to use?

Here is an example of product analysis for my cat feeder brief:

Features: A plastic bottle with biscuits inserted into the bottle. Lid to hold biscuits in.

Bad points: biscuits cannot get out so cat cannot be fed.

Good points: Entertains the cat, transparent so the biscuits can be seen easily, recycles materials at home.

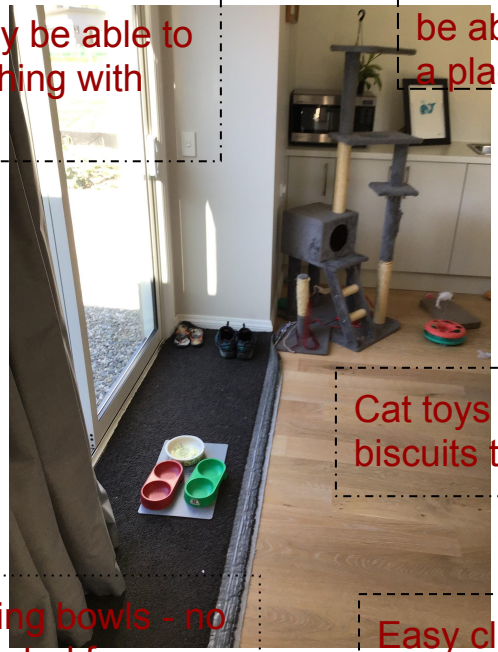
What could I take from this idea? Reusing packaging that would normally be thrown away, transparent materials so the cat can easily see the biscuits, cylindrical shape allows the toy to move - exercise while feeding?

Types of Research: Environment

Environment exploration is researching where the product will be used.

- It helps to spot any problems that need to be taken into consideration.
- Or identify things in the area that may help.

Here is an example of environment research for a cat feeder brief:



Window - may be able to attach something with suckers

Cat tower -may be able to use as a place to feed?

Cat toys - add biscuits to them?

Open feeding bowls - no quantity control for feeding cats

Easy clean wooden floor

Stakeholder research involves finding out about the main users of the outcome you will design.

- You could prepare some questions and interview them or get stakeholders to complete a survey.
- Stakeholder research can help to find out what the stakeholder needs and wants.

Types of Research: Stakeholder

For the cat feeding project I would interview the owner. Question could be:

What is the problem you would like me to solve? What type of cat food does your cat eat?

How often does the cat get fed? How much food does the cat need?

Would you like the product to link to.....(themes, room decoration, hobbies, favourite colours, etc)

How does your cat like to eat their food normally? Where do you feed your cat?

Types of Research: Ergonomics

Ergonomics is the study of the environment and the users in the environment.

- To research ergonomics you could take photographs of the environment, measure items linked to the project and measure user sizes (this is known as *anthropometrics*).

For the cat feeding project I measured the cat bowls to see how large they are for feeding and I measured my cats paws!

Length 225mm
Width 115mm
Bowl diameter 100mm

Length of cat paw to first joint 50mm

Width of paw 30mm

You are to research about **waste** in Aotearoa (New Zealand).

What kind of waste is produced?
Where is waste collected?
How much waste does NZ produce?

Where does it go:

- Landfill?
- Recycling?
- Compost?
- Wormfarm?
- Reuse?
- other?

Home Learning Task: Research: Waste Audit NZ

Lesson 6:
Brief Development

How to develop a brief through research and summarise findings

Continue with research into the given brief.

After you have completed your initial research it helps to **summarise** the key things you have learned. This will help you with the next stage of brief development.

For example:

- Observations: The cats eat biscuits in a wide open bowl, twice a day. As there are two cats they eat food quickly so that they don't fight over the last mouthfuls. Both cats love to play with toys and scratch on the tower. One favourite toy is the one where the cats put their paws in a hole and attack a ball. Could I take this idea and combine a toy with feeding to slow down how fats the cats eat?
- Materials I have at home: cardboard, plastic bottles, yoghurt pots, paper, cellotape, card tubes.
- Stakeholder: Needs to be easy to clean and durable as the cats can play quite fiercely!

Summary of Research

Decide how to present your research: *Possible digital tools:*
Google Jamboard
LucidChart
Padlet
Google Suite
Mindmup
Popplet
Analogue tools:
Design folio
Technology Book

Lesson 7:
Ideation

Starting the design process

Revisiting the Brief

After completing the Mood Board and research - it is time to revisit the brief given earlier (see next slides)

1) Does your conceptual statement still reflect the purpose of product?
2) Do you need to update any of your attributes/specifications ?

Brief Development

Context: *Sustainable Product Design*

Given Brief: In your latest design challenge you are to look at the potential for 3D printing to upcycle and re-invent a common item you would normally just throw away into something brand new.

You need to choose a disposable product and repurposing it for home, travel, garden, sports, science or anything that sparks your imagination.

Work through the design process to design and develop a technological outcome for a purpose.

Brief Development

Context: *Sustainable Product Design*

Attributes:

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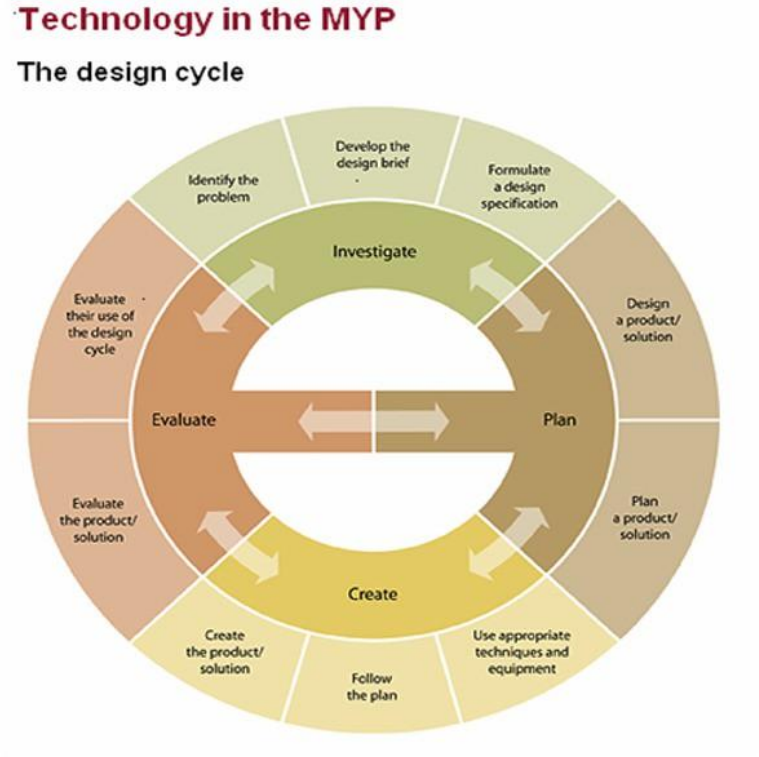
- 3D print designs must be able to fit into the 3D printer.
- 3D prints need to attach firmly to the repurposed product, so that the parts join together securely.
- 3D print material will be ABS, as this is recyclable after the product has finished its use, or PLA, which is a compostable material.

Ideation Introduction

The Design Cycle:

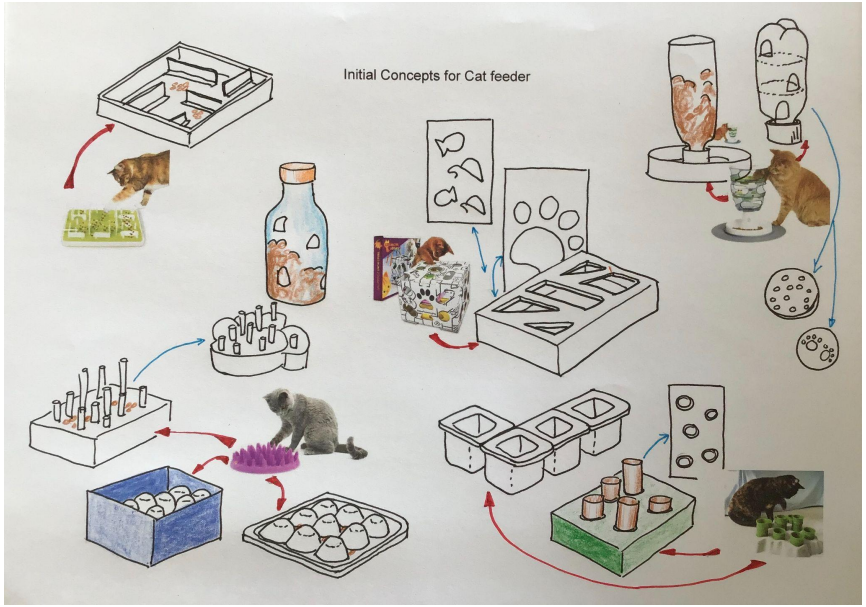
-



Ideation

What is ideation? Generating, Creating, Developing, New **Ideas**

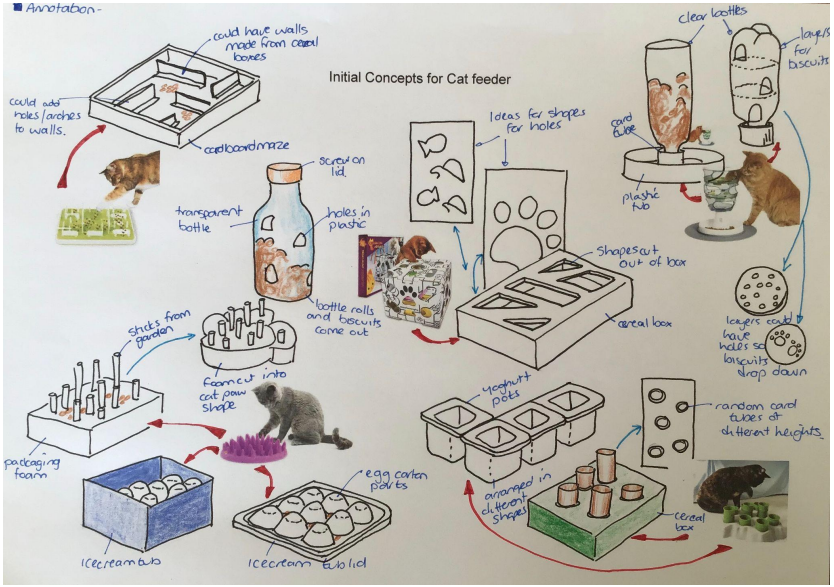
1) Explore and Generation



Ideation

What is ideation? Generating, Creating, Developing, New **Ideas**

2) New regenerated ideas with annotation



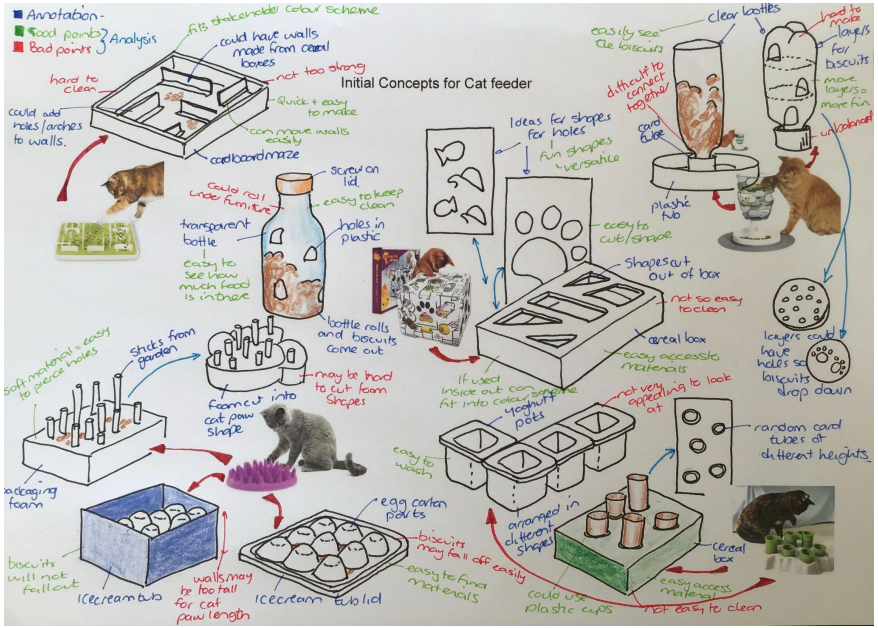
Ideation

What is ideation? Generating, Creating, Developing, New **Ideas**

3) Develop ideas with

Annotation and analysis linking

back to brief and specifications



Lesson 8:
Conceptual Design

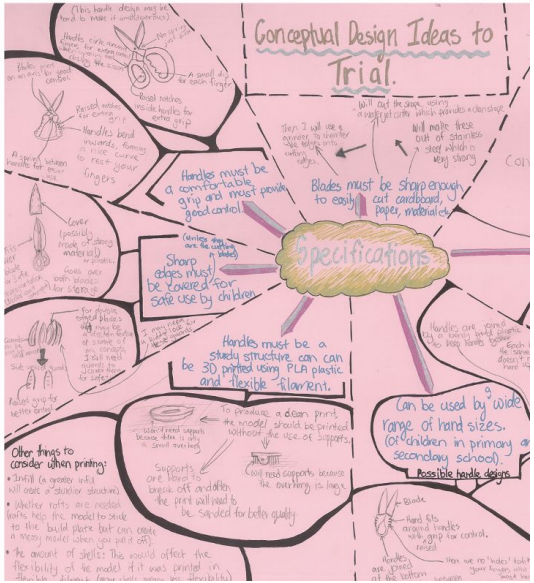
Vision to Reality

Conceptual Design

The concept drawings need to visually show the important points of the idea you are thinking about making. This is NOT your final design as you are still making decisions at this stage.

Draw a range of concept designs.
On each drawing you need to include the below information:

- Two different views of your product eg front and side
- A description of the product
- A list of functional features (handle, spout) be specific



Complete your initial ideation/conceptual designs.

Use analysis and stakeholder feedback to choose one idea to develop further.

Home Learning Task: **Concepts**

Lesson 9:
Properties of Materials

Research: 3D printing Materials

3D printing Materials: Plastics

	PLA	High stiffness, good detail, affordable.	$$$$$
	Resin	High detail and smooth surface, injection mold-like prototyping.	$$$$$
	ABS	Commodity plastic, improved mechanical and thermal properties compared to PLA.	$$$$$
	Nylon	Used to substitute functional injection moulded parts, good chemical resistance.	$$$$$
	PETG	Good for mechanical parts with high impact resistance and flexibility. Sterilizable.	$$$$$
	TPU	Rubber-like material, suitable for tubes, grips, seals and gaskets.	$$$$$
	ASA	UV stability and high chemical resistance, preferred material for outdoor applications.	$$$$$
	PEI	Engineering plastic, high performance applications, flame retardant.	$$$$$
	PC	Industrial thermoplastic with high accuracy, durability and high strength.	$$$$$

Thermoset Plastic

These plastics have the ability to be heated and manipulated into different shapes - however, once made they cannot be reshaped in to another 3D form.

(like an egg when heated - it cannot become fluid again)

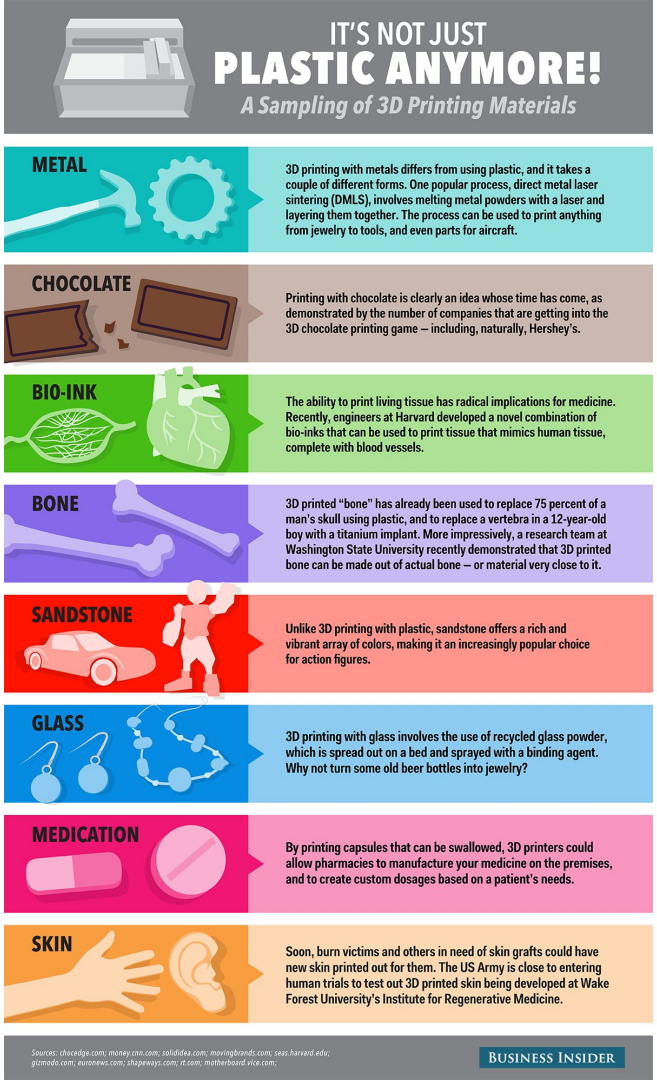
Thermoform (thermoplastic) Plastic

These plastics are able to be heated, moulded and shaped over and over again.

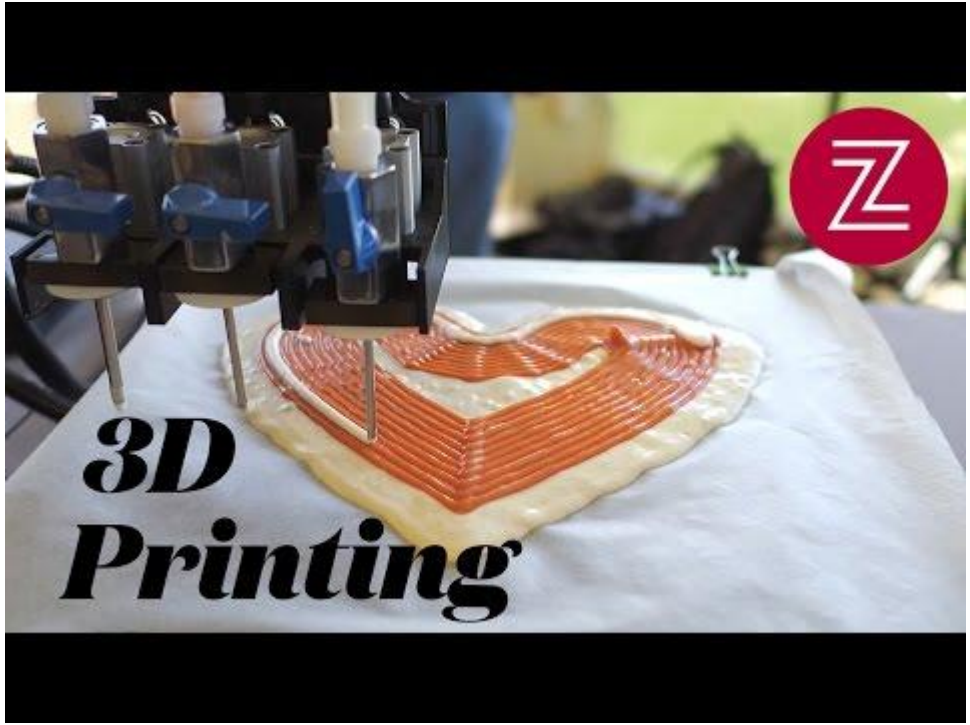
(for example water - when frozen it can be moulded into a solid shape but it can warm up, turn into a liquid and then be re-frozen into a new 3D form.

3D printing Materials:

[Link to examples of 3D printing materials]



3D printing Materials: **Food**



Primary: Performance Properties of Materials

Colourful	Compresses Easily	Easy to bend
Absorbent	Textural	Crease Resistant
Fire resistant	Impact Strength	Keeps a sharp edge
Waterproof	Easy to mold	Brittle
Soft	Strong	Durable

Primary: Performance Properties of Materials

Smooth	Shiny finish	Hard
Weather resistant	Smelly	Fluffy
Shiny	Easy to scratch	Stretchy
Easy to bend	Slight sheen	Transparent
Opaque	Translucent	Bumpy

Primary: Performance Properties of Materials

Rough	Plain	Sharp
Scratchy	Glossy	Wrinkly
Frays	Rubbery	Squishy
Easy to cut	Rip stop	Bendy

Primary: Performance Properties of Materials

Find a selection of materials.

Touch, feel, smell the material.

Identify the performance properties of those materials.

Think - what could this material be used for?

Material One:
Performance properties:
Crinkles
Rips easily
Shiny
Thin
Weak
Waterproof
Rustproof
Thermal

Possible Uses:
Keep food fresh
Keep food warm
Reflection

Aluminium Foil by pixabay

Intermediate: Performance Properties of Materials

Find a selection of materials.

Touch, feel, smell the material.

Identify the performance properties of those materials.

Think - what could this material be used for?

Explain - are these materials sustainable? why?

Material One:
Performance properties:
Crinkles
Rips easily
Shiny
Thin
Weak
Waterproof
Rustproof
Thermal

Possible Uses:
Keep food fresh
Keep food warm
Reflection

Aluminium Foil by pixabay

Senior: Performance Properties of Materials

Find a selection of materials.

Touch, feel, smell the material.

Identify the performance properties of those materials.

Think - what could this material be used for?

Explain - are these materials sustainable? Why?

Test & Trial - choose 2 or 3 3D printing plastics to explore. Research, test and trial their performance properties. Which one will be the most suitable for your project? why?

Material One:
Performance properties:
Crinkles
Rips easily
Shiny
Thin
Weak
Waterproof
Rustproof
Thermal

Possible Uses:
Keep food fresh
Keep food warm
Reflection

Aluminium Foil by pixabay

Lesson 10:
Technological Modelling

What are functional models?

Functional Models

Functional models are used by designers to help to develop, test and modify either

- Parts of a design
- Or the whole design

All models are reviewed by the stakeholder to help to improve the concept.

What should I model or test?

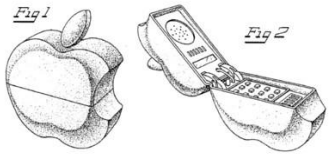
Some suggestions for development:

- Size
- Shape
- Position/layout
- Material choice
- Text and fonts
- How outcome is to be made
- How it could work
- Decoration
- Fastenings and fixings

Functional Models Freehand Sketches

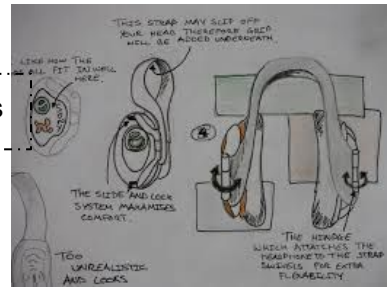
A wide variety of sketches can be used to help develop the appearance of a design:

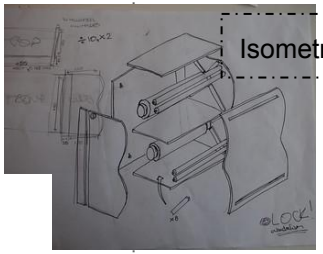
- 2D (birdseye view, side, bottom, etc)
- 3D (isometric, oblique, perspective)
- Annotated (labelled)
- Exploded views
- Sectional views



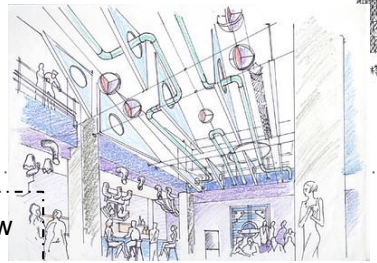
Examples of sketches:

Annotated sketches





Isometric, exploded view



Perspective view

Images from flickr.com

Functional Models 2D & 3D Models

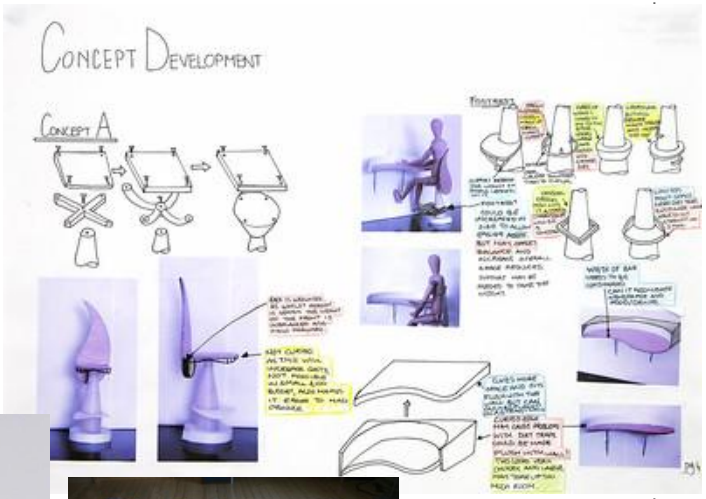
Freehand sketching

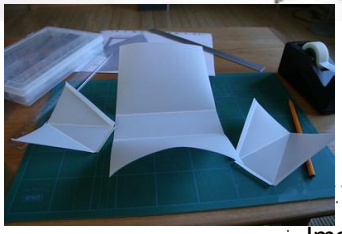
Material models can be used to help develop size, shape, material choice, function, etc:

- Cardboard
- Clay
- Wax
- Foam
- Multi material (wood, metal, plastic, etc)

These models can be actual size or scaled.

Examples of models:





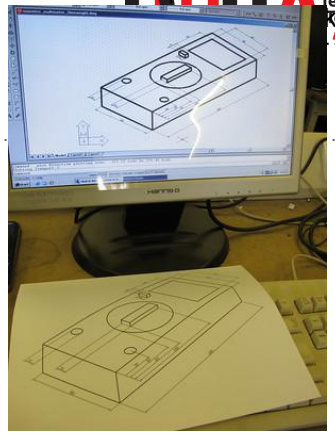
Images from flickr.com

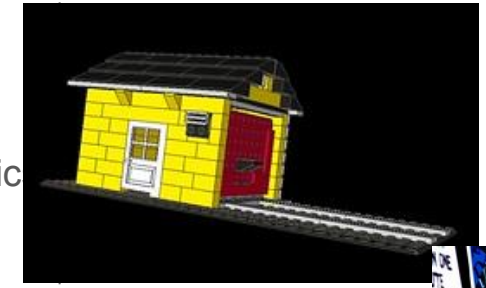
Functional Models CAD Models

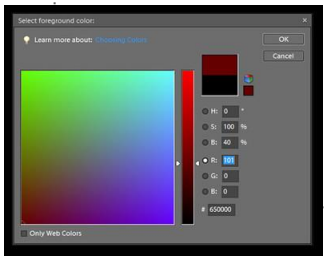
Using CAD (computer aided design) to develop and test aesthetics and function.

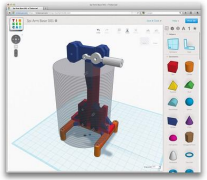
- TinkerCAD (for 3D models & electronic
- Sketchup (for 3D models)
- Photoshop/Pixlr Editor (for media design)
- G suite (for media design)

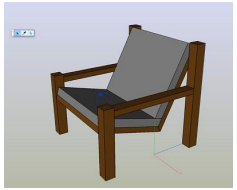
Examples of models:











Images from flickr.com

Functional Models Material Testing

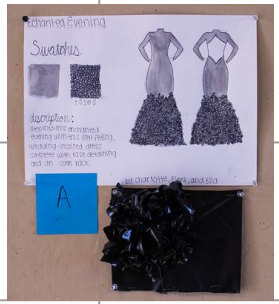
Freehand sketching

Material Investigation is where you research the materials you have available to you, e.g. what have you got in your home now?

Material testing can also be helpful. Test the *material properties* to help you to choose the best material, for example strength, durability, water resistant, washability, etc.

Taste testing can be used for Food Technology. (star analysis)

Material	Test One: *Strength*	Test Two: *Easy to clean* *(water resistant)*	Summary
Cardboard (cereal box)	*Easy to cut, can be flimsy, could be ripped easily.*	*Can be wiped down with a damp cloth. Turns soggy in water.*	*May be easy to cut and shape but not easy to clean after feeding.*
Plastic (bottle)			
Card tube			
Towelling (an old towel)			



Images from flickr.com

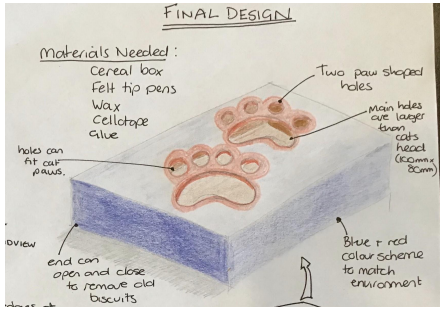
Developing an Idea through modelling

Create your first functional model: Final Sketch

Draw the final design in the table.

Gain stakeholder feedback.

Analyse the benefits and limitations - these are looking at the **type of model** - and not looking at your actual design idea.



What should I model or test?

Some suggestions for development:

- Size
- Shape
- Position/layout
- Material choice
- Text and fonts
- How outcome is to be made
- How it could work
- Decoration
- Fastenings and fixings

Primary: Developing an idea through modelling

Freehand sketching

Functional Model *(insert evidence of own models)*	**Stakeholder Feedback** *(ask at least 2 stakeholders for feedback)*	**Benefits of this as a model** *(How does this type of model help a designer?)*	**Limitations of this as a model** *(How does this type of model hinder a designer?)*
Final Sketch			
2D Card model			
3D Clay Model			
CAD Model			

Intermediate: Developing an idea through modelling

Functional Model *(insert evidence of own models)*	**Stakeholder Feedback** *(ask at least 2 stakeholders for feedback)*	**Does the idea still meet the need?** *(Look at feedback - what can you improve?)*	**Benefits of this as a model** *(How does this type of model help a designer?)*	**Limitations of this as a model** *(How does this type of model hinder a designer?)*
Final Sketch				
2D Card model				
3D Clay Model				
CAD Model				

Senior: Developing an idea through modelling

Freehand sketching

Functional Model *(insert evidence of own models)*	**Stakeholder Feedback** *(ask at least 2 stakeholders for feedback)*	**Does the idea still meet the need?** *(Is it still 'fit for purpose'? How can it be improved? What's next?)*	**Benefits of this as a model** *(How does this type of model help a designer?)*	**Limitations of this as a model** *(How does this type of model hinder a designer?)*
Final Sketch				
2D Card model				
3D Clay Model				
CAD Model				

Technological Modelling :

1. What is a **functional model**? Why do designers use functional models? What is a **prototype**? Why do designers prototype?

2. Find pictures of real life functional models and prototypes used by designers. Explain **what** was being tested and **why** they tested this.

Primary: Home Learning Task: Concepts

Technological Modelling :

1. What is a **functional model**? Why do designers use functional models? What is a **prototype**? Why do designers prototype?

2. Find pictures of real life functional models and prototypes used by designers. Explain **what** was being tested and **why** they tested this.

3. Explain how functional models/prototypes help designers to think ‘can’ we make this? (technically feasible)

E.g. has this chair been modelled to check it will work (technically feasible) before being made?

Intermediate: Home Learning Task: Concepts

Technological Modelling :

1. What is a **functional model**? Why do designers use functional models? What is a **prototype**? Why do designers prototype?
2. Find pictures of real life functional models and prototypes used by designers. Explain **what** was being tested and **why** they tested this.
3. Explain how functional models/prototypes help designers to think 'can' we make this? (technically feasible)

E.g. has this chair been modelled to check it will work (technically feasible) before being made?

4. Explain how functional models/prototypes help designers to think 'should' we make this? (socially acceptable)

Senior: Home Learning Task: Concepts

E.g. has this cleaning product been modelled to check if it is socially acceptable before being made? (it looks like a fruit energy drink!)

Lesson 11:
Technological Modelling

What are functional models?

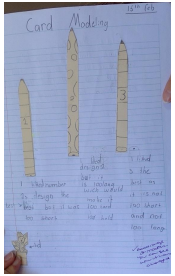
Developing an idea through modelling

Continue with your Functional modelling: Card model

You may need to make more than one model to test the idea and modify the design.

Make sure you continue to gain stakeholder feedback.

*Remember the benefits and limitations are looking at the **type of model** - and not looking at your actual design idea.*



What should I model or test?

Some suggestions for development:

- Size
- Shape
- Position/layout
- Material choice
- Text and fonts
- How outcome is to be made
- How it could work
- Decoration
- Fastenings and fixings

Lesson 12:
Technological Modelling

What are functional models?

Developing an idea through modelling

Continue with your Functional modelling: Clay model

You may need to make more than one model to test the idea and modify the design.

Make sure you continue to gain stakeholder feedback.

*Remember the benefits and limitations are looking at the **type of model** - and not looking at your actual design idea.*

What should I model or test?

Some suggestions for development:

- Size
- Shape
- Position/layout
- Material choice
- Text and fonts
- How outcome is to be made
- How it could work
- Decoration
- Fastenings and fixings

Examples of new, innovative creative practices that have resulted in new innovations

Choose a product to explore:

NIKE - sustainable innovation
https://about.nike.com/pages/sustainable-innovation
Bionic Ant - product of the future
http://www.stuff.co.nz/technology/gadgets/67564130/Bionic-ants-could-be-tomorrows-factory-workers
Sustainable, recycled sunglasses - made from plastics from the Ocean CleanUp project
https://products.theoceancleanup.com/

Describe the technological outcome.

Explain how this has had an impact on society and the environment

Primary: Home Learning Task: Designs of tomorrow

Examples of new, innovative creative practices that have resulted in new innovations

Choose a product to explore:

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http://www.stuff.co.nz/technology/gadgets/67564130/Bionic-ants-could-be-tomorrows-factory-workers
Sustainable, recycled sunglasses - made from plastics from the Ocean CleanUp project
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Describe the technological outcome.
Explain how this has had an impact on society and the environment

Upcycling products brief: write a list explaining the knowledge and skills needed by a designer to develop this project.

Intermediate: Home Learning Task: Designs of tomorrow

Examples of new, innovative creative practices that have resulted in new innovations

Choose a product to explore:

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https://about.nike.com/pages/sustainable-innovation
Bionic Ant - product of the future
http://www.stuff.co.nz/technology/gadgets/67564130/Bionic-ants-could-be-tomorrows-factory-workers
Sustainable, recycled sunglasses - made from plastics from the Ocean CleanUp project
https://products.theoceancleanup.com/

Describe the technological outcome.
Explain how this has had an impact on society and the environment
Explain how can this is expanding possibilities. **What** is creative about this design?

Upcycling products brief: write a list explaining the knowledge and skills needed by a designer to develop this project.

Senior: Home Learning Task: Designs of tomorrow

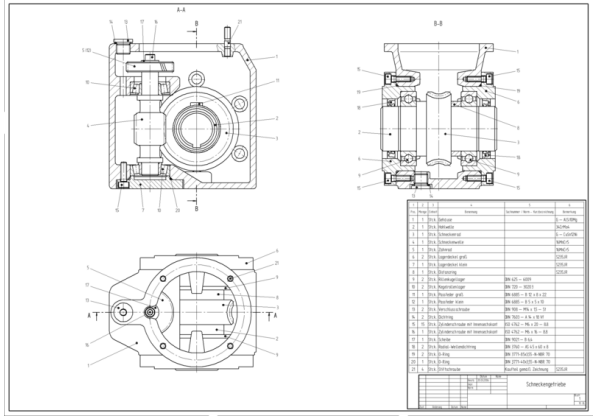
Lesson 13:
Software Trialling

What is CAD: TinkerCAD

What is CAD?

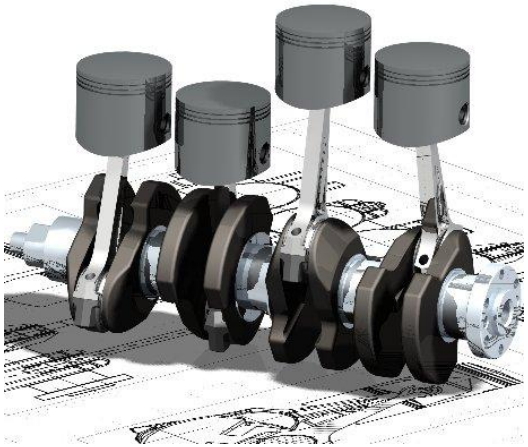
CAD is the use of computers to aid in the creation of ideas, models, simulations of technological products.

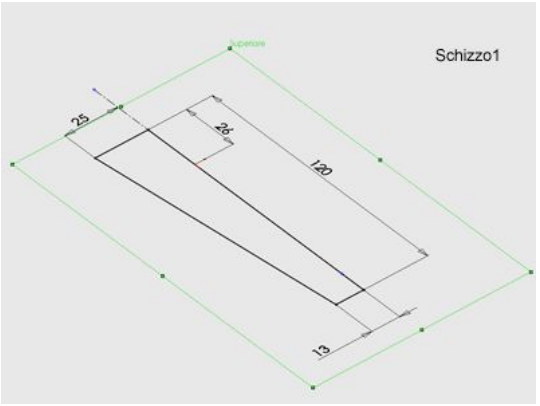
There are many different types of CAD model.



2D CAD Drawing

3D CAD Model





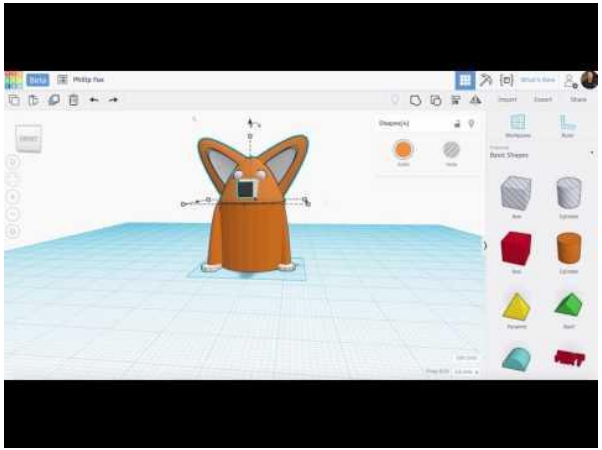
Creating a CAD Solid model

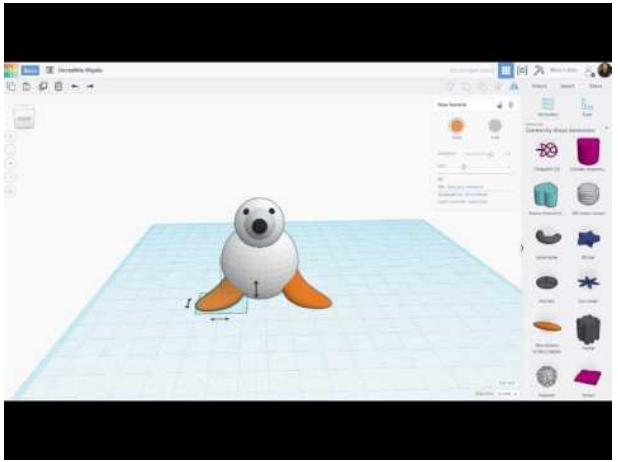
Primary: TinkerCAD tutorial www.tinkercad.com

Introduction to TinkerCAD tutorial - exploring TinkerCAD for the first time...

Intermediate: TinkerCAD tutorial www.tinkercad.com

Make an animal in TinkerCAD...





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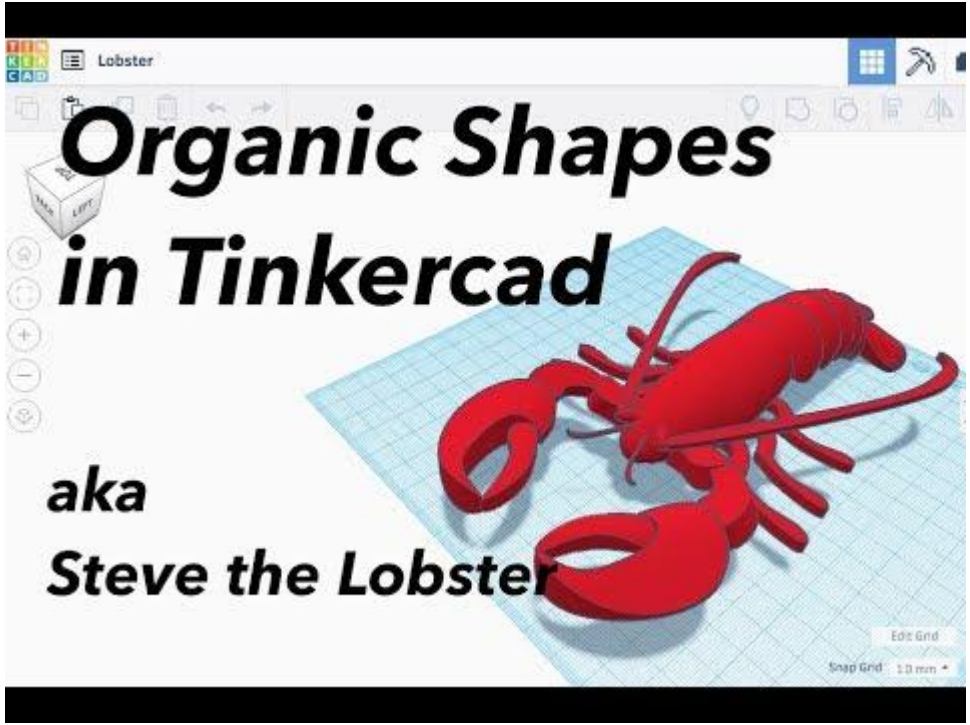
Senior: TinkerCAD tutorial www.tinkercad.com

Creating models with Organic shapes:



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Testing and trialling software

TinkerCAD: 3D modelling

Explain the benefits and limitations of TinkerCAD software.

- What is easy to use? Why? (User Interface)
- Where the tools easy to find? (User Interface)
- Did it respond to your commands quickly? (efficiency)
- Could you produce an accurate 3D model quickly and easily?

Home Learning Task: Testing and Trialling software

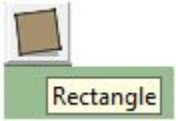
Lesson 14:
Software Trialling

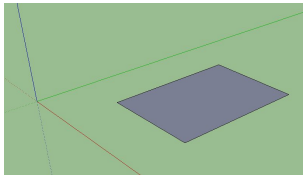
What is CAD: Sketch Up

Primary: Sketch Up tutorial

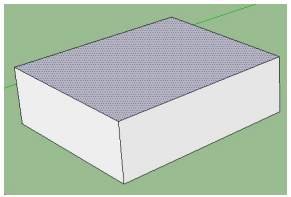
Create a house/whare.

1. Click the rectangle icon and draw a rectangle.

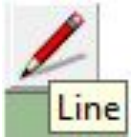


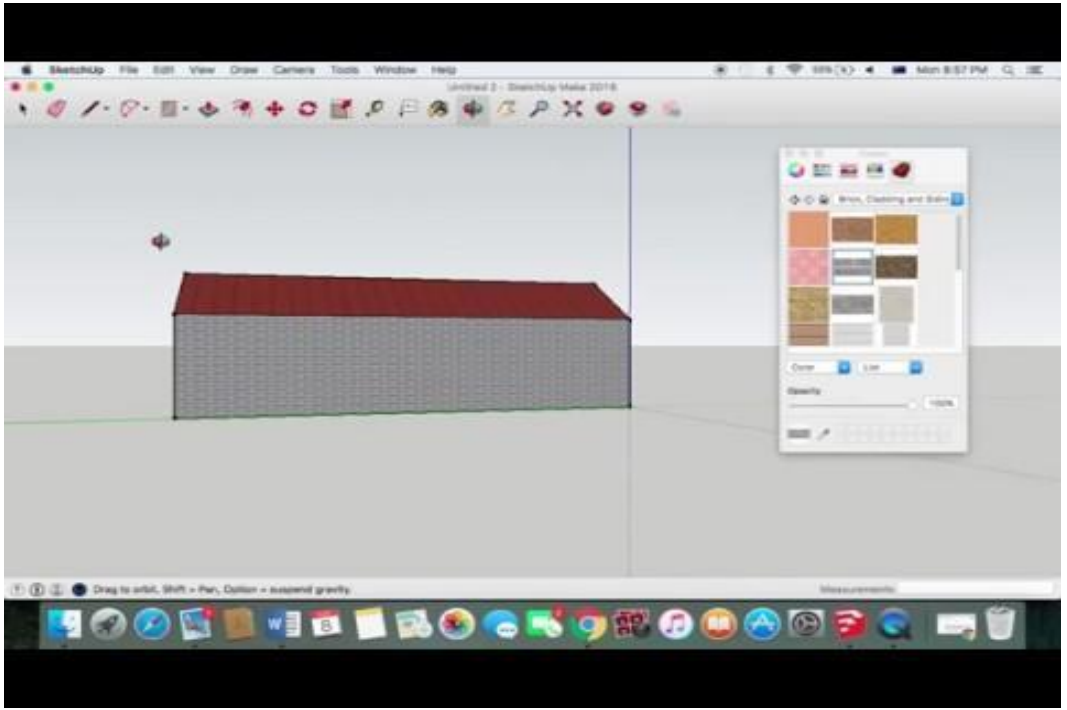


2. Click on the push/pull tool and drag the rectangle up.



3. Click the pencil 'line' tool.





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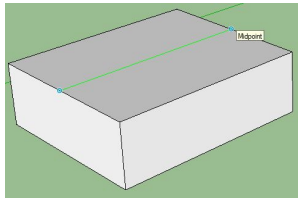
Primary: Sketch Up tutorial

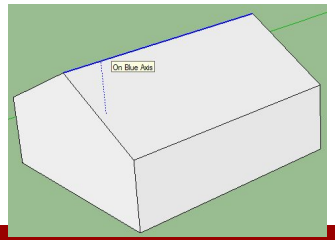
Create a house/whare.

4. Draw a line from one mid-point to another.
(Look for the blue dots!)



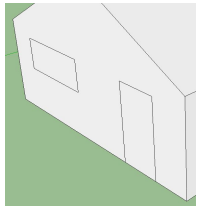
5. Click on the move icon.

6. Drag the mid-point line up.



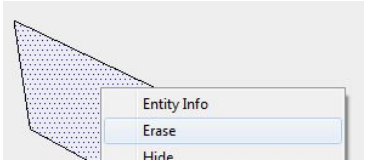
Or you can draw two lines from the midpoint on the side of the house and use the push/pull tool to remove the sides of the roof (see video)

7. Use the rectangle tool to draw a door and window.



Can you make an arch door like in the video?

8. Right-click on the door and window to erase them.



Or…

Use the paint bucket to fill the faces of the house in different colours and textures. You can choose a transparent window material to make it look realistic.

9. Use the: orbit, pan and zoom tools to change your viewpoint on the house.

Save your work regularly!

Can you import 3D models to add interest?

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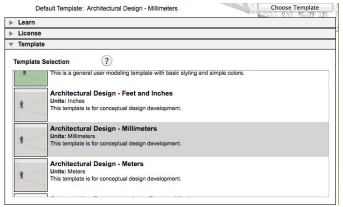
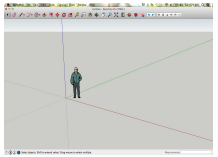
Intermediate: Sketch Up tutorial

Create a LEGO brick

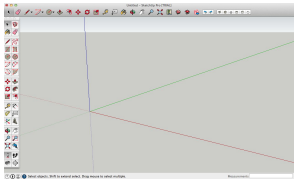


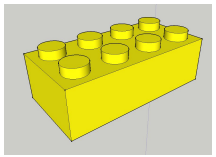
1. Open Sketchup and select the **Architectural Design – Millimeters** template. Select “Start using sketchup” to begin.



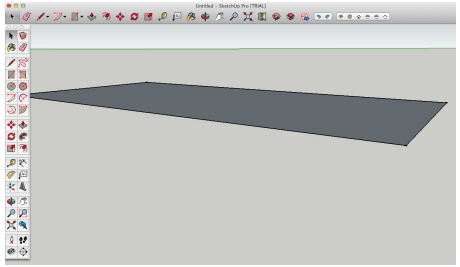
2. This screen will load. First you must delete the person: right click, erase. Then you must open the “Large Tool Set”. Goto **View, Tool Palettes, Large Tool Set.**

3. Your screen should now look like the image right. You are now set up to begin drawing a 2x4 Lego Brick.





4. To begin:



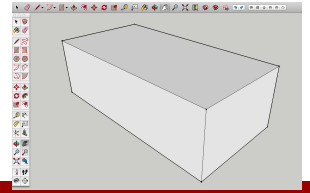
Select the tool shown above. This is the **Rectangle (R)** Tool. It allows us to draw rectangles and squares.

Now **click once** in the drawing area and drag your mouse across the screen. **Type** the following as the dimensions for the rectangle **31.8, 15,8** and press enter.

5. Thus far you have drawn the base of the Lego Brick. You must now add a thickness to it.

Select the **Push/Pull** Tool. **Click once** anywhere inside the rectangle and pull the shape upwards.

Type the following and press enter: **9.6** You now have the main brick shape as shown.



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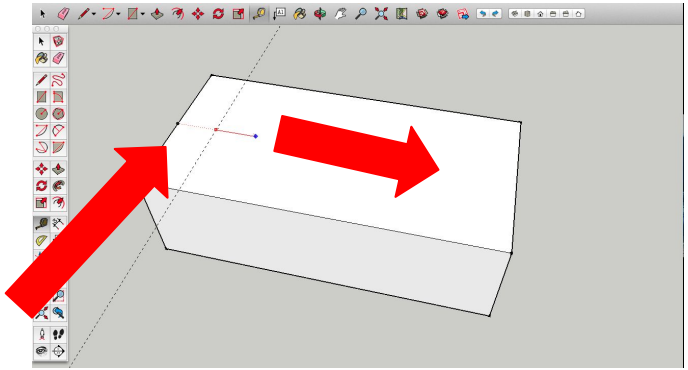
Intermediate: Sketch Up tutorial

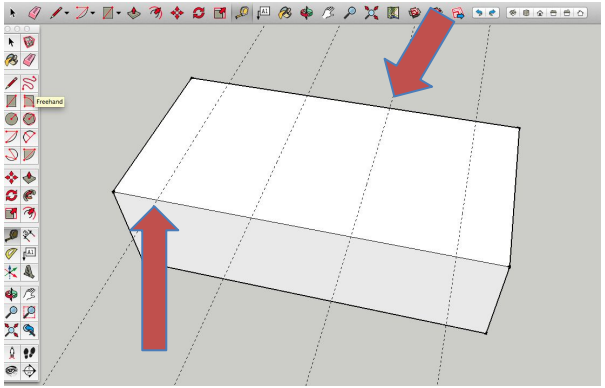
Create a LEGO brick

6. We must now use the **Tape Measure** to add gridlines to our shape so that we can accurately work out where the centres of each of the circles are on the top face of the rectangle.



7. Select the **Tape Measure** tool. **Click once** on the **left, top edge** (as shown above) and move the mouse right. **Type 3.9 and hit enter**. A gridline will appear as shown above.

Now click once on the new gridline and **repeat** the process – **type 8.0** as the distance. A second gridline will appear. Repeat this process twice more (both lines 8.0). You should now have **4 gridlines**, equally spaced apart. See below.



We must now add two final gridlines to locate the centre of each of the circles. Click on the **outer front edge**, drag inwards and **type 3.9** – press enter. *Repeat for the other edge*

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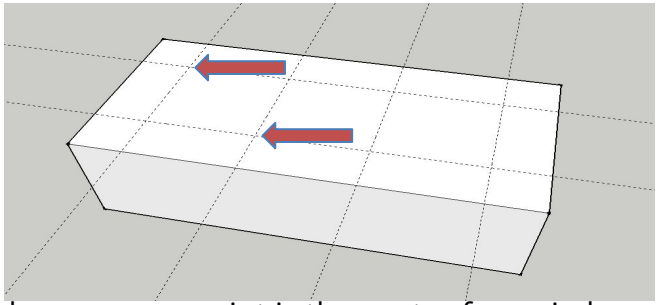
Intermediate: Sketch Up tutorial

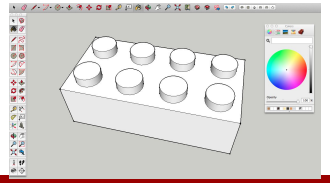
Create a LEGO brick

8. Repeat the process for the opposite guidelines. To find the measurement - measure a LEGO brick! Or use your judgement.

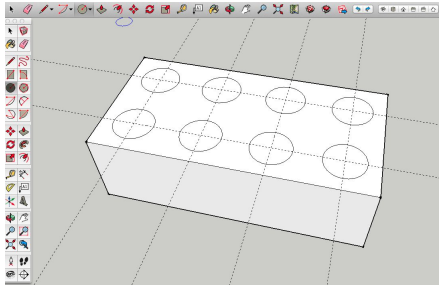
Your drawing should now have 6 gridlines as shown below.



Each cross over point is the centre for a circle.



9. Select the **Circle Tool**.

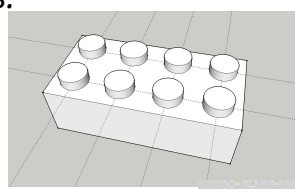


Click once in one of the identified centres shown opposite.

Type 2.4 and press enter.

Repeat so that you have 8 circles, each with a radius of 2.4mm.

10. Now use the **Push/Pull** tool and similar to the main block, add thickness to each of the circles. Click inside each circle once and **type 1.8**, before pressing enter. *Repeat for all 8 circles.*



11. To remove the gridlines, select the **Eraser** tool and click on each of the gridlines. Using the **Paint Bucket** tool allows you to add any colour or texture you choose to your drawing.

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Senior: Sketch Up tutorial

Exploring the follow me tool:

Testing and trialling software

SketchUp: 3D modelling

Explain the benefits and limitations of Sketch Up software.

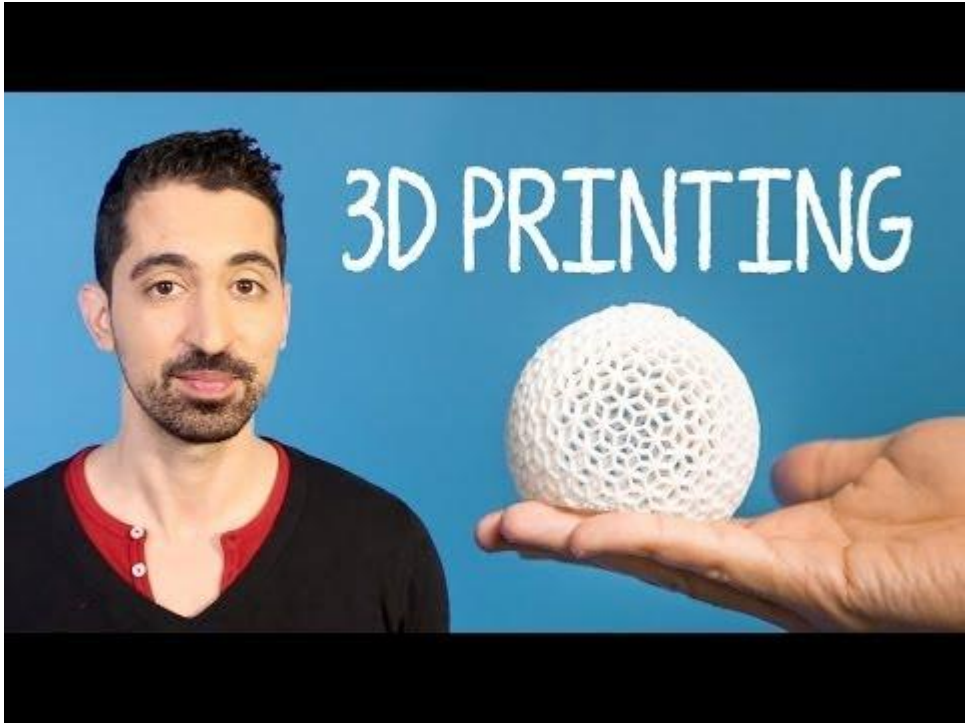
- What is easy to use? Why? (User Interface)
- Where the tools easy to find? (User Interface)
- Did it respond to your commands quickly? (efficiency)
- Could you produce an accurate 3D model quickly and easily?

Home Learning Task: Testing and Trialling software

Lesson 15:
3D Printing

What is 3D printing?

Additive Manufacturing



3D printing is a form of additive manufacture.

Thin layers of fluid material are built up gradually creating a 3D shell.

3D printing is used all over the world and can objects can now be printed from many different materials.

Production

Once you have made your 3D CAD model it needs to be saved as a .STL file.

This file will be uploaded to your 3D printer.

You are now creating your prototype.

It's time to print!

What is the difference between a functional model and a prototype?

3D Printing

Research into 3D printing

1. What materials can be used in 3D printing?
2. What types of objects can be made by 3D printing?
3. What types of 3D printing are there?
4. How does 3D printing help our society and environments?
5. How does 3D printing damage our society & environments?

Home Learning Task: 3D printing research

Lesson 16:
Product Creation

Testing/Trialling Modification

Production - test & trial

When your model has completed printing you need to tidy up the model.

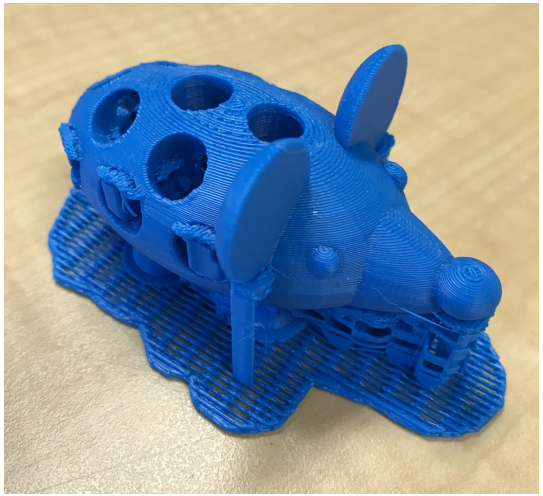
Use tools to remove waste materials like any rafting.

Now test and trial the first prototype.

Does it work?

Can it be modified to improve the design

Is it fit for purpose?



Prototypes

Research into real life prototyping

1. What is a prototype?

2. What is the difference between a prototype and a functional model?

3. Research online and find real life prototypes from designers and architects:
   - What type of product have they prototyped?
   - What have they learned from prototyping?
   - How did prototyping help them?
   - What do you think the specifications were for
     The prototypes?
   - Did the prototype fulfil these specifications?

Home Learning Task: Prototypes

Lesson 17 & 18:
Product Creation

Testing/Trialling & Modification

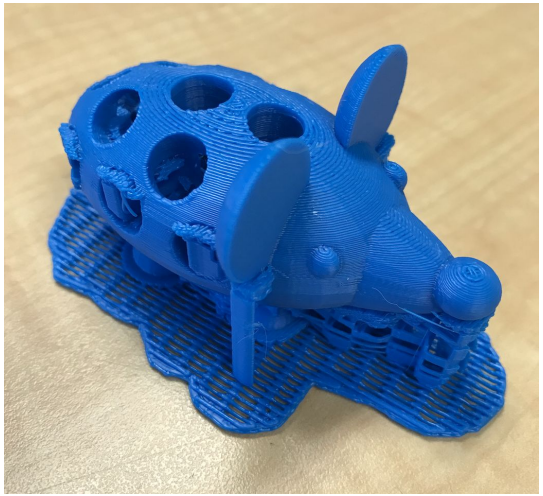
Production - modification

Once you have identified any improvements to need to go back to your CAD model and change/improve the design.

Re-print the model.

Again - remove the rafting & waste.

Prepare for testing and trialling.



As you can see this part of the design process is **Iterative.** You need to repeat this stage until the prototype meets the Design brief and Specification.

Primary: Developing an outcome

Prototype *(insert evidence of own models)*	**Stakeholder Feedback** *(ask at least 2 stakeholders for feedback)*	**Positives**	**Negatives**
One			
Two			
Three			

Home Learning Task: **Analysis of prototypes**

Intermediate: Developing an outcome

Prototype *(insert evidence of own models)*	**Stakeholder Feedback** *(ask at least 2 stakeholders for feedback)*	**Does the idea still meet the need?** *(Look at feedback - what can you improve?)*	**Positives**	**Negatives**
One				
Two				
Three				

Home Learning Task: **Analysis of prototypes**

Senior: Developing an outcome

Prototype *(insert evidence of own models)*	**Stakeholder Feedback** *(ask at least 2 stakeholders for feedback)*	**Does the idea still meet the need?** *(Is it still 'fit for purpose'? How can it be improved? Whats next?)*	**Positives**	**Negatives**
One				
Two				
Three				

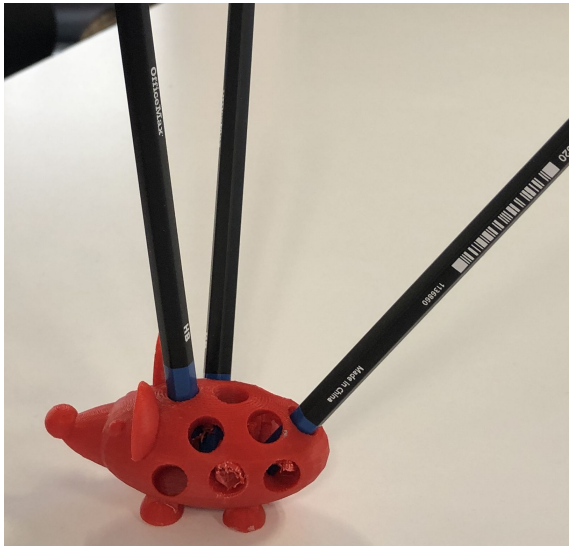
Home Learning Task: **Analysis of prototypes**

Lesson 19:
Final Product

Putting it all together

Final Product Assembly:

After all the iterations, now is the time to print and assemble your final product.



Home Learning Task: Advertise the product e.g.poster. Slide, movie

Lesson 20:
Final Evaluation

Reflection on final product

Final Evaluation

- The evaluation needs to cover the following:

  1)How the design process went?
  2)How does your product meet its fitness for purpose?
  3)The physical environment your product will be used in?
  4)How were the brief and specifications met?

- Final feedback from your stakeholder/End-user

- Include an image of your final product.

Final Evaluation:

SPECIFICATION:

Needs to be accurate and reliable

This specification has been met because the results are accurate and reflect the horse's heart rate over the time of the readings.

Needs to be durable

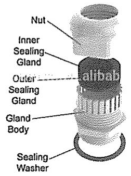
This has met but could be developed further when producing the final product. For the prototyping stage the device was durable as no damaged occurred and the device didn't deteriorate during testing. Improvements would be made when creating the final product by enclosing the thin wire that connects the sensor to the main board in a heat shrink tubing tube.

Needs to fit a wide variety of horses

This has been met, I have trailed it on both a small pony, who is very fluffy and thicker skinned and a sport horse, which has a thinner coat and doesn't have thick skin. Therefore the device has been tested on the two extremes when it comes to the variety of horse.

Useable in a variety of weather conditions

This still needs to be developed further, in the final product I would enclose the thin wire that connects the sensor to the main board in a heat shrink tubing tube to prevent damage due to water. I would also feed the wire into the box through a PVC water proof rubber water tight cable gland connector. (see picture)



Appealing to horse owners & trainers

This device is appealing to owners and trainers because it is easy to set up, accurately records and displays data in a form which is easy to read and interpret.